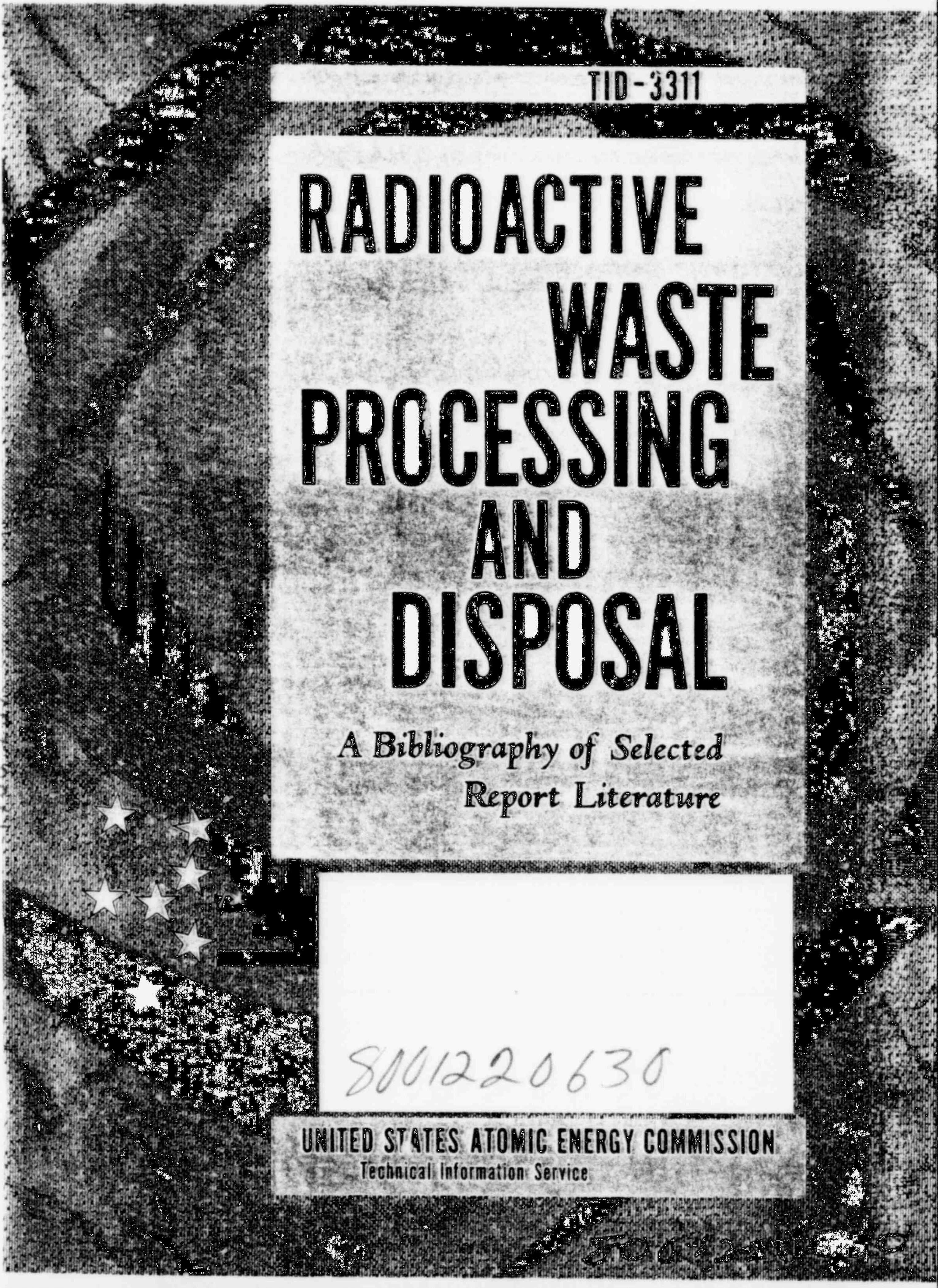

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RADIOACTIVE WASTE PROCESSING AND DISPOSAL

A Bibliography of Selected Report Literature

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RADIOACTIVE WASTE PROCESSING AND DISPOSAL

A Bibliography of Selected Report Literature

Compiled by

Hugh E. Voress
Theodore F. Davis
Thomas N. Hubbard, Jr.

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June 1958

ABSTRACT

This annotated bibliography contains 698 references to unclassified reports. References included cover information on current and proposed radioactive waste processing and disposal practices for solutions from radiochemical processing plants and laboratories, decontamination of surfaces, air cleaning, and other related subjects. Author, corporate author, subject, and report number indexes are included.

Photograph courtesy Oak Ridge National Laboratory

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INTRODUCTION

One of the major problems resulting from the development of nuclear energy is the disposal of large volumes of radioactive wastes. The future of nuclear power development may depend upon how effectively this problem can be solved both from the standpoint of economics and of hazard elimination. The original method of storing wastes in large tanks is still being used but is considered only an interim measure. Ultimate disposal methods now being studied show considerable promise. These include deposition into salt domes and deep wells, fixation in unleachable ceramics for ocean or land burial, and self-sintering in unpermeable surface pits. This bibliography brings together under one cover references on all the major aspects of waste disposal and related fields.

The references include selected unclassified reports from the United States Atomic Energy Commission and its contractors, from contractors of the United States Department of Defense, and from atomic installations of Canada and Great Britain. The reports are arranged by the subjects listed in the contents. Reports within each subject are grouped by issuing site and arranged alphanumerically by report number. Author, corporate author, subject, and report number indexes follow the list of references.

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The availability of non-AEC reports varies according to the type. Requests for United States Department of Defense reports should be directed to the issuing installation.

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British reports may be available from the British Information Services, 30 Rockefeller Plaza, New York, New York, or Her Majesty's Stationery Office, Stamford Street, London. Canadian reports may be available from the Scientific Document Office, Atomic Energy of Canada Limited, Chalk River, Ontario.

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Vienna, Institut für Radiumforschung der Oesterreichischen Akademie der Wissenschaften

BELGIUM

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YUGOSLAVIA
Belgrade, Federal Nuclear Energy Commission

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Liquid Wastes *(Continued)*

REFERENCES

General

Disposal Methods

Argonne National Laboratory, Lemont, Illinois

1

COMPLETE RADIOACTIVE EFFLUENT CONTROL FOR A RADIOCHEMICAL LABORATORY. Walton A. Rodger. Sept. 1951. Decl. Mar. 6, 1951. 22p. (AECD-3078)

The historical approach of bulk storage or disposal by dilution into watercourses is giving way to a program of waste volume reduction in which the effluvia released are at or near natural background. The types of wastes (gases, liquids, and solids) to be expected from the operation of an atomic research and development laboratory are discussed. The systems adopted for handling these wastes at Argonne National Laboratory are discussed in some detail. The equipment is described, and operating data and costs are given. A general flowsheet giving waste collection and processing procedures is included, and pictures of equipment are shown wherever possible. The processes discussed are gas filtration, incineration, evaporation, ion exchange, and drying.

Atomic Energy of Canada Limited. Chalk River Project, Chalk River, Ontario

2

REPORT ON WASTE DISPOSAL SYSTEM AT THE CHALK RIVER PLANT OF ATOMIC ENERGY OF CANADA LIMITED. C. A. Mawson. July 1956. 16p. (CRB-658; AECL-344)

Disposal methods now in use at the Chalk River Project are presented. Also discussed are new methods proposed and on test for disposal of waste.

Brookhaven National Laboratory, Upton, New York

3

STATUS OF RADIOACTIVE WASTE PROCESSING AND ACCUMULATION IN PRESENTLY OPERATING AEC RESEARCH AND PRODUCTION SITES. B. Manowitz and W. A. Rodger. April 5, 1951. Decl. with deletions Feb. 14, 1957. 20p. (BNL-1091(Del.))

This report presents a quantitative picture of the overall waste problems at the presently operating major AEC sites. Data are presented on the volumes and radioactive concentrations of the wastes handled and effluents discharged. Available tankage and process flowsheets from each site are included.

4

HANDBOOK OF RADIATION DOSIMETRY. CHAPTER 18. ISOTOPE SHIPMENT AND DISPOSAL. F. P. Cowan. Feb. 1, 1954. 42p. (BNL-1736). p.876-96 of RADIATION DOSIMETRY. Gerald J. Hine and Gordon L. Brownell, eds. New York, Academic Press, Inc. 932p. 1956.

Information is given on the following broad topics: shipment of radioisotopes and disposal of radioactive wastes. In the latter category, general techniques of segregation at the waste source, storage, dilution and concentration, are described. Information on gaseous disposal includes maximum permissible concentrations, meteorological considerations, air cleaning techniques, and sampling and monitoring. Liquid waste disposal information includes maximum permissible concentrations, methods of control, sampling and analysis, disposal of P^{32} and I^{131}, and concentration. Solid waste information includes land and sea burial, incineration, disposal on dumps, and operating experience.

5

RADIOACTIVE WASTE DISPOSAL AND CONTROL PROGRAMS AT BROOKHAVEN NATIONAL LABORATORY. Lee Gemmell. 1954. 5p. (BNL-1937)

Brief information is given on reactor and hot laboratory waste storage, treatment, and ultimate disposal. (This paper is also contained in WASH-275).

6

RADIOACTIVE LIQUID WASTE CONTROL. John M. Ruddy. July 12, 1955. 17p. (BNL-2409)

The liquid radioactive waste disposal systems for tracer-level, warm, and hot chemical laboratories are outlined. The designs of neutralizing tanks and proportional samplers are discussed. Sampling techniques are reviewed.

California Research and Development Company, Livermore, California

7

PROCESS DESIGN FOR THE LIVERMORE WASTE DISPOSAL PLANT. SUMMARY REPORT. J. L. Schwennesen, L. R. Michels, and M. L. Feldman. Sept. 10, 1952. Decl. April 11, 1957. 29p. (LWS-24632; CRD-T1-184)

Some of the singular problems connected with radioactive waste processing at the Livermore site are outlined. Several methods for treating and disposing of wastes were evalu-

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ated. These include disposal at sea in shielded containers following various degrees of concentration, underground storage of neutralized wastes at Livermore, direct dispersion of wastes in large volumes of sea water, and rail or truck shipment to either Hanford or Los Alamos for underground storage. Approximate costs per year are tabulated for these methods.

Canadian General Electric Company, Limited, Toronto, Canada

8

CANADA'S FIRST NUCLEAR POWER STATION. Jan. 1957. 50p. (AECL-356)

A brief description is given on p.44-5 of solid, liquid, and gaseous waste disposal practices to be employed at the nuclear power demonstration (NPD) plant.

Chemical Corps, Army Chemical Center, Maryland

9

A SURVEY OF RADIOACTIVE WASTE DISPOSAL. Fritz A. Hedman. March 1, 1956. 15p. (CRLR-648)

This report presents a summary of information pertinent to the recently assigned Chemical Corp's responsibility for radioactive waste disposal. All directives of Army, NBS, AEC for burial, incineration, disposal at sea, preparation of waste for disposal, and handling of wastes are briefly summarized.

Division of Engineering, AEC

10

WASTE MATERIALS IN THE UNITED STATES ATOMIC ENERGY PROGRAM. Abel Wolman and Arthur E. Gorman. Jan. 12, 1950. 20p. (WASH-8)

A review of the problem of disposal of waste containing radioactive materials is presented. The problem is discussed as being analogous to other problems of industrial waste disposal. Possibility of radioactive materials becoming dangerously concentrated in algae of streams and in sewer systems is indicated. It is noted that no gaseous material containing radioactivity may be released to the atmosphere. It is concluded that the future growth of this new industry from the developmental stage to that of applied use of its products may well hinge on its ability to find increasingly effective and reasonably economical methods of disposal of its hazardous waste products.

Division of Reactor Development, AEC

11

DISPOSAL OF RADIOACTIVE WASTES IN THE U. S. ATOMIC ENERGY PROGRAM. Abel Wolman, A. E. Gorman, and J. A. Lieberman. May 17, 1956. 15p. (WASH-408)

Brief discussions are given for the methods of handling and disposal of gases, liquid, and solid wastes from the nuclear energy program. A short summary of the activities of each major contractor is also given.

12

STATUS REPORT ON HANDLING AND DISPOSAL OF RADIOACTIVE WASTES IN THE AEC PROGRAM. Aug. 1957. 41p. (WASH-742)

Topics considered in this report include: waste disposal standards for licensed operations; present waste situation in regard to high-level liquid wastes, low-level liquid wastes, solid wastes, and gaseous waste treatment (costs, types of treatment, etc. listed for each type of waste); estimates for future wastes, research programs, industrial participation in waste disposal operations; fission product recovery and utilization; and interagency, public, and international relations.

Knolls Atomic Power Laboratory, Schenectady, New York

13

DISPOSAL OF RADIOACTIVE LIQUID AND SOLID WASTES. Robert H. Simon. Dec. 28, 1951. 18p. (AECU-1837)

The treatment and disposal of liquid and solid wastes from the laboratories, shops, and pilot plants at the Knolls Atomic Power Laboratory are discussed. Because of the heavily populated area near the laboratory no detectable activity is allowed to be discharged to the ground water or to the river, and no final disposition of radioactive wastes is practiced at this site. After treatment, liquid effluent is potable from the standpoint of radioactive content. Diagrams of equipment and flowsheets of processes are included.

14

DISPOSAL OF LIQUID WASTES AT THE KNOLLS ATOMIC POWER LABORATORY. M. M. Cohn, L. L. German, and C. N. Perleberg. June 8, 1951. Changed from OFFICIAL USE ONLY June 3, 1957. 33p. (KAPL-569)

The liquid wastes at KAPL are separated into two categories, regulated and unregulated effluent. Section I is devoted to the source, treatment and subsequent discharge of the unregulated or non-radioactive effluent. Section II presents the summary of the radioactivity content of all liquid wastes discharged into the Mohawk River.

15

DISPOSAL OF RADIOACTIVE WASTES. (AN INTRODUCTION FOR DESIGNERS OF NON-AEC LABORATORIES.) E. C. Pitzer. Nov. 1, 1951. 23p. (KAPL-703)

The topics considered are the amount of radioactivity in the normal environment, the amount of activity that might safely be discharged in industrial wastes, waste disposal procedures and waste disposal problems that would be encountered in typical hypothetical research projects.

16

RÉSUMÉ OF RADIOACTIVE WASTE HANDLING AT THE KNOLLS ATOMIC POWER LABORATORY. D. A. Manieri and C. N. Perleberg. May 1956. 6p. (KAPL-M-DAM-1)

The history of waste handling operations at KAPL is reviewed.

17

RADIOACTIVE WASTE DISPOSAL AT KNOLLS ATOMIC POWER LABORATORY. D. A. Manieri and W. H. Truran. Mar. 1958. 17p. (TID-8017)

One of Its Monograph Series "The Industrial Atom."

Disposal of radioactive wastes from KAPL is considered with respect to the three physical categories of waste —

solid, liquid, and airborne — and the three environmental recipients — ground, surface water, and atmosphere. Solid waste-handling includes monitoring radiation levels, segregation, collection, processing, packaging, storing if necessary, and shipping to a remote burial ground at the Oak Ridge National Laboratory. Liquid waste is collected by controlled drain systems, monitored for radioactivity content and stored if necessary or released to the Mohawk River. Exhaust air is cleaned before released and continuously monitored. The environment is monitored to assure safe and proper disposal of wastes. The cost of operations and the depreciation of facilities incurred by KAPL for disposing of radioactive contaminated waste is less than 0.7%/yr of the total cost of the Laboratory.

Massachusetts Institute of Technology, Cambridge, Massachusetts

18

DISPOSAL OF RADIOACTIVE WASTES FROM MASSACHUSETTS GENERAL HOSPITAL. May 19, 1950. 51p. (NP-1 23)

A general review of the problem of disposal of radioactive wastes and the procedures which are recommended for the disposal of radioactive I^{131}, P^{32}, and C^{14} is presented. The methods of disposal in use at the Massachusetts General Hospital are discussed.

Massachusetts Institute of Technology, Oak Ridge, Tennessee. Engineering Practice School

19

PERMANENT METHODS OF RADIOACTIVE WASTE DISPOSAL: AN ECONOMIC EVALUATION. A. C. Herrington, R. G. Shaver, and C. W. Sorenson. Mar. 11, 1953. 50p. (K-1005)

Nine proposed methods for the permanent disposal of radioactive waste materials are discussed and the five most promising evaluated from a standpoint of cost. The preparation of concrete from waste process streams and subsequent disposal of this concrete by burial or dumping at sea is the cheapest and most efficient means of radioactive waste disposal. A bibliography is given.

Naval Radiological Defense Laboratory, San Francisco, California

20

A REVIEW OF THE RADIOACTIVE WASTE DISPOSAL PROBLEM FROM THE MILITARY VIEWPOINT. SUMMARY REPORT. W. E. Strope. Feb. 7, 1949. Decl. July 8, 1954. 43p. (ADZ-77)

Sections are included on necessity for disposal; philosophy on methods; disposal of combustibles; disposal of fusibles; disposal of inert materials; and logistic disposal. Conclusions on suitability of methods and specific recommendations are presented. The report deals primarily with disposal of contaminated structures.

Oak Ridge National Laboratory

21

NOTES ON FISSION PRODUCT WASTES FROM PROPOSED POWER REACTORS. F. L. Culler, Jr. Mar. 4, 1955. Decl. Apr. 6, 1955. 31p. Contract [W-7405-eng-26]. (CF-55-4-25)

Reactor design characteristics, operating problems, and fission product yields are reviewed. Current and proposed methods for the disposition of radioactive wastes and the influence of proposed power reactors using difficulty soluble fuel elements such as Zr or stainless steel on the disposal of radioactive wastes are discussed. Economic requirements for waste disposal in a power economy are considered briefly.

22

ECONOMIC REQUIREMENTS FOR RADIOACTIVE WASTE DISPOSAL IN A NUCLEAR POWER ECONOMY. H. R. Zeitlin. June 9, 1955. 12p. (CF-55-6-152).

An attempt has been made to define the limits on the tolerable cost per initial gal of liquid radiochemical process waste as a function of: (1) reactor operating and design characteristics; (2) the radiochemical separations process employed; and (3) the fraction of 8 mill/kwhr power which is allocated to the disposal of wastes. The allowable cost of waste disposal for the case in which the reactor burnup is 5,000 Mwd (heat)/ton, the processing waste volume 1200 gal/ton, and the allocated cost for waste disposal is $4/gal. This is 2% or 0.16 mill/kwhr.

23

PROCESSING REQUIREMENTS, BUILDUP OF FISSION PRODUCT ACTIVITY, AND LIQUID RADIOCHEMICAL WASTE VOLUMES IN A PREDICTED NUCLEAR POWER ECONOMY. H. R. Zeitlin, E. D. Arnold, and J. W. Ullmann. Jan. 30, 1956. 18p. (CF-56-1-162)

Based on a predicted nuclear power economy growth rate, calculations have been made to determine the magnitude of several quantities of prime importance to the radiochemical processing and waste disposal industry as a function of time. Included are such quantities as required processing capacity, buildup of activity of important fission products, and accumulated volume of high activity liquid wastes.

24

THE ORR REACTOR BUILDING, REACTOR STRUCTURE AND SERVICES. W. L. Wright. Apr. 19, 1956. 58p. (CF-56-5-186)

A general description is given of the hot waste disposal and stack gas disposal of the ORNL Research Reactor.

25

WASTE AND DISPOSAL SYSTEM. J. E. Kuster. Oct. 1, 1956. 11p. (CF-56-10-15)

Waste and vent systems discussed are venting and evacuation, flooding, liquid waste, evacuation of holdup tank, steam blowdown from heat exchangers, disposal, gaseous wastes, and waste storage emergency overflow.

26

COMPILATION AND ANALYSIS OF WASTE DISPOSAL INFORMATION. E. D. Arnold. Mar. 1957. Decl. Mar. 13, 1957. 284p. (CF-57-2-20(Del.))

This report summarizes waste processing, treatment, and disposal information as extracted from many documents on the various aspects of the general problem. The material in this report is intended to serve as background for a program proposal at ORNL covering waste processing for fission product recovery, waste treatment and handling, and ultimate disposal of high-level, intermediate-level and low-level radioactive wastes. In addition to an introduction to the complex of problems in waste treatment and handling, a summary of various ultimate disposal schemes and related studies, the report catalogues informative papers on phases of: (a) waste solution characteristics, (b) economics, (c) predictions of activity and volume buildup in a nuclear power economy, (d) potential health hazards of fission and transmutation products, (e) waste storage, decay, and shipment prior to ultimate disposal, (f) fission product recovery processes and utilization, (g) treatment and disposal of intermediate- and low-level wastes, (h) reviews of engineering studies of problems at existing processing plant waste disposal sites, (i) disposal of wastes in tanks, (j) disposal of wastes in deep wells, (k) disposal of wastes in salt-domes, underground formations and the ocean, and (l) self-sintering at elevated temperatures as a method of ultimate disposal. A master reference list of 256 references is appended.

27

STATUS REPORT ON THE DISPOSAL OF RADIOACTIVE WASTES. Floyd L. Culler, Jr. and Stuart McLain, comps. and eds. June 25, 1957. 232p. (CF-57-3-114(Rev.))

A comprehensive survey of waste disposal techniques, requirements, costs, hazards, and long-range considerations is presented. The nature of high level wastes from reactors and chemical processes, in the form of fission product gases, waste solutions, solid wastes, and particulate solids in gas phase is described. Growth predictions for nuclear reactor capacity and the associated fission product and transplutonic waste problem are made and discussed on the basis of present knowledge. Biological hazards from accumulated wastes and potential hazards from reactor accidents, ore and feed material processing, chemical reprocessing plants, and handling of fissionable and fertile material after irradiation and decontamination are surveyed. The waste transportation problem is considered from the standpoints of magnitude of the problem, present regulations, costs, and cooling periods. The possibilities for ultimate waste management and/or disposal are reviewed and discussed. The costs of disposal, evaporation, storage tanks, and drum-drying are considered.

28

SECTION 9.0 TO STATUS REPORT ON THE DISPOSAL OF RADIOACTIVE WASTES. Floyd L. Culler, Jr., comp. and ed. Sept. 3, 1957. 47p. Contract W-7405-eng-26. (CF-57-3-114(Rev.) (Suppl. 1))

Chemical processes for fission product concentration, removal, or fixation are discussed. The concept of a multipurpose waste processing facility is reviewed. Waste treatment processes discussed in detail include evaporation, precipitation processes for fission product recovery from high level aqueous systems, fission product recovery by ion exchange, and fission product recovery by solvent extraction.

Vitro Corporation of America, New York

29

ECONOMIC EVALUATION OF POTENTIAL METHODS FOR CONCENTRATING REACTOR WASTES FOR STORAGE. STUDY OF IDAHO CHEMICAL PROCESSING PLANT WASTES. INTERIM REPORT FOR PERIOD MARCH 15–MAY 30, 1954. JOB 1095. June 15, 1954. Decl. with deletions Feb. 2, 1957. 99p. (KLX-1723(Del.))

Proposed methods were studied for reducing and storing wastes from the recovery of enriched U fuels at the Idaho Chemical Processing Plant. Cost comparisons were made with underground tank storage vs. the costs of reducing the wastes to smaller volumes. The limitations of estimating storage costs for these highly corrosive wastes are explained.

Westinghouse Electric Corporation.

Bettis Plant, Pittsburgh

30

RADIOACTIVE WASTE DISPOSAL SYSTEM. J. R. LaPointe. July 24, 1957. 9p. Contract AT-11-1-GEN-14. (AECU-3602)

Seven illustrations are given for convenience in developing operating procedures for disposal of PWR wastes. The illustrations include radioactive waste disposal systems for service building wastes, liquid effluents, solid and gaseous wastes, cooling water, steam system, and miscellaneous service lines.

31

RADIOACTIVE WASTE DISPOSAL SYSTEM. 314p. SYSTEM DESCRIPTION NO. 24 of SHIPPINGPORT ATOMIC POWER STATION MANUAL. VOLUME 2. (TID-7020(Vol. II) (SYSTEM DESCRIPTION NO. 24))

A radioactive waste disposal system was designed to provide facilities necessary to contain, process, and dispose of radioactive wastes from the Pressurized Water Reactor plant and its auxiliaries in such a manner as not to exceed specified tolerances for discharge of radioactive materials to the environment. Procedures and equipment used in segregating, processing or storing, and ultimate disposal of the radioactive wastes are described in detail.

32

RADIOACTIVE WASTE DISPOSAL. p.121-126 of DESCRIPTION OF THE SHIPPINGPORT ATOMIC POWER STATION. June 1957. 146p. Contract AT-11-1-Gen-14. (WAPD-PWR-970)

The ultimate disposal criteria for the PWR are described. The liquid wastes will be delivered, stored in underground stainless steel tanks and/or processed through demineralizers and a gas stripper or if within permissible limits the liquid is blended with the condenser cooling stream for discharge to the Ohio River. The system has been designed to process 16000 gal/month of 1.7 μc/ml. Spent demineralizer is stored in underground tanks. Combustible solid wastes will be burned in the incinerator with ashes and wash water slurried and stored in resin storage tanks. Gases from the combustion process will be scrubbed and filtered. Other solids will be sealed in drums for marine burial. Flowsheets for the waste disposal facilities are included.

33

CONTROL OF RADIOACTIVE MATERIAL AT THE PRESSURIZED WATER REACTOR. Jacques R. LaPointe and Robert D. Brown. [1957]. 24p. (WAPD-T-436)

Prepared for presentation at the 1957 Nuclear Engineering and Science Congress, March 10-16, Philadelphia.

Criteria are presented for the ultimate disposal of radioactive wastes from the Pressurized Water Reactor. The design aspects involved in applying these principles to the radioactive disposal facilities are discussed. The types of wastes encountered and the processes developed at the plant are detailed.

Bibliographies

University of California, Livermore.

Radiation Laboratory

34

RADIOACTIVE WASTE PROCESSING AND DISPOSAL

(1950-1957) BIBLIOGRAPHY. Frederick E. Frost. May 6, 1957. 23p. (UCRL-4891)

This bibliography consists of a title listing of reports compiled from the AEC Library Card Catalog. Only the classified and unclassified report literature is included. All progress reports covering the work on radioactive waste disposal have been omitted in order to exclude a large amount of duplicate information which is usually found in more detail in topical reports.

35

RADIOACTIVE WASTE DISPOSAL. A Bibliography. Apr. 25, 1957. 12p. Contract W-7405-eng-48. (UCRL-5068; M-6301)

This is a selective bibliography of books and periodical articles relating to radioactive waste disposal. Material in the bibliography is concerned primarily with methods for the handling and disposal of wastes and the results of these methods. Auxiliary material indicating methods of determining radioactivity in wastes has been included. Sources consulted include: *Chemical Abstracts*, 1950-1955; *Engineering Index*, 1950-1955; *Industrial Arts Index*, 1950-March 1957; *Nuclear Science Abstracts*, 1950- March 15, 1957; and *Physics Abstracts*, 1950-1955.

General Mills, Incorporated, Minneapolis, Minnesota

36

COMPREHENSIVE SURVEY ON FINE PARTICLE TECHNOLOGY. VOLUME 3. SURVEY OF TECHNICAL LITERATURE ON GRINDING AND SEPARATION. REPORT NO. 1191. E. M. Kemler, M. H. LaJoy, G. R. Whitnah, C. D. Fitz, R. J. Howe, and J. M. MacKenzie. May 15, 1953. 148p. (AD-25425)

This review of the literature relating to fine particles has been limited to 3 main phases. These are the general theories relating to particle production in general, the methods of particle separation and classification, and finally the commercial methods used in producing fine particles. Since this general field of activity involves so many phases of modern industry and concerns itself with such a wide range of materials and particle size requirements, it is to be expected that the classification and summarization of this material would present many practical difficulties. The 3 main sections of this report summarize briefly the work done in the three main fields covered. For a more detailed study of a specific problem it is necessary to resort to the original references. The appendix lists 529 references collected on this general problem.

Oak Ridge National Laboratory

37

RADIOACTIVE WASTE TREATMENT AND DISPOSAL—A BIBLIOGRAPHY OF UNCLASSIFIED LITERATURE. D. L. Africk, P. E. Novak, and J. O. Blomeke. Oct. 3, 1957. 33p. (CF-57-8-118)

This bibliography of the unclassified literature on radioactive waste treatment and disposal has been compiled from references published in the *Nuclear Science Abstracts*, Volume 4, No. 1 (January 15, 1950) through Volume 11, No. 10 (May 31, 1957). The 304 references have been categorized as to subject matter, and brief abstracts have been included where needed to show pertinent information not indicated by either the document title or category.

Union Carbide Nuclear Company, Y-12 Plant, Oak Ridge

38

DECONTAMINATION: A LITERATURE SEARCH. Rosalie L. Curtis. May 19, 1953. 32p. (Y-964)

A compilation of 70 abstracts of unclassified reports on the removal of radioactive contaminants from various materials is presented.

United Kingdom Atomic Energy Authority. Industrial Group H.Q., Risley, Lancs, England

39

GENERAL HEALTH PHYSICS. Information Bibliography. Sept. 1957. 12p. (IGRL-IB/R-21)

This is a selection of 70 report, book and journal references to publications issued up to December, 1956. Sources used were U.K., Canadian, and U.S. report abstracts, *Nuclear Science Abstracts*, Geneva Conference (1955) papers, *Engineering Index* (1950-1955) and *Industrial Arts Index* (1956).

40

HEALTH PHYSICS MONITORING INSTRUMENTS AND METHODS. Information Bibliography. Sept. 1957. 20p. (IGRL-IB/R-26)

This is a selection of 131 report, book and journal references to publications issued up to December, 1956. Sources used were U.K., Canadian, and U.S. report abstracts, *Nuclear Science Abstracts*, Geneva Conference (1955) papers, *Engineering Index* (1950-1955), and *Industrial Arts Index* (1956).

41

RADIOACTIVE DECONTAMINATION PROCEDURES AND EQUIPMENT. Information Bibliography. Sept. 1957. 12p. (IGRL-IB/R-27)

A selection of 57 report, book and journal references to publications issued up to December, 1956 is listed. Sources used were U.K., Canadian, and U.S. report abstracts, *Nuclear Science Abstracts*, *Engineering Index* (1950-1955), and *Industrial Arts Index* (1956).

42

TREATMENT AND DISPOSAL OF GASEOUS, LIQUID AND SOLID RADIOACTIVE WASTES. Information Bibliography. Nov. 1957. 34p. (IGRL-IB/R-28)

This is a title list of 251 unclassified report, book and journal references to publications issued up to December, 1956. Sources used were U.K., Canadian, and U.S. report abstracts; *Nuclear Science Abstracts;* Geneva Conference (1955) papers; Cleveland, Ohio, Nuclear Congress (1955) papers; *Engineering Index* (1950-1955); and *Industrial Arts Index* (1956).

Conference Reports

Ames Laboratory, Ames, Iowa

43

AIR CLEANING SEMINAR, AMES LABORATORY, SEPTEMBER 15-17, 1952. Mar. 1954. Changed from OFFICIAL USE ONLY June 22, 1956. 243p. (WASH-149)

The papers presented at this seminar represent a broad

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REFERENCES

attack upon all aspects of air and gas cleaning problems which confront the atomic energy industry. Topics discussed include the removal of soluble gases and particulates from air streams; the performance of reverse jet cloth filters; field studies of commercial dust-collector performance; electrostatically charged aerosol filters; wet cleaning investigations; dissolver off-gas filtration; efficiency of reverse-jet filters in U refining operations; removal of bacteria and bacteriophage from the air by glass fiber filters; deep-bed sand and glass fiber filters; the properties of aerosols; hygroscopic aerosols; the collection of aerosols on fiber mats; electrification of aerosols; solid waste disposal by incineration using tangential overfire air; the Argonne incinerator program; the performance of the Los Alamos incinerator effluent collector; and non-combustible and chemical-resistant air filters for high and low temperature use. An appendix contains an account of a round-table discussion of air sampling problems in AEC work, and requirements and specifications for sampling media.

Argonne National Laboratory, Lemont, Illinois

44

ULTIMATE DISPOSAL OF RADIOACTIVE WASTES. W. A. Rodger and P. Fineman. May 1, 1957. p.407-54 of SYMPOSIUM ON THE REPROCESSING OF IRRADIATED FUELS, HELD AT BRUSSELS, BELGIUM, MAY 20-25, 1957. BOOK I. 475p. (TID-7534)

This detailed report describes problems of disposal of 50 yr accumulation of long lived isotopes; effect of residual Sr^{90} on discardability of waste; cribbing operations; ORNL disposal in terrestrial pits; ground disposal at Chalk River; earth disposal at Savannah River; Project Hope waste pit; use of deep wells; disposal of wastes in salt domes; ocean disposal; reduction of liquids to solids; adsorption on montmorillionite clay; waste solidification by fused salt calcination; fixation of wastes in clay flux mixes; flush bed calcining of wastes to oxides; and heat problems of fission product wastes.

Brookhaven National Laboratory, Upton, New York

45

BROOKHAVEN NATIONAL LABORATORY WASTE PROBLEMS: SECTION I. CONFERENCE ON WASTE PROCESSING: MEETING OF U. S. ATOMIC ENERGY COMMISSION WASTE PROCESSING COMMITTEE, MARCH 27-28, 1950. J. H. Hayner and B. Manowitz. [nd]. 27p. (BNL-58)

Brief reports are given on the geological survey, meteorological survey, area survey and low level monitoring, liquid waste handling and treatment, and permanent disposal of radioactive wastes at Brookhaven. Experiments with 3 types of clay for waste removal and ultimate disposal are included.

46

THE THIRD INFORMATION MEETING ON HOT LABORATORIES, MAY 26-28, 1954. Decl. with del. Feb. 18, 1957. 79p. (BNL-302(Del.))

Topics discussed at this conference include: the design and operation of a high-level fission product recovery pilot plant; electrical control methods applicable to remote control of fabrication processes; design of a miniature pilot plant for high-level separations processes; radiometallurgical equipment at Hanford; the preparation of kilocurie quantities of Xe^{135}, design of the Idaho Chemical Processing plant; remote control aspects of the ANP fuel irradiation program; the organization and responsibilities of a radioactive materials laboratory; the cost of design, construction, and operation of a radioactive materials laboratory; design modifications in a lathe for radioactive machining; the performance of shielding window materials at high radiation intensity; design modifications in standard small equipment items developed at BNL; and design modifications in apparatus for the study of irradiated liquid metal fuel and breeder systems.

Department of Agriculture. Soil And Water Conservation Research Branch, Beltsville, Maryland

47

FACTORS AFFECTING THE DISPOSAL OF PLANT WASTES. M. E. Jefferson. p.111-116 of A CONFERENCE ON RADIOACTIVE ISOTOPES IN AGRICULTURE HELD AT MICHIGAN STATE UNIVERSITY ON JANUARY 12, 13, and 14, 1956. Jan. 1956. 420p. (TID-7512)

This paper describes the uses of radioisotopes as tools of agricultural research and presents the methods used at Beltsville for the disposal of low activity P^{32}, C^{14}, Fe^{55-59}, and Sr^{89} in sewage systems, combustion and/or dilution in soil.

Division of Civilian Application, AEC

48

PRINCIPALS AND RECOMMENDATIONS RELATING TO WASTE DISPOSAL. G. W. Morgan. p.7-16 of A CONFERENCE ON RADIOACTIVE ISOTOPES IN AGRICULTURE HELD AT MICHIGAN STATE UNIVERSITY ON JANUARY 12, 13, and 14, 1956. Jan. 1956. 420p. (TID-7512)

This paper describes methods of waste disposal used within the Atomic Energy Commission. Methods employed include disposal by dilution; incineration; concentration by ion exchange adsorptions on clays and distillation; confinement by storage in tanks, burial in soil and disposal in the ocean.

Division of Engineering, AEC

49

ATOMIC ENERGY COMMISSION METEOROLOGICAL INFORMATION MEETING; FEBRUARY 1-2, 1951. H. Newton, H. P. Munger, M. E. Smith, M. L. Barad, P. A. Humphrey, R. W. Houston, J. F. Newell, J. Z. Holland, C. A. Gosline, M. Eisenbud, R. C. Wanta, P. W. Allen, L. Machta, G. H. Strom, F. I. Badgley, D. L. Crowson, K. M. Nagler, H. Moses, and R. F. Myers. Aug. 8, 1951. Decl. Mar. 19, 1957. 103p. (TID-10081)

Work being carried out or contemplated in the various operating areas of the atomic energy industry for adequate evaluation of significant factors in meteorology which must be dealt with in resolving such problems as site selection, plant location and design, and the development and maintenance of facilities for disposal of wastes is discussed. The present meteorological programs at AEC production sites

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are reviewed, and photographs and diagrams of meteorological instruments are included.

50

THIRD ATOMIC ENERGY COMMISSION AIR CLEANING CONFERENCE HELD AT LOS ALAMOS SCIENTIFIC LABORATORY, SEPTEMBER 21, 22, AND 23, 1953. Nov. 1954. Decl. with deletions Mar. 13, 1957. 372p. (WASH-170(Del.)

The following papers were presented: Los Alamos Air Cleaning Activities. J. B. Graham; The Los Alamos Incinerator. H. F. Schulte; Ventilation and Air Cleaning Facilities for Normal Uranium Fabrication. W. H. Baumann; The Handling of Radioactive-Contamination Air at ORNL. W. G. Stockdale; Hanford Air Cleaning Operations. A. G. Blasewitz; Air Cleaning Activities at ANL. D. P. O'Neil; Ventilation Activities and Programs at ANL. R. W. Van Valzah; The Argonne Incinerator Program. W. A. Rodger and D. C. Hampson; Air Cleaning Problems at NRTS. A. L. Biladeau; Operating Economics of Air Cleaning Equipment Utilizing the Reverse Jet Principle. W. B. Harris and M. G. Mason; Ventilation and Dust Control in Refining Uranium Ores and Concentrates. H. I. Miller, Jr.; Tests of the Aerodyne Dust Collector. W. H. Smith; Brief Summary of Air Cleaning program at WAPD. E. C. Barnes; Tower Observations of Atmospheric Dust at NRTS. P. A. Humphrey, E. M. Wilkins, and D. M. Morgan; KAPL Air Cleaning Program. L. J. Cherubin and J. J. Fitzgerald; Brookhaven Air Cleaning Operations. Lee Gemmell; Air Cleaning Problems at the Savannah River Plant. J. R. Clark; Air Handling Facilities at the Ames Laboratory. R. W. Fisher; Site and Contractor Activities and Programs U. C. Radiation Laboratory. M. D. Thaxter; Air Cleaning Program at the Livermore Research Laboratory. G. T. Saunders; Meteorological Aspects of Air Cleaning. P. A. Humphrey and E. M. Wilkins; Fibrous Aerosol Filters. C. E. Lapple; Air-Cleaning-New Developments at UCRL. M. D. Thaxter; A Constant Volume Radiochemical Hood. G. T. Saunders; Filtration of Microorganisms from Air by Glass Fiber Paper Filters. H. M. Decker, J. B. Harstad, and F. J. Piper; Further Studies on Electrostatic Separation. A. T. Rossano; Further Studies of Fabric Dust Collectors. C. E. Billings, R. Dennis and L. Silverman; Performance Characteristics of the Model K Electro-Polar Filter – Preliminary Report. R. Dennis, C. E. Billings, and L. Silverman; Preliminary Report on Cotton Aerosol Filter Studies. R. D. Coleman; Incineration of Combustible Wastes Using Tangential Overfire Air. L. A. Spano and R. C. Corey; Properties of Various Filtering Media for Atmospheric Dust Sampling. W. J. Smith and N. F. Surprenant; Survey of Air Sampling Media and Sampling Methods Used at AEC Areas and by Others. W. J. Smith; Evaluation of KAPL Separations Process Stack Effluent. J. J. Fitzgerald; Turbulent Deposition and the Behavior of Deposits of Solid Particles. S. K. Friedlander; Collection of Aerosols by Fiber Mats. J. B. Wong; Filtration of Submicron Size Aerosols by Fibrous Media. C. Y. Chen; and Influences of Electrostatic Forces on the Deposition of Aerosols.

Division of Reactor Development, AEC

51

FOURTH ATOMIC ENERGY COMMISSION AIR CLEANING CONFERENCE HELD AT ARGONNE NATIONAL LABORATORY, NOVEMBER 1955. 320p. (TID-7513(Pt. I))

The following papers were presented at the meeting: Review of Air Cleaning Operations at Argonne National Laboratory; Air Cleaning Cost for Chemistry Building 200; Knolls Atomic Power Laboratory Air Cleaning Program; AEC Bettis Plant Air Cleaning Activities; Developments in Air Cleaning at Los Alamos; Los Alamos Air Cleaning Activities; Special Air Monitoring Program at the Brookhaven Reactor; A Review of Air Cleaning Experiences in Various Facilities at the Hanford Plant; A Method of Changing Alpha and Gamma Contaminated Filters without Interrupting Exhaust; Collection Efficiency of Air Cleaning and Air Sampling Filter Media in the Particle Size Range of 0.005 to 0.1 Micron; The Aerosol Size for Maximum Penetration through FG-50 Filter Material and Sand; A Preliminary Report on Contamination from Uncontrolled Incineration of Radioactive Particulates; Status Report on Standardization of Air Assay Papers; Arrestance Values and Loading Characteristics of Commercially Available Air Filters Against 0-5 Micron Test Dust; Evaluation of Particulate Filters; Meteorology as Related to Air Cleaning; Sampling the Atmosphere; Some Observations of Particle Distribution with Height in the Lower Atmosphere; Atmospheric Diffusion Studies Using Freon 12 as a Tracer; Photographic Techniques for Measuring Diffusion Parameters; Research and Development at the Harvard Air Cleaning Laboratory; A Study of a New Type Wet Collector; Gas Cleaning Studies of U. S. Bureau of Mines Incinerators, Stack Effluent Tests on BOMAEC-30 and BOMAEC-100 Incinerators; Further Studies on Electrostatic Mechanisms of Aerosol Filtration; High Temperature Filtration Studies with Mineral Wool; Blast Effects on Air Cleaning Equipment – Results of Filter Tests; Properties of Aerosol Agglomerates; and Absorption of Nitrogen Oxides from Waste Gases.

52

FOURTH ATOMIC ENERGY COMMISSION AIR CLEANING CONFERENCE HELD AT ARGONNE NATIONAL LABORATORY, NOVEMBER, 1955. Decl. Mar. 4, 1957. 31p. (TID-7513 Pt. 2))

Air cleaning problems associated with the control of U and F$_2$ contamination in a gaseous diffusion plant are discussed. Special air cleaning and ventilating equipment for use during the machining of shapes from oralloy, which contains a high concentration of U^{235} with some U^{234} impurity, are described and illustrated photographically. Air cleaning and inert atmosphere ventilation systems and equipment for the ANL Fuel Fabrication Facility, designed for the fabrication and development of reactor fuel components containing Pu and U^{233}, are described and illustrated photographically.

53

SANITARY ENGINEERING ASPECTS OF THE ATOMIC ENERGY INDUSTRY. A SEMINAR SPONSORED BY THE AEC AND THE PUBLIC HEALTH SERVICE, HELD AT THE ROBERT A. TAFT ENGINEERING CENTER, CINCINNATI, OHIO, DECEMBER 6-9, 1955. October 1956. 322p. (TID-7517(Pt. 1a))

The following papers were presented at the meeting: The Sanitary Engineering Objectives in the Atomic Energy Industry; Removal of Radioactive Fall-Out From Water By Municipal Water Treatment Plants; Summary of Investigations On The Removal Of Radioisotopes From Waste Water By Oxidation Ponds; Summary Of Princeton Conference On Disposal Of High Level Radioactive Waste Products In Geologic Structures; Ultimate Disposal Of Radioactive Reactor Wastes In The Oceans; Meteorological Parameters In Waste Disposal; Optimum Flow Detention Characteristics Of Tanks For Decay Of Pile Cooling-Water Activity And Storage Of Fuel Elements; Trends In Separations Process Development And Their Effects Upon Waste Handling; Operating Experience In The Disposal Of Radioactive Wastes In Open Pits; A Review Of The Ground-Water Geology Of The Major Waste-Producing Sites; Radioactive Waste Dis-

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posal At North American Aviation, Inc.; The Brookhaven Experience With Sea Disposal Of Radioactive Wastes; Chemical And Physical Reactions Of Radioactive Liquid Wastes With Soils; Hydraulic And Ion-Exchange Phenomena In The Underground Movement Of Radiostrontium; Demolition Of An Alpha-Contaminated Building; Problems In The Burial Of Solid Wastes At Oak Ridge National Laboratory; Considerations in Evaluating A Burial Ground For Solid Wastes; Solid Radioactive Waste Disposal At The National Reactor Testing Station; Solid Radioactive Waste Disposal Estimates; Liquid Wastes From Hafnium-Free Zirconium Production; Disposal of Fluoride Wastes; The Toxicity of Some of the Less Common Metals to Fishes; The Removal of Cesium and Strontium from Radioactive Waste Solutions; Decontamination of Fission Product Wastes with Separation of Kilocurie Quantities of Cesium, Strontium, Rare Earths and Ruthenium; and Treatment of Wastes Containing Radioactive Barium, Lanthanum, Strontium, and Yttrium.

54

SANITARY ENGINEERING ASPECTS OF THE ATOMIC ENERGY INDUSTRY. A SEMINAR SPONSORED BY THE AEC AND THE PUBLIC HEALTH SERVICE, HELD AT THE ROBERT A. TAFT ENGINEERING CENTER, CINCINNATI, OHIO, DECEMBER 6–9, 1955. October 1956. 313p. (TID-7517(Part 1b))

Information on the following experimental and theoretical studies are given in detail on the following subjects: Determination of Sr^{90} By Precipitation and Extraction Method; Fixation of Radioactive Wastes in Clay-Flux Mixes; Heat Experiments For Self Fixation of Radioactive Wastes in Clay-Flux Mixtures; Use of Artificial Clays in Removal and Fixation of Radioactive Nuclides; Processing of High Level Atomic Wastes With the View to Ultimate Disposal; Heat Conduction Losses in Reactor Waste Basins; Potential Hazards Associated With the Release of Laboratory Liquid Waste to the Mohawk River; Geological and Hydrological Aspects of the Disposal of Liquid Radioactive Wastes; Some Geologic Factors That Influence Disposal of Radioactive Wastes Into Pits; Disposal of Low-Level Liquid Radioactive Wastes In Inland Waterways; Preliminary Studies on the Fate of Fission Products in the Illinois River Systems; and Heat Problems in the Disposal of High Level Radioactive Wastes.

55

FIFTH ATOMIC ENERGY COMMISSION AIR CLEANING CONFERENCE HELD AT THE HARVARD AIR CLEANING LABORATORY JUNE 24–27, 1957. April 1958. 159p. (TID-7551)

The following papers were presented:

Particulate Airborne Contamination at Start-Up of the EBWR; Air Cleaning Activities at ANL; Air Sampling in Relation to the Meteorological Program at BNL; Two Gas Cleaning Problems at the Idaho Chemical Processing Plant Site; Air Cleaning Activities at Brush Beryllium Company; Air Cleaning Activities of the Beryllium Corporation; Air Cleaning Activity at Oak Ridge Gaseous Diffusion Plant; Air Cleaning Operations at the Rocky Flats Plant; AEC Bettis Plant Air Cleaning Activities; Air Cleaning Experience at the Naval Reactor Facility; Air Cleaning Activities at GE-ANP Idaho Test Station; Air Cleaning Operations at KAPL; Air Cleaning Activities at Atomics International; Air Cleaning Activities and Associated Studies at Goodyear Atomic Corporation; Developments in High Efficiency Air Filtration; Developments in the Manufacture of Absolute Filters; Development in the Manufacture of Ultra-Aire Space Filters; Fire-Resistive Filter Progress at HAPO; Moisture and Burning Tests of Space Filters; Application of Fire-Resistant Air Cleaning Filter at HAPO; Design and Calibration of an Improved Cascade Impactor for Size Analysis of Aerosols; A Multi-bed Low Velocity Air Cleaner; Air Cleaning Operations at UCRL; Economic Survey of Air and Gas Cleaning Operations Within the AEC; Air Cleaning Costs — A Study of Three Systems; Study of the Fundamental Properties of Aerosols; Air Cleaning Studies at Harvard University, 1956-57; Further Investigations of the Continuous Slag Wool Filter; Slag Wool for Acid Gas and Mist Removal; Agglomeration of Particulate Materials; Progress Report on Filtration of a Freshly Generated NaK Fume; and Development of a "Triboelectrified" Fluidized Bed for Aerosol Filtration.

56

SANITARY ENGINEERING CONFERENCE HELD AT SOUTH DISTRICT FILTRATION PLANT, CITY OF CHICAGO. Robert A. Lauderdale, Rolf T. Skrinde, Clair N. Sawyer, Earnest F. Gloyna, Albert P. Talboys, Warren J. Kaufman, William E. Dobbins, Harold A. Thomas, Jr., R. Stevens Kleinschmitt, Frank L. Parker, Carlos G. Bell, E. W. Steel, Jess C. Dietz, Leslie Silverman, Roy J. Morton, Conrad P. Straub, Oliver R. Placak, William J. Lacy, J. M. Garner, John F. Newell, A. L. Biladeau, D. E. Lynch, L. P. Hatch, C. V. Theis, Fred D. White, Paul A. Humphrey, C. C. Ruchhoft, L. R. Seiter, J. S. Nader, G. R. Hagee, and A. S. Goldin. Sept. 11, 1952. 203p. (WASH-129)

This report contains a compilation of papers on waste disposal. Included are the following: A Summary of the Work of the MIT Sanitary Engineering Department on the Decontamination of Radioactive Water; The Effect of Beta Radiation Upon Biochemical Oxidation in Polluted Waters; Radioactive Contaminated Laundry Waste and its treatment; Radioactive Contaminated and Adsorption Studies at Johns Hopkins; Removal of Radioisotopes by Sewage Treatment Processes; Research on Radioactive Waste Disposal at New York University; Fall-out in Surface Waters of Massachusetts; Univ. of Texas Waste Disposal Project Progress Report; Effects of Radioactive Substances on the Anaerobic Digestion of Sewage Sludges; Air Cleaning Investigations; Summary of Radioactive Liquid Waste Research and Development of Health-Physics Division; Water Decontamination Studies; Metal Dust Slurries and Clay Slurries as Removal Agents; Water Survey Instruments; Some Aspects of Waste Disposal Studies at Los Alamos; Ultimate Disposal of Radioactive Wastes; Work of the Geological Survey in Connection with Sanitary Engineering Problems of the AEC; Brief Discussion of the Meteorological Program at the NRTS with Emphasis on Current Atmospheric Dust Program; The Work of the Public Health Service in the Field of Radioactive Wastes; Limitations in the Use of the End-Window Counter in the Assaying of Stream Waters For Beta Radioactivity; The Determinations of Alpha and Beta Radioactivity in Surface and Ground Water and in Fresh Water Biota.

57

SANITARY ENGINEERING CONFERENCE, BALTIMORE, MARYLAND, APRIL 15–16, 1954. Aug. 1955. 332p. (WASH-275)

The following papers were presented: Biological Treatment of Radioactive Wastes; Oxidation Ponds — Radioactivity Uptake and Algae Concentration; Removal of Radioactivity from Laundry Wastes by Trickling Filters; The Effect of Radioactive Isotopes on the Anaerobic Digestion of Sewage Sludge; Summary of Off-Site Research and Development; Summary Report on AEC Research Project; Passage of Nuclear Detonation Debris Through Municipal Water Treatment Plants; The Fate of Fission Products

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Deposited in the Reservoirs of the Troy, New York Area Following Nuclear Detonations During the Spring tests of 1953; Radioactivity Fall-Out in Rain in the Cincinnati area; Air Cleaning Studies, 1953-1954; Biological Aspects of Low Level Radioactivity in the Columbia River; Summary of Sanitary Engineering Activities at Knolls Atomic Power Laboratory; Progress Review of Accomplishments at ORNL Since September 1952; Radioactive Waste Disposal and Control Programs at Hanford Atomic Products Operation; Disposal of Aqueous Radioactive Wastes at the Savannah River Plant; Summary of Westinghouse Atomic Power Division Waste Disposal Operations; 1953 Operating report—WD-2 Plant, Los Alamos, Industrial Waste Section, AEC, LAFO; Radioactive Waste Disposal and Control Programs at Brookhaven National Laboratory; A Resumé of the Operation of the Waste Disposal System, Argonne National Laboratory; Some Observations on the Decontamination of Fission Product Wastes; The Treatment of Radioactive Wastes from Aircraft Cleaning; Geologic and Hydrologic Factors in Ground Disposal of Waste; Technical Considerations of Sea Disposal; Technical and Economic Aspects of Disposal of Radioactive Waste at Sea—Cost Analysis; Administrative Relationships—Federal, State, Local, and Industrial; and Waste Disposal Problems.

General Electric Company.

Hanford Atomic Products Operation,

Richland, Washington

58

THE RETENTION OF HIGH LEVEL RADIOACTIVE WASTES. A. M. Platt. May 1, 1957. p.389-406 of SYMPOSIUM ON THE REPROCESSING OF IRRADIATED FUELS HELD AT BRUSSELS, BELGIUM, MAY 20-25, 1957. BOOK I. 475p. (TID-7534)

The report describes HAPO waste tank storage, SRP underground waste storage, Idaho Chemical Processing Plant Waste Tank Farm; Waste scavenging as practiced at HAPO, ground disposal at HAPO (cribs, etc.) and ORNL ground disposal.

National Academy of Sciences

59

DISPOSAL OF RADIOACTIVE WASTES. E. C. Pitzer. p.97-105 of LABORATORY DESIGN FOR HANDLING RADIOACTIVE MATERIALS. RESEARCH CORRELATION CONFERENCE, NOVEMBER 27 and 28, 1951. May 1952. 140p. (NP-3875; Research Conference Report No. 3)

This general paper discusses: the amount of radioactivity in our natural environment; the amounts of activity that may safely be discharged in industrial wastes; waste disposal practices investigated at KAPL; and waste disposal problems that would be encountered in typical hypothetical research projects. Two broad policies are advocated: (1) dilution of radioactivity of the waste solutions below an arbitrary level and its dispersion into a large body of water and (2) concentration and confinement of the activity by disposing it by burial or in the ocean.

Oak Ridge Institute of Nuclear Studies,

Incorporated

60

EXPERIENCE IN ANIMAL EXPERIMENTATION FROM THE STANDPOINT OF SALVAGE AND WASTE DISPOSAL. Cyril L. Comar. p.105-109 of A CONFERENCE ON RADIOACTIVE ISOTOPES IN AGRICULTURE HELD AT MICHIGAN STATE UNIVERSITY ON JANUARY 12, 13, and 14, 1956. Jan. 1956. 420p. (TID-7512)

The problems involved in the disposal of animals exposed to radiation either from external or internal sources and the decontamination of pens, stalls, and other experimental facilities are discussed in detail.

Oak Ridge National Laboratory

61

PREPARATION OF WASTE FOR LIQUID DISPOSAL. J. W. Ullmann. May 1, 1957. p.377-88 of SYMPOSIUM ON THE REPROCESSING OF IRRADIATED FUELS, HELD AT BRUSSELS, BELGIUM MAY, 20-25, 1957. BOOK I. 475p. (TID-7534)

This paper describes typical approaches which are used for liquid waste disposal. These include: asphalt lined pits; evaporation; crystallization; precipation; and ion exchange.

62

UNIT COSTS AND ECONOMIC RELATIONSHIPS FOR CERTAIN RADIOACTIVE WASTE DISPOSAL STEPS. F. L. Culler, J. O. Blomeke, and W. G. Stockdale. May 1, 1957. p.455-75 of SYMPOSIUM ON THE REPROCESSING OF IRRADIATED FUELS, HELD AT BRUSSELS, BELGIUM, MAY 20-25, 1957. BOOK I. 475p. (TID-7534)

The cost of several waste disposal systems is presented using tables, graphs, and schematic drawings. The systems discussed include evaporation and storage processes, and interim high level waste storage and shipment to possible ultimate disposal sites. Comparative costs between acid and neutralized waste storage are also given.

Phillips Petroleum Company.

Atomic Energy Division,

Idaho Falls, Idaho

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EFFLUENT DISPOSAL CONSIDERATIONS AND SUMMARY OF METHODS USED. C. E. Stevenson. May 1, 1957. p.351-62 of SYMPOSIUM ON THE REPROCESSING OF IRRADIATED FUELS, HELD AT BRUSSELS, BELGIUM, MAY 20-25, 1957. BOOK I. 475p. (TID-7534)

Certain problems involved in the disposal of effluent other than products from the chemical processing of nuclear fuels for fissionable material recovery are discussed. Major considerations of effluent treatment are outlined and the types of effluents are listed and described. The chief methods which have been used, studied, or proposed in the United States for the treatment and disposal of radioactive wastes from processes are noted and briefly compared in regard to experience obtained and future application.

Stack Gas Problem Working Group, AEC

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REPORT OF AND PAPERS PRESENTED AT THE 3RD MEETING OF THE STACK GAS DECONTAMINATION WORKING GROUP HELD JANUARY 12, 1949 AT THE ACADEMY OF SCIENCES BUILDING. Decl. with deletions Mar. 7, 1957. 86p. (M-4400(Del.))

Topics discussed at this meeting include: filter paper efficiency and the design and construction of filters; the removal of iodine from dissolver off-gas and design of an experimental iodine absorber; the absorption of tritium and tritium oxide by alfalfa growing in greenhouse sand-culture beds; the performance of sand filters; experiments on air decontamination at Los Alamos; the performance of air filters and accompanying monitoring instruments at Brookhaven; the design of cooling systems for air cooled reactors; the control of gaseous contaminants at KAPL; and pilot plant work on solid burnable waste disposal and incinerator design at Mound.

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England

65

SYMPOSIUM ON THE HANDLING OF RADIOACTIVE AND TOXIC SUBSTANCES HELD IN TWO SESSIONS ON SEPTEMBER 10-11th AND SEPTEMBER 13-14th 1951 AT BUCKLAND HOUSE, NEAR FARINGDON, BERKSHIRE. G. R. Hall, ed. Mar. 3, 1952. 68p. (AERE C/R-958)

The topics covered the use and design of glove boxes, remote control methods employed in handling radioactive materials, housekeeping and laboratory decontamination, and painting systems for use in active areas.

Waste Processing Committee, AEC

66

CONFERENCE ON WASTE PROCESSING, (HELD AT BROOKHAVEN NATIONAL LABORATORY), MARCH 27-28, 1950. SECTION 2. EVAPORATION. Changed from OFFICIAL USE ONLY Oct. 3, 1956. 43p. (BNL-59)

A process involving evaporation and de-entrainment for concentrating large volumes of slightly contaminated liquid wastes of low solid content is discussed. The requirements of such a process are that it gives a concentrate which may be stored economically and a condensate sufficiently low in activity that it may be discharged directly to the sewer. BNL has proposed that the maximum concentration of radioactive contaminants in the liquid wastes to be released from the laboratory shall not exceed 3×10^{-11} c/ml, and that the average concentration over a 3-month period shall not exceed 3×10^{-12} c/ml. It has been estimated that for the liquid waste anticipated an over-all decontamination factor from feed to produce of approximately 10^4 may be required to attain this low level. Several methods of evaporation and de-entrainment for effecting this decontamination have been investigated, the results of which are described. Only nonvolatile radioactive materials were considered.

67

MEETING OF THE AEC WASTE PROCESSING COMMITTEE [HELD AT KNOLLS ATOMIC POWER LABORATORY], JUNE 26-28, 1950. PART I. J. A. Ayers, ed. Sept. 27, 1950. Decl. Feb. 25, 1957. 33p. (KAPL-364(Pt. I)

The operation of facilities at KAPL for processing solid and liquid radioactive wastes are discussed in some detail with regard to both the evaporation and vacuum drying system for reducing liquid wastes to a minimum volume and the Hot incinerator for burning solid contaminated waste. The health physics aspects of waste processing are considered briefly. A recrystallization recovery process has been developed for the recovery of $Al(NO_3)_3$ from Redox waste. The process is described, and the results are presented of a series of runs to determine its effectiveness. Results of an investigation of the crystallization separation of $NaNO_3$ from radiochemical wastes at ORNL are discussed. Possible applications of crystallization processes have been considered briefly.

Progress Reports

Argonne National Laboratory, Lemont, Illinois

68

ENVIRONMENTAL RADIOACTIVITY AT ARGONNE NATIONAL LABORATORY. Report for the Year 1953. J. Sedlet and A. F. Stehney. Decl. Feb. 14, 1957. 35p. Contract W-31-109-eng-38. (ANL-5289)

Data are summarized on the radioactive content of samples of rain, surface water, soil, plants, and bottom silt from the beds of surface waters which were collected and analyzed during 1953.

69

STUDIES ON MOVEMENT OF WATER IN SOIL. H. F. Lucas, Jr. and A. F. Stehney, p. 16-22 of REPORT ON BIOLOGICAL, MEDICAL AND BIOPHYSICS PROGRAMS. PART I. SEMIANNUAL REPORT OF RADIOLOGICAL PHYSICS DIVISION. PART II. QUARTERLY REPORT OF BIOLOGICAL AND MEDICAL RESEARCH DIVISION. Jan. 1955. 205p. Contract W-31-109-eng-38. (ANL-5378)

This is a preliminary report on the rate of movement of water in soil as measured by using tritiated water as a tracer. The soil in the 300 Area where the tests were made is known as till, a glacial drift consisting of an unassorted mixture of clay, sand, gravel, and boulders. Near the surface, the soil is composed of yellowish oxidized clay extending to a depth of about 12 feet and blue-grey unoxidized clay below this. The tracer was introduced at a depth of 13 feet below the surface and two years later no tritiated water was found more than 6 feet from the injection site within the detection limits of 0.02% of the original tracer concentration. It seems evident then, that fission products would travel very slowly in this soil if we follow the reasonable assumption that solutes will not travel faster through soil than the water in which they are dissolved. A plot of the test holes in the 300 Area, chart describing elapsed time versus c/m dispersion in test holes, and soil sample results are included.

70

CHEMICAL ENGINEERING DIVISION SUMMARY REPORT FOR APRIL, MAY, AND JUNE, 1955. July 27, 1955. Decl. Feb. 7, 1957. 92p. Contract W-31-109-eng-38. (ANL-5466)

Studies of the calcination of reactor fuel processing wastes are given on p. 81-5. Information includes data on operating conditions for waste calcination runs and the effect of variations of Al_2O_3 particle size in waste calcination runs. Both bench scale and pilot scale experiments were run.

71

CHEMICAL ENGINEERING DIVISION SUMMARY REPORT FOR OCTOBER, NOVEMBER, AND DECEMBER, 1955. Feb. 10, 1956. Decl. with deletions Feb. 2, 1957. 129p. (ANL-5529(Del.))

A summary of the waste processing operations in regard to the volume and methods of waste processing for the year 1955 is presented on p. 132-3.

72

RADIOLOGICAL PHYSICS DIVISION SEMIANNUAL REPORT FOR JANUARY THROUGH JUNE, 1957. July 1957.

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86p. Contract W-31-109-eng-38. (ANL-5755)

Brief monitoring data summarizing continuous monitoring (one month) of the ionization in air from natural background sources are presented. A résumé made of some of the analysis of smoke diffusion measurements using the meteorological stack, K-24 aerial cameras, and the photogrammetric analyzer is given.

Brookhaven National Laboratory,

Upton, New York

73

PROGRESS REPORT ON WASTE PROCESSING DEVELOPMENT PROJECT. THE CONCENTRATION OF WASTE. B. Manowitz and R. Isler. Dec. 1, 1953. Decl. with deletions Dec. 7, 1955. 13p. (AECD-3777)

This report describes experimental and pilot plant development work and enlarges upon two schemes: (1) the concentration of dilute waste solutions to 60 to 70% solids in a batch slurry evaporator, removal of the residual water from the waste by evaporation, and fusion in the final waste container; and (2) accomplishment of the complete concentration and fusion cycle in one piece of equipment on a continuous basis.

74

QUARTERLY PROGRESS REPORT FOR OCTOBER 1-DECEMBER 31, 1950. [nd]. 127p. (BNL-93)

An analysis of health-physics activities for the period at Brookhaven is given. Included are reactor monitoring, contamination control problems, personnel monitoring studies, and urinary elimination studies.

75

PROGRESS REPORT ON FISSION PRODUCTS UTILIZATION. IV. PROPOSALS FOR CONCENTRATING HIGH-LEVEL WASTES. PART 2. F. V. Caccavo, R. J. Isler, and B. Manowitz. Apr. 1, 1953. Decl. with deletions March 6, 1957. 16p. (BNL-211(Del.))

Studies are reported which include comparisons between ORNL and KAPL container design concepts, calculations of specific heat generation of dried fission product solids, surface and internal temperatures of heat generating solids for various geometrics, radiation distribution in waste containers, and waste solids physical constants (includes specific gravity, viscosity, hygroscopicity, solubility in water, and melting point).

76

QUARTERLY PROGRESS REPORT FOR APRIL 1-AUGUST 15, 1953. Clarke Williams, comp. Decl. Feb. 14, 1957. 37p. (BNL-249)

Data are given on the physical properties of ORNL-D and SR Purex waste slurries, specific gravity determinations of various waste streams, and thermal conductivity values of these wastes.

77

QUARTERLY PROGRESS REPORT FOR AUGUST 16-NOVEMBER 15, 1953. Jan. 1954. 42p. (BNL-267)

A brief description and operating data for a 5 gal stainless steel slurry concentrator for Purex waste are given on page 19. A continuous calciner for Purex waste with a capacity of 1½ lb/hr is described. Diagrams are included.

78

QUARTERLY PROGRESS REPORT FOR NOVEMBER 16, 1953-FEBRUARY 15, 1954. 44p. (BNL-285)

Data are given on the corrosion of 304, 316, 347 stainless steels and 1020 steel by Purex wastes and the radiation corrosion of 304 stainless steel by a simulated waste solution containing 60% HNO_3 at a dose rate of 1.7×10^6R. Fluxing a sample of 1AW with molten $NaNO_3$ and filtering showed 98% total substrate associated with the filter cake.

79

QUARTERLY PROGRESS REPORT FOR MAY 16-AUGUST 15, 1954. Decl. Apr. 2, 1957. 47p. (BNL-309)

A brief description is given of the continuous calciner pilot plant. Physical property data of various Purex wastes are listed on p. 23.

80

QUARTERLY PROGRESS REPORT FOR AUGUST 16-NOVEMBER 15, 1954. Decl. with deletions Feb. 14, 1957. 51p. (BNL-316(Del.))

Three runs, ranging from 16 to 29 hr in duration, have been made on the continuous calciner pilot plant. These runs demonstrated that the calciner can continuously concentrate and fuse an aqueous solution to a molten salt. Some difficulties with freeze-up in the discharge system were experienced. The unit is now being modified to alleviate this problem. In the laboratory, corrosion studies were completed on a series of waste mixtures in contact with 1020 mild steel under boiling conditions both in and out of intense radiation fields. One system, containing gluconic and complexed scavenger cake waste, shows evidence of appreciable corrosion. This system is being carefully checked. Steam surge simulation experiments carried out on a battery jar scale have indicated cyclic temperature changes in sludge layers are possible.

81

PROGRESS REPORT ON WASTE DEVELOPMENT PROJECT. DESCRIPTION OF CALCINER PILOT PLANT. F. Hittman and B. Manowitz. Dec. 1954. 14p. (BNL-323)

The work of the Waste Processing Development Project at Brookhaven National Laboratory has led to the development of a piece of equipment capable of substantially reducing the volume of simulated high-activity aqueous waste streams. This equipment, known as a continuous calciner, is a heated tube, auger-agitated concentrator which dehydrates and fuses the various aqueous waste salt solutions to an anhydrous free-flowing melt on a continuous basis. Both a laboratory model and a pilot plant model of this equipment have been operated successfully. The pilot plant model has been operated without major difficulties for 150 hr and has produced approximately 1500 pounds of fused salt product. During this period of operation, a decontamination factor of approximately 500 was achieved. The corrosion rates of mild and stainless steel in the fused salt product are being studied, and preliminary results are presented in this report.

82

FEASIBILITY OF BOILING IN UNDERGROUND TANKS, p. 25-7 of QUARTERLY PROGRESS REPORT FOR FEBRUARY 16-MAY 15, 1955. Decl. Feb. 23, 1957. 60p. (BNL-348)

Temperature distribution studies during breakdown using simulated wastes are given. The corrosion behavior of steel in simulated Purex wastes was investigated. Tables and charts are included.

83

ULTIMATE WASTE DISPOSAL, p. 26-7 of QUARTERLY PROGRESS REPORT APRIL 1-JUNE 30, 1955. (UNCLASSIFIED SECTION). Sept. 1955. 69p. (BNL-355)

Results are presented for an experiment performed on $Al(NO_3)_3$ wastes in which the nitrate was converted to stable oxide and the fission products were leached by water. The

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data indicate that Cs of sufficient purity for radioactive sources may be recovered by leaching.

84

WASTE PROCESSING DEVELOPMENT. p. 32-7 of PROGRESS REPORT, MAY 16–NOVEMBER 15, 1955. Decl. Apr. 8, 1957. 74p. (BNL-380)

The following topics are presented. Tank Surge Test Experiment using a simulated Savannah River Purex-type waste; Resistivity of waste streams to current heat generations; metallic corrosion tests; melt corrosion studies; scaling characteristics of wastes; and Ru electroplating studies.

85

QUARTERLY PROGRESS REPORT JANUARY 1–MARCH 31, 1956. UNCLASSIFIED SECTION. 61p. (BNL-388)

Results of radioactivity and dust settling out of the atmosphere for the calender year 1955 are presented as well as an analysis of the exposures received at the pile by individuals and recorded regularly assigned personnel monitoring equipment for the 4 year period ending December 31, 1955.

University of California, Berkeley.

Sanitary Engineering Research Laboratory

86

REMOVAL OF RADIOISOTOPES BY SEWAGE TREATMENT PROCESSES; PROGRESS REPORT NO. 1, MAY 1, 1951 TO MARCH 31, 1952. Warren J. Kaufman, Gerhard Klein, and Harold B. Gotaas. Apr. 15, 1952. 27p. (AECU-2035)

The removal of P^{32} by the activated sludge process was studied both in batch and continuous operation. The effectiveness of the process varied widely as a result of changes imposed upon the amount and nature of BOD loading, suspended solids concentration, stable phosphate concentration and aeration period. In the course of treating a normal domestic sewage in the conventional treatment plant a high reduction of the radioactive phosphorus concentration may not be expected. The results presented permit the following fundamental observations. Phosphate is assimilated by activated sludge as a consequence of cell growth and isotopic exchange. Uptake of P^{32} by cell growth predominates at low sludge ages while isotopic exchange is favored by a high concentration of suspended solids. The BOD/N ratio appears to be more critical in the removal of radioactive phosphorus than in the reduction of BOD. Removal of P^{32} is a function of the stable phosphorus concentration in the waste. Removals as high as 98% are possible at stable phosphorus levels of approximately one ppm. However, at phosphorus concentrations of 6 ppm or higher, P^{32} removals may be 20% or less. The phosphorus exchange rate between the solution and solid phases for an activated sludge developed on 6.5 ppm phosphorus is approximately 0.35 ppm P per hour for the first seven hours after feeding.

87

CONCENTRATION OF RADIOISOTOPES BY ACTIVATED SLUDGE; PROGRESS REPORT COVERING PERIOD APRIL 1, 1952 TO MAY 31, 1953. Warren J. Kaufman, Gerhard Klein, and Arnold E. Greenberg. May 31, 1953. 71p. (AECU-2665)

This investigation was made to evaluate the effectiveness of the activated sludge process for the concentration of radioisotopes from liquid wastes. The study was concerned with possible applications of biological treatment methods to the wastes of the atomic energy industry and with the role of the municipal sewage treatment plant receiving the wastes of research and medical institutions. The isotopes studied included P^{32}, I^{131}, and Sr^{89} in the chemical forms of the orthophosphate, iodide, and strontium ions respectively. With each isotopes, studies were first made on a batch basis to determine the influence of variation [illegible] substrate composition as well as modifications in the [illegible]tion of the treatment process. These investigations were concerned with such parameters as the concentration of carrier and chemically similar elements, the presence of complexing agents, and the nutritional characteristics of the waste as related to the concentration and activity of the organisms present in the microbiological system. Following the preliminary batch investigations, continuous flow pilot scale studies were carried out with each isotope in order to estimate the removals to be expected in the full scale activated sludge treatment plant. Radioisotopes were added continuously over a sufficient period of time for steady state conditions to be reached and for a true tracer relationship to be established between the radio-element and its carrier. Additional tests were made to determine the manner of passage of transient concentrations of radioisotopes through the treatment plant with the objective of evaluating the relative influence of hydraulic and isotopic dilution.

88

REMOVAL OF RADIOISOTOPES BY SEWAGE TREATMENT PROCESSES. PROGRESS REPORT NO. 3 COVERING PERIOD JUNE 1, 1953 TO MAY 31, 1954. BIOLOGICAL TREATMENT OF RADIOACTIVE WASTES. Gerhard Klein, Arnold E. Greenberg, and Warren J. Kaufman. June 30, 1954. 67p. (AECU-2824)

Aerobic methods are given on the removal of mixed fission products and radioactive Sr from both natural domestic sewage and from a synthetic substrate. The activated sludge and trickling filter processes were found to remove from 70 to 85% of the fission products ranging in age from 1.3 to 2.7 yr. Variations in the methods of operation and in waste composition was shown to exert little influence on the uptake of fission products. Removals were independent of Ca and Mg concentrations up to 300 and 22 ppm, respectively, and were little affected by Al salts. The presence of the chelating agent, disodium ethylenediaminetetraacetic acid, caused the elution of fission products from the trickling filter slimes and reduced removals to nearly zero. Aeration periods as short as 2.7 hr did not reduce the uptake of fission products by activated sludge. Trickling filter loadings ranging from 2.2 to nearly 10 million gal of settled sewage per acre of filter area per day provided essentially the same degree of fission products uptake. The removal of radiostrontium generally did not exceed 20% and was closely dependent on the mineral composition of the substrate being treated. Ca, Mg, Al, and complexing agents all reduced Sr removal efficiencies. The P requirements of algal-bacterial systems, developed in a symbiotic relationship, were found to be proportioned to the rate of algal growth and generally greater than that reported for the activated sludge and trickling filter processes.

89

UNDERGROUND MOVEMENT OF RADIOACTIVE WASTES. Progress Report No. 1 covering period July 1, 1954 to June 30, 1955. Warren J. Kaufman, Richard G. Orcutt, and Gerhard Klein. Aug. 1, 1955. 92p. (AECU-3115)

A preliminary investigation was made of several physical and chemical factors influencing the feasibility of high-level radioactive waste disposal by injection into isolated

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geological formations. The report includes a review of the injection disposal practices of the petroleum and chemical industries and considers the problems likely to be encountered in using similar techniques for the disposal of fission product wastes of the nuclear energy industry. Laboratory model and field studies were made to determine the influence of hydraulic parameters on velocity variations during the flow of liquids through porous media. The contribution of longitudinal mixing in laminar flow to the development of concentration fronts has been considered. It was observed that even in homogeneous isotropic media, portions of the injected waste may travel at velocities exceeding six times the average. A Hele-Shaw parallel plate viscous flow model was employed to investigate density displacements resulting from the injection of a liquid differing in density from the formation water. Column studies of clays and a typical oil sand have shown that exchange reactions may retard the advance of radiostrontium concentration fronts to as much as one fortieth of that of the liquid fronts. Ion exchange may thus make a significant contribution to the waste storage capacity of connate formations.

90

THE MOVEMENT OF RADIOSTRONTIUM THROUGH NATURAL POROUS MEDIA. PROGRESS REPORT NO. 2 COVERING PERIOD JULY 1, 1955 to June 30, 1956. Richard G. Orcutt, Warren J. Kaufman, and Gerhard Klein. Nov. 1, 1956. 58p. (AECU-3608)

The feasibility of discharging radioactive wastes into underground formations is dependent on the predictability of the movement of certain hazardous radioisotopic components. This progress report examines several theories concerned with the equilibria and kinetics of ion-exchange as they apply to estimating the rate of underground movement of radiostrontium. Laboratory studies were conducted with the objective of testing the applicability of these theories to estimating the displacement and dispersion of radiostrontium fronts in natural media. The porous media studied with both batch and column systems included several connate-water bearing sands, an agricultural soil, and a standard halloysite clay. The parameters investigated were the exchange capacity, various expressions of equilibria, the influence of calcium, sodium, and hydrogen ions on the rate of Sr movement, the hydraulic rate of liquid application, and the rate coefficients controlling the ion-exchange reactions. The results indicate that a proper application of existing ion-exchange theory will greatly reduce the uncertainties in estimating the rate of radiocontaminant travel through natural media and may ultimately provide criteria for the design of subsurface disposal systems.

University of California, Los Angeles.

Atomic Energy Project

91

INDUSTRIAL HYGIENE, RADIO-ECOLOGY, AND DIVERSIFIED PROBLEMS DIVISIONS, p. 60-99 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1953. July 1, 1953. Decl. Mar. 6, 1957. 99p. (UCLA-260)

The testing and development of equipment for use in dust inhalation studies and routine health physics activities for the period are reported. Progress is reported in a study of factors affecting the precision and accuracy of the spectrographic analysis of bone ash. Additional data are included on the fixation and exchange of various isotopes by various soils and clays, and the uptake and metabolism of Sr^{90} + Y^{90} by rats. Data are tabulated on the activity found in plants and animals collected from areas contaminated by radioactive fall-out from atomic explosions.

92

THE INFLUENCE OF SOIL ORGANIC MATTER ON THE UPTAKE OF FISSION PRODUCTS. Hideo Nisheta and Bruce W. Kowalewsky. p.95-6 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING MARCH 31, 1954. Apr. 1, 1954. Decl. Jan. 14, 1956. 118p. Contract AT-04-1-Gen-12. (UCLA-286)

Data are given on the influence of soil organic matter on the availability of Sr^{90} to Barley Seedlings grown by the modified Neubauer technique.

General Electric Company.

General Engineering Laboratory, Schenectady, New York

93

UTILIZATION OF THE GROSS FISSION PRODUCTS. Progress Report No. 2 for the Period January 3, 1952 to January 14, 1953. E. L. Mincher and R. M. Lichtenstein. Mar. 20, 1953. Decl. Dec. 2, 1955. 46p. Contract W-31-109-Eng-52. (GEL-67; R53GL91)

Two methods of evaporating mixed-fission-product waste process solutions to dryness are discussed. Direct evaporation under reduced pressure with some added heat was found superior to the freeze-drying method. A β source of ~50 mc was prepared by the former method and activity calculations are presented.

General Electric Company.

Hanford Atomic Products Operation, Richland, Washington

94

RADIOLOGICAL SCIENCES DEPARTMENT RESEARCH AND DEVELOPMENT ACTIVITIES QUARTERLY PROGRESS REPORT [FOR] OCTOBER-DECEMBER 1954. H. M. Parker. Jan. 10, 1955. Decl. with Deletions Dec. 7, 1955. 27p. (AECD-3817)

Data are presented from a radiobiological ecological survey of the Columbia River and the Hanford area; studies on the toxicology of I^{131} in sheep; the effects of whole-body x irradiation in sheep; the effects of contact with radioactive particles on the skin of swine; Pu adsorption by rats; the absorption and tissue distribution of fission products in rats and mice; and tracer studies on plant metabolism of fission products. Research and development activities aimed at improving monitoring methods and instruments are discussed. The objectives of research and development activities of the Radiological Sciences Department are summarized.

95

PROGRESS REPORT FOR JANUARY, 1950. CHEMICAL RESEARCH SECTION. F. W. Albaugh. Feb. 15, 1950. Decl. Feb. 19, 1957. 36p. (HW-16076)

Data are given on RuO_4 decontamination from Redox solutions by distillation; Zr-Nb decontamination of dissolver solution on extraction-scrub with and without scavenging; decontamination of metal waste extracted with TBP; and decontamination of $BiPO_4$ process non-U wastes (Pu scavenging by tannic acid).

REFERENCES

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RADIOLOGICAL SCIENCES DEPARTMENT QUARTERLY PROGRESS REPORT, RESEARCH AND DEVELOPMENT ACTIVITIES FOR JULY-SEPTEMBER, 1952. H. M. Parker. Oct. 21, 1952. Decl. Aug. 31, 1956. 28p. (HW-25994)

Data are reported from the following studies: an evaluation of paints for use on steel retention basins, a radiobiological-ecological survey of the Columbia River, the effect of reactor effluent water on aquatic organisms, the absorption of Pu from the gastrointestinal tract of rats, a comparison of the tissue distribution and retention of tritium in sheep and in rats, delayed effects of radiation on algae, the accumulation of Sr, Cs, Y, and I on dead and living roots of bean plants, the uptake of environmental tritium by plants, tissue distribution and chronic effects of I^{131} on sheep, radiobiological monitoring of the production area, analysis for Ra content of cadavers, testing of agents from the removal of Pu contamination from skin, testing of separations-plant stack monitors, a technique for the analysis of Ru in vegetation, decay characteristics of noble gases in water, a procedure for the dissolution of Ra from soil samples, counters for β counting, and instruments for α, β, γ and neutron dosimetry, atmospheric contamination studies, ground waste investigations, and survey instrumentation.

97

RADIOLOGICAL SCIENCES DEPARTMENT QUARTERLY PROGRESS REPORT; RESEARCH AND DEVELOPMENT ACTIVITIES FOR OCTOBER-DECEMBER 1952. H. M. Parker. Jan. 5, 1953. Decl. Aug. 31, 1956. 30p. (HW-26523)

Data are presented on the following studies: a radiobiological-ecological survey of the Columbia river, effect of reactor-effluent water on aquatic organisms, tissue distribution of D and T, delayed effects of radiation on algae, Ru absorption by bean plants, uptake of radioactivity by plants grown in contaminated soil, toxicology of I^{131}, effect of route of administration on I^{131} metabolism, Pu toxicity and therapeutics, uptake of environmental D and T by plants, radiobiological monitoring of the production area, testing of separations-plant stack monitors, temperature in salmon nests, activity in stack-gas particulates, and decontamination of adsorbed Ce from Hanford soil.

98

RADIOLOGICAL SCIENCES DEPARTMENT QUARTERLY PROGRESS REPORT: RESEARCH AND DEVELOPMENT ACTIVITIES [FOR] APRIL-JUNE 1953. H. M. Parker. July 31, 1953. Decl. Aug. 31, 1956. 35p. (HW-28892)

Data are presented on the following studies: the uptake and distribution of P^{32} in aquarium communities of microorganisms, radiobiological-ecological survey of the Columbia River, effects of reactor effluent on aquatic organisms, a comparative study of D_2 and T_2 incorporation and retention in rats, effects of T_2 in the media on growth of algae and bacteria, uptake of Pu by plants, the effect of pH on the uptake of Ce by plants, and the uptake of Sr by plants. Data are included on the toxic effects of low-level chronic doses of I^{131} to sheep, and the relative effects of Zr citrate and Ca EDTA in the removal of injected Pu in the dog. Analytical techniques and methods used in routine monitoring studies, construction of radiation detection instruments, and environmental studies to check the adequacy of waste disposal systems are described.

99

ANNUAL REPORT ON BIOLOGY RESEARCH FOR 1952. July 7, 1953. 178p. (HW-28636)

Data obtained during the period from a radiobiological survey of the Columbia River indicated the distribution of radioactivity in river organisms to be similar to that of previous years. Tracer amounts of P^{32} introduced into aquaria were effectively removed by plankton and algae. Data are summarized on the effects of 3 yr retention in dilute reactor effluent on rainbow trout, and the effects of reactor effluent water on the eggs and young of salmon retained in reactor effluent for 11 months. Barley irrigated with various dilutions of reactor effluent water showed no effects attributable to radioactivity. Data are presented on the metabolism of tritium in the rat, the rate of percutaneous absorption of tritium from an HTO-contaminated atmosphere, long-term retention of tritium in the rat and sheep, the comparative metabolism of deuterium and tritium in the rat, the metabolism of H isotopes by algae, and the metabolism of H isotopes in bean plants. The rates of absorption through the skin of rats were determined for various types of Pu solutions, and the effectiveness of various decontaminating agents and procedures in decontaminating skin were investigated. Data are reported on the growth of algae in various concentrations of the β-emitting radioisotopes, P^{32}, S^{35}, Sr^{90}-Y^{90}, and H^3. Data are included on the uptake of radioactive elements present in Jangle test site soil, by four species of plants, and a tracer study of the absorption of Ru from nutrient solution by kidney bean plants as a function of Ru concentration and pH. Tracer studies of the absorption of P, S, Ca, Mn, Zn, Cu, and Sr by *Chlorella* showed that the amount of the element absorbed by the algae is a function of the element and its concentration in the nutrient solution. The maximum translocation did not exceed 2% by leaves of tomato and kidney beans exposed to I^{131} vapor. A study of the toxicity of I^{131} in sheep was continued. Biological radiation monitoring procedures were continued and data are included on wildlife thyroid activity densities as related to vegetation activity.

100

ANNUAL REPORT ON BIOLOGY RESEARCH FOR 1953. Jan. 4, 1954. 163p. (HW-30437)

Radiobiological conditions in the Columbia River during 1953 are compared with conditions during previous years and current studies are summarized. Data are presented from studies of the following: the effect of reactor effluent on young salmon and trout, and on cereal plants; the uptake of Pu^{239} and Ce^{144} by plants; the physical and chemical properties of soils for use in comparative studies of fission product uptake by plants; the radiosensitivity of vitamins; the mutagenic effects of P^{32} in *Neurospora;* the effects of tritium oxide on some synthetic processes in *Chlorella*. Data are presented from tracer studies of the absorption and distribution of Ru in fowl; the percutaneous and gastrointestinal absorption of Pu in rats; the effectiveness of various therapeutic agents in Pu poisoning; determination of α particle emitters in the lung; and the toxicity of I^{131} in sheep and rabbits.

101

BIOLOGY RESEARCH-ANNUAL REPORT [FOR] 1954. BIOLOGY SECTION, RADIOLOGICAL SCIENCES DEPT. Jan. 3, 1955. Changed from OFFICIAL USE ONLY Nov. 9, 1955. 188p. (HW-35917)

Research activities engaged in during the period are summarized. Progress is reported on studies of the effects of reactor effluent on aquatic and plant life; a radiobiological survey of the Columbia River; plant and animal absorption and metabolism of fission products, Pu, and tritium; the chronic effects of I^{131} and external radiations administered to sheep; the toxicity of radioactive particles; and the development of new or improved techniques applicable to radiobiological studies.

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REFERENCES

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RADIOLOGICAL SCIENCES DEPARTMENT RESEARCH AND DEVELOPMENT ACTIVITIES QUARTERLY PROGRESS REPORT FOR JANUARY-MARCH 1955. H. M. Parker. Apr. 10, 1955. Decl. with deletions Dec. 7, 1955. 28p. Contract W-31-109-eng-52. (HW-36301(Del.))

Data on the activity densities of whitefish flesh in the Columbia River and effects of reactor effluent on the chinook salmon are summarized. Experimental studies include: toxicology of I^{131}, irradiation of pig skin with radioactive particles, fission product absorption and metabolism, uptake studies of Sr^{90} and Ba^{140} using bean and barley plants, properties of stack gas particulates, wind tunnel particle pickup, and ground water investigations.

103

RADIOLOGICAL SCIENCES DEPARTMENT RESEARCH AND DEVELOPMENT ACTIVITIES. Quarterly Progress Report April-June, 1955. H. M. Parker. July 11, 1955. Decl. Dec. 6, 1955. 31p. (HW-38198)

Progress is reported in the radiobiological-ecological survey of the Columbia River; the effects of β particles from Ru^{106} plaques mounted against the skin of swine and rabbits; the tissue distribution and maximum permissible concentration of Ru in rats; tritium absorption and metabolism in rats; the radioisotope buildup in rats receiving reactor effluent as drinking water; factors influencing the uptake of fission products in plants; and modifications in methods of radiation monitoring and waste disposal.

104

RADIOLOGICAL SCIENCES DEPARTMENT RESEARCH AND DEVELOPMENT ACTIVITIES QUARTERLY PROGRESS REPORT [FOR] JULY-SEPTEMBER 1955. H. M. Parker. Oct. 11, 1955. Decl. Mar. 6, 1957. 35p. (HW-39624)

Progress is reported in the following studies: a radiobiological-ecological survey of the Columbia River; the toxicity of I^{131} in sheep; the synergistic effects of whole-body x irradiation combined with the effects of ingested I^{131} and I^{131} plus skin β irradiations from Sr^{90} plaques in sheep; cutaneous absorption and metabolism of Pu in rats; fission product absorption and metabolism in rats; the pathological effects of radioactive particles on the skin and following intratracheal and intravenous administration to experimental animals; tracer studies on the metabolism of Mn, Fe, and Cr in plants; factors affecting the uptake of Sr^{90} by plants; the relative biological effects of β and α particles in yeast; the genetic effects of internally deposited radioelements and externally administered x radiation in yeast; development of methods for the separation and determination of fission products from product waste solutions; application of geological, soil chemistry, and soil physics studies to process waste disposal problems; aerial observations on smoke and tracer particle diffusion and transport; the relative retention efficiencies for small particles on grass, rock, furrowed, and snow-fence-protected surfaces; development of an instrument for continuously measuring the dust loading of the atmosphere; and the development of instruments for radiation dosimetry and surveys. The status of the research program is summarized.

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RADIOLOGICAL SCIENCES DEPARTMENT RESEARCH AND DEVELOPMENT ACTIVITIES QUARTERLY PROGRESS REPORT [FOR] OCTOBER-DECEMBER 1955. H. M. Parker. Jan. 11, 1956. Decl. with deletions Feb. 26, 1957. 33p. Contract W-31-109-Eng-52. (HW-41026(Del.))

Progress is reported in the following studies: a radiobiological-ecological survey of the Columbia River; the toxic effects of continuous low-level exposure to I^{131} in pigs; the tissue distribution and retention of Ru^{106} and Cs in rats and mice; the pulmonary absorption of radioactive particles and the pathological effects of such particles in the lungs of mice; the uptake of I^{131} and other fission products from the soil and from air by plants; determinations of the relative biological effectiveness for yeast cells of Po^{210} α particles and P^{32} β particles; the development of chemical and radiological monitoring methods for studies of radioactive contamination, temperature, and concentration of non-radioactive toxic materials in waste streams, soil, ground water, and air; the separation of fission products from waste streams; and improvements in instruments for monitoring and low-level radiation counting.

106

BIOLOGY RESEARCH—ANNUAL REPORT FOR 1955. Feb. 16, 1956. 188p. (HW-41500)

Progress is reported in the following studies: the effect of Ca and Sr in soil on the uptake of Sr^{90} by barley plants; the effects of carrier upon the tissue distribution of Ca^{45} and Sr^{89} in rats; the effects of flow, diffusion, adsorption, and chemical reaction on isotopic dilution; observations on chinook salmon spawning the the Columbia River system over a 9 yr period; the toxic effects of chronic exposure to chromates on trout; the chronic build-up of radioisotopes in rats drinking concentrated reactor effluent water; the radiobiological monitoring of reptiles, birds, and mammals exposed to fission products in the Hanford area; the foliar sorption of I^{131} by plants; the uptake of Sr^{90} by barley from contaminated soil; a comparison of the uptake of fission product elements by barley plants under various laboratory and field conditions; the percutaneous absorption and decontamination of Pu in rats; the gastrointestinal absorption of Pu by rats; the absorption and turnover of Ru^{106} in rats; gastrointestinal radiation damage from ingested Ru^{106} in rats, the gastrointestinal absorption, distribution, bone deposition, and retention of various forms of P^{32} by rats; the pathological effects of both low-level chronic and acute administration of I^{131} in sheep.

107

RADIOACTIVITY LEVELS OF THE COLUMBIA RIVER BELOW RICHLAND, WASHINGTON FOR THE PERIOD JULY, AUGUST, SEPTEMBER, 1955. R. E. Rostenbach. Mar. 22, 1956. 9p. Contract W-31-109-Eng-52. (HW-42181)

Below Richland, Washington there is a gradual decrease in the concentration of β particle emitters in the Columbia River water. The concentration of α particle emitters in Columbia River water averages less than 5×10^{-9} μc/ml at all locations. The activity of α particle emitters in mud samples was less than the detection limit of 3×10^{-6} μc/gm; the average activity density of β particle emitters approximates those reported for the previous quarter.

108

RADIOLOGICAL SCIENCES DEPARTMENT RESEARCH AND DEVELOPMENT ACTIVITIES QUARTERLY PROGRESS REPORT [FOR] JANUARY-MARCH 1956. H. M. Parker. Apr. 13, 1956. Decl. Mar. 6, 1957. 33p. (HW-42403)

Progress is reported in the following studies: a radiobiological-ecological survey of the Columbia River; the toxicity of sodium dichromate in effluent water for chinook salmon; the toxic effects of continuous low-level exposure to I^{131} in sheep; fission product absorption and metabolism in rats; absorption and metabolism of reactor effluent radioisotopes in rats; fission product uptake in plants; in yeast; biological monitoring of waterfowl; development of a system for the quantitative measurement by γ counting of fission products in reactor effluent; the development of monitoring methods and instruments; counting techniques; and meteorological studies.

109

RADIOACTIVITY LEVELS OF THE COLUMBIA RIVER BELOW RICHLAND, WASHINGTON FOR THE PERIOD OCTOBER, NOVEMBER, DECEMBER, 1955. R. E. Rostenbach. May 1, 1956. 9p. (HW-42946)

Below Richland, Washington there is a general decrease in the concentration of β particle emitters in the Columbia River water. The concentration of α particle emitters in Columbia River water averages less than 5×10^{-9} μc/ml at all locations. The activity of α particle emitters in mud samples was less than the detection limit of 3×10^{-6} μc/gm; the average activity density of β particle emitters approximates those reported for the previous quarter.

110

RADIOACTIVITY LEVELS OF THE COLUMBIA RIVER BELOW RICHLAND, WASHINGTON FOR THE PERIOD JANUARY, FEBRUARY, MARCH, 1956. H. V. Clukey. Oct. 9, 1956. 9p. (HW-45983)

In the Columbia River downstream from Richland, Washington there is a gradual decrease in concentration of radioactive isotopes. At any one location there are fluctuations due to factors such as dilution and decay time. During this period at all locations the concentration of α particle emitters in water averaged below the detection limit of 5×10^{-9} μc/cc. In mud, all α particle emitter concentrations were below the detection limit of 3×10^{-6} μc/gm. β particle emitters in water upstream of McNary Dam increased by a factor of 1.5 to 2, with averages at various locations ranging from $(3 \text{ to } 40) \times 10^{-7}$ μc/cc, but in river mud the average of 2×10^{-5} μc/gm was about $^2/_3$ that during the previous quarter. Downstream from McNary Dam, β particle emitter average concentrations in water were about the same as those during the past three quarters.

111

RADIOACTIVITY LEVELS OF THE COLUMBIA RIVER BELOW RICHLAND, WASHINGTON FOR THE PERIOD APRIL, MAY, JUNE, 1956. H. V. Clukey. Oct. 17, 1956. 9p. (HW-46094)

In the Columbia River downstream from Richland, Washington there is a gradual decrease in concentration of radioactive isotopes. At any one location there are fluctuations due to factors such as dilution and decay time. During this period at all locations the concentration of α particle emitters in water averaged below the detection limit of 5×10^{-9} μc/cc. Special analyses for U showed an average of 1.1 μg/cc (7×10^{-10} μc/cc). In mud, all α particle emitter concentrations were below the detection limit of 3×10^{-6} μc/gm. β particle emitters in water upstream of McNary Dam decreased slightly due to increased river flow this quarter, with averages at various locations ranging from $(3 \text{ to } 25) \times 10^{-7}$ μc/cc, but in river mud the averages of 2×10^{-5} μc/gm were about the same as the previous quarter. Downstream from McNary Dam, β-particle emitter average concentrations in water were about the same as the past three quarters.

112

RADIOACTIVITY LEVELS OF THE COLUMBIA RIVER BELOW RICHLAND, WASHINGTON FOR THE PERIOD JULY, AUGUST, SEPTEMBER, 1956. H. V. Clukey. Dec. 10, 1956. 9p. (HW-47170)

During this period, at all locations, the concentration of α particle emitters in water averaged below the detection limit of 5×10^{-9} μc/cc. In mud, all α particle emitter concentrations were below the detection limit of 3×10^{-6} μc/gm. β particle emitters in water upstream of McNary Dam increased slightly due to normal decreased river flow this quarter, with averages at various locations ranging from $(3 \text{ to } 25) \times 10^{-7}$ μc/cc, but in river mud the averages of 2×10^{-5} μc/gm were about the same as the previous quarter. Downstream from McNary Dam, β particle emitter average concentrations in water were about the same as the past 3 quarters.

Knolls Atomic Power Laboratory, Schenectady, New York

113

WASTE DISPOSAL PROGRESS REPORT; DECEMBER 1950, JANUARY, FEBRUARY 1951. Changed from OFFICIAL USE ONLY June 3, 1957. 15p. (KAPL-479)

Concentration of low-activity liquid wastes in an evaporator to the point where they solidify on cooling is reported; thus driers are bypassed. All segregated, combustible contaminated wastes from SPRU operations and from maintenance are burned in the incinerator. Activity in the off-gases discharged to the atmosphere is below tolerable limits. A process research laboratory to study crystallization as a means of waste concentration is proposed. The process is established in two parts: (1) concentration of solution by evaporation and (2) removal of the crystallizable salts.

114

DEVELOPMENT ACTIVITIES IN THE HEALTH PHYSICS DIVISION. Semiannual Progress Report for the Period Ending December 31, 1950. R. Z. Bouton, R. W. Houston, and W. Van der Grinten. Jan. 1951. Changed from OFFICIAL USE ONLY June 26, 1956. 72p. Contract W-31-109-Eng-52. (KAPL-492)

Progress is reported in developmental activities during the period. A modified electrostatic precipitator was developed which utilizes a point-to-plane electrode configuration which deposits the entire aerosol on a half-inch diameter surface which may be removed quantitatively in a transparent plastic film for chemical analysis or microscopic size count. Preliminary results were obtained on size distribution of KAPL shop dusts. Progress is also reported on the development of a nuclear counting technique for the determination of tritium as HTO in urine or other aqueous samples, and a nuclear film procedure for the determination of very low levels of α activity.

115

WASTE DISPOSAL; PROGRESS REPORT JUNE, JULY, AUGUST, 1951. Changed from OFFICIAL USE ONLY June 3, 1957. [nd] 35p. (KAPL-604)

The increase in efficiency of decontamination obtained with a larger Pease-Anthony Scrubber at KAPL is discussed. Decontamination factors across the various pieces of equipment in the decontamination train were determined by gas sampling. The effects of a number of variables (reflux ratio, distilling pressure, acidity of distillate) on the decontamination of HNO_3 containing radioactive Ru were studied in glass equipment. Nonreproducibility of results led to the belief that the chemical state of the Ru might have changed as a result of repeated distillation or the introduction of some impurity. A study of the filtration of laundry wastes to remove the lint indicated that this one step would not decrease the activity content of the wastes below the allowable limits for discharge directly to the environment. Changes in waste disposal proposed by the KAPL Radioactive Waste Committee are discussed.

116

WASTE DISPOSAL; PROGRESS REPORT; MARCH, APRIL, MAY, 1951. Changed from OFFICIAL USE ONLY June 3, 1957. 16p. (KAPL-560)

The solid combustible wastes burned in the hot incinerator during the period had activity levels up to 9 rep/hr of β and 800 mr/hr of γ; the off-gases, except for one sample, were below tolerance in activity. A method of sampling the hot, heavily dust-laden gases leaving the furnace has been developed by making use of a special glass-fiber paper. A series of runs in glass equipment was made to study the recovery of HNO_3 from solutions containing active Ru. Tests of laundry wastes were made in order to see whether the volume sent to the evaporators could be reduced.

117

WASTE DISPOSAL PROGRESS REPORT [FOR] SEPTEMBER, OCTOBER, NOVEMBER 1951. Decl. Feb. 26, 1957. 27p. (KAPL-649)

Experimental work is reported on a pilot incinerator for contaminated combustible solids. Design criteria for a production-type incinerator are summarized. The concentration of liquid waste by evaporation is reported. Data are included on evaporation equipment and tests. Factors affecting the decontamination of HNO_3 by distillation are discussed. The problem of high-level waste storage at KAPL is outlined briefly.

118

SEMIANNUAL PROGRESS REPORT OF DEVELOPMENT ACTIVITIES IN THE HEALTH PHYSICS UNIT; JULY-DECEMBER 1951. Jan. 1952. 37p. (KAPL-679)

A sampling unit is described which was designed and constructed to provide a continuous, proportional sample of the sanitary sewer effluent. The efficiency of the health physics I_2 scrubbers was investigated and data are included.

119

RADIOLOGICAL DEVELOPMENT ACTIVITIES. Health and Safety Unit Semiannual Progress Report for January-June 1952. July 1952. Decl. Mar. 29, 1957. 42p. (KAPL-814)

Data are reported from a study of the total activity, the size distribution of the particulate material, and isotopic composition of the radioactive components discharged from the stack during the dissolving, head-end, and extraction operations of the separations process. The atmospheric dilution of the stack effluent was also estimated. Information obtained on the radioisotopic composition of evaporator condensate provided the basis for revision of the maximum permissible limits for discharge to the Mohawk River. A series of tests established a maximum detection efficiency of 19% for a scintillation probe in detecting γ radiation in a liquid medium. A smoke generator suitable for the evaluation of the efficiency of laboratory fume hoods is described, and a schematic sketch is included.

120

QUARTERLY REPORT OF THE KAPL ENVIRONMENTAL MONITORING RADIOLOGICAL SERVICES SUB-UNIT FOR JULY, AUGUST, SEPTEMBER, 1951. Decl. June 18, 1957. 31p. (KAPL-850)

Operations at the Knolls Site did not contribute significantly to any persistent increase in the normal environmental background radiation measurements. Levels of activity detected in the air and liquid waste discharge were attributed to normal Separations Pilot Plant operations, while the fission-product content in rain was probably due to outside influence.

121

RADIOLOGICAL DEVELOPMENT ACTIVITIES IN THE HEALTH AND SAFETY UNIT. Semiannual Progress Report for July-December 1952. Jan. 1953. Decl. Feb. 7, 1957. 80p. Contract W-31-109-Eng-52. (KAPL-863)

Progress is reported on separations pilot plant stack effluent studies, determination of the counting efficiency of an inert gas monitor, evaluation of the neutron spectra external to KAPL reactors, development of a BF_3 tube fitted with concentric polystyrene cylinders of varying thicknesses for intermediate neutron monitoring, and development of a procedure for the analysis of radiostrontium in vegetation. The particle-collection efficiency of an electrostatic precipitator and glass fiber air-filtering unit and performance characteristics of standard laboratory fume hoods under operating conditions were determined. A new sampling unit was designed for the collection of air-borne particulate matter, and data on its performance are included. It was concluded that Vinylite plastic bags are the most satisfactory method for protecting survey instruments from radioactive contamination. The maximum permissible air concentration for Th^{232} was calculated to be in the range of 1 to 7×10^{-13} μc/cc. It was concluded that incidence of bilobed nuclei in lymphocytes is not a practical indication of radiation exposure.

122

RADIOLOGICAL DEVELOPMENT ACTIVITIES IN THE HEALTH PHYSICS UNIT. Semiannual Progress Report [for] January-June 1953. Changed from OFFICIAL USE ONLY June 3, 1957. 33p. (KAPL-997)

The calibration of the constant air monitor used to detect Kr^{85} emanating from the Separations Process Operations was completed. An average detection efficiency of 1.1% and an absorption factor of 0.7 were determined from three series of analyses. The efficiency of Special Materials Shop air-cleaning unit in the collection of submicronic particles under specific operating conditions is reported. Recommendations to increase the efficiency are made. The collection efficiency, as a function of particle size, for air-cleaning and air-sampling filter media is reported for a face-velocity range of 0.5 to 100 cm/sec. The minimum collection efficiencies for the particle size and face-velocity ranges were investigated. The average absorptions of alpha and beta activity in the Hollingsworth and Vose-70 filter media for a series of analyses were 63 and 24%, respectively. Liquid waste studies during the period include the investigation and recommendation of a proportional sampler for combined sewer effluents and adsorption studies of fission-product activity on the Mohawk River sediment. A discussion of the metering and sampling system for the liquid waste discharged into the Mohawk River is included in this report. The adsorption of fission-product activity on Mohawk River sediment with respect to contact time, laundry detergents, dissolved solids, and the quantity of river sediment was investigated and the data are tabulated. A vegetation analysis for radioruthenium was investigated, and a tentative calculation of the maximum permissible concentrations of activity in vegetation was made.

123

QUARTERLY REPORT OF KAPL ENVIRONMENTAL MONITORING RADIOLOGICAL SERVICES SUB-UNIT [FOR] APRIL, MAY, JUNE, 1953. R. W. Trevithick. Changed from OFFICIAL USE ONLY June 3, 1957. 40p. (KAPL-1008)

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REFERENCES

The influence of outside sources on environmental fission-product contamination reached unprecedented proportions as a result of a heavy rain on April 26. General radiation levels were markedly increased as a result of vegetation and soil contamination. Significant activity was detected in the Mohawk River, West Milton Site Creeks, and in drinking water supplies. Operational discharge of radioactive wastes into the atmosphere and the Mohawk River was normal in magnitude and the pattern of environmental contamination from local sources was essentially unchanged.

124

RADIOLOGICAL DEVELOPMENT ACTIVITIES IN THE HEALTH PHYSICS UNIT. Semiannual Progress Report [for] July - December, 1953. Changed from OFFICIAL USE ONLY June 3, 1957. 44p. (KAPL-1099)

Results are reported from studies of the efficiency of various filter media for air cleaning and air sampling; an evaluation of air flow rate meters; a comparison of the light and the electron microscopes for studies of particle size and particle density; the chemical analysis of Ru^{106} in vegetation; the separation of K^{40} from fission products in urine and vegetation; adsorption of fission products on river sediment; and the performance of film badges for detecting γ doses from 0 to 800 R.

125

HEALTH PHYSICS REPORT FOR JANUARY, FEBRUARY, MARCH, 1954. Decl. Jan. 6, 1954. 34p. (KAPL-1116)

Routine personnel, in-plant, and environmental radiation monitoring procedures and radiation hazards incidents investigated during the period are reported.

126

RADIOLOGICAL DEVELOPMENT ACTIVITIES IN THE HEALTH PHYSICS UNIT. Semiannual Progress Report [for] January - June, 1954. Changed from OFFICIAL USE ONLY June 3, 1957. 25p. (KAPL-1268)

Results are reported from studies of the efficiencies of air-cleaning and air-sampling filter media; the efficiencies of a fast neutron scintillation detector and of film dosimeters; a comparison of film and rate meter data for determining effective energy of x radiation; design and construction of a radioactive gas counting system to measure the activity of gaseous β-emitters; the preparation and calibration of a Kr^{85} β source; design and performance of an experimental gas counting system to circulate and dilute samples of radioactive gases for calibration purposes; evaluation of radiochemical methods for the determination of Cs^{137} and of Zr^{95}; investigations of the adsorption of fission products on river sediment; and studies of methods for monitoring radioactive gases.

127

HEALTH PHYSICS REPORT FOR JANUARY, FEBRUARY, MARCH, 1955. Changed from OFFICIAL USE ONLY June 3, 1957. 37p. (KAPL-1297)

Routine personnel, in-plant, and environmental radiation monitoring procedures engaged in during the period are summarized.

128

RADIOLOGICAL DEVELOPMENT ACTIVITIES IN THE HEALTH PHYSICS UNIT. Semiannual Progress Report [for] July - December, 1954. Changed from OFFICIAL USE ONLY June 3, 1957. 26p. (KAPL-1313)

Data are presented from studies on the efficiency of air-cleaning filter materials and air-cleaning equipment. An illustrative schematic is presented of an extrapolation chamber and auxiliary components constructed for use in the determination of surface dose-rates from β sources. A radioactive gas counting system for the detection of A^{39} was calibrated. Resonance and threshold detector foils of In and S were tested for use in personnel neutron dosimetry under both normal and emergency conditions in reactor areas. The preparation of β sources is outlined. A method is outlined for the determination of Ra^{226} in urine. Liquid waste studies were confined to an analysis of P^{32} activity collected on suspended Mohawk River sediment.

129

HEALTH PHYSICS REPORT FOR APRIL, MAY, JUNE, 1955. Changed from OFFICIAL USE ONLY June 3, 1957. 35p. (KAPL-1379)

Routine personnel, in-plant, and environmental radiation monitoring procedures engaged in during the period are summarized.

130

HEALTH PHYSICS REPORT [FOR] JULY, AUGUST, AND SEPTEMBER, 1955. Changed from OFFICIAL USE ONLY June 3, 1957. 31p. (KAPL-1419)

Routine personnel, in-plant, and environmental radiation monitoring procedures engaged in during the period are summarized.

131

HEALTH PHYSICS REPORT FOR OCTOBER, NOVEMBER, DECEMBER, 1955. Changed from OFFICIAL USE ONLY June 3, 1957. 35p. (KAPL-1492)

Routine personnel, in-plant, and environmental radiation monitoring procedures engaged in during the period are summarized.

132

HEALTH PHYSICS REPORT FOR JANUARY, FEBRUARY, MARCH, 1956. Changed from OFFICIAL USE ONLY June 3, 1957. 28p. Contract W-31-109-Eng-52. (KAPL-1537)

Routine personnel, in-plant, and environmental radiation monitoring procedures engaged in during the period are summarized.

133

RADIOLOGICAL DEVELOPMENT ACTIVITIES IN THE HEALTH PHYSICS UNIT. Semiannual Progress Report [for] July - December 1955. L. J. Cherubin and J. J. Fitzgerald. Changed from OFFICIAL USE ONLY June 3, 1957. 52p. (KAPL-1572)

The efficiencies of millipore filters were determined for the collection of $KMNO_4$ dispersed in air in the particle size range of 0.005 to 0.2μ. The oscillating thermal precipitator was tested to determine its efficiency for collecting duraluminum particulate material in the particle size range of 0.1 to 2.1μ. Basic experimental equipment prepared for atmospheric dispersion studies included a fluorescent pigment aerosol generator, fluorescence microscopy arrangement, and supplemental meteorological equipment. A technique involving acid leaching was developed for the preparation of samples for the determination of fission-product activity in soil. A rapid method is described for the preparation of samples for the determination of fission products in urine. Data are tabulated on the concentration of radioactivity in Mohawk River plankton, vegetation, and fish. Rain-out is defined as the deposition of radioactivity from the atmosphere to the earth's surface when the radioactive particles are the nuclei for the formation of the raindrops, and wash-out is defined as the quantity of radioactivity deposited on the earth by the scrubbing action of raindrops or snowflakes passing through the radioactive cloud. The integrated external dose from rain-out and wash-out following a nuclear incident was calculated.

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REFERENCES

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CHEMICAL PROCESSING WASTE TREATMENT. D. L. Barney. p. 13, 15-19 of REPORT OF THE CHEMISTRY AND CHEMICAL ENGINEERING SECTION FOR MAY, JUNE, JULY, 1956. 87p. (KAPL-1573).

The neutralization step in the electrolytic process for waste treatment was simulated. It was found that in this step significant decontamination is obtained from Sr, Zr+Nb, and rare earths, but not from Ru or Cs. In the electrolysis of alkaline nitrate solution, only a small amount of H_2 is produced and the only gaseous reduction product of nitrate formed in significant amounts is NH_3. The concentration of nitrite ion, formed by reduction of nitrite, builds up to a steady-state concentration. Progress is reported in determining design factors for an electrolysis cell to be used in a process for treating Purex nitrate wastes. Indications are that cell compartmentation will not be necessary and that electrical costs for the electrolysis step will be (10¢/gal of Purex waste.

135

RADIOLOGICAL DEVELOPMENT ACTIVITIES IN HEALTH PHYSICS. Semiannual Progress Report for Janaury - June 1956. L. J. Cherubin and J. J. Fitzgerald. 45p. (KAPL-1615)

An evaluation was made of optimum particle size and face velocities for the penetration of $KMNO_4$ particles through millipore filters. An investigation was made of the rate of deposition of debris resulting from a liquid NaK-water reaction. An analysis was made of the dispersion rate and subsequent fall-out of fluorescent particles from the roof of a critical assembly. An automatic fall-out sampler was constructed to provide a means for determining the number of size characteristics of particles falling out from a cloud at finite periods after generation. The radio-operated on-off switch for an air sampler was tested for the radio control of portable air samplers. The energy dependence of the Cutie Pie and Juno radiation survey meters was determined using beta sources evaluated for surface dose rate by means of an extrapolation chamber. The feasibility of using a thyroid scintillation monitor as a quick, relatively sensitive, and accurate external monitor of the internal dose from the inhalation or ingestion of fission products following a nuclear (power reactor) incident was investigated. A method was investigated for the radiochemical determination of Th in urine. A study on the radioactivity of samples of aquatic life in the Mohawk River was continued. Criteria and methods for evaluating credible reactor hazards to the environs were developed to simplify the assessment of reactor hazards. Data are tabulated.

136

HEALTH PHYSICS REPORT FOR APRIL, MAY, JUNE, 1956. Changed from OFFICIAL USE ONLY June 3, 1957. 30p. (KAPL-1595)

Routine personnel, in-plant, and environmental radiation monitoring procedures engaged in during the period are summarized.

137

HEALTH PHYSICS REPORT FOR JULY, AUGUST, SEPTEMBER, 1956. 35p. (KAPL-1689)

Routine personnel, in-plant, and environmental radiation monitoring procedures engaged in during the period are summarized.

138

HEALTH PHYSICS REPORT FOR OCTOBER, NOVEMBER, AND DECEMBER, 1956. 36p. (KAPL-1699)

Personnel, in-plant, and environmental radiation monitoring procedures engaged in during the period are summarized.

139

HEALTH PHYSICS REPORT FOR JANUARY, FEBRUARY, MARCH, 1957. 32p. (KAPL-1831)

Personnel, in-plant, and environmental radiation monitoring procedures engaged in during the period are summarized.

Mound Laboratory, Miamisburg, Ohio

140

LIQUID WASTE DISPOSAL RESEARCH QUARTERLY REPORT FOR JANUARY, FEBRUARY, AND MARCH, 1950. Apr. 1, 1950. Decl. with deletions Feb. 16, 1956. 34p. (AECD-4147)

A complete radiochemical analysis has been made on the sample of first-cycle neutralized waste. A gravimetric analysis has also been made on the sludge in the sample of first-cycle waste. Sb has been shown to be in the pentavalent state in the waste solutions. Both tannic acid and silica gel can be used to remove Zr and Nb from the neutralized wastes. In addition to Zr and Nb, silica gel also adsorbs some Cs, Ru, and rare earths. By the addition of $Na_2S_2O_4 \cdot 2H_2O$ and Na_2SO_3 to waste solutions, a greater removal of activity is obtained by the precipitation of $Fe_2Fe(CN)_6$. An improvement in the method of precipitating FeS has been made. The greatest difficulty is experienced in the removal of Sb and Ru. With the 3 yr second-cycle waste a combination process involving an Fe scrub, a $Fe_2Fe(CN)_6$ precipitation, and neutralization appears most feasible. With this combination a reduction in activity of from 2000 to 250 cpm/ml was consistently attained, a reduction in volume of 500 to 1 (original volume of waste per burial volume) was accomplished, and no processing difficulties were apparent with the scale of equipment used. When a $Na_2S_2O_4 \cdot 2H_2O$ reduction was followed by a $Fe_2Fe(CN)_6$ precipitation, equally good decontamination was found. However, the hydrosulfite must be added one half to 1 hr prior to the cyanide precipitation, and decontamination was not complete until approximately 3 days had elapsed. When an Fe scrub was carried out in the presence of H_2S, followed by a neutralization step again, equally good reduction in counts was experienced at low feed pH's. However, the amount of precipitate was large, and the sulfides formed presented difficult solid-liquid separation problems. The Fe scrub-ferrocyanide-neutralization process when applied to the spiked second-cycle crib waste (3 yr old) reduced the activity from 125,000 to 23,000 cpm/ml and a second treatment from 23,000 to 5,000. The one attempt to remove Zr, Nb, and the rare earths by absorption on attapulgus clay and other on silica gel looked promising. When the effluents from these 2 operations were subjected to the Fe scrub, $Fe_2Fe(CN)_6$ precipitation, and neutralization process, a reduction in activity of 59,000 to 350 cpm/ml with the clay and a reduction of 37,000 to 300 cpm/ml with the gel was obtained.

141

LIQUID WASTE DISPOSAL RESEARCH QUARTERLY REPORT FOR APRIL, MAY, AND JUNE, 1950. Decl. with deletions Jan. 20, 1956. 32p. (AECD-4148)

Experiments have been carried out with both neutralized second-cycle wastes and pure isotopes which show that, in general, the presence of fluoride ion does not interfere with the removal of fission products from waste solutions. Analysis of a third sample of neutralized second-cycle wastes, whose estimated age was 6 months at the time the analysis was complete, shows that the rare earth elements are present in higher concentrations than any of the other fission products. In a single step the activity of this solution can be reduced from an initial value of 39,000 cpm/ml to 500 to 700 cpm/ml by precipitation with either FeS or $Fe_2Fe(CN)_6$. At the same time the α count is reduced from 150 cpm/ml to background. The percentage activity removal by FeS is a function of the pH at which precipitation occurs. Nuchar 000 and MnO_2 (formed both internally and externally) are better adsorbents for activity than silica gel or activated Al_2O_3. Upon subjection of the fresh reactor waste solutions to the adsorption, metal scrub, precipitation, and filtration scheme of processing, a reduction in activity was obtained from 39,000 to about 300 cpm/ml. Silica gel and activated Al_2O_3 were used in combination as adsorbents, Fe powder was employed for the metal scrub, and ferrocyanide was used as the precipitant for $Fe_2Fe(CN)_6$. The precipitate was first thickened in a small thickener then filtered on commercial filter cloth. It was found difficult to maintain the proper pH conditions in the adsorption column for maximum activity removal. The adsorbents appeared to possess a tremendous capacity for altering the solution. A small pilot model evaporator has been designed and constructed to obtain design data for a larger unit that is contemplated. This model was designed to minimize entrainment and foaming.

142

LIQUID WASTE DISPOSAL RESEARCH QUARTERLY REPORT FOR APRIL 1, 1949 TO JUNE 30, 1949. Frank C. Mead, Jr. July 1, 1949. Decl. with deletions Jan. 20, 1956. 28p. (AECD-4149)

Radiometric procedures have been developed for both routine β analysis and to determine the radioactive constituents by absorption studies. It is thought that Ru and Cs make up a great portion of the radioactive materials present in the two and one-half year old crib waste. Their presence has been corroborated by absorption studies. A satisfactory method for the quantitative determination of Ru in these solutions has been developed. Initial ion-exchange experiments indicate that it is not practical to use ion-exchange resins for the complete decontamination of crib wastes. Coprecipitation experiments for the removal of Ru as the sulfide or complex cyanide show some promise.

143

QUARTERLY REPORT FOR LIQUID WASTE DISPOSAL RESEARCH FOR JULY 1, 1949 TO SEPTEMBER 30, 1949. Oct. 1, 1949. Decl. Jan. 13, 1956. 24p. (MLM-380)

Processes for the decontamination of Hanford second cycle (crib) wastes proceeded along two lines: precipitation and adsorption. Precipitation experiments included the formation of $Fe_2Fe(CN)_6$ which is specific for Ru, precipitation of Cs carrier with silicotungstic acid and luteo phosphomolybdic acid and the formation of metallic Ru by reduction with Fe. Adsorption studies were made on activated carbons for Ru, and clays for Cs.

144

LIQUID WASTE DISPOSAL RESEARCH QUARTERLY REPORT FOR OCTOBER, NOVEMBER, DECEMBER, 1949. Jan. 1, 1950. Decl. Jan. 27, 1956. 29p. (MLM-406)

Experimentation on the Hanford second-cycle wastes, known as the Hanford crib wastes, for this period was devoted mainly to decontamination procedures. Qualitative analysis for the radioactive constituents of 2 samples of second-cycle wastes have been completed. Self-absorption studies were made on these samples as well as on pure isotopes of Ru and Cs. The work on decontamination procedures was devoted, for the most part, to the precipitation of radioactive elements rather than to their removal from the waste solutions by adsorption. Thus, Ru, Sb, and Te can be precipitated as their sulfides. Cs can be completely removed from the waste solutions by the precipitation of either FeS or $Fe_2Fe(CN)_6$. Some work was done on the adsorption of Cs by Fuller's earth.

145

REPORT FOR LIQUID WASTE DISPOSAL RESEARCH; NOVEMBER 13, 1950 TO MARCH 5, 1951. Apr. 9, 1951. Decl. with deletions Feb. 26, 1957. 9p. (MLM-554(Del.))

The removal of radioactivity from liquid wastes of the TBP process is being investigated with the ultimate objective of decontaminating these solutions to a value low enough to be able to discharge them either to the ground or to local streams without fear of creating a hazard. Certain solid-liquid separation problems are presented involving the removal of FeS, $Fe_2Fe(CN)_6$, $Fe(OH)_2$, and $Ca_3(PO_4)_2$ precipitates from solution. Studies have been initiated to determine the necessary data pertaining to each of the separation methods to make possible a proper selection when the final decontamination process has been developed. Such methods include filtration, sedimentation, and centrifugation.

146

REPORT FOR LIQUID WASTE DISPOSAL RESEARCH; MARCH 5, 1951, TO JUNE 4, 1951. July 9, 1951. Decl. Mar. 9, 1957. 15p. (MLM-579)

Decontamination of TBP metal-recovery wastes by FeS precipitation followed by $Fe(OH)_2$-$Ca_3(PO_4)_2$ precipitation as described in MLM-554(Del.) has been studied with respect to pH control, effect of temperature, NaOCl treatment, and effect of presettling agitation on the settling rate. Decontamination by precipitation of a number of mercaptans, CoS, NiS, MnS, CuS, $PbCrO_4$, $Fe(OH)_3$, BaC_2O_4, $AgCrO_4$, and Ni dimethylglyoxime at various stages of the process, has been investigated. A cost estimate of the precipitation process is compared favorably with costs of evaporation.

147

REPORT FOR LIQUID WASTE DISPOSAL RESEARCH; JUNE 4, 1951 TO SEPTEMBER 3, 1951. Oct. 8, 1951. Decl. Feb. 26, 1957. 19p. (MLM-614)

Development of the FeS, $Fe(OH)_2$-$Ca_3(PO_4)_2$ precipitation process for decontaminating tributyl phosphate (TBP) metal recovery wastes has been continued. Emphasis has been placed on reducing the burial volume of precipitates by eliminating addition of Ca after precipitation of FeS and by recycling all Fe except that going to burial with the first FeS precipitate. A tentative flowsheet for the process, listing relative volumes and chemicals required, has been prepared.

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REPORT FOR LIQUID WASTE DISPOSAL RESEARCH-SEPTEMBER 3, 1951 TO DECEMBER 3, 1951. Jan. 7, 1952. Decl. Feb. 7, 1957. 19p. (MLM-652)

The differences in decontamination obtained with TBP Metal Recovery Wastes and fresh, evaporated and neutralized wastes are compared. Purex wastes on repeated scavenging with FeS and $Fe(OH)_2$-$Ca_3(PO_4)_2$ precipitations has been traced to the insufficient amount of phosphate in the Purex waste to provide an excess over the stoichiometric amount equivalent to the Ca added. The Purex waste from treating 3 to 5 yr aged slugs responds to scavenging treatment similarly to the fresher wastes, providing an oxidizing treatment to break up Ru complexes is employed. The removal of Cs by FeS is not appreciably affected by pH. Better removal obtained when the precipitate is formed by addition of solid Na_2S rather than by addition of a solution of Na_2S. Fluoride interferes with removal. Decontamination factors of the order of 500 were obtained under optimum conditions such as an Fe concentration of $0.02\underline{M}$ and inactive Cs concentration of about $10^{-6}\underline{M}$ in 30% $NaNO_3$ solution.

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REFERENCES

New York Operations Office,

Health and Safety Laboratory, AEC

149

SOIL AND WATER URANIUM AND RADIUM SURVEY. Progress Report. D. E. Lynch. June 20, 1950. Decl. Dec. 8, 1955. 45p. (NYO-1521)

Soil and water surveys were made during 1949 at Lake Ontario Ordnance Works, N. Y. (near the mouth of the Niagara River); Middlesex sampling Plant, Middlesex, N. J.; Harshaw Chemical Works, Cleveland, Ohio; and the AEC storage area at Lambert Airport, St. Louis. The current data show the natural Ra content of soil to be from 9×10^{-13} to 15×10^{-13} g/g at the locations surveyed. The natural soil U is 3×10^{-6} to 9×10^{-6} g/g. These values are nearly in the radioactive equilibrium proportion. Klevin's earlier results, not reported here, showed higher U than normal in swampy ground west of Lambert Airport. The current survey shows U and Ra concentrations clearly above background in a similar area south of the Middlesex sampling plant. Significant increases in soil surface radioactivity were not demonstrated in other areas. Analysis of samples from ditches and drain pipes reveals that some radioactivity is being added to surface streams draining LOOW, the Middlesex Sampling Plant, Lambert Airport, Mallinckrodt Chemical Works (the Mississippi) and the Harshaw plant (the Cuyahoga). U seems to be penetrating 10 ft or more into the soil under Lambert Airport but concentrations more than 5 ft deep are less than twice background. There are signs of only slight Ra penetration. Surface streams and ground water were in every case found to be below 10^{-13} curies/gram. Ra analyses did not reveal any contamination not also shown by U determinations. Since the former are relatively expensive they should be made only where there is reason to suspect contamination with wastes having a high Ra: U ratio.

New York University.

Lewis Van Carpenter Sanitary

Engineering Research Laboratory

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PROGRESS REPORT FROM JULY 1, 1951-AUGUST 30, 1952, [ON] TREATMENT OF SYNTHETIC LAUNDRY WASTE ON TRICKLING FILTERS. William E. Dobbins, Gail P. Edwards, and Richard Ehrenreich. Nov. 1952. 12p. (NYO-4506)

Preparatory to studies on the removal of radioactivity from low-level liquid wastes, a nonradioactive solution simulating the laundry waste from the Knolls Atomic Power Laboratory has been treated on trickling filters. The results indicate that healthy, normal biological conditions accompanied by a high degree of removal of Biochemical Oxygen Demand can be obtained under a wide range of loading conditions.

151

REMOVAL OF RADIOACTIVITY FROM LAUNDRY WASTES BY TRICKLING FILTERS. PROGRESS REPORT FROM SEPTEMBER 1, 1952 TO NOVEMBER 30, 1953. William E. Dobbins, Gail P. Edwards, Richard Ehrenreich, and Frederic A. Friedman. Dec. 1953. 34p. (NYO-4567)

A radioactive laundry waste containing mixed fission products was treated continuously on single and two-stage trickling filters. The results indicate that about 90% of the gross activity can be removed at organic loading of 250 pounds BOD per acre foot day. The percentage removal decreases with increase in loading. Sludge was produced at a rate of about 0.3 lb dry solids per lb BOD removed. The activity level reached by the sludge is shown to be essentially independent of loading rate but dependent on the activity level of the waste.

North American Aviation, Incorporated.

Atomics International Division,

Canoga Park, California

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SODIUM GRAPHITE REACTOR QUARTERLY PROGRESS REPORT FOR JULY-SEPTEMBER 1955. SECTION A. A. B. Martin, ed. SECTION B. J. C. Cochran, ed. Mar. 15, 1956. Decl. Apr. 8, 1957. 141p. (NAA-SR-1513)

The shielding requirements for the radioactive liquid waste disposal system have been re-evaluated. Data on the radiation level from hold-up tank as a function of concrete thickness for one tank containing fresh cleaning cell effluent are plotted as well as calculations to check the adequacy of the earth shielding above the sump discharge line leading to the hold-up tank vault.

153

REACTOR EVALUATION QUARTERLY PROGRESS REPORT FOR JANUARY-MARCH 1957. R. J. Beeley, ed. June 1[illegible], 1957. 29p. (NAA-SR-1938)

Various methods of high-activity fission product waste disposal were considered; the present method of storage in large underground tanks can be considered only as a temporary expedient. Permanent methods of disposal must be found if an ever-growing waste-tank farm is to be prevented. Disposal in the ocean of liquid or packaged projectiles has too many uncertainties to warrant consideration. Permanent disposal in montmorillonite clay or in Al_2O_3 appears promising for land disposal and even ocean disposal. A number of permanent disposal methods are under development to obtain the objectives of maximum use and ultimate safe confinement at low cost. The problem of disposal, though serious, does not appear as insurmountable as is sometimes depicted.

154

PRE QUARTERLY PROGRESS REPORT FOR APRIL-JUNE 1957. D. I. Sinizer, J. R. Foltz, K. L. Mattern, and E. E. Motta. Sept. 15, 1957. 50p. (NAA-SR-2030)

The liquid waste from the Pyroprocessing-Refabrication Experiment facility has been defined as follows: (1) Low level: $< 10^{-4}$ μc/cc; (2) Medium Level; 10^{-4} to 1 μc/cc; (3) High level: >1 μc/cc. The low-level waste will be diluted with radioactively cold sewage to a level of $<10^{-6}$ μc/cc and sent to a disposal field. The medium-level waste will be used for mixing the concrete, which in turn will be used for the solid waste disposal. The surface intensity from a 55 gallon drum filled with "hot" concrete (made with liquid waste containing 1 μc/cc) is about 30 mr/hr. Since maximum surface intensities of 200 mr/hr are allowable solid waste may be canned in hot concrete in quantities sufficient to raise the surface intensity to 200 mr/hr. The high-level liquid waste will be run through a flocculation tank, filters, and a demineralizer. The effluent will be medium-level waste which can then be used as described above for mixing "hot" concrete for solid-waste disposal. (The information on waste disposal in the above report appears in its entirety in this abstract.)

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REFERENCES

Oak Ridge National Laboratory

155

ION EXCHANGE STUDIES. Quarterly Report for the Period August 10–November 10, 1951. I. R. Higgins. Nov. 7, 1951. Decl. Feb. 15, 1957. 11p. (CF-51-11-56)

The application of ion exchange to processing of highly radioactive solutions is frequently questioned because of the effect of the radiation on the organic adsorber. From previous studies using a Co^{60} γ source, Dowex 50 resin lost 10 to 15% of its capacity per whr/g of resin. This was checked by observing the damage from adsorbed β radiation. The β energy was calculated to be 0.00154 w/c and 100% adsorption of the β was assumed. On three checks by titration on the basis of oven dry resin the capacity loss was 9.5, 15.9, and 20.7% whr/g. The mechanism of the damage is believed to be a hydrolysis of the sulfonate groups on the resin to give free SO_4. Enough free SO_4 was found to account for 11.4% capacity loss on the sample that titrated 9.5%. Three independent free SO_4 checks indicated 60, 48, and 50 Mev of SO_4 released per whr. The Co^{60} γ tests indicated that the phenolic cation exchangers lost capacity by a factor of 2 or 3 slower than the styrene resins.

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EVALUATION OF REAGENT DECONTAMINATION. Quarterly Report for Period August 10, 1951–November 10, 1951. M. R. Bennett. Nov. 21, 1951. Decl. Dec. 22, 1955. 11p. (CF-51-11-123)

An evaluation was made of the decontamination and corrosion properties of various reagent mixtures on welded and non-welded specimens of types 309 and 347 stainless steel. A reagent mixture of 20% HNO_3–3% HF (by weight) was found to be superior to all other reagents tested in both decontamination and corrosion properties.

157

DEVELOPMENT OF DECONTAMINATION REAGENT. Quarterly Report for Period November 1, 1952 to February 1, 1953. M. L. Feldman and R. F. Rogers. Jan. 26, 1953. Decl. Dec. 16, 1955. 15p. (CF-53-1-283)

Procedures were evaluated for the decontamination of stainless steel. One criterion was that the pH of the final waste solutions must be high or neutral. Results are tabulated which were obtained by decontamination with 15 solution treatments. Solutions and procedures are also tabulated. The method of choice consists of 6.1$\underline{M}$ NaOH–1$\underline{M}$ $Na_2C_4H_4O_6$ used at 85°C for 0.5 hr with vigorous agitation followed by 1$\underline{M}$ $H_2C_2O_4$–0.1$\underline{M}$ NaF under the same conditions. This procedure should be repeated.

158

RADIOACTIVE WASTE DISPOSAL AND MISCELLANEOUS WORK. ANNUAL REPORT FOR CALENDAR YEAR 1956. H. E. Seagren and E. J. Witkowski, comps. Sept. 11, 1957. 10p. Contract W-7405-eng-26 (CF-57-1-172)

An annual report is given on the operation and costs of waste-disposal facilities at ORNL Laboratories and operating buildings in the Bethel Valley area. The operations of the hot-chemical and metal-waste systems, the process-waste system, and the radioactive-gas-disposal system which utilizes the 250 ft stack located in the radioisotope area are discussed. The miscellaneous operations which include the SS (source and special nuclear) material control, SS material recovery, off-shift service for research divisions, water demineralization plant operations, and hydrogen liquefaction are included. However, the disposal of cooling water from LITR, off-gases from the Hot Pilot Plant, and the ORNL Graphite Reactor buildings are not covered by the report.

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HEALTH PHYSICS DIVISION PROGRESS REPORT. RADIOACTIVE WASTE DISPOSAL RESEARCH AND DEVELOPMENT SECTION. R. J. Morton. Nov. 11, 1950. Changed from OFFICIAL USE ONLY Dec. 7, 1956. 42p. (ORNL-873)

Brief reports are included on the reduction of I^{131} by an experimental water treatment plant, laboratory studies on the removal of various other isotopes from water, phosphate flocculation, instrument development, an ecological study of White Oak Creek, analytical methods to determine radioactivity in fish tissue and in algae, and removal of radioisotopes as a contaminant in sewage by means of the trickling filter process of sewage treatment.

160

HEALTH PHYSICS DIVISION QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JULY 20, 1951. K. Z. Morgan. Nov. 23, 1951. 26p. (ORNL-1086)

Brief statements are made on the following phases of the work of the Health Physics Division: the operation of constant-flow water monitor, survey studies and ecological study of White Oak Creek drainage system, operation of fast-neutron pocket chambers, measurement of radiation by frequency variations of an r-f oscillator, design of a thermal-neutron survey meter, results of calculation of the air scattering of neutrons, design of x-ray control equipment, and the use of commercially available G-M survey equipment with light aircraft to locate contaminated areas.

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HEALTH PHYSICS DIVISION QUARTERLY PROGRESS REPORT FOR PERIOD ENDING OCTOBER 20, 1951. May 5, 1952. 26p. (ORNL-1174)

Methods of removal of Ce^{137}, Cd^{115}, and I^{131} from liquid waste are discussed. A study of the lime-soda softening process in the removal of Sr^{90} from water is reported. The level of radioactivity in bottom deposits and water samples from White Oak Creek and the Clinch and Tennessee Rivers was determined. Using gross β analysis the level of natural background activity in an uncontaminated spring in the White Oak Creek area was found to be 2.5×10^{-7} μc/cc. Progress is reported in ecological studies of the White Oak Creek region. Data from a series of airplane measurements over ground sources of Na^{24}, Co^{60}, Cs^{137}, Ra, and Ta^{182} made with NaI-crystal scintillometers indicate a build-up factor roughly proportional to the altitude. Radioisotopes are listed for which preliminary calculations of maximum permissible concentrations in total body, in air, and in water have been made to date.

162

HEALTH PHYSICS DIVISION QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JANUARY 20, 1952. June 12, 1952. 21p. (ORNL-1277)

Environmental monitoring activities are discussed and data are presented. Data from studies on the removal of radioisotopes from solution by slurries of metallic dust are presented in tabular form. Removals effected by using only a 500 ppm dose of various metallic dusts and a 90-min period of contact mixing followed by settling are reported. Preliminary results of a study of seasonal differences in the radioactivity in various tissues of fish and other aquatic animals in White Oak Lake indicate accumulation of radioactivity in bone, flesh, and other tissues of the fish is much greater during the warm months than during the winter season. Development and use of a column type of water monitor, employing a 10 in. glass G-M tube surrounded by a bed of ion-exchange resin, which is capable of measuring activities in the order of 10^{-7} μc/ml in the absence of large quantities of non-radioactive soluble salts is reported. This device is now being used to measure activity levels of natural ground and surface waters and of rain water.

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PROTECTIVE EQUIPMENT EVALUATION PROGRAM QUARTERLY PROGRESS REPORT FOR JULY 1, 1951 TO SEPTEMBER 30, 1951. Aug. 6, 1952. Decl. Jan. 13, 1956. 45p. (ORNL-1352)

Preliminary data are reported on the following: design of a monodisperse solid aerosol generator; techniques of forming, measuring, controlling and handling small particle aerosols; particle separation in smoke using electrostatic precipitators; design of an electrostatic precipitator; and diffusion constants and analytic methods for determining SO_3 and NH_3.

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RADIOACTIVE WASTE DISPOSAL RESEARCH. R. J. Morton, p.1-6 of HEALTH PHYSICS DIVISION PROGRESS REPORT FOR PERIOD JANUARY 20, 1952 TO JULY 20, 1952. Oct. 6, 1952. 24p. (ORNL-1353)

Better removals of I^{131} and Sr^{89} from tap water were obtained with a mixed resin bed than with either an anion or a cation bed alone. Data are presented from an evaluation of water purification equipment for the removal of fission products. Studies are described which are carried out in connection with the survey of chemical waste storage pits. Data are presented from an evaluation of electroscopes and G-M survey meters for the measurement of radioactivity in water.

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RADIOACTIVE WASTE DISPOSAL RESEARCH. R. J. Morton, p.1-4 of HEALTH PHYSICS DIVISION QUARTERLY PROGRESS REPORT FOR PERIOD ENDING OCTOBER 30, 1952. Jan. 2, 1953. 14p. (ORNL-1420)

Information is given on the experimental study of commercial water purification devices. Data obtained from ground water studies indicate that the shale formation of waste storage pit No. 2 is quite uniform and impermeable with respect to all isotopes with the exception of Ru. It is believed that some valence states of Pu do not react with the shale material as do other valence states. Other studies include adsorption of radioisotopes by natural soils.

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RADIOACTIVE WASTE DISPOSAL RESEARCH. R. J. Morton. p.5-10 of HEALTH PHYSICS DIVISION QUARTERLY PROGRESS REPORT FOR PERIOD ENDING Jan. 20, 1953. Mar. 30, 1953. 17p. (ORNL-1488)

Preliminary laboratory studies were performed on the removal of Ba^{140}, La^{140}, Cr^{51}, Sr^{89}, Y^{91}, Sc^{46} (all in chloride form in weak HCl), and W^{185} (as K_2WO_4 in KOH), each diluted in tap water. These studies include determinations of the percentages of: removal by coagulation at 3 levels of activity (20,000, 2,000, and 200 c/m/ml) by using 3 dosages each (1, 2, and 6 grains/gal) of $FeSO_4$, $FeCl_3$, and alum; take-up on natural clays; removal by water softening procedures; removal by phosphate coagulation; and removal by various materials in small glass columns. A second survey of the γ activity in bottom deposits in the Clinch and Tennessee Rivers has been completed. This survey covered 627 miles of the Tennessee River, about 60 miles of the Clinch River, and portions of all major streams feeding into these rivers. Direct readings were made by lowering a Flounder to the bottom of the stream.

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RADIOACTIVE WASTE DISPOSAL. R. J. Morton. p.19-26 of HEALTH PHYSICS DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1953. K. Z. Morgan. Oct. 20, 1953. 39p. (ORNL-1596)

Data are presented on the decontamination of water by coagulation using $FeSO_4$, $FeCl_3$, and alum for the removal of the following isotopes: P^{32}, Sc^{46}, Cr^{51}, Sr^{89}, Y^{91}, Zr^{95}-Nb^{95}, Mo^{99}, Ru^{103}, I^{131}, Cs^{137}, Ba^{137}, Ba^{140}, La^{140}, Pr^{142}, Ce^{144}, Pr^{144}, Pm^{147}, Sm^{153}, W^{185}, and Re^{186}. The use of an electrolytic ion-exchange cell to separate mixed fission products in distilled water showed that about 99% of the activity could be removed. A mixed fission product waste solution, passed through a Greensand (Zeo-Dur) ion-exchange column to the breakthrough, showed that an average of 90% of the activity is removed to the hardness breakthrough, that 20% NaCl may be used for regeneration, that 50% of the activity is removed by regeneration, and, removal of 70 – 80% activity may be made with a Ca-exhausted bed.

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RADIOACTIVE WASTE DISPOSAL RESEARCH. R. J. Morton. p.19-26 of HEALTH PHYSICS DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING JANUARY 31, 1954. Apr. 20, 1954. 34p. (ORNL-1684)

Three pilot-scale experimental waste-treatment units are described and a flow diagram is shown. Surface adsorption studies of montmorillonite clays are given. Radiologging equipment is described. Riverbottom studies are continued, and a portable well-logging instrument for β measurement in the earth walls above water level and in test wells is described.

169

RADIOACTIVE WASTE DISPOSAL. R. J. Morton, O. R. Placak, et al., p.11-16 of HEALTH PHYSICS DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1954. Sept. 27, 1954. 24p. (ORNL-1763)

A flotation process is given for liquid waste-decontamination using kaolinite clay as an absorbent. Progress is reported on process-waste-treatment; experimental plant studies; chemical laboratory studies with reactor-waste solutions; removal studies of radioisotopes from reactor-waste solutions; and removal of carrier-free radioisotopes from clay soil by leaching.

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HEALTH PHYSICS DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING JANUARY 31, 1955. May 9, 1955. 34p. (ORNL-1860)

Progress is reported on studies of the metabolism of U in humans after a single intravenous injection of uranyl nitrate hexahydrate; the development of an analytical procedure for the determination of radioactive Sr in urine; the tissue distribution of Co^{60} in rats; the additive effect of successive coagulations on the removal of radioactive materials from water; the exploration of fields for waste storage pits; the adsorption of fission products by various types of soil; measurements of aerosol particle size; and the development of radiation dosimeters.

171

SANITARY ENGINEERING RESEARCH. E. G. Struxness. p.12-20 of HEALTH PHYSICS DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1955. Oct. 20, 1955. 40p. (ORNL-1942)

Studies are given on the removal of radioactivity from contaminated water by adsorption of organic complexes on carbon; the exploration of new fields and the performance of old fields for waste storage pits; evaluation of procedures for the recovery from soil and identification of the major long-lived fission products; the cation-exchange capacity and exchange complex of rock materials from proposed waste-storage sites; and the efficiency of sand as an aerosol filter.

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HEALTH PHYSICS DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING JANUARY 31, 1956. May 3, 1956. 68p. (ORNL-2049)

Information is presented from the following studies: the distribution and excretion of U in man; the influence of soil fertility on the uptake of Sr by plants; the effects of γ irradiation on vigor and fertility of the beetle, *Onthophagus texanus;* the radiosensitivity of different species of arthropods; the uptake of fission products by earthworms; the separation of Cs^{137} from biological material; the spectrographic analysis of human tissues; investigations of waste-disposal pits for radioactive and chemical wastes; the disposal of radioactive waste material by fixation and fusing in an insoluble ceramic mass; factors affecting the ion-exchange removal of radioactive ions from contaminated water; the use of solvent extraction procedures for the separation of fission products from waste solutions; factors effecting the uptake of fission products by various soil types and clay storage-pit liners; the evolution of K^{42} from hot and boiling solutions; the efficiency of sand filters and lead shot columns in the removal of aerosols of various particle size; and developmental studies on design and improvement of radiation dosimeters.

173

AIR ACTIVITY PRODUCED BY THE BSR. W. R. Champion, p.35-8 of APPLIED NUCLEAR PHYSICS DIVISION ANNUAL REPORT FOR PERIOD ENDING SEPTEMBER 10, 1956. Nov. 20, 1956. 234p. (ORNL-2081)

Describes the jet-scram system of the Bulk Shielding Reactor (BSR) employed to safeguard the buildup of particulate contamination. Gamma-ray spectra measurements of trapped activity are described and plotted. p.32-35 of this report explains the water purification and circulation systems at the Bulk Shielding Facility (BSF).

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HEALTH PHYSICS DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1956. Nov. 2, 1956. 103p. (ORNL-2151).

Information is presented from the following studies: the tissue distribution and excretion of U following injection in man, dogs and rats; the design and performance of inhalation apparatus for the generation and quantitative delivery of U aerosols to dogs; the development of analytical procedures for the determination of Cs^{137} in fish muscle tissue; a mathematical analysis of factors affecting the distribution of radioisotopes in animal tissues; the lethal effects of radiation on soil microorganisms; the delayed effects of radiation on arthropods; studies on the life history and culture of arthropods; the design and performance of an aerosol entrainment well for use in studies of radioactive aerosols produced by hot reactor wastes; the concentration and decontamination of radioactive wastes by evaporation and liquid storage; tracer studies on the movement of radioactive liquid wastes through soil; the influence of sand type on the performance of sand filters; the development of precipitation methods for the preparation of water samples for the radiometric determination of low level radioactive Cs; Zr, and Nb; the improvement of methods for the chemical removal of fission products from radioactive liquid wastes; tracer studies on the ion exchange properties of soils; the rate of leaching of fission products from shale; and the development, calibration, and evaluation of radiation dosimeters.

175

WASTE DISPOSAL RESEARCH. p.52-88 of HEALTH PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR THE PERIOD ENDING JULY 31, 1957. Nov. 26, 1957. 131p. (ORNL-2384)

Progress and/or data are reported for the following topics: analysis of water, soils, and river bottom mud for fission products; solvent extraction of fission products from acid $Al(NO_3)_3$ solutions by various solvents; development of ceramic mixtures for disposal of high level wastes by sintering; leaching of sintered material; adiabatic self sintering experiment; disposal in deep wells and salt formations; laboratory soil columns studies using Cs^{137} tracer and waste solutions for adsorption on dried Conasauga shale; removal of non-cationic radionuclides from intermediate level waste by $KMnO_4$ and NaOCl; wastes released to ORNL pit; evaporation and seepage in the pits and hydrology of the pits; extent of underground dispersion; and selection of future disposal sites.

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GASEOUS FISSION-PRODUCT DISPOSAL. p.147-148 of HOMOGENEOUS REACTOR PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING OCTOBER 31, 1957. Jan. 21, 1958. 207p. (ORNL-2432)

Dynamic studies of the adsorption of fission gases on HRT charcoal showed that Xe was adsorbed 16 times more strongly than Kr. In equilibrium-adsorption studies, Linde molecular sieves 5A had ~25% of the capacity of charcoal for Kr adsorption.

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PROTECTIVE EQUIPMENT EVALUATION PROGRAM QUARTERLY PROGRESS REPORT FOR OCTOBER 1, 1949 TO DECEMBER 31, 1949. Dec. 15, 1949. Decl. Mar. 1, 1956. 35p. (Y-532)

Progress is reported in an evaluation of gas mask canisters and filter materials for the removal of radioactive aerosols. Test equipment was adapted for use with tracers. A method is presented for the synthesis of methylene blue. A method is also given for the production of S^{35}-labeled sulfur dioxide. A methylene blue aerosol was generated and assessed as to mass concentration and particle size.

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PROTECTIVE EQUIPMENT EVALUATION PROGRAM QUARTERLY PROGRESS REPORT FOR JANUARY 1, 1950 TO MARCH 31, 1950. May 15, 1950. Decl. Mar. 1, 1956. 38p. (Y-605)

Progress is reported in an evaluation of gas mask canisters and filter materials for the removal of radioactive aerosols. A method is described for the preparation of $S^{35}O_2$. Methods and equipment are described for radiometric and chemical determination of $S^{35}O_2$. A method is described for the preparation of S^{35}-labeled methylene blue. Data are presented on the particle size distribution of methylene blue aerosol following deposition by a thermal precipitator and by a cascade impactor.

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PROTECTIVE EQUIPMENT EVALUATION PROGRAM QUARTERLY PROGRESS REPORT FOR APRIL 1, 1950 TO JUNE 30, 1950. Aug. 9, 1950. Decl. Jan. 30, 1956. 56p. (Y-638)

Progress is reported in an evaluation of gas mask canisters and filter materials for the removal of radioactive aerosols. Data are included on the preparation of $S^{35}O_2$ from S^{35} using a sulfur burner; the performance of equipment for end window counting of S^{35} as $BaS^{35}O_4$; ion

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chamber determination of S^{35} as $S^{35}O_2$; the results of M-11 canister tests; the synthesis of S^{35}-labeled methylene blue; ion chamber determinations of S^{35}-labeled methylene blue; efficiency of the precipitator electrometer method to determine the aerosol penetration of filter paper; the efficiency of electrostatic precipitators as aerosol collectors; aerosol penetration determinations with standard stain tests; filter evaluations using dioctyl phthalate; and the effects of x irradiation on filtration of DOP with type 6 filter paper.

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Atomic Energy Project

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PHOTOMULTIPLIER CIRCUIT FOR AIRBORNE DUST SAMPLING INSTRUMENT. George A. Simon, p.70-3 of INSTRUMENTS RESEARCH AND DEVELOPMENT. QUARTERLY TECHNICAL REPORT JULY 1, 1951 THRU SEPTEMBER 30, 1951. Henry A. Blair. Oct. 25, 1951. 18p. (UR-189)

Design of an instrument for continuous sampling and recording of airborne dust concentration from an inhalation chamber is reported. A continuous strip of filter paper is pulled at a constant rate through an airlock and across a sampling port where the aerosol is filtered from a constant flow of exposure chamber atmosphere. The paper is brought out through another air-lock. A photomultiplier tube scans the blank filter paper before the aerosol deposit is laid down and a second photomultiplier tube scans the strip after the deposit is laid down. Each photomultiplier circuit traces a separate curve on a strip chart recorder. The design of the photomultiplier circuit is discussed.

Vitro Corporation of America, New York

181

WASTE METAL RECOVERY PROCESS ENGINEERING SUMMARY REPORT FOR JULY 18, 1949 - MARCH 1, 1950. Research Project 15D-1 (103). Mar. 7, 1950. Decl. with deletions Feb. 26, 1957. 8p. (KLX-1066(Del.))

A flowsheet for the feed-preparation portion of a process for recovery for U from Hanford metal wastes was developed. Major steps include precipitation of the U as soda salt, metathesis to remove phosphate ion, and dissolution of the soda salt in 68% HNO_3. Work on this project was stopped March 1, 1950 following decision to develop a recovery facility based on an alternate process.

182

PROGRESS REPORT FOR MAY, 1951. Job 23. June 27, 1951. Decl. Mar. 28, 1957. 70p. (KLX-1217)

Data are given on the recovery of U from MCW sewer streams using ion exchange resins and chemically treated cotton. Tests completed on the amenability of various Tonawanda and St. Louis solid waste residue to leaching with H_2SO_4 showed most of the residues were susceptible to acid leaching. Alkaline leaching using Na_2CO_3 and $NaHCO_3$ was not as successful.

183

GAS DECONTAMINATION SUMMARY PROGRESS REPORT FOR AUGUST, 1950. JOB 24-A2. W. A. Bain. Sept. 8, 1950. 6p. (KLX-1314)

Application of several previously developed particle build-up techniques to a wet suspension of NaCl gave the same build-up as was obtained with the standard dry NaCl suspension. It was determined by the jet-impinger analyzer that both cyclone and impingement-scrubber types of particle separators remove the equivalent of all the standard NaCl suspension which has been built up to 5 μ or larger and practically all in the 2 to 5 μ range but fail to remove particles under 2 μ. This test also confirms the view that jet-impinger analysis can be used to predict the performance of certain types of separators.

184

GAS DECONTAMINATION PROJECT STATUS; THIRD QUARTER; JULY 1 - SEPTEMBER 30, 1950. W. A. Bain. Oct. 27, 1950. 80p. (KLX-1316)

Under this project the applicability of certain particle-conditioning techniques to gas streams containing radioactive particulate matter has been investigated for the purpose of improving the clean-up efficiencies of commercially available separators such as cyclones and scrubbers used in wet removal systems. It was found that under optimum conditions a NaCl aerosol could be built up to the extent that <1% of the mass passed through the analytical cyclone and jet impinger, which was designed to remove particles greater than 5 and 2 μ, respectively, (99% build-up above 2 μ). These results were achieved with steam injection of 10 lb/1000 ft^3 and multiple water fog injection of 13 lb/1000 ft^3 followed by sonic agglomeration at 800 cycles for 12 sec. Somewhat less desirable results (98.2% build-up to above 2 μ) were obtained with multiple water fog injection and sonic agglomeration alone. Tests of the commercial type separators, cyclone and Peabody scrubber, indicate that they are capable of efficiently separating particles of the type investigated which have been built up to 2 μ or higher. Build-up techniques applied to a water insoluble AgI suspension (0.8 μ maximum particle size, 0.3 μ average particle size, with loading of 0.3 grain/1000 ft^3 were less effective than with NaCl, the maximum build-up to above 2 μ particle size being only 83%. The factors controlling build-up in this case are obscure. On the basis of this work, it would appear that about 98% of the mass of particulates can be removed from an aerosol of the types employed in this investigation by building up particle size with water fog injection and sonic agglomeration with particle removal by a cyclone separator. The cost has been estimated.

185

GAS DECONTAMINATION. Project Summary [for] February 1950 - December 1951. Job 24-A2. Decl. Jan. 11, 1956. 66p. (KLX-1380)

The effectiveness of certain particle conditioning techniques applied to gas streams containing radioactive particulate matter for the purpose of improving the clean-up efficiencies of commercially available separators such as cyclones and scrubbers used in wet removal systems was evaluated.

186

INDUSTRIAL APPLICATION OF GROSS FISSION PRODUCTS. Progress Report [Covering the period] January 1 - July 31, 1953. Job 24. Aug. 17, 1953. Decl. with deletions Feb. 27, 1957. 44p. (KLX-1394(Del.))

Recommendations are presented concerning the scope and direction which future research should take for the complete development of fission-product radiation sources for industrial use in food and pharmaceutical sterilization. Methods of concentrating fission products are reviewed, and a brief outline of each process and a discussion of its limitations are included. It was concluded that concentration of fission products by evaporation, and subsequent drying to a powder is the most feasible method for the preparation of fission-product wastes from the Purex separation process. Procedures are discussed in detail. Schematic sketches are included for a concentration plant and a packaging plant. Chemical and physical problems are discussed.

187

HOMOGENEOUS REACTOR FUEL REPROCESSING. JOB 87. QUARTERLY PROGRESS REPORT NO. 1. JULY 1-SEPTEMBER 30, 1953. Oct. 19, 1953. Decl. Feb. 27, 1957. 17p. (KLX-1704)

In a study of solubilization conditions of rare-earth fluorides in 0.02$\underline{M}$ UO_2SO_4 at 100°C, it was found necessary to have about 0.3 g of residual fluoride/l in solution to maintain the rare-earth fluorides insoluble. Tests are reported for rare-earth adsorption by CaF_2 at 100°C, fused alundum pellets impregnated with 1% CaF_2, garnet minerals, Ca titano-silicate mineral, and a natural Ca Mg silicate (diopside). Treatment of effluent from a CaF_2-packed absorption column with stoichiometric Th ion plus 10% excess reduced the fluoride ion to 90 ppm with negligible U removal; 10% excess reduced the fluoride ion to 90 ppm with negligible U removal; anhydrous $CaSO_4$ in contact with a similar effluent reduced the Ca content from 0.6 to 0.042 g/l, also with negligible U removal.

188

HOMOGENEOUS REACTOR FUEL REPROCESSING. JOB 87. Quarterly Progress Report for October 1-December 31, 1953. Jan. 18, 1954. Decl. Mar. 9, 1957. 28p. (KLX-1711)

Three alternative processes are presented for removing rare earth fission product contaminants from UO_2SO_4-D_2O reactor fuel solutions, based on adsorption of rare earths by CaF_2 at 100°C. These methods for treating adsorber effluent vary in cost and completeness of objectionable F^{-1} removal. The processes and the concentration of fluoride achieved are as follows: 1. Precipitation of dissolved Ca as $CaSO_4$ at 250-300°C and no F^{-1} removal (400 ppm F^{-1}). 2. Th^{+4} addition, causing precipitation of ThF_4 with $CaSO_4$ at 250-300°C (60 ppm F^{-1}). 3. Precipitation of $CaSO_4$ at 250-300°C followed by evaporation of fuel to dryness, driving off DF at 300°C, and redissolution of cake in recovered D_2O and SO_3 (< 1 ppm F^{-1}).

189

HOMOGENEOUS REACTOR FUEL REPROCESSING. Quarterly Progress Report for January 1-March 31, 1954. Job 1087. Apr. 19, 1954. Decl. Mar. 1, 1957. 21p. (KLX-1720)

The solubility of individual and mixed rare-earth sulfates in 0.02$\underline{M}$ UO_2SO_4 at 250-325°C was studied. A natural mixture of rare-earth sulfates and individual sulfates of the Ce group were soluble to <0.2 g/kg of solution above 280°C. Individual rare earths of the Y group (and Y itself) showed higher solubilities. Continuous adsorption of rare earths by CaF_2 was successfully carried out in the newly installed pilot plant. A flow diagram of the pilot plant is presented. Simulated spent reactor fuel consisting of 0.02$\underline{M}$ UO_2SO_4 with 25% excess H_2SO_4 and 0.2 g of Eu^{154}-traced, r[illegible]d, rare-earth sulfates/l, was passed through a column [illegible]-110°C at flow rates corresponding to residence times of 5 to 43 min. The adsorber, a 60-120 mesh mixture of 95% sand and 5% sintered C.P. CaF_2, removed 88-99% of the rare earths when the residence time was 7.6 min or greater. Results of a final laboratory-scale CaF_2 adsorption test in a ¾ in. Pyrex column are reported. Included are studies of (1) column operating and drying characteristics and (2) distribution of rare-earth tracer, CaF_2 and sulfate in the bed after completion of the run.

190

HOMOGENEOUS REACTOR FUEL REPROCESSING. Quarterly Progress Report for April 1-June 30, 1954. Job 1087. July 30, 1954. 17p. (KLX-1722)

Solubility studies were made in static bomb tests of Nd, Ce, and Sr sulfates in 0.02$\underline{M}$ UO_2SO_4 (with 25% excess H_2SO_4), at 250 to 325°C. Also, similar solubility tests were made to determine the carrying effect of the coprecipitation of rare earths. These tests were made with Ce, Nd, and Eu plus radioactive tracers in the presence of gross quantities of mixed rare earths. In these solubility studies all rare earths exhibited pronounced decrease in solubility with temperature. $Ce_2(SO_4)_3$ was the least soluble, and its solubility was lowered the most by the presence of other rare earths. A study of Nd tracer reliability indicated that not over 11% of its radioactivity was Pa. Bomb tests are being made to study the behavior of I_2 in 0.02$\underline{M}$ UO_2SO_4, at reactor temperatures. Emphasis is being given the interaction of I_2 with stainless steel. The second alternative process for CaF_2 absorber effluent post-treatment has been revised. It was learned that simultaneous precipitation of ThF_4 and $CaSO_4$ as a single operation at 275° would give low fluoride removal, due to the tendency of Th to precipitate as the sulfate at that temperature. Therefore, the process flow sheet and cost analysis were amended to include ThF_4 removal at 100°C before the high-temperature $CaSO_4$ precipitation in either (1) two zones of a cartridge or (2) in two separate cartridges, at a very small additional cost. Precipitation of ThF_4 by adding anhydrous $Th(SO_4)_2$ to a 1-liter batch of adsorber effluent and filtering the resulting slurry in a column-type sand-bed was demonstrated.

Vitro Laboratories,

West Orange, New Jersey

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HOMOGENEOUS REACTOR FUEL REPROCESSING QUARTERLY PROGRESS REPORT FOR JULY 1-SEPTEMBER 30, 1954. Job 1087. Oct. 30, 1954. Decl. Dec. 1, 1955. 13p. (KLX-1732)

A laboratory study was made of the behavior of I_2 in fuel solution at reactor temperatures, and to develop a means of reducing the level of build-up of this fission product in the core system. Batch tests were made in stainless-steel and quartz-lined bombs. Simulated fuel solution from these bombs, containing a small amount of I_2, could be sampled through a quartz filter at temperatures up to 310°C. It was found that I_2, initially present as (IO_3^-) ion, tended to distribute between the iodate and elemental forms in the sample liquid removed at 310°C, but no conversion to I_2 was observed at 100°C or lower. There was a net loss of about 20% of the initial 0.2 g(IO_3^-)/kg solution in the 310°C tests, indicating a possible reaction of I_2 vapor with exposed stainless steel surfaces in the bomb. The extreme insolubility of AgI and $AgIO_3$ suggested the use of metallic Ag for removing I_2 from the reactor fuel system. Three alternative processes are considered: 1. Ag in contact with fuel circulating in the primary reactor loop at 280-310°C, 2. Ag in contact with cooled solution, as in the fuel dump tanks, at 100°C, and 3. Ag in contact with vapor in the off-gas system to remove I_2.

192

HOMOGENEOUS REACTOR FUEL REPROCESSING QUARTERLY PROGRESS REPORT FOR OCTOBER 1-DECEMBER 31, 1954. Job 1087. Jan. 24, 1955. Decl Feb. 28, 1957. 13p. (KLX-1741)

REFERENCES

Batch tests, carried out in quartz-lined stainless steel bombs, have shown that I_2, initially present as 0.001 g of (IO_3^-)/liter of 0.02M UO_2SO_4, can be reduced to 0.02 ppm (IO_3^-) or 10^{-7} gram-atoms of I_2/liter by the reaction of I_2 vapor with metallic Ag in the gas phase above such a solution at 310°C. An experiment was made to study the removal of Cs from a simulated fuel solution by inorganic ion exchange. A column containing $Zr(PO_4)_4$ exchanger was operated at room temperature through 513 bed volumes of solution containing 0.2 g of Cs/liter as Cs_2SO_4 before breakthrough occurred. A loading of 67 mg of Cs/g of initial adsorber was obtained.

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HOMOGENEOUS REACTOR FUEL REPROCESSING. QUARTERLY PROGRESS REPORT FOR JANUARY 1-MARCH 31, 1955. JOB 1087. John D. McAdoo, Robert J. Abelson, and Gloria K. Koenig. May 9, 1955. Decl. Feb. 28, 1957. 13p. (KLX-10000)

Batch experiments were continued in the investigation of a process for removing I_2 from simulated core solution by metallic Ag in contact with equilibrium vapor at elevated temperature. The concentration of pentavalent I in oxygenated UO_2SO_4 solution decreases rapidly with a half period of 2 min when the amount of molecular I in solution is negligible. Rate of total I removal from solution after the two forms reach equilibrium was found to correspond to a half period of 20 to 30 min when metallic Ag was exposed to the vapor above a 3.3 cm^2 liquid-gas interface. Rare earth precipitation studies were carried out in an externally heated stainless steel circulating system. Rare earth sulfates dissolved in cold UO_2SO_4 solution were fed to the 300°C loop in 5- to 10-fold excess of the saturation concentration. Almost all of the precipitated material was deduced to have been deposited in the walls of the loop, and about 20% remained there after cooling and draining the system. An ion exchanger, $Zr_3(PO_4)_4$, adsorbed 35 mg of Cs/g of exchanger from simulated fuel solution at 95°C. The exchanger was found to have little or no capacity for Ni and Mn ions at 95°C but did remove some Cu.

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HOMOGENEOUS REACTOR FUEL REPROCESSING QUARTERLY PROGRESS REPORT FOR JULY 1-SEPTEMBER 30, 1955. Harold F. Reichard, John D. McAdoo, Stanley J. Klach, Gloria K. Koenig, and Paul E. Smith. Nov. 15, 1955. Decl. Mar. 25, 1957. 21p. (KLX-10012)

The equilibrium distribution of elemental I_2 was studied between vapor and liquid phases in a simulated homogeneous reactor fuel solution (pH = 2.1). A distribution coefficient, K, defined as the ratio of mol fraction I_2 in vapor to mol fraction I_2 in liquid, was found to be ~7 over a wide range of concentrations and at 280 and 330°C. In the absence of the $UO_2SO_4-H_2SO_4-CuSO_4$ solutes, K was found to be on the order of 0.25 with little variation between pH 3.8 and 9.9. Calculations were made to determine the feasibility of using countercurrent inert gas stripping of fuel solution in packed columns. The results indicate that an infinite number of transfer units would be required to effect a separation of >3.5 (concentration of I_2 inlet/concentration of I_2 outlet). As an alternative to using packed columns for I_2 stripping, a liquid-jet ejector for inert gas stripping of fuel solution is proposed.

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HOMOGENEOUS REACTOR FUEL REPROCESSING. QUARTERLY PROGRESS REPORT FOR OCTOBER 1-DECEMBER 31, 1955. Dept. of Chemical Research and Development. Harold F. Reichard, John D. McAdoo, Stanley J. Klach, Gloria K. Koenig, and Paul E. Smith. Jan. 31, 1956. Decl. Apr. 2, 1957. 27p. (KLX-10020)

A gas stripping process for shot-term I_2 removal is being studied as a means of Xe^{135} poison control in an aqueous homogeneous reactor. Laboratory studies of the batch scrubbing of I_2 from strip gas have shown water to be an efficient agent during the early part of an adsorption cycle. An abrupt increase in the amount of I_2 in the effluent gas may be interpreted as the point at which molecular I_2 builds up in the scrubber solution, the major portion of I_2 absorbed previous to this point having been converted to (IO_3^-) by the high concentration of O_2 in solution. A dilute solution of Ag_2SO_4 adsorbed I_2 from a vapor stream, depositing insoluble AgI quantitatively in the absorption vessel. Such a solution would accomplish effective removal of I_2 from the gas and at the same time chemically fix the I_2, thus permitting a large concentration factor to be obtained by solid separation or rapid flashing of heavy water vapor.

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HOMOGENEOUS REACTOR FUEL REPROCESSING. QUARTERLY PROGRESS REPORT FOR JANUARY 1-MARCH 31, 1956. Dept. of Chemical Research and Development. Vitro Job 1087. Harold F. Reichard, John D. McAdoo, Stanley J. Klach, Gloria K. Koenig, and Paul E. Smith. Apr. 30, 1956. Decl. Feb. 26, 1957. 25p. (KLX-10026)

Studies were continued on the rapid removal of I_2 from reactor core solutions by scrubbing and on the dissolution of ThO_2 blanket slurry solids by $HF-HNO_3$ solutions prior to Thorex processing.

197

HOMOGENEOUS REACTOR FUEL REPROCESSING. Quarterly Progress Report for April 1-June 30, 1956. Vitro Job 1087. Harold F. Reichard, John D. McAdoo, Stanley J. Klach, Gloria K. Koenig, and Paul E. Smith. July 31, 1956. Decl. Mar. 29, 1957. 14p. (KLX-10034)

The behavior of volatile fission products in aqueous homogeneous reactor core solution was studied. Particular attention is given to the chemistry of I_2, with the specific objective of removing I_2 rapidly from the fuel as a means of controlling Xe^{135} poisoning. Feasibility of high-pressure oxygen stripping of I_2 with an ejector is being studied as a means of implementing this process.

198

HOMOGENEOUS REACTOR FUEL REPROCESSING. Quarterly Progress Report for July 1-September 30, 1956. Vitro Job 1087. Harold F. Reichard, John D. McAdoo, Charles J. Anderson, Stanley J. Klach, Gloria K. Koenig, and Paul E. Smith. Oct. 31, 1956. Decl. Mar. 4, 1957. 26p. (KLX-10045)

Further studies are reported on the behavior of I_2 in aqueous homogeneous reactor systems. Gas-stripping of I_2 from a circulating simulated HR fuel solution stream (O_2 overpressure) at 230°C and 850 to 960 psi was studied. I_2 vapor-liquid equilibria, I_2 adsorption from off-gases in the low-pressure recombiner catalyst bed, and the use of CuO as solid sorber in a high-pressure I_2 removal system were also investigated.

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FISSION PRODUCT SEPARATIONS STUDY. Quarterly Progress Report [for] December 1, 1956-February 28, 1957. Vitro Job 2077. R. A. Keeler, C. J. Anderson, and M. Kibrick. Mar. 31, 1957. 26p. (KLX-10066)

Study of the solubility of $SrSO_4$ in H_2O and in HNO_3 at 0 to 350°C was continued. Results indicate that the solubility of $SrSO_4$ in H_2O decreases with increasing temperature, whereas in HNO_3 it increases with temperature.

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Tests were conducted with 5M HNO_3 to illustrate the effect of coprecipitating agents. The feasibility of using a $SrSO_4$ precipitation process for the decontamination of acid wastes is discussed. Selected minerals were evaluated in room-temperature batch tests as inorganic exchangers for removing Cs and Sr from 2.5M and 7.0M HNO_3.

200

FISSION PRODUCT SEPARATIONS STUDY. QUARTERLY PROGRESS REPORT FOR MARCH 1, 1957 – MAY 31, 1957. R. A. Keeler, C. J. Anderson, and M. Kibrick. June 28, 1957. 19p. (KLX-10078)

Decontamination factors of 3440 and 4050 were obtained by coprecipitating Sr with a $BaSO_4$ carrier at 334 and 350°C, respectively, from a 5M HNO_3 solution that initially contained 0.005g of $SrSO_4$/liter and 2g of $BaSO_4$/liter. At higher initial Sr concentrations with both 2 and 6g of $BaSO_4$/liter, the factors were considerably less. Results of the evaluation of several silicate and phosphate minerals for removing Sr and Cs from fission product acid waste liquors indicated that increasing the acidity from 7.0 to 9.0M HNO_3 did not increase the Sr distribution coefficient for the systems under study. A further study of minerals as exchangers or adsorbers of Cs from strong HNO_3 solutions indicated that none of the sixteen minerals tested were particularly good.

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FISSION PRODUCT SEPARATIONS STUDY. Final Report for the period September 27, 1956 – June 30, 1957. R. A. Keeler and C. J. Anderson. Nov. 29, 1957. 47p. (KLX-10089)

The solubility of $SrSO_4$ as a function of temperature and HNO_3 concentration was studied to evaluate this property as a means of separating Sr from radioactive waste. Coprecipitating tests at low and high temperatures were conducted to determine the effectiveness of Ca, Ba, and Pb in scavenging Sr from acid solutions. Several silicate and phosphate minerals were evaluated for their ability to remove Cs and Sr from fission product waste solution. The possibility of extracting slightly soluble cesium picrates from HNO_3 solution by butyl alcohol was investigated with studies of Cs distribution vs. HNO_3 concentration.

Radiological Hazards and Health Considerations

Monitoring

Brookhaven National Laboratory, Upton, New York

202

MONITOR FOR AIRBORNE RADIOACTIVE DUST. J. B. H. Kuper, E. H. Foster, and W. Bernstein. [nd]. 8p. (AECU-800)

A monitor is described which is designed for the continuous detection of α, β, and γ contaminated dust removed from air by filter paper through which air is pumped. The monitor consists of the air collector, filter paper, gears for regulating rate of movement of the filter paper, mica window Geiger-Mueller tube, scaler and an α counter. Sample data are given.

203

SENSITIVITY OF LIQUID WASTE MONITORING BY THE EVAPORATION METHOD. Frederick P. Cowan and John V. Nehemias. Mar. 30, 1951. 17p. (AECU-985)

A statistical criterion for detectability of radioactivity in waste liquids and its application to an evaluation of minimum detectable concentrations for the effluent from the BNL sewage processing plant is given. The results may be summarized as follows:

Isotope	Particle	Sample Volume	Minimum Detectable Concentration
P^{32}	β	500 ml	1.6×10^{-6} μc/cc
C^{14}	β	500 ml	1.8×10^{-7} μc/cc
Po	α	200 ml	3.0×10^{-9} μc/cc

204

AREA SURVEY MANUAL. AREA RADIATION DETECTION INSTRUMENTATION, MAINTENANCE, AND RESULTS. Max M. Weiss. Jan. 1, 1952. Revised June 15, 1955. 152p. (BNL-344)

This is a revision of BNL-167.

A series of 16 automatically operated radiation monitoring stations was set up at distances up to 10 miles from the center of the Brookhaven National Laboratory site. Instruments were installed to measure α, β, and γ activities, and to differentiate between airborne activity and activity arising from the soil or subsurface water. Each instrument panel is photographed automatically ten times an hr to provide a permanent record of monitoring data. Instruments designed for use in these monitoring stations are described in detail. Photographs of the instruments and components and circuit diagrams are included. Installation, calibration, operating, and servicing procedures are described. Analyses of data on natural background radiation and on area radiation measurements as affected by pile operations and atomic explosions are included.

University of California, Livermore. Radiation Laboratory

205

A CONTINUOUS ALPHA AIR MONITOR COMPENSATING FOR THE NATURAL ATMOSPHERIC RADIOACTIVITY. David R. Sawle. Aug. 24, 1955. 26p. (UCRL-4556)

An instrument has been built and tested which, when placed in a room containing α activity, will under most conditions give a positive indication that activity is present by the time the operator has received one half the maximum permissible daily dose of U or, if the activity stems from Pu, five times the maximum daily dose. Under many conditions it will give a positive indication sooner. It operates on the principle that when air is drawn through a filter paper, the Rn daughters reach equilibrium after a short time, and upon reaching equilibrium, 94% of the α emitted are 7.68 Mev. By discriminating electronically between these and the lower-energy, longer-lived activity, it is possible to build a continuous α air monitor with a fast response and good sensitivity.

Division of Reactor Development, Maritime Reactor Branch, AEC

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NUCLEAR POWERED SHIPS FOR AMERICAN SHIP OPERATORS. A SYMPOSIUM HELD AT WASHINGTON, D. C., JULY 30, 1957. 196p. (TID-7539)

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REFERENCES

Brief information is given p. 22, 68 on a radiation monitoring system, waste disposal practices, and hot laundry facilities to be installed in nuclear powered ships.

Dugway Proving Grounds, Tooele, Utah

207

SURFACE RADIATION MONITOR. Developmental Report No. 2. Richard O. Salisbury, Don B. Clark, and William B. Tench. Dec. 24, 1953. 17p. (NP-5720)

Design features are described for a surface radiation monitor developed to monitor clothing exposed to radioactive dust and particles, and to indicate when either of two levels of radiation were exceeded. Photographs of the instrument and circuit diagrams are included.

Du Pont de Nemours (E.I.) and Company.

Savannah River Laboratory,

Augusta, Georgia

208

IODINE STACK MONITOR. B. M. Carmichael and D. G. Karraker. Aug. 1955. 7p. (DP-129)

An instrument for continuously monitoring radioiodine in a flowing caustic solution was assembled for use with a stack monitoring system. An absolute counting efficiency of 3.2% was obtained.

209

A MONITOR FOR LOW-LEVEL RADIOACTIVITY IN LIQUID STREAMS. E. C. Wingfield and P. R. Liller. Jan. 1956. 14p. (DP-145)

A continual monitor for low-activity water streams is described. The monitor automatically collects constant-volume samples of the water, evaporates the samples to dryness, and presents the residues to two scintillation counters. It can reliably detect, within 10 min, an α activity of 5.2×10^{-11} c/ml, a β activity of 7.3×10^{-9} c/ml, and/or a γ activity of 3.3×10^{-9} c/ml.

210

AN ALPHA MONITOR FOR WASTE STREAMS. Edward C. Wingfield. Jan. 1957. 8p. (DP-197)

A continuous α monitor was developed for aqueous streams that may contain traces of radioactivity. A scintillation screen was submerged directly in the water. The instrument detected concentrations as low as 3.3×10^{-10} c/ml. The monitor's sample cell could be decontaminated easily if background activity accumulated within it.

Evans Signal Laboratory,

Belmar, New Jersey

211

HELICOPTER TO GROUND RADIOLOGICAL SURVEY EQUIPMENT. Robert H. Sugarman and Eric C. Ellstrom. Oct. 16, 1953. 14p. (SCEL-M-1541; AD-20963)

Equipment is described which was developed to measure γ radiation intensity at any spot in an inaccessible area. A helicopter with a suspended radiation detector provided an easily installed and operated system for making a wide variety of radiological measurements from the air.

General Electric Company.

Atomic Power Equipment Department,

San José, California

212

ENGINEERING TEST REACTOR ENGINEERING DESIGN AND SAFEGUARDS REPORT. July 1956. 347p. (IDO-24020; GEAP-0554; KE-56-19-R)

Of particular interest in this report (p. 44-90) are the following: A description of the gross γ monitoring devices in the reactor building; airborne particle monitors; area monitoring in the compressor and heat exchanger buildings; personnel monitoring; water and service water monitoring: primary secondary, and fission products monitoring; stack gas and bypass demineralizer monitoring; information on the normal disposal of radioactive solid, liquid, and gaseous wastes. Also included are plans of the buildings and a liquid waste disposal layout flow diagram.

General Electric Company.

General Engineering Laboratory,

Schenectady, New York

213

AIR SAMPLING CHAMBER FOR S.I.R. R. A. Dewes and E. E. Goodale. Aug. 8, 1952. 8p. (R52GL167)

The design and performance are described of a sturdy, light-weight air sampling chamber for the continuous monitoring of representative air samples for β activity.

General Electric Company.

Hanford Atomic Products Operation,

Richland, Washington

214

A RECOMPUTATION AND EXTENSION OF PARAMETERS INVOLVED IN SUTTON'S DIFFUSION HYPOTHESIS. M. L. Barad and G. R. Hilst. June 19, 1951. Changed from OFFICIAL USE ONLY July 6, 1956. Supplement, Nov. 16, 1953. 37p. (HW-21415 and Suppl.)

Corrections of two errors in HW-21415 are presented. The original values of the virtual diffusion coefficients, C_x and C_y, for the neutral lapse conditions have been found to be in error, and corrected values are presented. In the computations of the original Table III an error was made and a corrected table is presented.

215

GROUND LEVEL CONCENTRATIONS IN THE VICINITY OF A 185 FT. STACK. B. Shorr. April 20, 1953. Changed from OFFICIAL USE ONLY Jan. 23, 1957. 20p. (HW-27781)

The results are presented of a series of field tests designed to measure short-period concentrations at about three stack heights during conditions of marked atmospheric instability and low wind speeds. The data indicate that, relative to a source emitting 1 g/sec from an elevation of 185 ft, it is unlikely that a short-period concentration of 10^{-3} µg/cc or a short-period dosage of 10^{-2} µg sec/cc be exceeded. A nomogram is developed for estimating the probability of exceeding a critical concentration, given the rate of emission and critical concentration. Measurements of long-period concentrations are presented which show good

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agreement with Lowry's expression for the maximum concentration during these meteorological conditions.

216

A SCINTILLATION WELL-LOGGING SYSTEM. W. G. Spear and M. O. Rankin. May 1, 1956. 19p. (HW-39273)

A scintillation well-logging system was developed and fabricated to determine the extent and energies of various γ-emitting isotopes in wells up to 500 ft deep. The system comprises a watertight scintillation probe, a single connecting coaxial cable, a high voltage supply, a linear amplifier, a pulse height analyzer, a count-rate meter, recorder, cable drum, and a variable-speed electric drive unit. Attached to the cable drum are slip rings which convey high voltage to the probe from the high voltage supply and pulses from the probe to the linear amplifier.

217

AUTOMATION IN THE BETA MONITORING OF LIQUID WASTE STREAMS. H. G. Rieck, Jr. and J. D. McCormack. Dec. 15, 1955. 26p. (HW-40460)

A mechanism which automatically monitors liquid waste streams for total β activity was designed, fabricated and tested.

218

COLUMBIA RIVER SURVEY, 1951, 1952, 1953. J. F. Honstead. July 21, 1954. Decl. Mar. 1, 1957. 91p. (TID-10126)

The results of sampling and velocity determinations across the Columbia River at numerous locations below Hanford effluent discharge points and during various seasons are presented. A total of 59 such traverses is shown with the observed velocity and effluent distribution patterns for each river profile. A method of normalizing the data to permit closer comparison of the observed patterns at different locations is presented. The method is based upon the use of fractional quantity distributions to avoid the confusing variations in profile shape at different locations. The results of an intensive river survey below the 100-C reactor discharge are shown. These data were collected to permit mathematical analysis of the turbulent diffusion mechanism in the river. One such analysis derived from these data is presented.

University of Georgia, Athens

219

ECOLOGICAL ASPECTS OF WASTE DISPOSAL. Eugene P. Odum. p.95-103 of A CONFERENCE ON RADIOACTIVE ISOTOPES IN AGRICULTURE HELD AT MICHIGAN STATE UNIVERSITY ON JANUARY 12, 13, AND 14, 1956. Jan. 1956. 420p. (TID-7512)

The following topics are discussed in detail: the status of ecology in general; the scope of radiation ecology; accomplishments at AEC installations; and the integration of basic and radiation ecology.

Los Alamos Scientific Laboratory

220

ALPHA FLOOR MONITOR. Mark H. Tattan. Aug. 2, 1954. 23p. (LA-1713)

The floor monitor, Model FM-1, has been designed to detect α contamination. It is a portable type, battery operated instrument which is pushed over the floor like a vacuum cleaner. This report describes the physical design, mechanical and electrical assembly, and operating procedure.

New York Operations Office, Health and Safety Laboratory, AEC

221

ENVIRONMENTAL RADON CONCENTRATIONS. Interim Report. Harold Glauberman and A. J. Breslin. Mar 1957. 11p. (NYO-4861)

Preliminary data showing ambient concentrations of Rn in the Metropolitan New York area are presented. An attempt has been made to define the variability of concentration of Rn in the general atmosphere with location, time, and weather conditions. Samples have been analyzed from the outdoor air, inside of buildings, and above and below the surface of the ground. Comparisons with the data obtained by other investigators are also shown.

Oak Ridge Gaseous Diffusion Plant

222

CONTINUOUS BETA-GAMMA AIR MONITOR FOR K-1004-J. B. J. Bogardus. June 7, 1949. Decl. Nov. 28, 1955. 21p. (K-418)

This report covers the design changes and the experimental data obtained on the constant air monitor for β and γ radiation detection in its application at the K-25 Plant. This air monitor is of the type used at the Oak Ridge National Laboratory for sampling airborne activity absorbed in dust particles, etc. Problems of a practical nature involved in making the instrument more quantitative are discussed. Data needed for the application of a factor of safety to the radiation tolerance standard of the exhaust air from the stack of the K-1004-J building are suggested.

Oak Ridge National Laboratory

223

SPECIAL PROCESS EQUIPMENT. E. R. Edmondson. Oct. 12, 1951. Decl. Feb. 13, 1957. 52p. (CF-51-10-71)

Information on service waste monitoring and metering equipment is included.

224

APPLIED HEALTH PHYSICS RADIATION SURVEY INSTRUMENTATION [MANUAL]. D. M. Davis, E. D. Gupton, and J. C. Hart. Jan. 1, 1954. 230p. (ORNL-332(1st Rev.))

Radiation detection and measuring instruments used by the Applied Health Physics Section of ORNL are described. Operating characteristics, applications, calibration, and routine maintenance of each instrument are discussed. A photograph of each complete instrument and circuit diagrams for many of the instruments, a discussion of radiation types, units, and permissible exposure levels, data on calibration devices, sources, and procedures are included. Appended are three reports by staff members: A Review of Film Dosimetry; Calibration and Dosage Determinations in Beta-Gamma-X-Ray Film Dosimetry at ORNL; and The ORNL Cutie Pie.

225

A PORTABLE ALPHA SURVEY METER. W. M. Hurst, G. S. Hurst, and W. B. McDonald. Mar. 14, 1950. 23p. (ORNL-602)

This report presents a description, operation instructions, photographs, and circuit diagrams of a portable α survey meter designed for semi-quantitative measurement of α particle radiation. The instrument includes a proportional counter tube, amplifier with thyratron output tube, headphones for aural counting, and batteries to supply all the required voltages.

226

A PORTABLE ALPHA SURVEY METER. W. B. McDonald. Aug. 15, 1950. 9p. (ORNL-602(Suppl.))

Further development and redesign of the portable α survey meter eliminating the use of a desiccant and the associated service problems are discussed.

227

MONITORING OF LIQUIDS FOR RADIOACTIVITY. W. M. Hurst. Mar. 11, 1952. 34p. (ORNL-1155)

The development of an instrument to monitor continuously drinking water for α, β, and γ radioactivity in solution has progressed so that a preliminary design and some test results can be presented. Two devices are described: (1) the continuous-flow water cell with the radiation detector assembly; and (2) an instrument, for calibrating the water cell and detector response, which can also be used to measure the activity of liquid samples.

Phillips Petroleum Company.

Atomic Energy Division,

Idaho Falls, Idaho

228

MONITORING THE LIQUID WASTES DISCHARGED FROM THE IDAHO CHEMICAL PROCESSING PLANT. William C. King. June 12, 1956. 29p. (IDO-14378)

A continuous liquid waste monitor which has been in operation for 24 months at the Idaho Chemical Processing Plant is described. By detecting the γ activity, the monitoring system provides a method of measuring the activity in large volumes of liquid wastes which are discharged from the ICPP. The monitoring system, as described, provides a permanent record of the flow-rate and instantaneous concentration of γ activity in the discharged waste independent of background activity. It will integrate the product of the flow-rate and count-rate to give the total activity discharged over any given period of time. The monitor activates alarms if the concentration of activity in the discharge stream becomes too great. It also collects a continuous proportional sample of the discharged liquids which can be submitted for radiochemical analyses.

University of Rochester,

Rochester, New York.

Atomic Energy Project

229

USE OF COMMERCIALLY AVAILABLE PORTABLE SURVEY METERS FOR EMERGENCY FISSION PRODUCT MONITORING OF WATER SUPPLIES. J. B. Hursh, S. Zizzo, and A. H. Dahl. Aug. 3, 1951. 32p. (UR-180)

As a result of tests using 6 commercially available survey meters of the thin side-wall, G-M tube, γ- or β-detecting type, it was found that such an instrument had a sensitivity range which made it usable for emergency β monitoring of water contaminated by fission products. A convenient measurement kit has been assembled consisting of an 8-oz metal container for the water to be tested and two calibration standards with the radioactive material distributed on the inner surface of duplicate container lids. These standards are adjusted to give the same meter deflection as produced by mixed fission products in water at concentrations (3.5 $\mu c/l$) judged safe for 10-day consumption, and concentrations (90 $\mu c/l$) judged an acceptable risk for 10-day consumption, respectively.

School of Aviation Medicine,

Randolph Air Force Base, Texas

230

A CONSTANT AIR MONITOR FOR ALPHA-EMITTING ISOTOPES. (PROJECT NO. 21-3501-0003, REPORT NO. 7). John A. Auxier, Univ. of Texas and Air Force Radiobiology Lab; and Walter Blakey, School of Aviation Medicine. 8p. (NP-5316)

A dependable instrument was constructed and tested for monitoring air for α contamination. An air-filled proportional counter, pulse amplifier, alarm unit, and power supplies were assembled in such a manner as to operate satisfactorily.

United Kingdom Atomic Energy Authority.

Research Group.

Atomic Energy Research Establishment,

Harwell, Berks, England

231

THE MONITORING OF EFFLUENT FOR ALPHA-EMITTERS. PART 3. RADIUM. E. N. Jenkins and G. W. Sneddon. Nov. 1953. Decl. with amendment Apr. 1957. Reissued 1958. 26p. (AERE-C/R-2385)

A full use of the permissive terms of the Harwell Effluent Agreement requires regular Ra analyses, probably at very low levels, in the presence of other α emitters. An existing (Argonne National Laboratory) co-precipitation method for Ra in urine has been modified for this purpose. It has been shown that Ra may be isolated almost quantitatively from treated effluents, in a state of radiochemical purity. It may be measured directly using the α scintillation counter Type 1093B. The lower limit of sensitivity of the method, without previous concentration of the sample, is about 2 d/m/l (4 $\mu\mu c$/gal). All α active Ra isotopes are included. Ra^{226} may be distinguished by α growth measurements.

232

A SOLID PARTICLE ACTIVITY DETECTOR. A. E. Herriott. Aug. 4, 1954. 28p. (AERE-RE/R-1492)

The basic principles, general design, physical details, photographs, and drawings are given for a solid particle activity detector.

233

THE RAPID DETECTION AND CONTINUOUS MONITORING OF RADIOACTIVE CONTAMINATION ON DUST IN LABORATORY AIR. K. E. G. Perry. Sept. 7, 1955. 65p. (AERE-EL/R-1753)

This report summarizes the work accomplished towards the development of instruments for the continuous monitoring and rapid detection of airborne particulate radioactive contamination. Since the permissible level of Pu^{239} constitutes the most serious hazard, the major part of the development has been towards the rapid detection of low levels of α activity. Beta measuring instruments have also been developed. Instruments are described and illustrated.

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Westinghouse Electric Corporation.

Bettis Plant, Pittsburgh

234

PWR PREOPERATIONAL RADIATION MONITORING PROGRAM. Preliminary Report. Mar. 21, 1956. 7p. (WAPD-CTA-IH-87)

The proposed radiation monitoring program to be used with the PWR is briefly outlined.

Hazards

Argonne National Laboratory,

Lemont, Illinois

235

RADIATION SAFETY GUIDE. J. R. Novak, ed. June 1956. 74p. (ANL-5574)

Work with radioactive substances may involve some danger, and safety precautions must be taken before the work is started. This Guide includes suggested precautions to provide adequate protection, as well as some general information concerning possible radiation hazards and the effects of radiation on the body. It also contains procedural information which will be an aid in coping with radiation safety problems as they occur.

Army Chemical Center, Maryland.

Chemical and Radiological Laboratories

236

MAXIMUM ALLOWABLE CONCENTRATIONS OF FISSION PRODUCTS IN THE AIR AS A FUNCTION OF EXPOSURE TIME AND TIME AFTER DETONATION (Continued). Robert L. Harvey. Jan. 16, 1952. 11p. (CRLIR-81)

In a previous report, CRLIR 64, the internal hazard resulting from airborne concentrations of fission products was evaluated in terms of an equivalent Sr^{90} hazard, and a graph was drawn showing the maximum permissible fission product concentrations for three periods of exposure at 1 hr to 1 yr after detonation. In this paper, some of the assumptions have been modified, the calculations have been refined, and the presence of Pu is considered. A new graph has been prepared showing maximum permissible concentrations up to 50 times greater.

Atomic Energy of Canada Limited.

Chalk River Project,

Chalk River, Ontario

237

PRECAUTIONS FOR WORKERS USING RADIOACTIVE ISOTOPES. 1948. 11p. (NRC-1878)

A brief outline of the hazards and the type of precautions which must be taken when working with radioactive isotopes is given. Other topics covered are health hazards, laboratory design and equipment, health instruments, film monitoring service, special clothing, special cleaning services, disposal of radioactive waste materials and contamination control.

Brookhaven National Laboratory,

Upton, New York

238

SUPPLEMENT TO REPORT ON THE BROOKHAVEN NUCLEAR REACTOR PREPARED FOR REACTOR SAFEGUARD COMMITTEE OF THE ATOMIC ENERGY COMMISSION. L. B. Borst. Aug. 30, 1948. Decl. Sept. 21, 1956. 133p. (BNL-18(Suppl))

Factors affecting the operating safety of the Brookhaven Reactor on which data are presented include: a survey on the possibility of earthquakes; procedures for the transfer of radioactive material from the canal and heat generation in the canal; procedures for handling liquid wastes; a survey of meterological data and their relationship to pile operation.

239

SAFETY MANUAL. 2nd EDITION. Oct. 1949. 75p. (M-4484)

Information is divided into two parts as follows: Part I. Radiation Safety: general procedures, personnel monitoring, emergency coverage, laundry procedures, waste disposal, and fire dept. procedures. Part II. General Safety: procedures for treating, classifying, reporting and investigating occupational injuries, general safety practices, personal protective equipment, and motor vehicle safety.

Bureau of Medicine and Surgery

(Navy)

240

RADIOLOGICAL SAFETY REGULATIONS (Revised 1951). [nd]. 57p. (NP-4064; U23300; NavMed P-1325)

Protective measures and safety regulations to be observed in all peacetime laboratory and industrial operations (naval) dealing with ionizing radiations or radioactive materials are described. Information is given on the types of radiological hazards; maximum permissible exposures; medical examinations; photographic dosimetry; personnel protection; use of radioactive isotopes; the organization and duties of the Radiological Defense Staff; storage and transportation of radioactive materials; waste disposal; and safety indoctrination. The federal rules and regulations on transportation of radioactive materials are appended.

University of California,

Berkeley.

Radiation Laboratory

241

AIR BORNE AND SHORT WAVE RADIATION HAZARDS IN THE PROJECT AT THE UNIVERSITY OF CALIFORNIA. H. F. Ballenger. Sept. 10, 1945. 27p. (AECD-2858)

The results are given of ~2 yr of study into the problem of detecting and eliminating sources of hazards due to the presence of toxic gases or vapors of U and its products and to radiation. A summation of the dust, vapor, gas hazards, and radiation problems are given. Methods of collection, analysis, and study of hazards for U dust, Hg vapor, and CO are discussed. Methods for detection of radiation and methods to eliminate hazards of α and β particles, γ rays, x-rays, and neutron flux are included.

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REFERENCES

Division of Organization and Personnel.

Safety and Fire Protection Branch, AEC

242

A SUMMARY OF ACCIDENTS AND INCIDENTS INVOLVING RADIATION IN ATOMIC ENERGY ACTIVITIES, JUNE 1945 THROUGH DECEMBER 1955. Daniel F. Hayes. Aug. 1956. 79p. (TID-5360)

Criticality incidents, reactor incidents, contamination incidents, fires and explosions involving radioactive material, and miscellaneous accidents involving radiation which occurred from June 1945 through Dec. 1955 are described. Safety measures resulting from review of the accidents are included.

243

A SUMMARY OF INCIDENTS INVOLVING RADIOACTIVE MATERIAL IN ATOMIC ENERGY ACTIVITIES, JANUARY-DECEMBER 1956. Daniel F. Hayes. Aug. 1957. 28p. (TID-5360(Suppl.))

Pertinent details of the incidents are given. Some are illustrated with photographs or diagrams.

General Electric Company.

Hanford Atomic Products Operation,

Richland, Washington

244

STUDY OF ATMOSPHERIC CONTAMINATION IN THE MELT PLANT BUILDING. F. E. Adley, W. E. Gill, and R. H. Scott. Apr. 4, 1952. Decl. Dec. 1, 1955. 94p. (HW-23352(Rev.))

A preliminary survey of operations in the Melt Plant Building indicated that virtually all production activities were potential contributors to atmospheric contamination by U oxide fume and dust. The dust is disseminated in the air when dislodged from oxidized surfaces of U or during oxide-handling operations; fume arises when small pieces of U metal are allowed to burn. Oxide-handling, machining operations, burnout, and rod-handling were the chief contributors to atmospheric dust and fume. For personnel in the remelt processes, the weighted daily exposures they experienced varied from 40 to 78 times the weighted daily MPC level. Weighted daily exposures at rod-handling showed an exposure $2\frac{1}{2}$ times the MPC. Studies of particle distribution showed that 90% by weight of airborne particles are of respirable size ($<10\ \mu$ in diam.). Particles $<5\ \mu$ in diam. remain suspended in the air for long periods, resulting in continuous above-tolerance concentrations. Particles that do settle out are disturbed by plant traffic, vibration, and air turbulence and are thus redistributed in the atmosphere. Ventilation is more effective in the furnace room than elsewhere. Ventilators in the burnout room, in the oxide furnace, and at the rod straightener provide incomplete control. Fume and dust arising from some machining operations and from some oxide-handling procedures are without benefit of satisfactory control. Cross-contamination of the atmospheres at some processes and at nonproduction areas occurs by reason of the general ventilation that intermixes the atmospheres of the various plant areas. The wearing of respirators is required, but experience in other industries has shown that the degree of protection is uncertain. Discomfort and the imperfect fit of them to facial contours are contributing factors. Reliance on respirators as a primary control measure is not, therefore, a recommended practice. In view of these findings, recommendations are presented for improved general ventilation, for extending the application of local exhaust to all of the principal dust- and fume-producing operations, and for meticulous housekeeping through widespread use of vacuum-cleaning.

Naval Radiological Defense Laboratory,

San Francisco, California

245

RULES AND PROCEDURES FOR RADIOLOGICAL SAFETY. FINAL REPORT. April 1949. 48p. (AD-136(H))

This manual consists of two parts: Section I gives general rules and procedures concerning radiological hazards; Section II contains a glossary of terms and specific information on various procedures pertaining to handling radioactive materials.

246

A PROGRAM FOR THE EVALUATION OF THE EFFICIENCY OF RESPIRATORY PROTECTIVE DEVICES AGAINST RADIOACTIVE SUBSTANCES. INTERIM REPORT; NRDL-542. F. R. Holden. Sept. 26, 1949. Decl. Aug. 2, 1954. 10p. (AD-165(H))

A program for the evaluation of the efficiency of respiratory protective devices against radioactive substances is outlined. Rn decay products and radioactive dusts of controlled particle size will be used to measure filtration efficiencies of military and industrial protective equipment. The chambers in which the studies will be made are described.

New England Deaconess Hospital.

Cancer Research Institute,

Boston, Massachusetts

247

RADIOISOTOPES IN THE HOSPITAL. R. F. Cowing and Shields Warren. 1953. 10p. (AECU-2598)

Precautions to be observed by the staff of hospitals using radioisotopes to insure the safety of other personnel and of the public are reviewed. The procedure for obtaining radioisotopes for medical use from the Atomic Energy Commission is outlined. Precautions to be taken to prevent external exposure, ingestion or inhalation of radioactive material, and contamination by spilling or spreading of radioactive materials are discussed. The problem of waste disposal is considered briefly.

New York Operations Office,

Health and Safety Laboratory, AEC

248

INVESTIGATION OF THE POTENTIAL HAZARD IN RELEASING SCRAP STEEL CONTAMINATED WITH URANIUM TO COMMERCIAL CHANNELS. Hanson Blatz, John H. Harley, and Merril Eisenbud. June 15, 1951. Decl. October 24, 1952. 14p. (NYO-1558)

Tests were conducted on a laboratory and semi-plant scale to determine the effect of permitting scrap grossly contaminated with U to be used in steel manufacture. It was found that most of the U is removed with the slag. Steel made with this scrap would have a U constituent so

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little above that made with uncontaminated scrap as to be hardly significant. The slag itself would not present any hazard in handling or normal use. It is recommended, therefore, that in the future steel with only surface U contamination be released through normal scrap channels.

249

RADIATION FROM RADIUM BEARING SLUDGE STORAGE TOWERS. Eugene V. Barry. Apr. 1952. Changed from OFFICIAL USE ONLY Aug. 17, 1956. 16p. (NYO-4003)

Design data are presented for Ra bearing sludge storage towers including information as to amount of radiation that could be expected from towers of different diameter through the concrete wall at points external to the tower.

250

STANDARD PROCEDURES FOR ASSESSING AVERAGE DAILY AIR CONTAMINANT EXPOSURES. Paul B. Klevin and William B. Harris. May 2, 1955. 9p. (NYO-4644)

A procedure is presented for rapidly and efficiently evaluating average occupational exposures to hazardous environmental factors. This procedure has been used for several years and has been proved both effective and accurate. Typical examples of dust exposure evaluations are presented with forms suitable for collecting and recording data. Methods and calculations are discussed.

Oak Ridge Gaseous Diffusion Plant

251

MAXIMUM ALLOWABLE CONCENTRATION FOR AIR-BORNE BETA CONTAMINATION. J. C. Bailey and H. F. Henry. July 5, 1951. Changed from OFFICIAL USE ONLY Nov. 28, 1956. 16p. (AECD-3753)

By comparing the damage produced by β particles and U α particles emitted by material uniformly distributed in the lungs, an equation was derived by which the maximum allowable concentration in the atmosphere of a β-emitting isotope for which lung damage is the limiting consideration can be calculated. It was calculated that for such isotopes a conservative value for the maximum allowable concentration is 20 c/m/ft^3 as measured by the counter presently in use at K-25 for air sample β counting. The equation for calculating the maximum allowable concentration for β emitters which are retained in the body and for which lung damage is not the limiting consideration is given. As examples of the use of this equation, maximum allowable air-borne concentrations as determined by retention in the body were calculated for Sr^{89}, Sr^{90}, and UX_1. An equation for the maximum allowable concentration of an isotope for which body retention is the limiting factor, in combination with isotopes for which lung damage is the limiting factor was derived. A curve is given which shows the maximum allowable counting rate for Sr^{90} in combination with other β emitters having an average energy of 0.4 Mev, as a function of the fraction of the disintegrations due to Sr^{90}.

Oak Ridge National Laboratory

252

THE IMPACT OF RADIOACTIVE WASTE DISPOSAL ON CHEMICAL PROCESSING. Conrad P. Straub and E. G. Struxness. Aug. 15, 1955. 16p. (CF-55-8-97)

An attempt was made to bring to attention the need and desirability of reconsidering and reexamining fuel element construction, reactor operation techniques, chemical processing procedures, and waste disposal practice now in use to produce less hazardous and toxic waste effluents. Pretreatment for the removal of some of the longer-lived materials such as Sr^{90} and Cs^{137} is also pertinent.

253

THE ECONOMICS AND HAZARD POTENTIAL OF WASTE DISPOSAL. E. D. Arnold. July 8, 1957. 19p. (CF-57-7-31)

The two most important considerations in the disposal of radioactive wastes are safety and economy. All other steps in the waste disposal complex must be tuned to accomplish these two goals. In general, the hazardous waste in the nuclear power complex affect the cost of the nuclear power reactor fuel cycle, the general environment since disposal must exclude radioactivity from the environment for over 500 yr, the costs and/or methods of waste treatment including fission product utilization, the methods of shipping, the location of chemical processing plants and waste disposal sites, the methods of disposal best suited for a particular type of waste or site location, and potential public damage and third-party liability.

254

ENVIRONMENTAL PROBLEMS OF RADIOACTIVE WASTE MATERIALS. Roy J. Morton. p.353-399 of THE ROLE OF ENGINEERING IN NUCLEAR ENERGY DEVELOPMENT; THIRD ANNUAL OAK RIDGE SUMMER SYMPOSIUM; AUGUST 27 TO SEPTEMBER 7, 1951. Neil F. Lancing, comp. Dec. 1951. 516p. (TID-5031)

A discussion concerned primarily with health problems that result from the escape or release of radioactive materials to the environment is given. The potential health hazards from radioactive wastes are considered with regard to other problems of public health and environmental sanitation. The significance of environmental control and the essentials of waste disposal in general are briefly reviewed, while the problem of radioactive wastes is considered more specifically.

255

RADIATION EXPOSURE AND SAFETY EXPERIENCE IN RADIOCHEMICAL PLANTS. G. S. Sadowski, T. W. Hungerford, R. E. Blanco, and F. L. Culler. May 1, 1957. p.1022-36 of SYMPOSIUM ON THE REPROCESSING OF IRRADIATED FUELS, HELD AT BRUSSELS, BELGIUM, MAY 20-25, 1957. BOOK III. (TID-7534)

A general comparison of the accident experience of the AEC and chemical industries in the United States is given. Other information includes maximum permissible exposure limits, radiation exposure experience in radiochemical separation plants, and whole body irradiation experience.

Oak Ridge Operations Office, Isotopes Division, AEC

256

AIR CONTAMINATION AND RESPIRATORY PROTECTION IN RADIOISOTOPE WORK. G. W. Morgan and C. R. Buchanan. Jan. 19, 1953. 29p. (AECU-2821)

Air contamination associated with the use of radioactive isotopes in the laboratory is discussed. Positive control measures to prevent contamination are emphasized. The various forms of possible contamination and mechanisms influencing their stability in the air are discussed. Data are included on maximum permissible air contamination values, the pathway of inhaled contaminants once they enter the respiratory system, and the characteristic absorption, deposition, and pulmonary retention pattern of contaminants.

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The characteristics of various respiratory protective devices are discussed.

257

BASIC SAFETY REQUIREMENTS IN RADIOISOTOPE WORK. G. W. Morgan. p.252-72 of CONFERENCE ON THE USE OF ISOTOPES IN PLANT AND ANIMAL RESEARCH. HELD ON JUNE 12, 13, 14, 1952. Apr. 1953. 276p. (TID-5098)

The basic problems involved in the safe handling of radioisotopes and in the safe disposal of radioactive wastes are reviewed. Topics discussed include units of measurement and maximum permissible exposure limits, principles of protection, surveying and monitoring procedures, design of laboratories for radioisotope work, and the basic principles and problems of disposal of radioactive laboratory waste.

Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio

258

RADIOLOGICAL HEALTH HANDBOOK. Simon Kinsman. Jan. 1957. 358p. (PB-121784)

This edition of the handbook contains a large amount of readily available information of interest to anyone working in the field of radiation. Sections are included on physical, chemical, and mathematical data; radioisotope, decay, and radioassay data, and radiation protection data. A list of all the radioactive and stable isotopes of the elements, together with a number of their salient features including decay schemes is given. A glossary, a subject index, and a list of references are included.

University of Rochester, Rochester, New York.

Atomic Energy Project

259

HEALTH HAZARDS IN RADIATION WORK. M. Ingram. Oct. 25, 1950. 15p. (UR-139)

The general subject of health hazards in work with ionizing radiations is discussed. Types of injurious ionizing radiations and examples of occupations in which they may be encountered are reviewed. Minimizing the dangers associated with radiation work involves the recognition of the hazard, the development of conservative criteria for safe working conditions, and the enforcement of safety measures. The importance of educating personnel in such a manner that they appreciate the need for strict observance of routine safety measures is stressed.

260

PERSONNEL PROTECTION IN THE RADIOACTIVE INHALATION PROGRAM. G. Hoyt Whipple, J. N. Stannard, G. J. Miller, M. L. Ingram, and T. T. Mercer. Feb. 4, 1955. 40p. (UR-310)

This report summarizes measures taken to adapt standard radiation protection practices in a special laboratory for inhalation exposure studies using α or β emitting isotopes. It includes calculations of waste water activities which can be released into the Genesee River, and maximum amounts of radioactive materials permitted outside of dry boxes. Special features include protective clothing, self-contained breathing equipment, background hematological information on the personnel in the group, and the application of monitoring procedures in a laboratory handling radioactive aerosols.

Radioisotope Uptake

University of California, Los Angeles.

Atomic Energy Project

261

THE UPTAKE OF RADIOACTIVE FISSION PRODUCTS BY RADISHES AND LADINO CLOVER FROM SOIL CONTAMINATED BY ACTUAL SUB-SURFACE DETONATION FALL-OUT MATERIALS. Kermit H. Larson, Jon H. Olafson, James W. Neel, and Allen J. Steen. Dec. 14, 1953. 35p. (UCLA-272)

Certain radioactive products, predominantly Sr^{90}, originating from an underground detonation were found to be available to radishes and ladino clover. The studies reported are based on data obtained for the period 8 to 570 days after the underground detonation. The total amount of activity accumulated by the crop plants is not proportional to the radioactive contamination remaining in and on the soil. The maximum activity accumulated by the radish plant was 175 d/sec/g dry plant material grown in fall-out contaminated soil assaying 480 d/sec/g at the time the crop was planted (109 days after detonation). The availability of certain fission products from fall-out material from an underground detonation appears to be a function of solubility. The radioactivity in the plants was due primarily to Sr^{89}.

262

THE INFLUENCE OF SOIL ORGANIC MATTER ON THE UPTAKE OF Sr^{90} BY BARLEY AND TOMATO PLANTS. Hideo Nishita, Bruce W. Kowalewsky, and Kermit H. Larson. Oct. 17, 1955. 42p. (UCLA-349)

Studies of the influence of soil organic matter on plant uptake of Sr^{90} in modified Neubauer and pot experiments showed that the Sr^{90} uptake by barley and tomato plants was influenced by incubation time before cropping, organic matter concentration, and the kind of organic matter. The relative effect of a given organic material on Sr^{90} uptake depended on soil type. The uptake of Sr^{90} decreased as organic matter concentration was increased; this treatment, in turn, increased the soil microbial population. The reduction of Sr^{90} uptake with increasing organic matter concentration appeared to be a result of several factors: microbial immobilization of Sr^{90}, increased Na and K uptake causing a suppression of Sr^{90} uptake, and the detrimental effect of an organic matter decomposition product, or products, on absorption. The uptake of Ca closely paralleled the uptake of both radioactive and stable native Sr. The root Sr/Ca atom ratios increased with increasing additions of organic matter to soils. The top Sr/root Sr ratios were decreased by the addition of organic matter to the soil, indicating that Sr translocation was affected. Mg and Mn uptake was influenced by organic matter, but they did not appear to be closely related to Sr uptake. A study of the plant availability of Sr^{90} from non-radioactive soil treated with radioactive plant material and radioactive soil treated with non-radioactive plant material showed little or no difference between the two modes of contamination.

263

PLANT UPTAKE OF Fe^{59}-TAGGED IRON FROM A SLOWLY SOLUBLE SOURCE. W. A. Rhoads, E. M. Romney, and A. Wallace. Oct. 19, 1955. 19p. (UCLA-350)

REFERENCES

Crops of barley, soybean, and lemon plants obtained less than 0.025% of the total amount of Fe^{59}-tagged iron applied to Sassafras, Hanford, and Sorrento soils in the form of a fused, glassy material that might be used to simulate primary fall-out materials.

264

THE RELEASE OF Sr^{90} AND Cs^{137} FROM VINA LOAM UPON PROLONGED CROPPING. H. Nishita, A. J. Steen, and K. H. Larson. Nov. 6, 1956. 32p. (UCLA-380)

The uptake of Sr^{90}, stable Sr, Ca, Cs^{137} and K by Ladino clover from contaminated Vina loam was studied as a function of intensive, prolonged cropping and with regard to exchangeable and nonexchangeable forms of these ions. Both pot and flat culture methods were used. Data are tabulated.

General Electric Company.

Hanford Atomic Products Operation, Richland, Washington

265

BIOLOGICAL MONITORING OF THE LABORATORY AREA BY ANALYSES OF RODENTS AND OTHER FORMS OF WILDLIFE. K. E. Herde. May 26, 1947. Decl. July 12, 1950. 14p. (AECD-2888; M-3862; HW-3-5520)

An examination of water fowl and small animals taken from the area around the waste disposal pond, and mice from laboratory rooms, for radioactive (α and β) materials showed an accumulation of traces of radioactivity.

266

THE ABSORPTION AND TRANSLOCATION OF SEVERAL FISSION ELEMENTS BY RUSSIAN THISTLES. A. A. Selders. June 8, 1950. Decl. Dec. 6, 1955. 25p. (HW-18034)

An investigation was conducted to determine the absorption and translocation of fission products by Russian thistle from a localized spot of contaminated soil. The amount and identity of the radioactive elements absorbed and translocated by the Russian thistle is given along with the location of these elements in the plants. β radioactivity to the amounts of 10 μc/g caused no visible effects on the growth habits of the plants. Illustrations of gross autoradiographs and of autoradiographs of sectioned material are included.

267

THE ABUNDANCE OF THE PRINCIPAL CRUSTACEA OF THE COLUMBIA RIVER AND THE RADIOACTIVITY THEY CONTAIN. R. W. Coopey. June 25, 1953. Decl. Jan. 5, 1956. 15p. (HW-25191)

The species and abundance of crustacea together with the radioactivity they contained were traced for a 14 month period. Seasonal changes were found to influence the amount of radioactivity present in the organisms. Rapid growth favored high activity density. Unequal seasonal changes in radioactivity levels of body organs indicated functional differences in the utilization of the isotopes. A pronounced spring pulse and a smaller fall pulse were evident in the abundance of bottom cladocera. Radioactivity was highest during the fall pulse. Crayfish averaged 134 ± 22 g live weight and 39 ± 16 individuals per 36 ft^2 sampling area. Cladocera showed 2.6 g per ft^2 live weight and 260,000 individuals per ft^2 at maximum. No decrease could be found downstream from the Hanford Operation. P^{32} was the principal isotope present in crustacea, notwithstanding a variety of isotopes present in crustacean food and in the river water.

268

THE ABSORPTION AND TRANSLOCATION BY PLANTS OF RADIOACTIVE ELEMENTS FROM "JANGLE" SOIL. A. A. Selders, J. H. Rediske, and R. F. Palmer. Feb. 16, 1953. 12p. (HW-27620)

A study was made of the uptake of radioactive elements from Jangle test-site soil by 4 species of plants. The addition of nutrients to this soil increased the uptake of these radioactive elements, but in no case was the uptake over 2.8% of the activity in the soil on a concentration basis.

269

A PRELIMINARY COMPARISON OF THE NANNOPLANKTON AND NET PLANKTON OF THE COLUMBIA RIVER. R. W. Coopey. Sept. 10, 1953. Decl. Jan. 5, 1956. 11p. (HW-29298)

Plankton collected from the Columbia River by the net method and by the centrifuge method were compared. The centrifuged plankton (nannoplankton) exceeded the net plankton in weight, in abundance of organisms, and in radioactivity. Similar seasonal trends were present in both types of plankton.

270

THE UPTAKE AND TRANSLOCATION OF CESIUM BY PLANTS. J. H. Rediske and A. A. Selders. Sept. 15, 1953. 20p. (HW-35174)

In Red Kidney bean plants grown at a pH of 6.0 in nutrient culture, there was no significant redistribution of Cs from the older leaves, whereas the younger leaves demonstrated retranslocation where concentration gradients existed. The concentration of Cs in the aerial portions of the plant is nearly proportional to the concentration of Cs added to the nutrient solution. The absorption of Cs tends to increase as the pH of the nutrient environment is decreased. Uptake efficiency for Cs with bean plants was 0.68, tomato 0.32, Russian thistle 0.05, and wheat 0.02. Barley plants can attain a concentration of Cs in the leaves only 0.13 times the concentration in an Ephrata fine sandy loam soil.

271

THE ABSORPTION OF FISSION PRODUCTS BY PLANTS. J. H. Rediske, J. F. Cline, and A. A. Selders. May 17, 1955. 17p. (HW-36734)

The absorption of the important fission products by plants is quantitatively presented as a concentration factor which is defined as the ratio of the fission product concentration found in the leaves to the fission product concentration found in the nutrient substrate. Of the fission products, the isotopes of Sr were found to be the most important by virtue of their high concentration factor, long half life, and low maximum permissible amounts for animals. I$_2$ and Ba follow in importance, with Cs moderately important in some soils. All other fission products have concentration factors less than Sr by 100 or more. The effect on the concentration factor of different agricultural plants, as well as different organs of the same plant, causes variations of about a factor of ten or less for each isotope. The concentration factor tends to increase as the pH of the nutrient substrate is decreased. Addition of stable carrier to the substrate does not decrease the amount of the radioactive isotope that is absorbed into the plant. The presence of I$_2$ and Y carrier actually causes a significant increase in the concentration of the respective radioactive isotopes in the plant tissue.

272

THE ABSORPTION BY PLANTS OF BETA-EMITTING FISSION PRODUCTS FROM THE BRAVO SOIL. A. A. Selders, J. F. Cline, and J. H. Rediske. Dec. 20, 1955. 10p. (HW-40289)

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REFERENCES

Barley and bean plants were grown to maturity in soil from a Pacific island which contained fallout material from a thermonuclear explosion. The leaves of bean and barley plants showed a concentration factor of 0.05 and 0.02, respectively, for the total β emitters absorbed. Leaves of both bean and barley plants had a higher concentration of fission products than did the fruit. Addition of nutrients to the soil decreased the uptake of fission products into the bean plant but had no effect on uptake into barley. With the exception of those for Cs, concentration factors for the individual elements were comparable with values previously obtained in the laboratory using local soils. The concentration factor of 4 to 8 for Cs is over 20 times higher than is obtained using local soils. All values are determined on oven dried material.

273

THE FOLIAR SORPTION OF IODINE BY PLANTS. A. A. Selders and F. P. Hungate. Sept. 1, 1956. 11p. (HW-44890)

Iodine gas is taken up both by the epidermis and the mesophyll tissue of the leaf. The rate of uptake depends on the I^{131} concentration in the air with an average value of $(5.4 \pm 3) \times 10^4$ $\mu c/g/\mu c/cc$ of air/hr. The presence of stable I_2 along with radioactive I_2 did not reduce the amount of I^{131} sorption to the leaf but did reduce the amount translocated in the plant. Five per cent or less of the total I_2 sorbed by a leaf was translocated to other plant parts during 3 days following exposure to either gaseous I_2 or I^- in solution.

Oak Ridge National Laboratory

274

STUDIES OF RADIOACTIVITY IN FISH FROM WHITE OAK LAKE AND THE CLINCH RIVER. Venus I. Knobf. July 9, 1951. 39p. (ORNL-1031)

Fish in the White Oak Creek drainage system were scanned for over-all radioactivity; samples of bone, scale, and flesh were taken and in some cases internal organs were processed. Sr^{89}, Sr^{90}, and Y^{90} were found to be responsible for most of the activity in bones and scales, while Cs^{137} accounted for 96.8% of the activity in the flesh. Fish in White Oak Lake are unsafe as food and those in the river are not recommended, but those in the Clinch River below the mouth of White Oak Creek appear to have insignificant activity.

275

PREPARATION OF BIOLOGICAL SAMPLES AND CORRECTION OF DATA. Venus I. Knobf. Aug. 3, 1951. 24p. (ORNL-1048)

Numerous problems were encountered in the laboratory studies of radioactivity of fish taken from the Clinch River and White Oak Lake. Acid digesting and ashing of flesh of fish taken from White Oak Lake resulted in a small loss of activity but this treatment of bone and scale from the same fish produced no detectable loss. Ashing of samples reduced self-absorption and, thus usually permitted a more accurate counting measurement. HNO_3 digestion without the addition of H_2SO_4 appeared preferable since the samples treated with both acids had higher ashed weights and were also more hygroscopic. The internal organs and gills of fish from White Oak Lake often contained volatile radioactive isotopes. The inconsistency of results from Al absorption and decay studies indicated the presence of a diversity of short-lived high-energy isotopes.

276

THE SUSPENDED MICROBIOTA OF THE CLINCH RIVER AND ADJACENT WATERS, IN RELATION TO RADIOACTIVITY IN THE SUMMER OF 1956. J. B. Lackey. Nov. 13, 1957. 36p. (ORNL-2410)

The Clinch River enters the Oak Ridge area virtually free of plankton due to Norris Dam. It is fertilized in this area and develops a considerable plankton by the time it enters Watts Bar Lake. Some figures are presented showing the radioactivity accumulated by various species, and the rate of accumulation as compared to reproductive rates. Diminution of radioactivity in both plankton and water is traced downstream. Conditions in the Clinch River are compared with the Columbia River. The principal source of radioactive wastes for the Clinch River, insofar as known, is the effluent from the ORNL settling basin, which empties via White Oak Creek. Along with this small quantity of radioactive waste the river receives some nutrient materials and a mixed population of microörganisms. A small amount of radioactive seepage from the ORNL disposal pits may enter the creek. The possibility of other sources of radioactivity for the River was not investigated in this study. The Clinch River and neighboring waters yielded 425 species of algal or protozoan microörganisms in the summer of 1956. These are listed in an appendix.

United Kingdom Atomic Energy Authority.
Industrial Group.
Windscale Works,
Sellafield, Cumb., England

277

THE MECHANISM OF ACCUMULATION OF FISSION PRODUCTS BY FINE PARTICLES AND MARINE ORGANISMS. R. F. Jones and Isabel Batty. Dec. 1957. 11p. (IGR-TN/W-755)

A brief review of the results of investigations carried out to determine the accumulation of fission products, particularly Ru^{106}, by fine particles and marine plants and animals is presented. Detailed results of the investigations will be the subject of a separate report. The period covered is from Sept. 1956 to July 1957.

United Kingdom Atomic Energy Authority.
Research Group.
Atomic Energy Research Establishment,
Harwell, Berks, England

278

EXPERIMENTS ON THE UPTAKE OF IODINE 131 VAPOUR BY GRASS. A. C. Chamberlain and R. C. Chadwick. Aug. 6, 1952. 10p. (AERE HP/R 993)

Field trials have been done to determine the rate of uptake of I^{131} vapor by grass. The velocity of deposition, v_g defined as rate of deposition of I^{131} per unit area of ground/amount of I^{131} vapor per unit volume of air, is found to average 2.5 cm/sec. Experiments in the open air and in a wind tunnel have been done to compare the uptake by vegetation with the uptake by filter paper. Taking the maximum permissible level of I^{131} in vegetation as 1×10^{-4} $\mu c/g$ it is deduced that the permissible output of I^{131} from a stack is 10 mc a day for a stack height of 10 m, rising to 500 mc a day for a stack height of 100 m.

REFERENCES

Analysis

Atomic Energy of Canada Limited.

Chalk River Project, Chalk River, Ontario

279

RAPID DETERMINATION OF STRONTIUM ACTIVITY IN A MIXED FISSION PRODUCT SOLUTION. E. Mizzan. June 1, 1954. 13p. (PDB-122)

A rapid method is presented for the determination of Sr activity in the presence of the relatively long-lived fission product activities. The extraneous activities, with the exception of Ce, are removed by an $Y(OH)_3$ scavenging. The Sr is separated from the Ce in the supernatant solution by a SrC_2O_4 precipitation. The oxalate precipitate is then transferred to an Al disc to be dried and counted for Sr activity. The results agree with those obtained by the fuming HNO_3 procedure. The precision of the method is ±3%. Decontamination from the other long-lived fission product activities is very good. The method is much shorter and safer than the fuming HNO_3 procedure.

University of California, Los Angeles.

Atomic Energy Project

280

STRONTIUM AND CALCIUM IN MUNICIPAL WATER SUPPLIES, THEIR OCCURRENCE AND REMOVAL. George V. Alexander, Ralph E. Nusbaum, and Norman S. MacDonald. May 20, 1954. 27p. (UCLA-293)

Samples of raw water and tap water were obtained from 50 cities located throughout the United States. Analyses for Sr, Ca, and Mg were made by an emission spectrographic technique which required no preliminary concentration of the water samples. Comparison of the concentrations before and after chemical treatments indicated that reduction of Sr concentration accompanies removal of Ca. Interferences concerning the removal of radiostrontium from contaminated drinking water were drawn.

Chicago University.

Enrico Fermi Institute for Nuclear Studies

281

THE CHICAGO SUNSHINE METHOD; ABSOLUTE ASSAY OF STRONTIUM-90 IN BIOLOGICAL MATERIALS, SOILS, WATERS, AND AIR FILTERS. E. A. Martell. May, 1956. 65p. (AECU-3262)

The analytical techniques and counting method developed for the routine absolute assay of trace levels of Sr^{90} activity in a wide variety of biological and inorganic materials are discussed.

General Electric Company.

Hanford Atomic Products Operation, Richland, Washington

282

ANALYSIS OF VEGETATION FOR I^{131}. M. B. Leboeuf. Jan. 27, 1950. Changed from OFFICIAL USE ONLY Aug. 31, 1956. 11p. (HW-157 3)

An analytical procedure in which the I_2 is extracted from the vegetation by the use of a caustic solution is described. A limiting sensitivity of 0.002 to 0.004 μc/kg results when a 5g sample is analyzed.

283

COLLECTION AND ANALYSIS OF ACTIVE PARTICLES. Chester W. DeLong. Jan. 27, 1950. Decl. Feb. 7, 1956. 12p. (HW-15802)

The results are given of a radiochemical analysis of particles collected by electrostatic precipitation from ventilation air of the "B" plant at Hanford Works.

284

DETERMINATION OF RADIOCESIUM BY COMPLEX COBALTICYANIDE PRECIPITATION. J. C. Langford. Apr. 15, 1957. 33p. (HW-49668)

Several quantitative precipitants for radiocesium were investigated to determine their effectiveness in separating radiocesium from other common radiocontaminants in fission product waste solutions. Cobaltous cobalticyanide was found to be most satisfactory because of its stability in strong acid solution and its tendency to not carry other radiocontaminants in a strongly acid solution. A satisfactory radiocesium procedure was developed which gave a decontamination factor $>10^5$ for the γ emitting contaminants, $Zr\text{-}Nb^{95}$, Ru^{106}, Ce^{144}, and Sb^{125}. The recovery of radiocesium is >99%. The only substances found to interfere with quantitative separation in $3\underline{N}$ H_2SO_4 were $(NH_4)^{+1}$ at $>0.5\underline{M}$ concentration and HNO_3 at $>1\underline{M}$ concentration.

Mallinckrodt Chemical Works,

St. Louis, Missouri

285

THE DETERMINATION OF URANIUM IN PLANT [ORE REFINERY] SEWER WATER. O. J. Buckheim. Jan. 8, 1948. Decl. Dec. 2, 1955. 4p. (NYO-5214)

A number of methods for U determination were tested, and satisfactory results were obtained by precipitating a minute quantity as a phosphate, using a coprecipitant.

Massachusetts Institute of Technology,

Cambridge, Massachusetts.

Sedgwick Laboratories of Sanitary Science

286

ASSAYING TECHNIQUES FOR RADIOISOTOPIC CONTAMINANTS IN WATER SUPPLIES. A. Gordon Wheler, Jr., Warren J. Kaufman, and Rolf Eliassen. July 1, 1952. 73p. (NYO-4437)

The investigations described in this report deal with methods for determining the types and amount of radiation, from radioactive isotopes, present in water supplies. The primary objective of the research was to determine if tolerance amounts of β activity, of the order of 10^{-7} μc/ml, can be detected with standard laboratory end-window and windowless flow G-M counters. Statistical determinations were made of the reliability and minimum level of detection possible on end-window and windowless flow G-M counters. The determinations were based on the criterion that the minimum detectable activity is that activity for which the 90% reliability deviation is equal to the activity. Minimum levels of detection, with no solids present,

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were established for a variety of radioisotopes. The other major variables which effect counting, such as geometry, self-absorption, counter efficiency and energy of radiation were studied in an effort to clearly evaluate their effects on low level counting and minimum levels of detectability.

New York Operations Office,

Health and Safety Laboratory, AEC

287

ANALYSIS FOR LONG-LIVED PRODUCTS IN SOIL. N. I. Sax, J. J. Gabay, D. Revinson, and B. Keisch. Sept. 1, 1954. 24p. (NYO-4604)

Results are reported from an analysis for long-lived fission products in a sample of Marshall Islands soil contaminated by heavy fall-out following the March 1, 1954, nuclear tests. An attempt was made to account for the total activity of the sample. Chemical procedures for the separation of the Sr, Ru, rare earth, and Zr groups are given in an appendix.

Oak Ridge Gaseous Diffusion Plant

288

DETERMINATION OF ALPHA ACTIVITY OF URANIUM IN MUD. C. A. Kienberger, R. E. Greene, and C. E. Pepper. July 15, 1949. Decl. Sept. 8, 1955. 8p. (K-434; KLO-132)

A method for the isolation of traces of U in mud, silt and sewage disposal sludges and the determination of its α activity is described. The method employs solvent extraction, using di-ethyl ether and NH_4NO_3, for the recovery of U into a state sufficiently pure for electrodeposition and subsequent α counting. At the 95% probability level, this method gives a precision of 11% and a low bias of 6% at trace concentrations. The precision of α counting of the isolated U is limited by its counting rate, the lower limit being ~2 α counts/min.

Oak Ridge National Laboratory

289

RADIOACTIVITY OF DISSOLVER GAS. W. A. Brooksbank and E. J. Fuller. Aug. 26, 1953. Decl. Nov. 22, 1955. 32p. (ORNL-1064)

An apparatus for counting β activity in off-gas is described. It consists of 3 parts; the dilution section, the absorption section, and the sample counting tubes. The dilution apparatus provides a rapid and simple way of reducing activity concentration. The absorption section is used to absorb the I_2 activity from the diluted sample. The sample counting tubes hold the gas under known conditions while it is being counted. Geometry for the sample counting tubes was determined to be 3.5% for Kr^{85}. I_2 dissolver gas was analyzed with the ion chamber, and the proportions of Xe^{133} and X^{135} contained in it were measured. The proportions of Kr^{85} and Xe^{133} in a mixture of the 2 were checked by use of the apparatus with a fair degree of accuracy. A detailed procedure for noble gas analysis is given in the Appendix.

Union Carbide Nuclear Company,

Y-12 Plant, Oak Ridge

290

URANIUM CONTENT OF SEWAGE SLUDGE; OAK RIDGE DISPOSAL PLANTS. L. J. Brady and C. D. Susano. Aug. 10, 1949. Decl. Dec. 6, 1955. 10p. (Y-471)

Results of tests are given on the U content of sludge which is produced at the Oak Ridge sewage disposal plants. The sludge produced at the West Plant is reported to contain 25 to 50 ppm of U, and that produced at the East Plant is reported to be of the order of 5 to 10 ppm.

Solid Wastes

Decontamination

Argonne National Laboratory,

Lemont, Illinois

291

DECONTAMINATION OF STAINLESS STEEL. F. Johnston and J. J. Katz. Jan. 1953. Decl. Feb. 11, 1957. 14p. (ANL-4970)

The information obtained from absorption curves and radioautographs indicates that the problem of decontaminating stainless steel surfaces which have been immersed in active UO_2 slurries is one not of removing a particular adsorbed radioactive species but of removing minute UO_2 particles which are tenaciously held by the surface. Consistent with these observations, reagents which effectively dissolve UO_2 or have a corrosive effect on stainless steel were efficient decontaminating agents. Complexing agents, detergents, and wetting agents, on the other hand, were, in general, poor decontaminating agents. An exception was Victamul 116C, a non-ionic organic phosphate produced by the Victor Chemical Co. This product was found to be several times more effective than any of the other mild reagents tested. It did not, however, compare with the oxidizing mixtures in equivalent concentrations. The effectiveness of the $H_2O_2 - H_2SO_4$ mixture was markedly enhanced by the addition of Solvadine BL, a wetting agent produced by Ciba.

Atomic Weapons Research Establishment,

Aldermaston, Berks, England

292

PHYSICOCHEMICAL INVESTIGATIONS INTO THE ABSORPTION AND REMOVAL OF RADIOISOTOPES FROM TEXTILES (RADIOLOGICAL DECONTAMINATION). PART I. POLYVALENT CATIONS ON COTTON. D. G. Stevenson. Nov. 7, 1955. 51p. (AWRE-O-42/55)

The effect of several variables governing the removal of representative radioisotopes from cotton has been studied and it is shown conclusively that the uptake and removal are straightforward ion exchange processes on a carboxylic material. In order to effect efficient removal under mild conditions it is necessary to use a complexing agent which will form an anionic complex with the contaminant ion. The activation energy of the process is 12 kcals and high temperatures are therefore very beneficial. Limits of decontamination are set mainly by the low diffusion rates. The general behavior is governed by mass action with respect to the solution within the fibre and this is in turn governed by Donnan membrane effects. The stability constant of the Ce-cotton complex is estimated at 3×10^5, and of the decontamination reaction with EDTA $\log^{-1}$ 8.16.

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Diffusion constants in the more effective solutions at 25°C are of the order of 5×10^{-16} cm^2/sec.

California Research and Development Company, Livermore, California

293

WASTE DISPOSAL-DECONTAMINATION AND DECONTAMINATION LAUNDRY FACILITIES. W. A. Clark. May 1954. 25p. (LRL-120)

Methods of collecting liquid and dry wastes are described. Facilities were constructed to efficiently and economically handle from 10 to several hundred barrels of waste per month. The decontamination glove box has solved numerous problems inherent to various types of surfaces. It is easily operated, and, being a closed system, adequately confines acid vapors and activity. The glove box is also a very flexible system and if it becomes too highly contaminated, the old section can be closed off and removed. The new section can then be installed with a minimum of lost time. The decontamination laundry will handle 25 lb of dry laundry/hr and is efficiently operated by one man. Housing all 3 facilities in the same building has tended to decrease the required amount of supervision and upkeep.

General Electric Company. Hanford Atomic Products Operation, Richland, Washington

294

FACILITIES FOR DECONTAMINATION OF LABORATORY EQUIPMENT. O. L. Olson and J. F. Gifford. June 30, 1953. 20p. (HW-26502)

An inexpensive, versatile decontamination chamber has been constructed for cleaning laboratory equipment. It has been used successfully for manual disassembly and cleaning of equipment showing radiation levels as high as 5 r/hr. A sandblasting cabinet was also constructed for decontamination of laboratory equipment. Trial runs showed that sandblasting would often reduce radiation levels as much as 99% on equipment which had been previously subjected to chemical decontamination without success.

295

SANDBLAST DECONTAMINATION OF STAINLESS STEEL. L. E. Kattner. Oct. 7, 1953. 17p. (HW-29576)

Comparative decontamination tests based on stainless steel contaminated with Hanford U dissolver solution show that sandblasting is considerably more thorough than the usual chemical method. It is evident that sandblasting not only reduces the decontamination time but also removes 99+% of the contamination.

296

A STUDY OF THE EFFECTIVENESS OF DECONTAMINATING AGENTS ON CONTAMINATED PROTECTIVE CLOTHING. J. L. Norwood. July 29, 1955. 19p. (HW-38218(Rev.))

A series of 139 tests was conducted using 22 decontaminating agents either singly or in combination. The tests clearly indicated that complexing agents are most effective in removing metallic ions strongly fixed to cotton cloth. It was also demonstrated that large quantities of water in the washer wheel provide greater possibilities for floating away loose radioactive particles and also show better results in removing complexed or inactivated metallic ions from cotton fabric. Soaps, clays, silicates and other recognized commercial laundry materials have little value in removing normal radioactive contaminants from plant clothing. The compounded agents containing glassy phosphate salts, carbonate and ammonium ions proved to be most effective throughout the tests. Specifically, Turco 4182-A which combined the most desirable characteristics has been adopted in the Process Laundry as the basic decontaminating agent.

Internuclear Company, Incorporated, Clayton, Missouri

297

DECONTAMINATION AND WASTE DISPOSAL IN INDIUM GAMMA IRRADIATION FACILITY. Lawrence C. Widdoes. May 14, 1956. 7p. A-1 Project. (AECU-3339; IC-LCW-56-6)

Flushing and draining should sufficiently decontaminate the irradiation equipment so that it can be maintained easily, but experimental work should be performed to make positive that In, or some radioactive impurity, is not preferentially absorbed on equipment walls so that it cannot be removed by simple flushing. Even after 5 yr decay it may be difficult to reduce, by dilution, the Tl and perhaps other impurities in commercial $In_2(SO_4)_3$ solution to drinking water tolerance, but the use of high purity In in the loop could alleviate this situation.

Johns Hopkins University, Baltimore, Maryland

298

CONTAMINATION OF PLUMBING BY LOW-LEVEL RADIOISOTOPE WASTES: [FINAL REPORT]. Albert P. Talboys. May 1, 1952. 31p. (NYO-4010; JHUX-7)

Solutions of I^{131}, Sr^{89}, and P^{32} at low levels of activity were passed through a 9-ft section of plumbing, simulating an actual waste drain line. The pipes and fittings retained on the average about 16% of the I^{131} and Sr^{89} present in the solutions, and nearly 22% of the P^{32}. This retention is attributed in large part to selective adsorption of the isotopes on the metal surfaces. In general, the more complex fittings were more highly contaminated than the straight sections. Flushing the system with water removed nearly 30% of the I^{131} and up to 40% of the Sr^{89}, but even continuous flushing did not dislodge more than about 25% of the P^{32}. However, removals of more than 90% of the P^{32} were accomplished by the use of highly alkaline solutions (NaOH and Na citrate). HNO_3 rinses were similarly effective in reducing the Sr^{89} contamination.

299

AN EVALUATION OF LAUNDERING AGENTS AND TECHNIQUES USED IN THE DECONTAMINATION OF COTTON CLOTHING. Albert P. Talboys and Eugene C. Spratt. Mar. 1, 1954. 114p. (NYO-4990)

An evaluation was made of laundering agents used in the decontamination of clothing, with the view of employing agents which are effective decontaminants and are still amenable to treatment by economical biological processes. Techniques are reported including dry-cleaning methods, that afford maximum decontaminating efficiency and at the same time result in a minimum volume of waste to be evaporated.

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REFERENCES

Knolls Atomic Power Laboratory, Schenectady, New York

300

DECONTAMINATION AND REMODELING OF A HIGH LEVEL CHEMISTRY CELL. B. V. Coplan and D. J. Smith. May 26, 1954. 19p. (AECU-2902)

A hot cell containing a separations pilot plant, after operating for 3 yr at high activity level, was decontaminated and remodeled. The timing, cost, and manpower requirements for the reconstruction and decontamination are discussed. Decontamination procedures and corresponding radiation reductions are reported, followed by a discussion of the design revisions necessary to reduce future maintenance.

301

HIGH-LEVEL CONTAMINATION CONTROL AND WASTE DISPOSAL. R. F. Stearns. Nov. 1, 1955. 19p. (KAPL-1406)

The clean-up and disposal of radioactive waste in the Radioactive Materials Laboratory at the Knolls Atomic Power Laboratory is lessened considerably if the problems of radioactive contamination are taken into consideration during the design of irradiation test devices and laboratory equipment. Operational experience and engineering work have also resulted in development of many techniques and equipment which have aided in reducing the costs of high-level radioactive clean-up and waste disposal.

Los Alamos Scientific Laboratory

302

LABORATORY STUDIES ON THE REMOVAL OF PLUTONIUM FROM LAUNDRY WASTES. John F. Newell, C. W. Christenson, J. D. Shaykin, H. L. Krieger, D. W. Moeller, and C. C. Ruchhoft. 2p. (AECU-837; LADC-800)

Laboratory scale chemical coagulation experiments were made in parallel with 2 stages trickling filter experiments. Results indicated that the Pu removal could be attained either chemically or biologically but the simplicity of operation and the volume of sludge to be disposed of seemed to favor the latter treatment. Satisfactory Pu removal was obtained by chemical precipitation with $CaCl_2$, CaO, NaOH, activated silica, and $FeCl_3$ added in sequence at pH values of 11.5 or higher.

Naval Radiological Defense Laboratory, San Francisco, California

303

CHAPTER 10–DECONTAMINATION RADIOLOGICAL DEFENSE VOL. II. William H Sullivan. Feb. 1, 1950. Decl. Sept. 28, 1950. 36p. (AD-206Y)

This report summarizes various methods of surface decontamination using such agents as water, steam, detergents, complexing agents, organic solvents. acids, etc. Methods of aging and sealing of contaminated materials are discussed. Waste disposal methods include demolition, concentration by combustion and fusion, handling, and sea or land burial.

304

OPERATIONAL FEASIBILITY OF DECONTAMINATING MATERIALS EXPOSED TO ATOMIC WARFARE; I. BACKGROUND AND GENERAL PRINCIPLES; INTERIM REPORT (Technical Objective SR-2z). Nathan E. Ballou. Aug. 15, 1950. 29p. (AD-236(Z))

The many factors to be considered in radioactivity decontamination are enumerated and analyzed. Among these are usefulness, necessity, and value vs. risk; damage and degree of contamination; dosage allowed; amount of decontamination required; time needed for decontamination; length of time elapsed after detonation; intensity of radiation; nature of surface; nature of contamination; rates of reaction; recontamination; advance preparation; drainage; and disposal of wastes. Decontamination methods include removal of loose contaminated material, treatment with chemical agents such as complexing compounds, highly charged ions, and detergents, and removal of surface layers by chemical or physical means. Anticontamination measures include the preparation of special surfaces which have low contaminability characteristics or which are easily decontaminated, and methods which cause physical interruption of the contamination process.

305

CHEMICAL DECONTAMINATION OF STAINLESS STEEL AND 24ST ALCLAD ALUMINUM (Final Report). W. Shelberg, R. Fuller, L. Graham, B. Lane, J. Mackin, and L. Wentzler. July 24, 1951. Decl. Nov. 11, 1954. 24p. (AD-337(C))

Comparisons are made regarding the abilities of a number of surface active agents, complexing agents, commercial detergents and mixtures of these materials to decontaminate surfaces of stainless steel and alclad Al (24ST) contaminated with neutral mixed-fission-product contaminant (Sr, Y, Zr, and Nb); comparisons are made at room (20–25°C) and steam cleaning (70–76°C) temperatures. Several reagents are quite efficient at room temperature, and a tendency for an increase in decontamination with an increase in temperature is frequently noted. Graphs define the dependency of decontamination upon pH at both temperatures for stainless steel and alclad Al.

Oak Ridge National Laboratory

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DECONTAMINATION AND CORROSION RESISTANCE PROPERTIES OF SELECTED LABORATORY SURFACES. C. D. Watson, T. H. Handley, and G. A. West. Aug. 29, 1950. Decl. Oct. 3, 1950. 27p. (AECD-1996(Rev.); ORNL-732(Rev.))

Detailed test results are presented on a selection of 50 materials including baked interior panels, protective plastic coatings, laboratory bench top materials, floor tiles, and strippable plastic films, which were compared for ease of decontamination when used in radiochemical laboratories.

307

SUMMARY OF SURFACE DECONTAMINATION EXPERIENCE AT OAK RIDGE NATIONAL LABORATORY. F. N. Browder. Nov. 1943 through July 1948. Decl. with deletions Jan. 5, 1956. 38p. (AECD-3998)

In the course of 5 yr experience at Oak Ridge National Laboratory, it has been found that all impervious materials such as stainless steel, mild steel, lead, glass, certain plastics, and certain surface coatings can be decontaminated by vigorous washing with the proper reagents. Each decontamination operation is carried out by starting with mild reagents (water) and increasing the severity of the treatment until the desired decontamination is obtained. Porous materials such as bare concrete, wood, and some plastics have been impossible to decontaminate satisfactorily except by the physical removal of the contaminated portions.

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REFERENCES

308

A GENERAL DECONTAMINATION MANUAL FOR THE IDAHO CHEMICAL PROCESSING PLANT. C. D. Watson. Mar. 11, 1953. Decl. Dec. 7, 1955. 18p. (IDO-26081)

Decontamination procedures are outlined for the removal of radioactive contamination from stainless steel chemical processing equipment, stainless steel laboratory surfaces, concrete surfaces, painted surfaces, asphalt floor tile, and Cu and brass surfaces. Two methods for the destruction of oxalic acid are included.

309

EXPERIENCE IN EQUIPMENT AND BUILDING DECONTAMINATION IN THE MANUFACTURE OF Ba^{140}. E. J. Witkowski. Nov. 19, 1946. Decl. Mar. 7, 1957. 7p. (MonT-205)

Solutions to problems encountered in the decontamination of buildings and equipment are reported. Some of the techniques and methods employed may have general application.

310

REVIEW AND OUTLINE OF PRESENT LAUNDRY PROCEDURES AT ORNL. H. J. McAlduff, Jr. Mar. 1, 1950. 10p. (ORNL-600)

Information is given on the collection and checking of clothing, special treatment of α-contaminated clothing, washing cycle, and protection of laundry personnel.

311

ELECTRODECONTAMINATION OF STAINLESS STEEL. M. R. Bennett. Nov. 1, 1954. Decl. Dec. 1, 1955. 28p. (AECD-4169)

Decontamination factors of 1000 to 3000 were obtained by electrostripping deposited radioactivity from stainless steel surfaces, used as the anode, in 2% H_2SO_4 at current densities as low as 0.01 amp/in.^{2}. Stainless steel cathodes were used. The method was successfully applied to contaminated equipment.

312

DECONTAMINATION OF THE HOMOGENEOUS REACTOR EXPERIMENT. D. O. Campbell. June 12, 1956. 44p. (ORNL-1839)

After shutdown the Homogeneous Reactor Experiment system was decontaminated in about 1 month, without descaling, from an activity level of 1000 r/hr to 5 to 200 r/hr. This was sufficient to permit dismantling. The treatment consisted in washing twice with each of the reagents 5% HNO_3, 35% HNO_3, and 10% $NaOH$-1.5% $Na_2C_4H_4O_6$-1.5% H_2O_2 and numerous times with water. Over-all decontamination factors were 22 to 25, including decay. Decontamination factors with a single reagent were between 1 and 2.25. More than 2000 curies each of Ce and Zr, more than 1000 curies each of Ba, Sr, and La, and large amounts of Nb, Ru, and I_2 were removed. The significant contaminants remaining were Nb and Zr. These could have been removed only by descaling the system, which laboratory experiments indicated would have given a further decontamination factor of about 100.

313

RADIOCHEMICAL CONSTITUENTS IN THE EFFLUENT ACTIVITY, p.22-6 of DECONTAMINATION OF THE ORNL THOREX PILOT PLANT. K. H. McCorkle and W. R. Winsbro. July 25, 1956. 31p. (ORNL-2058)

The principal radiochemical constituents contributing to the γ activity were Pa and Nb, constituting ~80% of the total activity. The remaining 20%, in order of decreasing importance, was due to Zr, Ru, and rare earths. Decontamination of the Thorax feed preparation and extraction equipment apparently is limited by Pa removal. Information is also given on decontamination time, costs, and procedures.

Oak Ridge Operations Office,

Isotopes Division, AEC

314

DECONTAMINATION AND DISPOSAL OF RADIOACTIVE WASTES. G. W. Morgan. Paper 14 of HEALTH PHYSICS INSURANCE SEMINAR [HELD] FEBRUARY 6-10, 1950. Mar. 12, 1951. 161p. (TID-388)

Methods of decontaminating structural materials, glassware, porcelain, metals, plastics, clothing, and hands and body are discussed. Interim recommended procedures for the disposal of I^{131}, P^{32}, and C^{14} are outlined, and the general methods of disposal of radioactive materials by dilution with water or air, concentration, storage, and burial on land or at sea are discussed. Tables list permanent and strip coatings and their manufacturers, permissible amounts and concentrations of radioisotopes, natural radioactivity of some United States water sources, and quantities in mc of radioisotopes shipped to various cities.

Incineration

Argonne National Laboratory,

Lemont, Illinois

315

BASIC OPERATIONAL REPORT OF THE ARGONNE ACTIVE WASTE INCINERATOR. Donald C. Hampson, Edwin H. Hykan, and Walton A. Rodger. Feb. 6, 1953. 72p. (ANL-5067)

The active waste incinerator at ANL has been successfully operated for 20 months on a combined routine production and experimental basis. Sixteen thousand ft^3 of wastes have been incinerated with a volume reduction from feed material to ash of 95%. The normal burning rate is ~17 ft^3/hr. An experimental program to evaluate equipment performance and to obtain optimum operating conditions has been carried out. The immediate measured activity of the exhaust gas from the gas scrubbing train has been consistently lower than that of the normal outside air. A plot of decontamination factor versus the activity level of the feed indicates that 3×10^7 is the limiting over-all decontamination value for the present operating conditions of the incinerator. This value is confirmed by cumulative decontamination factors for the individual pieces of equipment.

University of California, Los Angeles.

Atomic Energy Project

316

REDUCTION OF COMBUSTIBLE, LOW-LEVEL CONTAMINATED WASTES BY INCINERATION. Louis B. Silverman and Richard K. Dickey. May 15, 1956. 20p. (UCLA-368)

Specifications of the incinerator and methods of incineration used at UCLA for disposal of small animal carcasses, excreta, paper, and towels are presented. The physical reduction of these combustible wastes resulted in better than 95% reduction by weight and volume. A summary of all loads and activities placed in the burn-all unit from January 1954 to December 1955 are tabulated.

REFERENCES

Johns Hopkins University, Baltmore, Maryland

317

BEHAVIOR OF INSTITUTIONAL INCINERATORS WHEN USED TO BURN RADIOACTIVE WASTES: FINAL PROJECT REPORT [FOR] AUGUST 1, 1950-NOVEMBER 1, 1952. C. W. Kruse, P. V. Freese, A. Machis, and V. C. Behn. Nov. 1, 1952. 58p. (NYO-4517)

This report deals with the development of methods and techniques for measuring the amounts of radioisotope on the stack wall, in ash, stack gas, and atmosphere during and after incineration in the conventional refuse-type destructor. Controlled experiments were conducted with P^{32}, I^{131}, and Sr^{89}. It was found that with P^{32} and Sr^{89} about 90% of the isotope remains in the ash where it may produce a hazard during ash removal and disposal. With I^{131} about 80% of the isotope charged is in the stack discharge; however, it is shown that to reach undesirable atmospheric concentrations, the I^{131} loading would greatly exceed amounts permitted for safety in ash handling.

Knolls Atomic Power Laboratory, Schenectady, New York

318

A REPORT ON THE DEVELOPMENT AND OPERATION OF A PILOT INCINERATOR FOR CONTAMINATED COMBUSTIBLE SOLID WASTES. F. N. Schell. Oct. 1, 1951. Changed from OFFICIAL USE ONLY June 26, 1956. 65p. (KAPL-610)

An incinerator has been developed which will burn the combustible contaminated solid wastes produced at KAPL. The train of equipment includes a furnace, a settling chamber, a Pease-Anthony scrubber, a water-sealed by-pass around the scrubber, a rough filter (glass wool), 2 CWS filters in parallel, and a blower. The capacity of the incinerator is ~40 lb/hr, and, on the basis of a 70% use factor, the total number of lb burned/week would amount to 1200 as compared with the present accumulation rate of 950 lb/week. Ten samples of the exhaust gases taken since the unit has been in operation were found to contain activity in excess of the allowable limits. Only 3 of these samples, however, were greater than twice these limits. An investigation was made to determine the most satisfactory method of preparing the charges of waste material in regard to both handling and burning characteristics. The best results were obtained when the charges were baled and weighed <60 lb.

319

SOLID WASTE DISPOSAL AT THE KNOLLS ATOMIC POWER LABORATORY. R. E. Larson and R. H. Simon. June 15, 1953. 25p. (KAPL-936)

Segregation of high-level from low-level radioactive wastes at KAPL is the basis for handling contaminated solid wastes. This method allows the slightly contaminated wastes which form the great bulk of the material to be handled by inexpensive methods. A comparison of baling and incineration, both of which have been used at KAPL, showed that baling was a simpler operation, had a lower operating cost, and involved a much smaller capital investment. Consequently, baling is used to reduce the volume of the compressible wastes.

Little (Arthur D.) Incorporated, Cambridge, Massachusetts

320

REPORT ON DESIGN FOR VOLUME PRODUCTION OF COMBUSTIBLE RADIOACTIVE WASTES BY INCINERATION. June 30, 1950. 187p. (ALI-C-57867)

A final report is presented which includes design drawings, specifications, heat and material balances, process description, operating information, and cost estimates sufficiently detailed to permit contract negotiations for the construction of a radioactive-waste incinerator. A description is also provided of experimental work carried out on the choice of a scrubbing solution, various methods of dust collection and their efficiencies, and the settling of incinerator ash.

Los Alamos Scientific Laboratory

321

INCINERATOR FOR RADIOACTIVE RESIDUE. W. D. McNeese, W. J. Maraman, and T. E. Chronister. Mar. 1954. Decl. Apr. 1, 1957. 22p. (LA-1691)

A batch-type incinerator has been built which will dry and burn 12 liters of wet, packed rags or the equivalent in other organic matter in 8 hr. The material is ignited and burned in a stream of O_2. Tars in the off-gas are trapped in a water bubbler, residual contaminated particles are caught by a CWS filter, and acid vapors are reacted in a caustic scrubber. The unit was designed to process Pu residues; however, other radioactive materials could be handled by the use of appropriate shielding and manipulators.

Mound Laboratory, Miamisburg, Ohio

322

PILOT PLANT WORK ON SOLID BURNABLE WASTE DISPOSAL FOR MOUND LABORATORY. P. J. Schauer. Nov. 1, 1948. Decl. Apr. 22, 1955. 14p. (MLM-232)

Design, description, and run data for a pilot plant size incinerator using the steam expansion method for removal of contaminants from air of stack gases are given. Drawings are included.

323

DEVELOPMENT OF THE FLOW SHEET FOR INCINERATING CONTAMINATED COMBUSTIBLE WASTE. ENGINEERING RESEARCH FINAL REPORT. M. McEwen, P. J. Schauer, and T. Aponyi. May 15, 1951. Decl. Nov. 14, 1955. 52p. (MLM-567)

An incineration process was developed as a means of reducing the volume of contaminated combustible waste. Standard equipment was incorporated into the recommended design for the incineration process with the main exception of the nozzle system. This system was used to enlarge submicron particles to proportions removable by standard methods. Decontamination without this mechanism would be sufficient for the majority of wastes but because of the ease and economy of operation, it was added as insurance against the penetration of activity when hotter batches are burned. A flowsheet is included for the entire incineration process.

Naval Radiological Defense Laboratory, San Francisco, California

324

POSSIBLE HEALTH HAZARD FROM THE BURNING OF COMBUSTIBLES CONTAMINATED BY RADIOACTIVITY. M. L. Worsham, W. G. Neall and A. F. Owings. June 17, 1949. Decl. Sept. 8, 1955. 13p. (AD-134(H))

A preliminary small scale experiment was performed to estimate the amount of radioactivity which escapes into the air during the burning of contaminated materials. Painted and unpainted wood surfaces contaminated with a mixture of radioisotopes were burned and the resulting air-borne activity collected on filter paper. In determining percentage recovery, however, only the β activity contributed by the daughters of Ce^{144} and Ru^{106} was considered. Greater air-borne loss resulted from burning the unpainted wood, with and upper limit of 50%. The high volatility of RuO_4 was reflected by an increase in the Ru constituent on the filter paper relative to that in the original contamination.

Parsons (Ralph M.) Company, Pasadena, California

325

REPORT OF INVESTIGATIVE STUDIES AND TENTATIVE DESIGN CRITERIA FOR DESTRUCTOR PLANT. T. W. Burtt and W. E. Grebe. Dec. 8, 1949. Decl. with deletions Mar. 4, 1957. 55p. (WASH-4 and Suppl. (Del.))

Details of a proposed "destructor plant" for the disposal of contaminated wastes at Los Alamos are presented. Design criteria, feed flow, engineering features, safety provisions and cost estimates are included. Appended details cover air-decontamination methods and systems.

Ocean Disposal

Division of Reactor Development. Engineering Development Branch, AEC

326

UNITED STATES' SEA DISPOSAL OPERATIONS. A. SUMMARY TO DECEMBER 1956. Arnold B. Joseph. 16p. (WASH-734)

Some atomic energy activities in the United States have been disposing of radioactive wastes at selected ocean disposal sites since early 1946. It is the purpose of this report to describe the extent of these disposal operations including a summary of types of packaging used, and of places where the wastes are dumped. The status of related oceanographic research (1956) is briefly discussed.

Du Pont de Nemours (E. I.) and Company. Savannah River Laboratory, Augusta, Georgia

327

DISPOSAL OF ACTIVE WASTES AT SEA. James E. Evans. Apr. 10, 1952. Decl. Apr. 9, 1954. 14p. (DP-5)

A possible method for disposal of aged radioactive waste-concentrates 100-ft beneath the ocean floor at depths of 15,000 ft is described.

Liquid Wastes

Methods of Treatment

Biological

Brookhaven National Laboratory, Upton, New York

328

ENGINEERING STUDIES OF FILTER BED EFFICIENCY FOR THE TREATMENT OF RADIOACTIVE WASTES. Lee Gemmell. [nd]. 9p. (BNL-1187)

The general layout of the BNL sewage disposal plant is shown. The efficiency of the filter beds in removing some of the most common radioactive isotopes from the laboratory low-level sewage is discussed. The amount of activity coming through the filter beds was calculated, and the radioactive waste distribution was found. About 90% of the total activity adsorbed in the filter beds remains in the top 3 in., 8% in the next 9 in., and 2% in the remaining 5 ft. A number of columns were set up to examine the possibility of the filter beds, or parts of them, becoming saturated and refusing to further hold up certain isotopes at all. For the first 16 dosings (4 days), the column removed about 98% of the activity. For the next 10 dosings (2½ days), the efficiency dropped to about 70% removal. On the 37th dosing, at the end of 9 days, only 20% of the activity was removed. Tests with specific isotopes indicated that the beds would not become saturated so that the efficiency of activity removal would drop below 50%. Over 1000 yr would be required for saturation.

Idaho Operations Office, AEC

329

RADIOACTIVE WASTE REMOVAL IN A TRICKLING FILTER SEWAGE PLANT. A. L. Biladeau. May 1953. 12p. (IDO-24010)

A modified conventional trickling-filter sewage system designed to handle simultaneously both domestic sewage and radioactive laundry wastes is described. In this system radioactive materials in suspension or solution are concentrated by bacteria, thus reducing the activity in the final effluent. Provision is made for measuring the flows and testing the activities at various stages in the system. Controls enable flow rates and other quantities to be varied to ensure optimum operating conditions.

University of Illinois, Urbana. Engineering Experiment Station

330

THE EFFECT OF RADIOACTIVE SUBSTANCE ON SLUDGE DIGESTION. FINAL REPORT. R. H. Harmeson and J. C. Dietz. Jan. 1957. 40p. (AECU-3406)

A study of the effect of various concentrations and combinations of radioactive materials on the anaerobic digestion of sewage sludges at various temperatures was undertaken. Particular emphasis was placed on P^{32}, I^{131}, and S^{35}. The effects of these materials on digestion was measured by quantitative digestion such as: rates, volume, quality

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of gas production, pH, acidity, volatile acids, odor, drying characteristics of sludge, and moisture obtained from drying of sludge. (This report is also available as University of Illinois Engineering Experiment Station Bulletin No. 441.)

Johns Hopkins University,

Baltimore, Maryland

331

ADSORPTION AND ASSIMILATION OF P^{32} BY BACTERIAL SLIMES; FINAL REPORT FOR NOVEMBER 15, 1948 TO NOVEMBER 15, 1949. George W. Reid. March 20, 1950. 16p. (JHUX-4)

Comparisons are given for the removal of P^{32} from bacterial slimes prior to and after metabolic uptake. Formulae are derived to predict the uptake of P^{32} by bacterial slimes, and by metabolic uptake. Figures are shown on the physical features and dimensions associated with slime traps, and total uptake in μμc for each size and type of trap at various contact times.

332

FINAL REPORT ON RETENTION OF I^{131} BY BACTERIAL SLIMES IN DRAINS FOR NOVEMBER 15, 1949, TO NOVEMBER 15, 1950. Albert P. Talboys. Nov. 15, 1950. 39p. (JHUX-5)

A laboratory investigation of the uptake of I^{131} by heterogeneous bacterial slimes often present in waste-drain systems is reported. It is one of a series of studies undertaken by the Sanitary Engineering Department of The Johns Hopkins University to explore contamination of waste-line plumbing in institutions discharging radioisotope-bearing waste. Since I^{131}, as iodide, is not metabolized by the slimes, there is little tendency for concentration of the isotope by the slimes. However, the slimes retain small amounts of I^{131} by the processes of physical adsorption and adsorption of the active waste liquid. Resultant hazards to maintenance workers who may contact the contaminated slimes were computed from the experimental results and found to be of a very low level.

333

CONTAMINATION OF METAL SURFACES BY I^{131} IN SOLUTION; FINAL REPORT; JUNE 1 TO JANUARY 1, 1951. Albert P. Talboys. Apr. 1, 1951. (NYO-1573; JHUX-6)

This report describes the laboratory investigation of the uptake of radioiodine (I^{131}) from solution by metallic materials commonly used in drain systems. Chemisorption of the I^{131} is primarily responsible for contamination of the metals, and the most important factors involved are the type of metal, concentration of I^{131} in solution, time of contact, condition of surface, and pH of solution. Potential hazards resulting from disposal of I^{131} to drains were computed from the experimental results. They indicate that special care should be exercised to avoid contaminating exterior surfaces. However, retention of I^{131} by the interior surfaces of plumbing is not likely to reach hazardous proportions if very strong wastes are sufficiently diluted before disposal and if the active solutions are quickly and thoroughly flushed out of the system.

334

TRICKLING FILTER TREATMENT OF RADIOACTIVE CONTAMINATED LAUNDRY WASTES: FINAL REPORT. Earnest F. Gloyna and John C. Geyer. Dec. 15, 1952. 149p. (NYO-4514; JHUL-3)

The biological oxidation of complex synthetic laundry wastes and the concentration of radioactive isotopes in biological slimes and sludges were studied. Rotary slime tubes, a trickling filter, and agitation flasks were used to study the effects of laundering aids on organisms. The primary biological treatment device developed to treat radioactive laundry waste was a system of rotary tubes in which slimes were grown. These rotary tubes received wastes at the rate of one drop/sec which gave a loading believed to be equivalent to that on a trickling filter 6-ft deep, when operating at a loading rate of 8 million gal/acre/day and receiving a waste similar to that applied to rotary tubes. The major laundry-waste contaminants investigated were citrate, Versene, Igepal, and 7 radioactive isotopes. Citrate was readily utilized by bacteria and yeast, while Versene, in concentrations over 125 ppm, displayed serious slime-destroying properties. Igepal, in concentrations less than 125 ppm, exhibited little effect upon slimes. Organisms, in an agitated batch process where the pH became alkaline because of metabolic processes, attained maximum removals of 99+% for Sr^{89}, 95% for P^{32}, 85% for Ce^{144}, and lesser amounts for Ru^{106}, I^{131} and Cs^{134}. Rotary-tube slimes, supplied with various laundry wastes at a pH of 7.0, detained 45% Ce^{144}, 20% P^{32}, and lesser amounts of the other isotopes. Only P^{32} was released from the cell structure after the cells lost their viability. The primary factors which controlled the removal of radioactivity by microörganisms were pH, viability of organisms, type of isotope, toxicity of the waste, and the ratio of stable to radioactive isotopes.

Los Alamos Scientific Laboratory

335

LABORATORY STUDIES ON THE REMOVAL OF PLUTONIUM FROM LAUNDRY WASTES. John F. Newell, C. W. Christenson, H. L. Krieger, D. W. Moeller, E. R. Mathews, and C. C. Ruchhoft. Jan. 9, 1951. 11p. (AECU-1008)

A comparison of the chemical precipitation process with the trickling-filter process for removing Pu from laundry wastes shows the following: (1) Either process will effectively remove Pu from the wastes. (2) The volume of sludge produced by the chemical process will be of the order of 25 to 30 times the volume produced by the trickling-filter process. This factor is extremely important, since the sludge will contain the Pu, and handling radioactive sludge is hazardous and complicated. On [illegible], the trickling-filter process appears the more attractive. (3) A trickling-filter plant design should provide the following features: (a) A holding tank to allow continuous application of the laundry waste to the filter system at a constant rate. (b) A two-stage trickling-filter system with provisions for varied recirculation ratios. Present data indicate that series operation with a recirculation ratio of 6 to 1 over each filter will effect the desired Pu removal. However, it may be necessary to recirculate at a rate as high as 15 to 1 while placing the filter system into operation. (c) Extremely low rates of application of the raw laundry waste with respect to volume and biochemical oxygen demand (B.O.D.). The data show that desired Pu removal may be effected at an application rate of 0.3 million gal/acre/day with a B.O.D. loading of about 150 lb/acre-ft/day, based upon the primary filter. (d) Facilities for adding supplemental N and P to the laundry waste before it is applied to the primary filter. The N may be added in solution as $(NH_4)_2SO_4$, and the P may be added in solution as Na_3PO_4. The amount of N in the waste should be sufficient to ensure that the final effluent will contain a relatively high concentration of nitrates. (4) The secondary effluent should be filtered to ensure removal of any carried-over suspended matter. Exploratory studies indicate that an ordinary rapid

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sand filter will be effective. The filter backwash shoud be returned to the laundry waste-holding tank.

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ACTIVATED SLUDGE TREATMENT OF A MIXTURE OF RADIOACTIVE LAUNDRY WASTE AND SANITARY SEWAGE. Leo M. Reading, Everett R. Mathews, C. W. Christenson, and J. F. Newell. [1953]. 11p. (AECU-2671)

The activated-sludge process was found to be satisfactory for the treatment of a mixture of 15% radioactive waste from the Los Alamos industrial laundry and 85% settled sewage. Both Pu and organic matter removals were excellent under the experimental conditions employed. The process is described, and experimental results obtained are discussed.

Massachusetts Institute of Technology, Cambridge, Massachusetts. Sedgwick Laboratories of Sanitary Science

337

APPLICATION OF THE DROPPING MERCURY ELECTRODE TO B.O.D. DETERMINATIONS. Arthur W. Busch and Clair N. Sawyer. May 27, 1952. 55p. (NYO-4436)

Results are given on the extensive investigation of the use of the dropping mercury electrode (polarograph) for dissolved O_2 measurements in B.O.D. studies as a possible method of eliminating contamination hazards involved in the Winkler method.

338

EFFECT OF BETA RADIATION UPON BIOCHEMICAL OXIDATION IN POLLUTED WATERS. Rolf T. Skrinde and Clair N. Sawyer. Sept. 30, 1952. 55p. (NYO-4438)

A study of the inhibitory effects of P^{32} upon waste purification by biochemical oxidation in natural and synthetic sewage is reported. Use of a Warburg apparatus for oxidation measurements is described. Results of experiments using full strength substrates indicate that the effect of P^{32} upon oxidation is of a rather erratic nature, being distinctly inhibitory to oxidation in synthetic sewage at concentrations of 60 and 80 mc/l while failing to show this effect in undiluted domestic sewage.

New York University. College of Engineering

339

CALCULATION AND STATISTICAL ANALYSIS OF THE BIOCHEMICAL OXYGEN DEMAND VELOCITY CONSTANT. Werner N. Grune. Nov. 1949. 40p. (NYOO-1501)

Results of the investigation made to determine the effect of incubation bottle size, time of obtaining samples, and day to day variations of samples on the B.O.D. of sewage are presented.

340

BIOCHEMICAL OXYGEN DEMANDS OF RADIOACTIVE SEWAGE. PROGRESS REPORT. Rolf Eliassen, Werner N. Grune and Theodore Jaffe. Mar. 1950. 77p. (NYO-1510)

The reaction rate constant of the B.O.D. of sewages, the dilution water used for this purpose, nitrification, and both first and second stage observations are all compared to the possible effect that radioactivity might have on sewage when discharged as a waste product.

341

EFFECT OF RADIOACTIVITY ON THE BIOCHEMICAL OXIDATION OF DOMESTIC SEWAGE; FINAL REPORT. William E. Dobbins, Gail P. Edwards, Werner N. Grune, and Richard Ehrenreich. Oct. 1951. 84p. (NYO-1567)

This study has been devoted to the effect of P^{32} and I^{131} on the course of the biochemical oxidation of fresh domestic sewage. The results indicate that P^{32} exerts no measurable effect with initial activity levels of 0.1 and 1.0 mc/l but effects a very small reduction in the rate of oxygen utilization at the 10.0 mc/l level. The presence of I^{131} with initial activities of from 0.01 to 10.0 mc/l appears to produce a decrease in the rate of oxygen utilization, which results in a reduction in the total oxygen demand of about 10% by the seventh day.

342

REMOVAL OF RADIOACTIVITY FROM LAUNDRY WASTES BY TRICKLING FILTERS. Final Report. William E. Dobbins, Gail P. Edwards, and Wladimir Gulevich. May 1955. 47p. (NYO-4641)

A radioactive laundry waste containing fission products was treated continuously on single- and two-stage trickling filters. The results indicate that about 90% of the gross activity of mixed fission products can be removed at organic loadings of 250 lb B.O.D./acre ft/day. The percentage removal decreased with increase in loading. Sludge was produced at a rate of about 0.3 lb dry solids/lb B.O.D. removed. The activity level reached by the sludge is shown to be essentially independent of loading rate but dependent on the activity level of the waste. Removals of individual radioisotopes were obtained as follows: Ce, 97.3%; Ru, 79.1%; Sr, 69.4%; Y, 86.7% and Zr-Nb, 79.5%.

University of Texas, Austin. Sanitary Engineering Laboratories

343

OXIDATION PONDS—RADIOACTIVITY UPTAKE AND ALGAE CONCENTRATION. E. W. Steel and E. F. Gloyna. Feb. 28, 1954. 82p. (AECU-2837)

The operation of sewage oxidation ponds, types of algae associated with oxidation ponds, treatment of laboratory wastes, removal of radioactivity through the action of oxidation ponds, and the concentration of algae and other particulate matter by chemical precipitation and vacuum filtration are discussed. The most effective means of separating radioactive-contaminated organisms and associated debris from oxidation pond effluent was found to be filtration of the suspension through a diatomaceous earth cake. The cost of diatomaceous earth was about $0.15/1000 gal of algae-water treated. The filtered effluent was clear, free of color and suspended matter. Chemical precipitation and settling with subsequent filtration of the chemical sludge was expensive and removal was not as effective as vacuum filtration through a diatomaceous earth precoat.

344

OXIDATION PONDS—WASTE TREATMENT STUDIES, RADIOISOTOPE UPTAKE, AND ALGAE CONCENTRATION. Technical Report No. 2. E. F. Gloyna, E. R. Hermann, and W. R. Drynan. June 1, 1955. 98p. (AECU-3113)

As a step toward developing design and operating criteria for oxidation ponds, two pilot plants were constructed and placed in operation. Design data are presented. Numerous wastes and conditions were studied and typical experimental results are reported. Based on the experimental

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results, it is not recommended that oxidation ponds be used as primary radioisotope control and removal devices. However, oxidation ponds can be designed to be one of the most effective ways to concentrate, delay, and possibly remove many of the radioisotopes that may be in waste streams, especially when these isotopes are in concentrations approaching approved tolerance levels. Dilution, radioactive decay, biological and chemical concentration with detention and subsequent dilution, and combinations of these and several other mechanisms are ways in which oxidation ponds may delay the radioactive isotope from reaching a stream.

345

DEVELOPMENT OF DESIGN CRITERIA FOR WASTE STABILIZATION PONDS. Final Report. E. R. Hermann and E. F. Gloyna. March 1, 1957. 169p. (AECU-3481)

Waste stabilization ponds have been used for many years as primary, secondary, and even tertiary sewage treatment devices; however, data for their economical and efficient design and operation have been lacking. The problem of developing rational design criteria for stabilization ponds was attacked on a broad basis; information from prior and contemporary investigators was collected and studied, factors thought to be important in stabilization pond processes were investigated in laboratory models and in outdoor pilot plants, and data reported since 1950 on pond installations at 188 communities throughout the State of Texas were compiled for statistical analysis. From these 3 sources of information along with certain theoretical considerations, empirical relations were formulated for the design and operation of a specific type of waste stabilization pond within a certain range of climatic conditions. The type of stabilization pond finally adopted for study was one in which the algal population density is low and bacterial stabilization of organic waste materials takes place largely under anaerobic conditions, since surface reaeration and photosynthetic oxygenation cannot satisfy the imposed B.O.D. in such systems. Design criteria are summarized.

346

RECOVERY OF URANIUM FROM SALINE SOLUTIONS BY BIOLOGICAL SLIMES. Final Report. B. B. Ewing, W. R. Drynan, and E. F. Gloyna. Oct. 1, 1955. 33p. (ORO-148)

The phenomenon responsible for the removal of U from a liquid and concentration upon biological material is a result of U utilization during metabolism, adsorption on the surface of the cell or absorption into the cell, and precipitation onto the zoogloeal surfaces. It has been found in repeated tests that most of the U uptake effected by the biological sludge occurs within 5 or 10 min of mixing. Violent mixing does not greatly improve uptake. The amount of suspended solids in biological suspensions has been found to influence the removal of U. The initial concentration of U in solution also effects the uptake. Usually the ratio of U recovered to sludge solids was lower for small initial concentrations. The biological activity of the sludge has been found to have an important effect on the concentration of U.

Calcination and Leaching

Aeroprojects, Incorporated,

West Chester, Pennsylvania

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SECTION III. ULTRASONIC LEACHING IN AQUEOUS SOLUTIONS. p.14-8 of APPLICATIONS OF ULTRASONIC ENERGY. PROGRESS REPORT NO. 7 COVERING PERIOD FROM DECEMBER 1, 1957 TO JANUARY 31, 1958. Feb. 1958. 50p. (NYO-7927)

Ultrasonic leaching of Cs bearing Al_2O_3 waste with 0.01$\underline{N}$ HNO_3 indicated a positive ultrasonic effect on rate of leaching in a continuous-flow or fixed-bed array. Undesirable breakup of the calcined waste pellets obtained under certain conditions suggests that non-cavitation leaching should be investigated.

Brookhaven National Laboratory,

Upton, New York

348

DEVELOPMENT OF A WASTE CALCINER. Progress Report on WASTE PROCESSING DEVELOPMENT PROJECT. B. Manowitz and S. Zwickler. Apr. 1957. 11p. (BNL-447)

The work of the Waste Processing Development Project at BNL has led to the development of a piece of equipment capable of substantially reducing the volume of high activity aqueous waste streams. This equipment, known as a "continuous calciner," is a heated-tube auger-agitated concentrator which dehydrates and fuses the various aqueous salt solutions to an anhydrous free-flowing melt on a continuous basis. A pilot plant model of this equipment has been operated successfully with an attendant decontamination factor of ~1000. The corrosion rate of mild steel in neutralized solutions and in the fused salt product was studied. No corrosive effects were detected, which indicated that mild steel is a safe storage container material. An economic evaluation was also made to compare relative costs of processing and storing an acid waste solution in a raw, neutralized, or anhydrous state.

349

SEPARATION OF CESIUM AND STRONTIUM FROM CALCINED METAL OXIDES AS A PROCESS IN DISPOSAL OF HIGH LEVEL WASTES. A. Abriss, J. J. Reilly, and E. J. Tuthill. Apr. 1957. 12p. (BNL-453)

Results are reported from exploratory studies to determine design parameters for a plant for processing Redox Al-type and STR Zr-type wastes for the recovery of Sr^{90} and Ca^{137}. The three types of leaching procedures investigated included a non-continuous agitated system, a continuous non-agitated system, and a continuous system with mixing. Data are presented graphically.

Phillips Petroleum Company.

Atomic Energy Division,

Idaho Falls, Idaho

350

RECOVERY OF FISSION PRODUCTS FROM CALCINED FIRST CYCLE SOLVENT EXTRACTION WASTES. E. S. Grimmett. June 26, 1956. 28p. (IDO-14408; PTR-86)

A study of the fission products present in reactor fuel wastes indicate that at a calcination temperature of 400°C, the long-lived radioactive elements such as Sr^{90}, Cs^{137}, Pm^{147}, and Ce^{144} will remain with the inert calcined portion of the fuel. This study also indicates that if these calcined solid wastes were leached with suitable reagents a rough separation of valuable fission products could be achieved with a minimum of process equipment. For example, if 120-day cooled MTR element first cycle waste is calcined at 400°C, a cold water leach of this material would extract

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a mixture of fission product oxides, which when evaporated to a solid would have a specific γ activity of 20.5 c/g of oxides.

351

CALCINATION OF ALUMINUM-TYPE REACTOR FUEL WASTES IN A FLUIDIZED BED. E. S. Grimmett. Aug. 1, 1957. 18p. (IDO-14416)

The conversion of aqueous Al-type reactor fuel wastes into a free-flowing granular Al_2O_3 solid by means of a fluidized bed calciner, has been studied at the Idaho Chemical Processing Plant. A 6-in. diameter calciner at ICPP has been successfully operated on simulated Al type waste over feed rates varying from 20 to 110 ml/min, over temperatures ranging from 180° to 500°C, and for periods of operation between startup and shutdown of from 8 to 336 hr. The effect of operating variables on the operation of the calciner is discussed. Presented at the American Nuclear Society Meeting held in Pittsburgh, Pennsylvania, June 10–12, 1957.

Electrolysis

Knolls Atomic Power Laboratory, Schenectady, New York

352

ELECTROLYTIC RECYCLE METHOD FOR THE TREATMENT OF RADIOACTIVE NITRIC ACID WASTE. A Status Report at the Termination of the Project at KAPL. H. W. Alter, D. L. Barney, J. K. Davidson, A. C. Schafer, Jr., and F. J. Witt. June 26, 1957. 81p. (KAPL-1721)

A method is described for the treatment of radioactive neutralized HNO_3 waste solutions. The process consists of electrolysis of $NaNO_3$ solutions and recycle of the caustic formed to neutralize incoming HNO_3 waste. Removal of a large fraction of the bulk inert substances by this method allows greater reductions in waste volume than conventional treatment by evaporation alone. Process chemistry studies show that a large fraction of the NO_3^- in alkaline solution can be electrolytically reduced to gaseous nitrogen reduction products at reasonable current efficiencies. Process engineering studies have resulted in the development of a prediction equation for the design of electrolysis cells used in the process. Pilot plant studies using "cold" HNO_3 waste have demonstrated the feasibility of the electrolytic recycle method. A preliminary cost estimate was performed which indicates a cost of from $2.75 to $2.95 per initial gal of waste processed. Basis for this estimate is a conceptual design of a plant capable of handling the high-level waste produced from reprocessing one ton of U metal/day. These costs are considered reasonable in a nuclear power economy, and indications are that ultimate disposal of the concentrated waste in clay may be possible.

Oak Ridge Gaseous Diffusion Plant

353

AN EVALUATION OF SELECTIVE ELECTRODIALYSIS. H. H. Willard and J. J. Finley. Feb. 29, 1956. 22p. (K-1219)

The applications of selective electrodialysis have been demonstrated for the separation of unlike ions, the fractional separation of like ions, the dissolution of difficultly soluble salts, and the control of ionic strength or pH. The usefulness of the electrodialysis technique can be extended by changing ion charges with complexing agents or cathodic reduction and by a choice of solvents, both aqueous and organic. The behavior of Fe, Cr, Mo, W, and U ions has been characterized during selective electrodialysis in a number of common solvents. The behavior of metals in mixed solutions may be predicted from their behavior in simple systems. The limitations in the selectivity of the membranes commonly allow migration of traces of analytically undesired ions. However, the relatively quantitative retention of U during electrodialysis from a bicarbonate catholyte using a cation selective membrane or from a perchloric catholyte using an anion selective membrane may be useful in analytical applications. The Hg cathode may be used with either of these catholytes to remove impurities. Demonstrations were made of gross separation of U from complex mixtures in bicarbonate and mixed acid solutions.

Evaporation and Distillation

Brookhaven National Laboratory, Upton, New York

354

PROGRESS REPORT ON WASTE CONCENTRATION STUDIES. III. DECONTAMINATION EFFICIENCY OF THE FILTRATION PROCESS. B. Manowitz and R. H. Bretton. October 1, 1950. 24p. (BNL-90)

A decontamination factor of at least 10^7 (concentrate to effluent) can be obtained by simple evaporation followed by de-entrainment by means of a fiberglass filter (filtration process). The efficiency of the process is relatively insensitive to observed changes in operating variables. The presence of fine suspended solids that may adsorb activity in the concentrate, be entrained in the vapor, and later impart contamination to the condensate by desorption, is a limiting factor to the decontamination of non-volatile fission products by this process. The following expression is considered to be adequate for a conservative design of a simple submerged coil evaporator with offset condenser, when evaporating a non-volatile fission product solution containing fine suspended solids:

$\text{D.F.} = 42\ G^{0.9}$ (G = 5 to 50) and

$\text{D.F.} = 2.9 \times 10^5\ G^{-1.3}$ (G = 50 up)

where

$$\text{D.F.} = \frac{\text{concentrate activity (stillpot)}}{\text{effluent activity (condensate)}} \text{ and}$$

G = boil-up rate lb/hr/ft^2 of disengaging area

For cases of liquid entrainment only – i.e., no suspended solids present or suspended solids that do not readily adsorb the activities present – the following expression is considered adequate:

$\text{D.F.} = 6.4\ G^{0.78}$ (G = 10 to 30) and

$\text{D.F.} = 3.5 \times 10^{11}\ G^{-3.7}$ (G = 30 up)

where D.F. and G have the same meaning as above.

355

PROGRESS REPORT ON WASTE CONCENTRATION STUDIES. IV. R. V. Horrigan. Jan. 8, 1951. 17p. (BNL-92)

A description is given of the BNL-modified Cleaver-Brooks DVC-8E Compression Distillation Still, with its

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accessories, modifications, and instrumentation. An appendix gives the timetable of delivery, installation, and acceptance tests; typical startup, operating, and shutdown procedures; precautions to be observed when handling radioactive materials; and typical sampling and analytical techniques. This report summarizes all work done on the experimental unit previous to the start of "hot" runs.

356

FINAL REPORT ON EVALUATION OF PROCESS DESIGNS FOR THE BNL WASTE CONCENTRATION PLANT. B. Manowitz, R. V. Horrigan, and H. Fried. May 28, 1951. 18p. (BNL-112).

Five process designs of 600-g/h evaporation units for concentrating dilute radioactive liquid wastes are discussed in reference to their probable engineering feasibility, maintenance problems, ease of operation, and relative costs. Two variations of the Knolls forced-circulation process and 3 variations of the BNL vapor-compression system were studied. For these systems, flow-sheets are presented which include complete heat, material, energy, and activity balances. The single-effect Knolls process and the simplified BNL vapor-compression process, were chosen for detailed cost analysis. Results of the cost analyses are tabulated and arranged for ready cost comparison between the two systems.

357

PROGRESS REPORT ON WASTE CONCENTRATION STUDIES; V. ENGINEERING RESULTS ON THE BNL SEMI-WORKS VAPOR FILTRATION VAPOR COMPRESSION EVAPORATOR. R. V. Horrigan and H. M. Fried. Aug. 15, 1951. 25p. (BNL-121)

The results of all experimental "hot" runs made with the BNL-modified Cleaver-Brooks DVC-8E Vapor Compression Still are discussed. An engineering estimate is given of the feasibility, reliability and operating costs of the vapor compression process applied to the concentration of dilute radioactive liquid waste. A study was made of liquid entrainment released into the vapor from radioactive solutions boiling in a vertical tube evaporator. Fiberglas filter material, a cyclone separator and a vapor dome baffle are evaluated as de-entraining agents. Results on the intermediate concentration of laboratory D waste are given and the proposed method of concentrate storage is described.

358

THE OCCURRENCE AND CONTROL OF RADIOACTIVE ENTRAINMENT IN EVAPORATIVE SYSTEMS. B. Manowitz, R. H. Bretton, and R. V. Horrigan. Oct. 1953. 27p. (BNL-1639)

A study has been made of entrainment generation in a submerged coil evaporator and a vertical-tube natural circulation evaporator. Both evaporators generated about the same amount of entrainment at comparable boil-up rates. The decontamination efficiency of a submerged coil evaporator is correlated to the boil-up rate. The efficiency of a bubble-cap column, a Raschig ring packed tower, and a glass wool-packed tower as de-entrainment devices was studied, the glass wool-packed tower proving to be the most effective.

General Electric Company.

Hanford Atomic Products Operation,

Richland, Washington

359

TREATMENT OF RADIOACTIVE WASTE SOLUTIONS. Charles E. Hirsch. [nd]. Decl. with deletions Jan. 4, 1952. 8p. (AECD-3291)

Hanford waste solutions are not reduced 75% in volume by semibatch evaporation before storage in underground tanks as a sludge of approximately 41.8% dissolved-solids content and 1.38 specific gravity. A schematic flow diagram of the evaporation process is given, and problems of foaming, deentrainment, sludge crystallization, control, etc., are discussed briefly. Average steam consumption is 1.21 lb/1.0 lb of waste-solution condensate. The cost per gal of waste solution treated is $0.05 compared to $0.37/gal for underground waste-solution storage.

360

STATIC CORROSION TESTS OF FABRICATION MATERIAL FOR D-12 WASTE EVAPORATOR. D. F. Shepard. June 25, 1953. Decl. Mar. 4, 1957. 8p. (HW-28491)

Three types of stainless steel (309 SCB, Carpenter 20, 304-L) were exposed to both the liquid and vapor phase of each of three types of solutions. The time of exposure totaled ten days during which the specimens were cleaned and weighed periodically. The three synthetic D-12 waste solutions contained respectively chrome-high chloride, chrome-low chloride and high chloride sans Cr. The solutions were renewed at each weighing. Calculation and tabulation of results indicate the order of acceptance of the 3 metal types tested to be 309-SCB, 304-L, and Carpenter 20. However, in the light of physical handling (welding, etc.), economic and other metallurgical factors this order may be altered.

361

THE RESULTS OF THE D-12 BOIL UP TEST AND RECOMMENDATIONS TO IMPROVE THE PERFORMANCE OF BAYONET TUBE BUNDLES. M. W. Cook. Feb. 7, 1956. 37p. (HW-41295)

Tests performed on the D-12 Redox waste evaporator for evaluation of the bayonet tube bundles as removable expendable heat transfer surfaces are reported. To overcome the difficulty encountered in the production of secondary streams in the condensate, a D-11 condenser was designed and tested.

Knolls Atomic Power Laboratory,

Schenectady, New York

362

CONCENTRATION OF RADIOACTIVE LIQUID WASTE BY EVAPORATION. G. E. McCullough. Sept. 22, 1950. Changed from OFFICIAL USE ONLY June 26, 1956. 43p. (KAPL-391)

This report reviews the progress made since this facility has been in operation, explains how the service building is operated and why it is done this way, and provides a record for reference. In order to segregate and separate Redox wastes and to prepare them for storage and future treatment, five neutralizers have been provided. The neutralizer equipment, duplicated five times in various sizes, consists of a jacketed vessel equipped with an agitor or recirculating pump, a packed column, a condenser, and a receiving tank. The function of this equipment is to remove solvent from Redox waste solution by distillation. The overhead passes through the packed column and is condensed and collected. If the distillate contains the normal solvent used in the Redox Process, it is returned to that process. If there is any other solvent, it may be removed from the system. The material remaining in the neutralizer is adjusted to the proper pH and removed for storage and future treatment. Its concentration may also be adjusted by distillation or addition of water.

363

GAS EVOLUTION IN SLURRIES FROM KAPL EVAPORATOR WASTES. F. C. Steiner. Mar. 17, 1953. Decl. June 23, 1955. 17p. (KAPL-893)

A 55-gal drum containing slurry which was obtained from the evaporation of radioactive liquid wastes exploded shortly after the drum was filled. The explosion was caused by a low pH (between 1 and 2) of the slurry and by the presence of about $1\underline{M}$ carbonate in the slurry which gave rise to the evolution of CO_2. The carbonates are believed to be introduced by the neutralization of waste streams with NaOH which contains Na_2CO_3 and from the absorption of CO_2 by alkaline waste. In this report the method of liquid-waste concentration at KAPL and the causes of the slurry-drum explosion are briefly reviewed.

Massachusetts Institute of Technology, Oak Ridge, Tennessee.

Engineering Practice School

364

TEST OF STEAM JACKETED FALLING FILM EVAPORATOR. G. R. Nelson, T. F. Furlong, and J. B. Robinson. June 28, 1950. 11p. (AECU-3244; KT-76)

The results of a test to obtain operating data on a steam-heated falling-film evaporator for elimination of radioactive condensates are given. The maximum practical steam pressure useable was 25 psig, the maximum flow of feed without flooding was about 0.2 lb/min, and the maximum flow of feed for 10 psig steam pressure was 2 lb/min. Entrainment was encountered in all runs. The highest concentration obtained using 1.7% nitrate solution for feed was 38.4%. The average over-all heat transfer coefficient was found to be 386 ± 77 BTU/(hr)(ft^2).

365

PERFORMANCE OF FALLING-FILM EVAPORATOR IN CONCENTRATING SYNTHETIC WASTE SOLUTIONS. H. C. Harrison, P. J. Hess, and H. T. Tupper. Apr. 8, 1950. 17p. (AECU-3246; KT-77)

The operation of the falling film evaporator is described. These runs demonstrate that the waste solutions from ORNL may be successfully concentrated by the falling film evaporator if satisfactory decontamination can be achieved at higher evaporation rates.

Mound Laboratory, Miamisburg, Ohio

366

ENGINEERING STUDY OF EVAPORATION FOR CONCENTRATING RADIOACTIVE LIQUID WASTES. ENGINEERING RESEARCH FINAL REPORT. R. L. Bates and M. McEwen. Nov. 1, 1950. Decl. with deletions Jan. 20, 1956. 15p. (AECD-4150)

The problem of evaporation of secondary radioactive wastes resulting from waste disposal studies at Mound Laboratory has been studied experimentally to determine the fundamental design characteristics of a plant size unit. Emphasis, of course, was on decontamination, but the factors affecting foaming and scaling also had to be investigated and evaluated. Generally speaking, the final design is a standard type of evaporator, the only unique feature being the relation of the two effects. Where critical, as affecting performance, the particular design features have been specified.

367

DEVELOPMENT OF THE FLOW SHEET FOR THE MOUND LABORATORY LIQUID WASTE EVAPORATION SYSTEM. ENGINEERING RESEARCH FINAL REPORT. G. W. Frink, R. L. Bates, and M. McEwen. Dec. 8, 1950. Changed from OFFICIAL USE ONLY July 30, 1956. 9p. (MLM-532)

The development of a flowsheet for the decontamination of radioactive liquid wastes is described. The entire liquid waste handling system is grouped and discussed under the headings: collection, neutralization, evaporation and condensation, distillate storage, instrumentation, sampling, and shielding. A drawing showing the recommended design of a large liquid waste evaporator is included.

Oak Ridge Gaseous Diffusion Plant

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PILOT PLANT EVAPORATION OF UAP PROCESS WASTES. J. C. Barton and G. J. Vogel. Aug. 29, 1949. Decl. Jan. 6, 1955. 14p. (K-493)

Radioactive, U-free waste from the UAP process has been concentrated by evaporation on a pilot plant scale to a volume equal to about 120% of that occupied by the metal waste processed. This concentrated process waste is a saturated solution at ~20°C. The maximum allowable radioactivity in solutions discharged through normal sewage channels is tentatively set at 100 d/min/ml. Evaporator condensate which met this specification was produced by each of 2 techniques: (1) passage of the condensate from a single-effect evaporator through a cation exchange column and (2) use of a reflux column on a single-effect evaporator.

Oak Ridge National Laboratory

369

DESIGN CALCULATIONS FOR THE WASTE SYSTEM EVAPORATOR REBOILER WL-300, WASTE EVAPORATOR CONDENSER WL-301, AND EJECTOR EXHAUST CONDENSER WL-302. A. F. Arruzza. Oct. 16, 1951. Changed from OFFICIAL USE ONLY Oct. 3, 1956. 31p. (CF-51-10-138)

370

MULTI-STAGE EVAPORATION OF PUREX ACID WASTES. V. J. Reilly. Jan. 4, 1952. Decl. Feb. 14, 1957. 12p. (CF-52-1-22)

This report discusses the over-all decontamination factors obtainable in two or more stages of evaporation where no entrainment separator is used.

371

CONTINUOUS EVAPORATION OF THE PUREX PROCESS ICU STREAM IN THE ORNL PILOT PLANT. A. E. Wible. Feb. 27, 1952. Decl. Feb. 12, 1957. 12p. (CF-52-2-215)

Holdup in the continuous evaporator is given. Control is fully automatic. At 20% excess boil-up the evaporator recovers from sudden purges of feed in a reasonable time. Increasing the boildown required at the same U throughout has no effect on operation. A continuous chart record of product specific gravity at steady conditions showed fluctuations of ±0.01 specific gravity units around a given set point. The equipment is described in detail.

372

RUTHENIUM DISTILLATION IN PUREX ACID WASTE EVAPORATION. J. R. Flanary and V. J. Reilly. July 20, 1953. Decl. Feb. 14, 1957. 8p. (CF-53-7-130)

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Ru has been found to distill to a significant extent from boiling 7N HNO_3. The formation of distillable Ru at this acidity requires an appreciable length of time, but is noticeable in 5 to 10 hr. There is some evidence from this work that Ru distills more readily from dilute acid containing $Fe_2(SO_4)_3$, H_2SO_4, and $NaNO_3$, the non-volatile components of Purex acid wastes.

373

PRECONCENTRATION OF HIGH ACTIVITY ACID WASTE FOR THE OAK RIDGE CHEMICAL PROCESSING PLANT. J. L. Dodson. May 17, 1954. Changed from OFFICIAL USE ONLY Dec. 21, 1956. 6p. (CF-54-5-89)

A preliminary process and cost analysis for the preconcentration of the high activity waste from the Oak Ridge Chemical Processing Plant has been prepared. These data show that it is considerably cheaper to continuously evaporate the raffinate as it comes from the (1A) extraction column rather than evaporate batch wise in waste hold tanks. In addition continuous evaporation appears to be a much more attractive process. On the basis of these data it is recommended that continuous evaporation be used if preconcentration is required.

374

HRT SOLIDS PRODUCTION RATE CONSIDERATIONS IN CHEMICAL FACILITY DESIGN. H. E. Williamson. July 12, 1955. Decl. June 21, 1957. 9p. (CF-55-7-42)

The effects of solids production rate on the design of the chemical facility for the HRT are discussed. It is necessary to know the degree to which solids can be concentrated in the evaporator without limiting operation or rendering a slurry too difficult to handle. Additional decay storage capacity in the chemical process cell seems desirable.

375

STUDY OF HRT-CP WASTE EVAPORATOR, ENTRAINMENT SEPARATOR, CONDENSER AND RELATED PIPING. W. L. Carter, P. S. Lindsey, and G. W. Gray. Nov. 25, 1955. 7p. (CF-55-11-143)

A design check was made to determine the feasibility of making design modifications in the HRT-CP waste evaporator, entrainment separator, condenser, and related piping.

376

HRT WASTE TANK EVAPORATOR SAMPLER. J. E. Kuster and C. A. Burchsted. Oct. 11, 1956. 4p. (CF-56-10-16)

A schematic illustration of the aspirator-type sampler for HRT waste evaporators is given. Methods of preventing UO_2SO_4 freezing in suction lines are discussed.

377

PILOT MODEL EVAPORATOR FOR CONCENTRATION OF RADIO-ACTIVE CHEMICAL WASTES. S. E. Beall. Feb. 7, 1949. Decl. June 13, 1957. 34p. (ORNL-224)

A scale model of the evaporator designed for concentration and decontamination of radiochemical wastes was installed and operated for 2 weeks. Satisfactory operation of the designed system is predicted by the experimental work which indicates: (1) an over-all heat transfer coefficient of 150 to 250 BTU/hr-ft^2-°F, (2) no scaling in acid solutions, (3) evaporation rates greater than the required 12.8 lbs/hr/ft^2 heating surface, (4) decontamination factors $>10^3$ and perhaps as high as 10^5 (exclusive of I_2).

378

DESIGN AND INITIAL OPERATION OF THE RADIOCHEMICAL WASTE EVAPORATOR. E. L. Nicholson. Sept. 22, 1949. Decl. Jan. 6, 1956. 71p. (ORNL-393)

Design data and operating results on several of the first evaporator runs are presented for the radiochemical waste evaporator. The evaporator is designed to evaporate 300 gal/hr of water from a radiochemical waste feed with a minimum concentration factor of 20:1 and a decontamination factor $>10^3$. The evaporator is capable of continued operation under adverse scaling and corrosive conditions. Results from the first runs show that design specifications have been exceeded for concentration factor and decontamination. Foaming has been held to a minimum by adjusting evaporator liquid level and using anti-foam agents.

379

CONTROL OF FOAMING DURING EVAPORATION OF RADIOCHEMICAL WASTES. T. C. Runion. June 27, 1950. Decl. Jan. 6, 1956. 21p. (ORNL-722)

Results of studies on ORNL evaporator feeds indicate that dissolved organic matter is the primary cause of foaming, and not the actual salt concentration. This foam is probably stabilized by the presence of suspended solids (Ca, Al, etc.), since clarified solutions showed decreased foaming properties and antifoam agents were generally more effective. The foam volumes were reduced by factors of 4 to 5 by the use of such commercially available antifoam agents as "Nonisol-300," "Alrowax" and Span-20, in concentrations of about 100 ppm. The first two are vended by the Alrose Chemical Company and the last by the Atlas Powder Company. Oleyl 0-8, sold by M. Michel and Co., and DC-200 (Dow Corning Corp.) were also good anti-foam agents for this sytem but somewhat inferior to the others. A final choice probably should be made solely on the basis of cost.

380

DISTILLATION OF PUREX WASTES. R. G. Mansfield. April 24, 1952. Decl. with deletions Mar. 5, 1957. 18p. (ORNL-1472(Del.))

Experiments on distillation of Purex waste, containing fission products, showed that the activity in the distillate is due principally to volatilized Ru. This can be minimized by keeping the still-pot HNO_3 concentration below 9M.

381

ORNL RADIOCHEMICAL WASTE EVAPORATOR PERFORMANCE EVALUATION, DECEMBER 1949 THROUGH DECEMBER 1950. E. M. Shank. June 26, 1953. Decl. Jan. 6, 1956. 32p. (ORNL-1513)

The evaporator is described briefly, the operating procedure outlined, and the effect of feed composition discussed. A description is given of the instrumentation for condensate activity monitoring and the foam-level indicator. The proposed condensate resin column layout plan is included.

382

WASTE STUDIES. p.53-6 of CHEMICAL DEVELOPMENT OF THE 25-TBP PROCESS. J. R. Flanary, J. H. Goode, A. H. Kibbey, J. T. Roberts, and R. G. Wymer. Apr. 9, 1957. Decl. with deletions Sept. 18, 1957. 72p. (ORNL-1993(Rev.)(Del.))

A discussion of the evaporation of IAW wastes is presented and laboratory corrosion data in the evaporation step using both neutralized and unneutralized simulated IAW wastes with stainless steel are listed.

Phillips Petroleum Company.
Atomic Energy Division,
Idaho Falls, Idaho

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EXPERIENCE OF HANDLING LOW LEVEL ACTIVE LIQ-

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UID WASTES AT THE IDAHO CHEMICAL PROCESSING PLANT. S. F. Fairbourne, D. G. Reid, and B. R. Kramer. June 17, 1955. 61p. (IDO-14334)

Presented are the results of the first 2 yr experience with low-level radioactive waste handling equipment at ICPP. Included are mechanical evaluation, changes made to the equipment, quantity and sources of the various types of wastes handled, costs of processing, and the results of the effects of various process variables on decontamination during evaporation.

384

SEPARATION OF NITRATE AND ALUMINUM FROM RADIOACTIVE CHEMICAL WASTES. John B. Huff. Nov. 1, 1956. 19p. (IDO-14392)

A laboratory process for fractionating Al and NO_3^- from fission products in solution is described. Nitrates are removed by reduction to NO_2^- with C. Excess C absorbs the residues to form a porous sinter. The sinter is chlorinated at elevated temperatures to expel Al as the volatile Cl^-. Burning the C residue from chlorination yields an ash of crude fission product compounds. Some plant design problems are discussed.

Vitro Corporation of America, New York

385

EFFLUENT CONCENTRATION. Report for Period July 18, 1949 – March 7, 1950. Decl. Feb. 25, 1957. 7p. (KLX-1067)

Test runs of an evaporator on waste from Hanford metal recovery process are described.

Fixation

Atomic Energy of Canada Limited. Chalk River Project, Chalk River, Ontario

386

ULTIMATE FISSION PRODUCT DISPOSAL. THE DISPOSAL OF CURIE QUANTITIES OF FISSION PRODUCTS IN SILICEOUS MATERIALS. J. M. White and G. Lahaie. Mar. 1955. 34p. (CRCE-591)

Several proposed methods of permanent disposal are discussed. The fusion of fission products with siliceous materials is one method which might satisfy disposal requirements. Of the siliceous materials investigated nepheline syenite approaches closely the requirements of an ideal glass forming silicate. This silicate can be mixed directly with HNO_3 – fission products wastes to form a solid gel. The gel on drying and heating to about 1225°C forms a glass containing the fission products. The only isotope which is volatile to any extent is Ru. Some commercially produced glasses, glazes, or enamel frits may combine with fission products to form insoluble glasses but the cost will be greater than that of nepheline syenite.

387

DISPOSAL OF HIGHLY ACTIVE SOLUTIONS. 1. FISSION PRODUCT DISPOSAL IN GLASS. R. W. Durham and L. C. Watson. 2. WASTE DISPOSAL INTO THE GROUND. C. A. Mawson. PAPERS PRESENTED AT FOURTH UK-CANADA TECHNICAL CONFERENCE, OCTOBER 17–19, 1955. Oct. 1955. 4p. (UK/C/4/113)

Studies of fission product fixation by incorporation into glass are given. Fusion with feldspar and nepheline syenite is known to be relatively inexpensive, however, the silica gel formed during heating results in a loss of Ru. Pretreatment of the solutions were determined necessary to remove Ru to be followed by a separate disposal. Waste disposal methods into the ground are summarized.

Brookhaven National Laboratory, Upton, New York

388

PREPARATION OF FUSED CLAY RADIATION SOURCES. I. YTTRIUM MACROSPHERES. William S. Ginell and Robert Doering. June 1955. 6p. (BNL-341)

A procedure is described for the fabrication of radiation sources by the incorporation of radioactive isotopes into fused montmorillonite spheres. Specific activities (~0.33 mc/mg) have been obtained using Y^{90}.

389

PREPARATION OF SPHERICAL CLAY PARTICLES CONTAINING RADIOACTIVE IONS. William S. Ginell and George P. Simon. Nov. 1952. 12p. (BNL-1277)

In a study of ultimate disposal of fission products, it was found possible to replace the naturally occurring exchangeable cations in mineral montmorillonite clay by fission-product cations. On thermally altering the mineral structure, the exchange properties were lost to a great extent and the radioactive ions were rigidly bound within the particles of the resulting mineral. The thermal treatment, which results in particles of spherical shape, is described and a drawing of the apparatus used for the production of the clay spheres is included. The use of the isotope-impregnated clay spheres as radiation sources for inert insoluble tracer studies and for medical and biological uses is discussed. It is pointed out that with such sources it is possible to standardize the physical features of the source while varying the half life, the type, the energy, and the specific activity of the radiation. A partial list of elements which would be chemically suitable for incorporation into montmorillonite, and the specific activities and nuclear data on the elements, are included. (NSA 6-2368).

390

ULTIMATE DISPOSAL OF RADIOACTIVE WASTES. L. P. Hatch. Jan. 1953. 20p. (BNL-1345)

A general discussion is given of the problem of storage and disposal of industrial radioactive wastes. The problem is attacked, speculatively, from the standpoint of electrical power, assuming that in the future a certain percentage of the electrical power of the world will be supplied by nuclear reactors. An investigation on the possibilities of using one of the natural clays (montmorillonite) to combine with the radioactive elements is briefly discussed.

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ULTIMATE DISPOSAL OF RADIOACTIVE WASTES. L. P. Hatch, J. J. Martin, and W. S. Ginell. Feb. 1954. 31p. (BNL-1781)

Results are reported from laboratory experiments on the take-up of fission products on montmorillonite clay. Synthetic fission product solutions with tracer amounts of radioactive fission products added were used in the study. It was found that high concentrations of H, Na, or NH_4 ions are detrimental to the take-up of fission products on the clay. Best results were obtained on acidic wastes following acid removal by means of anion exchange, electrolysis, or distillation. Investigations of anionic adsorptive properties are incomplete, however the long-lived activities are generally associated with cations. Advantages of the clay include its capacity and selectivity as a cation exchanger,

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its relatively low cost, its ease of process handling, and its chemical and physical stability before and after heating to high temperature.

392

THE EVALUATION OF MONTMORILLONITE CLAY FOR THE PICKUP AND FIXATION OF M.F.P. ACTIVITY IN THE PRESENCE OF BORIC ACID. George P. Simon. Sept. 27, 1954. Decl. Dec. 5, 1955. 13p. (BNL-2388)

An attempt was made to evaluate the pickup of mixed fission product activity on montmorillonite clay from 0.1$\underline{M}$ H_3BO_3. The average decontamination factor observed for an 8 liter run using a 30 g extruded clay column was 190. This decontamination factor shows no apparent sign of decreasing at the present time. The clay column effluent was further cleaned by using various organic cation and anion exchangers. It has been observed that an over-all process decontamination factor of 0.5×10^4 may be realized with a clay-anion exchanger system.

University of California, Los Angeles.

Atomic Energy Project

393

FIXATION AND EXTRACTABILITY OF FISSION PRODUCTS CONTAMINATING VARIOUS SOILS AND CLAYS: I. Sr^{89}, Sr^{90}, Y^{91}, Ru^{106}, Cs^{137}, and Ce^{144}. Hideo Nishita, Bruce W. Kowalewsky, and Kermit H. Larson. Feb. 23, 1954. 32p. (UCLA-282)

Water-soluble, exchangeable and non-exchangeable forms of long- and medium-lived fission products (Sr^{89}, Sr^{90}, Y^{91}, Ru^{106}, Cs^{137}, and Ce^{144}) contaminating 8 soils and 2 clay minerals were investigated by using chemical and plant uptake methods. With few exceptions, the general relationships between these fission products and soils were: for the water soluble fraction, $Ru^{106} \gg Sr^{89} > Sr^{90} > Y^{91} > Ce^{144} > Cs^{137}$; for the exchangeable fraction, $Sr^{89} > Sr^{90} > Cs^{137} \gg Ru^{106} > Y^{91} > Ce^{144}$; for the non-exchangeable fraction, $Ce^{144} > Y^{91} > Ru^{106} > Cs^{137} > Sr^{90} > Sr^{89}$. Exceptions are discussed on the basis of soil pH, chemical properties of isotopes, and clay mineral type. The order of uptake of these fission products by barley plants was $Sr^{90} > Cs^{137} > Y^{91}$, Ru^{106}, Ce^{144}. A relatively large amount of Sr^{90} was absorbed and translocated to plant tops. The uptake of Y^{91}, Ru^{106}, and Ce^{144} was very small, and in most cases, their translocation to plant tops was insignificant at the 5% probability level. The kind of clay mineral and the kind of adsorbed ion influenced fixation of isotopes. The extractability of Y^{91} and of Ce^{144} followed their respective hydrolysis curves.

Division of Reactor Development, AEC

394

REPORT OF WORKING MEETING ON FIXATION OF RADIOACTIVITY IN STABLE, SOLID MEDIA AT THE JOHNS HOPKINS UNIVERSITY JUNE 19-21, 1957. March 1958. 102p. (TID-7550)

The following papers were presented: Waste Characteristics Governing Fixation in Soils; Chemical Processing of the Alumina Fluid Calciner Product into Alumina Silicates; Fixation of Fission Products in Stable Compounds; Résumé of Ceramic Section of the Oak Ridge National Laboratory; Fixation of Fission Products in Ceramic Glazes; Fission Product Disposal in Glass; Leaching Studies on Fired Clays Containing Radionuclides; Evaluation of Experimental Clinkers; Fixation of Active Wastes in Solid Form Using Natural Soils as Media for Glass Formation; Separation of Cs and Sr from Calcined Metal Oxides as a Process in Disposal of High Level Wastes; Fixation of Radioisotopes on Hanford Type Soils; Tests of Stability; Calcination of Aqueous Reactor Fuel Wastes in a Fluidized Bed; Experiments on Fluidized Bed Calcination of Idaho Chemical Processing Plant Wastes Using Radioactive Feed Material; Preliminary Design of Fluidized Bed Calciner for Idaho Chemical Processing Plant Wastes; Ball Kiln Calcination of Alloy Fuel Element Wastes; Incorporation of Fission Products Into Glass; Ultimate Disposal of Long-Lived Fission Products; High-Temperature Gas Cleaning Problems; Heat Evaluation and Dissipation; Problems Associated with the Formation of Ceramic Clinkers; and Storage of Reactor Fuel Wastes in Salt Formations.

Oak Ridge National Laboratory

395

PACKAGING OF RADIOACTIVE WASTE IN CERAMIC BODIES. Lane Mitchell. Jan. 30, 1956. 24p. (CF-56-1-131)

A preliminary investigation was made of the adsorption and absorption of radioisotopes by porous ceramic slugs. Procedures for the tests are outlined, and results are summarized.

396

CERAMIC ASPECTS OF WASTE DISPOSAL AND SELF FUSION EXPERIMENTS. p.98-104 of METALLURGY DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING OCTOBER 10, 1955. June 14, 1956. Decl. Apr. 26, 1957. 104p. (ORNL-2078(Del.))

Experiments are reported on the fixation of radioisotopes in various ceramic bodies. Experiments show that a mixture of Na_2CO_3 and limestone with shale is more effective in retaining radioisotopes than a mixture of limestone and shale alone. Of all the isotopes tested, the radioactive Cs-Ba mixture appears to be the most difficult to fix in a ceramic body. The degree of fixation required will depend to a large extent on the storage conditions. The amount of fixation is dependent upon the temperature used to fire bodies.

Phillips Petroleum Company.

Atomic Energy Division,

Idaho Falls, Idaho

397

EVALUATION OF WASTE DISPOSAL BY ELECTRODEIONIZATION AND CLAY ABSORPTION. W. H. Burgus and E. S. Grimmett. Oct. 20, 1954. Decl. with deletions Mar. 11, 1957. 14p. (IDO-14367(Del.))

An evaluation has been made of the Brookhaven -ICPP waste handling process consisting of electrodeionization to reduce Al content followed by adsorption of the fission products on clay. The limited state of technical knowledge prevents drawing firm conclusions; however, if preliminary laboratory studies are borne out, the process may offer means of separating Al from fission products and concentrating the latter (except Ru) in a small volume suitable for permanent storage. A preliminary estimate indicates an order-of-magnitude cost of $2.69/gal for treating ICPP wastes of the current type, excluding cost of permanent storage of clay concentrate and alumina. The dilution of wastes, indicated as necessary for the electrodeionization step, contributes to the high cost. A tentative process

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flowsheet is outlined on the basis of available information. Questions requiring laboratory and pilot plant resolution are indicated. The status of development suggests that effort be concentrated on obtaining necessary basic data to determine if the process can be economic.

United Kingdom Atomic Energy Authority.
Research Group.
Atomic Energy Research Establishment, Harwell, Berks, England

398

FIXATION OF ACTIVITY IN SOLID FORM BY ABSORPTION ON SOILS. PART I. FIRING AND LEACHING TESTS. C. B. Amphlett and D. T. Warren. June 1956. 11p. (AERE-C/R-1686; FPSD/P-15).

The absorption of radioactivity from waste solutions on soils, followed by firing at high temperatures, has been studied as an alternative to fixation processes involving clay minerals. Fixation on soil is as efficient as on clay. Two types of process have been investigated, one based on ion exchange, and one in which the soil is used as a base for manufacture of a ceramic product by mixing with the waste and firing. Both types of operation give high decontamination factors under suitable conditions, but the second enables a higher loading to be achieved and is applicable to a much wider variety of wastes. The engineering problems associated with large-scale operation are simpler in the first case, although there is no doubt that the second system can also be scaled up if desired.

399

THE TEMPERATURE DISTRIBUTION IN A HEATED CLAY BLOCK AND ITS APPLICATION TO THE PROBLEM OF FISSION PRODUCT DISPOSAL. C. B. Amphlett and D. T. Warren. Feb. 1956. 9p. (AERE-C/R-1861; FPSD/P-11).

The heating produced in a large volume of clay by a highly-active fission-product source at its center has been simulated by means of a furnace placed in the center of a large block of clay. Temperature-distribution curves are given, and the significance of the results in relation to the self-fixation of fission products by radioactive heating is indicated. A general account is also given of the effects produced on heating natural clays to high temperatures.

400

THE POSSIBILITY OF SELF-FIXATION OF HIGHLY ACTIVE WASTES. C. B. Amphlett. Feb. 1956. 8p. (AERE-C/R-1862; FPSD/P-12)

This report summarizes the uses of siliceous minerals to absorb activity either by ion exchange or by firing to produce mixed silicates. It is concluded that ion-exchange methods are best suited to fairly pure active materials in solution, but that the alternative process offers promise for absorption and fixation in solid form of bulk highly active wastes containing large proportions of inactive contaminants and of acid. It may also be applicable to solid wastes and suspensions.

401

FIXATION OF ACTIVITY IN SOLID FORM BY ABSORPTION ON SOILS. PART 2. FINAL REPORT. A. B. Amphlett and D. T. Warren. Apr. 1957. 11p. (AERE-C/R-2202; FPSD/P-22)

By incorporating radioactive solutions into mixtures of waste solutions and soil, glasses are formed on heating to temperatures of ~1000°C. Leaching tests show that these are highly resistant to water and would be suitable for disposal of highly-active wastes. Only Ru volatilizes appreciably during the firing process, and its loss may be kept to a minimum by suitable control of the processing, as it is easily trapped, and could be returned to the process if required. The results of this work are compared with those of other studies on solid fixation.

402

GRANULAR CLAY FOR ION EXCHANGE USE IN EFFLUENT DISPOSAL. J. R. Grover. Apr. 1957. 5p. (AERE-CE/M-200)

The results of studies for the disposal of long lived fission products in AERE silica bonded clay in regard to the breakthrough capacity, ultimate capacity and friability is presented.

403

FIXATION OF HIGHLY ACTIVE WASTES IN SOLID FORM. C. B. Amphlett. Sept. 25, 1956. 17p. (UK/C/5/19)

Radioactive species in waste solutions may be fixed by mixing with suitable siliceous materials (e.g. soils, clays, or natural silicate minerals) and firing to high temperatures to produce a ceramic which suffers very little leaching by water or aqueous solutions. Fluxes may be added if required to lower the temperature of melting, without adversely affecting the fixation of activity. Apart from the case of Ru under certain conditions, the loss of activity during the firing process is negligibly small. The method is more versatile than one based on ion exchange, and allows slurries and solids to be treated as well as solutions. Comparison is made between these 2 alternative processes regarding remote operation on a highly active scale, and the development work necessary to scale up the ceramic process is outlined briefly.

Vitro Corporation of America, New York

404

DISPOSAL OF RADIOACTIVE WASTES IN CEMENT. JOB 24-A. June 18, 1952. Decl. Dec. 5, 1955. 15p. (KLX-1377)

Based on the laboratory and pilot plant operations, the recommended procedure for the disposal of aqueous radioactive solutions in cement is as follows: A 55-gal drum is placed on a drum roller and is charged with ~25 gal of alkalized radioactive liquid waste. To this solution four 95 lb bags of Portland cement are added. The drum is then closed and rolled at 3 rpm for about 15 minutes with periodic venting to a hood to prevent excessive pressure build-up. The drum is removed from the roller and allowed to stand until the cement mixture has set, which usually takes place in about 4 hr.

Westinghouse Electric Corporation.
Bettis Plant, Pittsburgh

405

EVALUATION OF MONTMORILLONITE CLAY FOR USE IN DECONTAMINATION OF PWR RADIOACTIVE WASTE LIQUORS. R. Ehrenreich. Feb. 14, 1957. 11p. (WAPD-PWR-CP-2164)

The results of treating a solution of soluble long-lived mixed fission products indicate that montmorillonite clay has a specificity for Cs and Ce.

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REFERENCES

Ion Exchange

Harvard University,
Cambridge, Massachusetts.
Harvard College

406

INVESTIGATION OF ION-EXCHANGE MATERIALS. J. Carrell Morris. Oct. 1954. 48p. For Chemical Corps Medical Labs., Army Chemical Center. (MLCR-43)

Results are reported from an investigation of the use of ion-exchange materials in the treatment of water supplies for the removal of toxic or hazardous substances. Cation exchange resins proved ineffectual for removal of amine or ammonium-type contaminants from water. Substantial amounts of exchange were obtained between anion exchange resins and organic arsenate and phosphate-type materials. The strongly basic anion exchange resins were found to be most effective for the removal of organic arsonates or phosphonates. Results indicate that anion selectivity is much more dependent on specific molecular structure than is cation selectivity.

Knolls Atomic Power Laboratory,
Schenectady, New York

407

RADIOACTIVE WASTE DISPOSAL. John A. Ayres. December 7, 1949. Decl. Jan. 31, 1950. 14p. (AECD-2802)

Two procedures have been described for treatment of laboratory liquid wastes containing radioactivity. The first procedure is based on a two column anion and cation exchange system while the second employs only a simple cation exchange column. Experimental evidence has been obtained to show: (1) A high deceontamination factor may be obtained, using synthetic solutions which represent laboratory conditions; (2) A high concentration factor may be obtained making possible the compacting of the wastes into small volumes; and (3) The presence of ordinary contaminants such as oils, solvents, and precipitates do not have a great deleterious effect on resin capacity.

Los Alamos Scientific Laboratory

408

TREATMENT OF WASTES CONTAINING RADIOACTIVE BARIUM, LANTHANUM, STRONTIUM, AND YTTRIUM. J. P. Hutchinson, E. H. Rex, E. R. Mathews, and C. W. Christenson. 1956. 15p. (AECU-3359)

Isotopic components of one of the wastes of a major operating unit of Los Alamos are described and tabled as to half-life and maximum permissible concentration in water. After storage, Sr^{90}, because of its long half-life and very low maximum permissible concentration in H_2O, is the critical component. These conditions indicated the necessity for supplementary treatment for removal of Sr^{90} before final discharge of the waste. Several methods of Sr^{90} treatment before discharge are considered. These are by phosphate coagulation, by lime softening, and by ion exchange materials either alone or in conjunction with chemical precipitation. The ion exchange method, although showing removals of nearly 100% before exhaustion of the resin bed, demonstrated that the quantity of solution which could be decontaminated was controlled by the quality of raw waste and the depth of the resin column and was, within limits, independent of rate of flow through the column. Experimentation with various combinations and types of ion exchange resins demonstrated that a cation resin, in the acid cycle, would provide an effluent of satisfactory quality in low level wastes, however, the volume and quality of wastes to be treated precluded replacement of resin on exhaustion as economically impractical. Results of a typical regeneration study are presented in tabular form.

Oak Ridge National Laboratory

409

REMOVAL OF RADIOACTIVE CONTAMINANTS FROM WATER BY ION EXCHANGE SLURRY. William J. Lacy and Don C. Lindsten. Jan. 25, 1955. 16p. (CF-55-1-200)

The removal of radioactive contamination from H_2O by ion exchange materials is determined by the total dissolved salt content of the water, ionic or colloidal state of the contaminant, type of ion exchange material, chemical valence of contaminant, and other factors. Tests indicated that under certain conditions the ion exchange batch slurry treatment decontaminates radioactively contaminated H_2O to a level suitable for emergency drinking purposes within 15 min.

410

PRELIMINARY LABORATORY EVALUATION OF AN ELECTRO-DIALYTIC METHOD FOR THE TREATMENT OF RADIOACTIVE WATERS. M. S. Seal and D. A. Pecsok. May 18, 1955. 20p. (CF-55-5-171)

An electrodialytic method using permselective ion exchange membranes is described which has been used on a laboratory scale for the decontamination of radioactive wastes and for the concentration of radioelements contained in low-level radioactive waters at Oak Ridge National Laboratory. The application of this method for decontamination purposes is of interest in the treatment of low-level radioactive wastes or in the treatment of drinking water supplies which have been rendered unsafe through radioactive contamination. The use of the method for concentrating contaminants contained in a solution is of particular importance where radiochemical analyses of low-level wastes are required. The laboratory studies described are of preliminary nature. In view of the versatility of the method for the concentration of any ionic constituents in water, these preliminary findings may be of interest in solving other water treatment problems.

411

PROPOSED DEVELOPMENT PROGRAM FOR TREATMENT OF RADIOACTIVE WASTES FROM MERCHANT SHIP REACTORS. I. R. Higgins and W. J. Neill. Mar. 19, 1958. 6p. (CF-58-3-67)

A proposed development program is made for the treatment and disposal of radioactive wastes from Merchant Ship Reactors. Both ion exchange resin and filters are to be used for coolant system cleanup. The development program is concerned with methods of handling and packaging of the spent resin, filter cake, and rare gases for safe disposal.

412

SEPARATION OF FISSION PRODUCTS FROM ALUMINUM WASTE SOLUTIONS BY ION EXCHANGE. Period covered: September 1947–September 1948. R. E. Blanco, I. R. Higgins, and A. H. Kibbey. Aug. 14, 1956. 52p. (ORNL-301(Rev.))

A process utilizing a scavenging precipitation and ion exchange has been developed for the separation of fission

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products from Al waste solutions. The behavior of individual fission products in the Al-resin system was studied. Gross β and γ decontamination factors of 10^3 with an Al yield of 97 to 99% are obtained. Decontamination factors for Cs and Sr were 10^3 to 10^4, respectively.

413

PRODUCTION SEPARATIONS OF FISSION-PRODUCT GROUPS FOR THE RADIOISOTOPE PROGRAM. P. O. Schallert. July 28, 1952. Decl. July 27, 1955. 19p. (ORNL-1144)

A general description is given of 5 yr experience in routine production of fission products of high concentration and high activity levels for the radioisotope program. Details of construction and production processes are given for two systems which were built on ion-exchange principles.

414

DIBAN — ION EXCHANGE WASTE DISPOSAL SCHEME. PART I. I. R. Higgins and R. G. Wymer. Nov. 28, 1955. 20p. (ORNL-1984)

A scheme, based on experimental work, is proposed for decontaminating radioactive wastes that contain $Al(NO_3)_3$ and HNO_3 as their primary constituents. Ninety per cent of the Nb and >95% of the Ru and Zr are removed by a $Fe(OH)_3-MNO_2$ scavenging precipitation. The $Al(NO_3)_3$ is converted to dibasic $Al(NO_3)_3$ by destructive distillation, and dissolved by a 12 hr digestion at 160°C. The Sr, Ce, and rare earths are removed by cation exchange in a continuous contractor. The decontamination waste can be volume-reduced to about 6<u>M</u> Al before disposal and then stored cheaply. The fission products can be eluted from the column, concentrated into a small volume of highly radioactive waste, and stored with all necessary precautions.

United Kingdom Atomic Energy Authority.

Research Group.

Atomic Energy Research Establishment, Harwell, Berks, England

415

THE UPTAKE OF FISSION PRODUCTS BY NUNEHAM COURTENAY LOWER GREENSAND. PART I. CESIUM AND STRONTIUM. C. B. Amphlett and L. A. McDonald. Sept. 16, 1955. 27p. (AERE-C/R-1708)

A summary is given of the way in which soils can decontaminate radioactive solutions, and in particular the mechanism of ion-exchange by clay minerals present in soil. Results are given of ion-exchange between Cs^{++} or Sr^{++} solutions and a Lower Greensand soil possessing good exchange properties. The exchange isotherm for the mixed system $Cs^{++} + Sr^{++}$ has also been obtained, and is compared with isotherms obtained by other workers on pure montmorillonite. Relevant thermodynamic data have been calculated for this system by standard methods.

Vitro Corporation of America, New York

416

STUDIES ON THE DECONTAMINATION OF WASTE SOLUTIONS BY ION EXCHANGE METHODS. W. A. Bain. June 3, 1949. Decl. Dec. 5, 1955. 20p. (M-4497)

It has been established in basin water decontamination studies that the fission products Cs, Ce, Sr, and Y can be removed almost quantitatively from simulated basin water solutions in which they are originally present in concentrations of 10^{-6} ppm by means of ion exchange. A column run on these activities indicated that 13.4 ft^3 of IR-120 H resin could decontaminate one 250,000 gal basin from 10,000 c/m/ml to <10 c/m/ml at a flow rate of 2 gal/ft^3/min. When Ru and Zr are present a second column containing IR-120 Na is placed in series. Under best conditions found to date 50 ft^3 of resin in the second column are required to decontaminate a 250,000 gal basin with the effluent in the range of 15 - 25 c/m/ml.

417

PROJECT SUMMARY. DECONTAMINATION OF DILUTE LOW ACTIVITY WASTES (24-A3). Job 24-A. July 5, 1952. Decl. Mar. 12, 1957. 74p. Contract AT(30-1)-850. (KLX-1372)

This investigation lead to the successful design and operation of an ion exchange resin pilot plant in which 50,000 gal of simulated still over heads, containing 500 c/m/ml (~10 ppm total solids) of Purex waste, were processed per ft^3 of resin at 40 gal/hr with a final effluent activity of ~10^{-6} μc/ml. Provision was made for the disposal of the loaded resin as a monolith or for elution and disposal of the eluate as a monolith with re-use of the adsorbent.

418

INTERIM SUMMARY DEVELOPMENT OF LABORATORY WASTE DISPOSAL UNIT (24-A4); JOB 24; PERIOD SEPTEMBER 1, 1950 - MARCH 1, 1952. June 6, 1952. 51p. (KLX-1374)

A laboratory scale unit has been developed to adsorb and concentrate dilute low activity solutions with ion exchange resins. The unit permits safe and efficient disposal of radioisotopes from such solutions.

419

PROJECT SUMMARY DECONTAMINATION OF UO_2SO_4 SOLUTIONS (57-C). JOB 57. July 31, 1953. Decl. April 11, 1957. 41p. (KLX-1617)

Studies have been made on ion exchange resin decontamination of U from spent homogeneous reactor UO_2SO_4 fuels, on carrier precipitation to supplement the resin decontamination, and on inorganic adsorbent removal of fission product rare earth ions from short-cooled $UO_2SO_4-D_2O$ fuel solution. Total fission product separation factors obtained in the ion exchange resin and carrier precipitation studies (before the major emphasis was placed on rare earth removal) are reported. The capacity of a number of inorganic agents for removal of rare earths from U in UO_2SO_4 solution is described together with their solubilities in the solution. The agents having the best combination of rare earth capacity, low U removal and minor effects on other ions are: CaF_2 at 100°C or less and garnet (calcium iron silicate) at 250°C.

Westinghouse Electric Corporation.

Bettis Plant, Pittsburgh

420

CRUD ABSORPTION BY ION EXCHANGE RESINS. G. P. Simon and W. J. Singley. May 1956. 13p. Contract AT-11-1-Gen-14. (WAPD-SFR-PD-105)

The results of investigations to determine effects of crud absorption on demineralizer life are presented herewith. The tests consisted of contacting known amounts of ion exchange resin; with hydrogen form cation, hydroxyl form anion, or mixed bed hydrogen-hydroxyl; with known amounts of synthetic crud for periods up to 10 weeks. On the basis of results from these tests, it was concluded that no serious problem exists as a result of crud absorption by mixed bed

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resins. Resin capacity losses for crud concentrations encountered to date in mixed bed resins would be $< 5\%$ of the total capacity. Since design life calculations for demineralizer are probably inaccurate by at least 5 to 10%, it is recommended that no allowances, for crud absorption, be made in the demineralizer size unless crud concentrations in excess of 5g per 100 ml of cation resin are expected to be found in the ion exchange resin bed.

421

REMOVAL OF CARRIER-FREE RADIOISOTOPES FROM PURE WATER BY MIXED-BED ION EXCHANGE COLUMNS; APPLICATION TO PWR WASTE DISPOSAL SYSTEM. W. T. Lindsay and C. S. Abrams. 35p. (WAPD-PWR-CP-2126)

It has been demonstrated that the magnitude of the decontamination factors obtainable on processing high-resistivity solutions of carrier-free isotopes, representative of the alkali metal, alkaline earth, rare earth, Ru, Rh, Zr, and Nb fission products in the PWR primary coolant, are at least as great as required by the PWR Waste Disposal System design. The volume of high-resistivity water, containing the above mentioned representative isotopes at levels equivalent to or greater than the expected maximum steady-state levels of the corresponding fission products in the PWR coolant after 24 hr decay, which can be processed by the PWR waste disposal ion exchangers before activity break-through is such that resin consumption would be negligible. It is even possible the normal resin deterioration and mold growth would govern the resin replacement rate. Hold-up of discharged coolant prior to or subsequent to ion exchange for a period of over 24 hr is unnecessary for the isotopes studied. Process rates through the ion exchanger could be raised to the equivalent of 7.5 $g/m/ft^2$ (23.5 g/m total flow rate) without sacrifice of resin performance for removal of the isotopes.

Lime Soda Softening Process

Massachusetts Institute of Technology, Cambridge, Massachusetts. Sedgwick Laboratories of Sanitary Science

422

A STUDY OF THE LIME-SODA SOFTENING PROCESS AS A METHOD FOR DECONTAMINATING RADIOACTIVE WATERS. Robert F. McCauley, Robert A. Lauderdale, and Rolf Eliassen. Sept. 1, 1953. 94p. (NYO-4439)

A study was made of the capacity of the lime-soda softening process for removing radioisotopes from water. The mechanism by which Sr was coprecipitated with $CaCO_3$ in lime-soda softening was determined to be one of mixed crystal formation. This study was made by use of the principles of physical and crystal chemistry and by x-ray diffraction. These methods showed that this mixed crystal coprecipitation was characterized by: (a) Increased removal of the coprecipitated Sr was noted with an increasing removal of the Ca which it replaced in mixed crystal formation; (b) Uniformity of Sr^{+2} removal was observed with varying concentrations of stable Sr; and (c) A straight line variation occurred in one of the lattice constants of the precipitated calcite crystals with increasing concentrations of Sr in the treated waters. A method of repeated precipitation was studied in connection with the removal of radioactive Sr with lime-soda softening. By use of this process it was possible to reduce Sr activity from 200 c/sec or higher to near background.

Oak Ridge National Laboratory

423

PROCESS WASTE WATER TREATMENT PLANT. Preliminary Report. Feb. 1957. 52p. (AECU-3370)

A proposal is presented for the construction, at a cost of \$180,000, of a plant to treat the low level radioactive liquid waste from the various laboratory processes. The proposed plant will reduce the radiation activity of that waste to a level that will not exceed the accepted standards for discharges into White Oak Creek and the Clinch River.

Precipitation, Co-precipitation, and Scavenging

Argonne National Laboratory, Lemont, Illinois

424

WASTE DISPOSAL. Problem Assignment No. 223-X6AS. Final Report for Period July 1, 1944 to Sept. 15, 1944. Nov. 17, 1944. Decl. Feb. 2, 1956. 22p. (CN-2049)

The programs on decontamination of nonmetal wastes; waste neutralization with 50% NaOH; Al precipitation in the coating removal waste; stability of metal waste at elevated temperatures; and settling characteristics of Hanford wastes have been completed and results are summarized.

General Electric Company. Hanford Atomic Products Operation, Richland, Washington

425

THE REMOVAL OF CESIUM AND STRONTIUM FROM RADIOACTIVE WASTE SOLUTIONS. W. W. Schulz and T. R. McKensie. Nov. 29, 1955. 13p. (HW-40180)

Metal ferro- and ferricyanides are the most efficient Cs scavengers known at the present time. These compounds are extremely efficient in removing radiocesium from aqueous wastes of widely different gross salt composition. The ease of handling ferrocyanide precipitates and their small cost are attractive features for large scale waste treatment or fission product recovery operations. Ferrocyanides cannot be applied to the removal of Cs from highly alkaline wastes since they are ineffective at pH's > 10. Solid adsorbents, particularly montmorillonite type clays, have shown some promise as agents for removing Cs from highly alkaline solutions. However, to date, no agent has been found that will remove Cs from these wastes with the efficiency that ferro- and ferricyanides exhibit at pH's below 10. Radiostrontium can be removed from alkaline wastes with a wide variety of compounds. Since many wastes contain metal ions whose hydroxides and phosphates are insoluble, merely neutralizing these wastes effects considerable Sr decontamination. Additional Sr decontamination can be obtained with the further precipitation of insoluble phosphates. In particular, Ca and Sr phosphates are very effective scavengers for radiostrontium. (This report appears in TID-7517 Part I.)

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REFERENCES

Knolls Atomic Power Laboratory, Schenectady, New York

426

MEETING OF THE AEC WASTE PROCESSING COMMITTEE ON JUNE 26–28, 1950. PART II. COPRECIPITATION AS A METHOD OF WASTE DISPOSAL. J. A. Ayres, ed. Apr. 25, 1951. Changed from OFFICIAL USE ONLY Sept. 9, 1957. 35p. (KAPL-364(Pt. II))

Radioactive waste disposal following processing by coprecipitation methods was discussed. The exploratory program on carrier precipitation at KAPL is discussed in detail. Other topics discussed include the removal of Pu from laboratory wastes; phosphate flocculation for the decontamination of dilute liquid waste; laboratory coagulation experiments for the removal of activity; and biological methods such as the activated sludge process and trickling filter methods for the treatment of radioactive wastes.

Los Alamos Scientific Laboratory

427

THE REMOVAL OF PLUTONIUM FROM LABORATORY WASTES. C. W. Christenson, M. B. Ettinger, Gordon G. Robeck, E. R. Hermann, K. C. Kohr, and J. F. Newell. Aug. 20, 1951. 16p. (AECU-836)

A study of the removal of Pu from laboratory wastes was undertaken in order to secure information upon which to base pilot plant design. The methods investigated have included: (1) co-precipitation with Fe, Al and other metal ions, (2) adsorption by various agents such as activated carbon, "Celite," kaolin, etc., and (3) removal by living biological floc (activated sludges). The activated sludge process indicated a need for a three-stage counter-current plant with the addition of organic food sources ahead of each stage in order to reduce the Pu content of the effluent to the desired level. All the adsorption agents studied removed Pu with a fairly high degree of efficiency, with activated carbon being the most efficient. Effective adsorption was found to require a protracted period of contact. In order to secure the desired Pu removal without creating a new problem in the form of a large amount of contaminated adsorption agent, split treatment with long periods of mechanical agitation was indicated as being required. In the absence of substantial amounts of organic complexing agents, the coprecipitation treatment appeared to be the simplest, cheapest and most efficient. Because its efficiency was less subject to variation at different pH values, Fe floc was deemed to be preferable to an alum floc. The amount of Fe required for the treatment was quite nominal, 10 ppm of $FeCl_3$ with sufficient lime added to bring the pH above 7 being adequate to produce the desired Pu removal.

Massachusetts Institute of Technology, Cambridge, Massachusetts.

Sedgwick Laboratories of Sanitary Science

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THE REMOVAL OF RADIOACTIVE ANIONS BY WATER TREATMENT. Warren J. Kaufman, John B. Nesbitt, Morton I. Goldman, and Rolf Eliassen. Sept. 20, 1951. 143p. (NYO-1571)

The effectiveness of conventional water-treatment processes in the removal of minute quantities of anionic radioisotopic contaminants has been considered, with detailed studies limited to the removal characteristics of P^{32} as the orthophosphate and I^{131} as the iodide. Possible future sources of radioactive contamination are considered. The mechanism of incorporating small quantities of orthophosphate into the hydrous oxide precipitates formed from alum and $Fe_2(SO_4)_3$ and the influence of various normal constituents of surface water on the removal of phosphate by coagulation has been investigated. The removal of phosphate and iodide from 3 typical synthetic U. S. waters was carried out in coagulation-jar and pilot-plant experiments. The important elements of a rapid sand filtration plant were found to be the reaction and coagulation units. The direct adsorptive capacity of clean filter sand was found to be negligible.

429

THE REMOVAL OF RADIOACTIVE STRONTIUM FROM WATER BY PHOSPHATE COAGULATION. John B. Nesbitt, Warren J. Kaufman, Robert F. McCauley and Rolf Eliassen. Feb. 15, 1952. 128p. (NYO-4435)

In a study of methods for the decontamination of public water supplies containing radioactive cationic contaminants, the removal characteristics of Sr^{90} were investigated. Previous work on the removal of radioactive substances from water is reviewed. The fundamental mechanisms of the phosphate coagulation process in the removal of cationic contaminants from water and the basic concepts of colloidal chemistry relating to absorption, coprecipitation, and flocculation are summarized. Experimental data are presented on the removal of Sr^{90} by phosphate coagulation and the removal of excess phosphate from phosphate-process effluent. Data are included from pilot-plant studies on the effect of rapid sand filtration in the removal of Sr from the phosphate-process effluent and the mechanisms by which removal is accomplished. It was concluded that a phosphate coagulation process is effective in the removal of Sr at a pH near 10.2 with excess phosphate, but that with the excessive phosphate doses required, the process is not economically feasible at the present time.

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A STUDY OF THE REMOVAL OF RADIOACTIVE PARTICULATE MATTER FROM WATER BY COAGULATION. Nathan C. Burbank, Jr., Robert A. Lauderdale, and Rolf Eliassen. Sept. 1, 1955. 116p. (NYO-4440)

Three investigations were made to determine the common methods of coagulation used in water treatment to remove radioactive particulate matter and the fundamental mechanism of the process. These investigations were as follows: (1) The character of radioactive particulate matter in rainout was determined as to size, distribution, and elemental composition. (2) The particulate removal efficiency of alum, chlorinated copperas, and lime-soda ash softening was determined for waters typical of the Midwest and Southwest areas of the United States and of alum and chlorinated copperas for water typical of New England and the Far Northwest. (3) The mechanism by which particulate matter was removed by coagulation utilized the principles of physical and crystal chemistry and x-ray diffraction. These methods showed:

(a) Radioactive particulate matter, when suspended in water, demonstrates a preferential adsorption of anions upon its surface. The electrical activity of the particle is determined by the ions adsorbed. (b) The removal by coagulation with either alum or chlorinated copperas occurs through the action of the particles serving as nuclei for the formation of hydrous oxide floc. The presence of an adsorbed layer of sulfate ions on the radioactive particles increases the production of nuclei and improves removal

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efficiency. These anions are acquired by the microcrystalline floc in the process. (c) The removal by softening with lime-soda ash is accomplished by the precipitation of calcite and/or brucite in chains and aggregates about a particle. The attachment is similar to that of the hydrous oxide flocs and the crystal is attached at the corner or edge of a face, the active surface of crystal growth.

Mound Laboratory, Miamisburg, Ohio

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DECONTAMINATION OF LIQUID WASTES BY IRON SULFIDE, IRON HYDROXIDE, AND CALCIUM PHOSPHATE PRECIPITATIONS. (FINAL REPORT). C. S. Lowe, L. L. Bentz, J. R. Heiks, F. C. Mead, Jr., E. L. Murphy, E. Orban, F. Reichel, C. E. Shoemaker, and T. C. Tesdahl. Dec. 28, 1953. Decl. with deletions May 21, 1954. 21p. (AECD-3632; MLM-662(rev.))

Chemical precipitation methods for the decontamination of radioactive wastes have been studied at Mound Laboratory, and a highly successful process based on the adsorption and/or coprecipitation of fission products by FeS, $Fe(OH)_2$, and $Ca_3(PO_4)_2$ precipitates has been developed. This process has been demonstrated to successfully decontaminate a variety of wastes and to show special promise in decontaminating those of high level activity and high salt content. Decontamination factors of the order of 5×10^2 are obtained for one FeS, $Fe(OH)_2$-Ca_3PO_4 cycle, with a decontamination of 10^5 for a 3-cycle process. Extremely high volume reductions are realized by filtering, with volume reductions of 10 to 1 expected by settling. Laboratory work on several different types of wastes has been completed.

432

RESEARCH ON REACTOR WASTE DISPOSAL. Information Report. C. S. Lowe, M. McEwen, F. C. Mead, Jr., and E. Orban. Dec. 15, 1950. Decl. with deletions Jan. 10, 1956. 29p. (AECD-4066)

Laboratory work on second decontamination cycle wastes centered around FeS precipitation, $Fe_2Fe(CN)_6$ precipitation, and preformed adsorbent methods. The best results were obtained with FeS as a precipitant in conjunction with an adsorbent. It was possible to take the freshest second decontamination cycle waste solution available and to remove all the activity countable by treating first with activated C in the presence of H_2S and then precipitating FeS three times under the same conditions. Equally good results were obtained by passing the same original solution through an activated C column and subsequently through an activated alumina column impregnated with ferrous Fe. $Fe_2Fe(CN)_6$ precipitation method has removed as much as 97.9% of the activity. This treatment may have application where process time and storage capacity are of little concern, such as in a cascade system. On a continuous basis of processing second cycle crib wastes, a possible method exists in a treatment consisting of silica gel adsorption, activated alumina adsorption, metallic Fe scrub, $Fe_2Fe(CN)_6$ precipitation, neutralization, and filtration. The burial volume of concentrate from such a method is very low compared to the original waste volume, and expensive process solution storage is not required in the processing operations. The activity level in the final supernatants could be maintained below 300 cm/ml. Decontamination of "fresh" first cycle wastes is best accomplished by repeated scavenging with FeS. Where column operation proves desirable, passage through silica gel will remove better than 99% of the gross activity, thus permitting further processing to be accomplished with relatively little shielding. Repeated use of the silica gel appears possible by stripping with oxalic acid. FeS scavenging of wastes has given decontamination factors of the order of 60, leaving residual activity of 5×10^5 cm/ml. A significant amount of this residual activity is carried by a precipitation of $Fe(OH)_2$. Additional activity is removed with MnO_2 yielding an over-all decontamination factor of 1×10^4.

433

REACTOR WASTE PROCESSING COST ANALYSIS. Information Report. M. McEwen. Mar. 5, 1952. Decl. Mar. 9, 1957. 15p. (MLM-672)

Results are reported from a study of comparative costs of evaporation vs. coprecipitation methods (FeS process) for the concentration of liquid reactor wastes prior to burial. The costs shown for plant-scale operation of the coprecipitation method are based on laboratory studies. Data indicate the FeS process competes economically with evaporation when the percent of dissolved solids in the feed reaches the 1 to 3% value, and the economic advantage of the coprecipitation method becomes very pronounced in processing high-solid-content wastes.

434

PILOT PLANT STUDIES OF THE FERROUS SULFIDE PROCESS FOR THE DECONTAMINATION OF PUREX-TYPE REACTOR WASTES. (FINAL REPORT). T. Aponyi, W. Recher, P. J. Schauer, T. C. Tesdahl, J. Tullis, and J. Woeste. Apr. 17, 1953. Decl. March 1, 1957. 47p. (MLM-835)

The FeS, $Fe(OH)_2$-$Ca_3(PO_4)_2$ method for decontaminating high-salt-content reactor wastes was studied on a pilot-plant scale using as a feed a typical (Purex) reactor waste. Results obtained in the pilot plant duplicated to a large degree those obtained in laboratory tests. Waste streams with an activity level in the order of 5×10^6 c/m/ml (α plus β) were processed, and an over-all decontamination factor of 2.7×10^2 was realized. Precipitates were separated from liquids by settling processes. Total volume reduction of liquids to solids was 15.5 to 1. Modifications in the process promise to yield a decontamination factor of 4×10^4 and a volume reduction >30 to 1.

435

THE USE OF SEQUENTIAL FACTORIAL DESIGNS IN THE ESTABLISHMENT OF OPTIMUM CONDITIONS FOR A DECONTAMINATION PROCESS. M. K. Barnett, P. M. Hamilton, and F. C. Mead, Jr. Jan. 11, 1954. 24p. (MLM-921)

The advantages of factorial design are first illustrated by a simple experiment devoted to the effect of two pH factors and an Fe concentration factor on the efficiency of a decontamination process employing FeS as a scavenging agent. The broadening of the base of an investigation by the expansion of a factorial is illustrated by addition of the sulfide concentration as a factor. Finally, the principle of expanded factorials is further utilized in the later phases of the study in which additional levels are assigned to the pH factors in order to arrive at a closer estimate of the optimum conditions for the process.

Naval Radiological Defense Laboratory, San Francisco, California

436

DIATOMITE FILTER, TEST TO DETERMINE FEASIBILITY OF USE IN REMOVING Y^{91} FROM FRESH WATER. M. M. Bigger and A. J. Hodges, Jr. July 24, 1950. Decl. July 16, 1953. 11p. (AD-229(OE))

The test indicates that flocculation may be expected to remove Y^{91} or similar fission products from fresh water with a factor of ~100. Diatomite filtration was less effective, with a factor of ~ 8. Subject test was conducted with minimum flow rate and pump discharge pressure. In addition the test was made with an obsolete model. A later model filter might give slightly better results. The later models require no judgement on the part of the operator as to the mixture and rate of feed of the filter aid slurry. The mixture and rate of feed selected for subject test may not have been the best for the purpose. While significant decontamination was achieved it should be noted that the effluent contamination of 2.52 d/sec/ml is 682 times the tolerance of 10^{-7} μc/ml for drinking water.

Oak Ridge National Laboratory

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PROPOSAL FOR "25" OR THOREX WASTE DISPOSAL: SELECTIVE RECOVERY OF FISSION PRODUCTS IN RELATION TO THE LONG-RANGE ASPECTS OF CHEMICAL WASTE ECONOMICS. A. T. Gresky and R. P. Wischow. Nov. 17, 1955. 13p. (CF-55-11-97)

Laboratory data and a preliminary flowsheet for partial recovery of fission products from Thorex and/or "25" process waste streams are presented for evaluation. The flowsheet permits significant separation and concentration of fission products and would provide suitable source materials for a radioisotopes separation plant. Residual wastes from this process will be significantly improved with respect to biological hazards and may thus be more susceptible to economic permanent disposal.

438

THE ALKALINE METHOD FOR TREATMENT OF HIGH RADIATION LEVEL ALUMINUM WASTES. I. R. Higgins. Jan. 17, 1957. 7p. (CF-57-1-139)

The method is based on caustic precipitation and centrifugation (which removes the Cs and small amounts of Sr, rare earths, Zr, Nb, and Ru). These are removed in the supernatant and run through a cation exchange column. This separates Zr-Nb and Ru. The effluent is precipitated and the Zr-Nb is stored in an asphalt pit. The Ru then may be recovered from the precipitate. The precipitate from the original centrifugation is calcined, pressed and transported to a deep well.

439

STUDIES ON THE REMOVAL OF RADIOISOTOPES FROM LIQUID WASTES BY COAGULATION. Robert A. Lauderdale, Jr. Jan. 23, 1951. Changed from OFFICIAL USE ONLY Oct. 23, 1956. 30p. (ORNL-932)

Work completed to date on the removal of radioisotopes from water using a $Ca_3(PO_4)_2$ floc as a carrier is reported. It has been found possible to remove from solution essentially all the Ce, Y, Zn, Nb, and Zr by phosphate precipitation. Approximately 10% of the W, 67% of the Sb, and 95% of the Sr were removed by the phosphate treatment. Efficiencies of removal >99% have been obtained with a mixture of fission products by using clay in conjunction with the phosphate, followed by sand filtration. The efficiency of the process when used with a mixture of radioactive isotopes will depend on the composition of the mixture. The greatest concentrations of activity in the floc were obtained under conditions of high pH and with an excess of phosphate.

440

LABORATORY STUDIES ON THE GROUND DISPOSAL OF ORNL INTERMEDIATE-LEVEL LIQUID RADIOACTIVE WASTES. Richard L. Blanchard, Bernd Kahn, and Gordon C. Robeck. Apr. 11, 1958. 34p. (ORNL-2475)

Radioactive waste and ground water solutions were passed through columns of indigenous Conasauga shale to determine the sorptive behavior of the radionuclides. Cs^{137}, the major radioactive constituent of the basic waste solution, was adsorbed very effectively with a shale solution distribution ratio of 500. A small fraction of Ru^{106}, the only other radionuclide present in relatively large concentration, was adsorbed per unit weight of shale, but this adsorption occurred even when the radionuclide had previously passed through 200 ft of shale. The Ru and the small amounts of Co^{60} and Sb^{125} present were removed by coprecipitation with PbO_2 after the addition of NaClO. By combining coprecipitation with adsorption on shale columns, it was possible to obtain decontamination factors of 2×10^3 for gross β, 3×10^3 for gross γ, 4×10^4 for Cs, and 2×10^2 for Ru. Because of these decontamination factors, the PbO_2 precipitation combined with the hydroxide precipitation now in use, followed by passage of the supernatant solution through a shale column, is recommended. In addition, this alternative to seepage pit disposal would provide a more positive control of the usual environmental problems of external radiation and biological uptake.

United Kingdom Atomic Energy Authority. Research Group.

Atomic Energy Research Establishment, Harwell, Berks, England

441

THE SORPTION OF FISSION PRODUCT MIXTURES IN RELATION TO EFFLUENT DISPOSAL. G. B. Cook and J. Wilkinson. Dec. 1948. Decl. Apr. 2, 1957. 14p. (AERE-C/R-340)

Possible methods for the disposal of radioactive β-active effluent are considered, and the previous work on the absorption of fission-product mixtures in aqueous solution is reviewed. A method is developed for the sorption of >99% of the fission products from dilute acid solution on a mixture of soil and $BaSO_4$ for the treatment of laboratory effluent. It is proposed that the secondary Pu plant solutions be treated with ferric or $Al(OH)_3$ which adsorb 96% of the fission products from alkaline solutions.

442

THE REMOVAL OF FISSION PRODUCTS FROM SOLUTION WITH A PRECIPITATOR-COLUMN TREATMENT. PART I. LABORATORY TRIALS. K. G. Seedhouse, J. Monahan, and G. Wallis. 1958. 36p. (AERE-ES/R-2220)

A synthetic effluent was treated in a Sludge Blanket Precipitator with 80 ppm PO_4, 40 ppm Fe^{3+}, at a pH of 11.5, being then passed through soil columns to achieve further activity removal. The decontamination in the Precipitator was 95 to 96%, the remaining activity consisting of 40% Ru and 60% Cs. All the Cs, and most of the Ru was removed in the columns, resulting in over 99% over-all removal of all the radioactivity. By employing long columns or columns in series, a decontamination factor of 10^3 can be achieved. Serious defects were observed with Nuneham Courtenay Greensand. These can partly be remedied by conditioning with polyelectrolytes, quaternary ammonium compounds, and silicones. Vermiculite is to be tested as an alternative column adsorbent, its properties appearing to be ideal. Tests which are being made on the use of two precipitators, the second one employing a ferrous sulfide 'blanket' to remove Ru, are giving very promising results.

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Methods of Disposal

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Academy of Natural Sciences of Philadelphia

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SAVANNAH RIVER BIOLOGICAL SURVEY, JUNE 1951 – MAY 1952. FINAL REPORT FOR E. I. DU PONT DE NEMOURS AND COMPANY, SAVANNAH RIVER PLANT. Feb. 1953. 330p. (AECU-2600)

This survey indicated that the Savannah River is biologically typical of coastal plain streams of the southeastern United States. The river system receives relatively little pollution except from the cities of Augusta and Savannah and their associated industries. All the survey stations would be classified as "healthy," since there was a normal diversity of aquatic species representing a well-balanced biodynamic cycle at each. The biological productivity in terms of total specimens present is relatively low as a result of such natural factors as high silt lead, shifting river bed, high summer water temperature, and a limited number of suitable habitats. At the present time very little commercial or recreational fishing is carried on in the region studied.

Dounreay Works, Caithness, Scotland

444

FACTORS AFFECTING THE DISTANCE OF THE DISCHARGE POINT FROM THE SHORE IN THE SEA DISPOSAL OF EFFLUENT. A. E. Shaw. Feb. 1957. 11p. (IGR-TN/D-443)

The most important single items are, that a suitable depth of water is chosen, and that the effluent density be kept as different from the sea as is possible. Secondly, the maximum use of the wind as a mixing agent should be made, which in practice means that the prevailing wind shall, if possible, be offshore and that an exposed outfall area is chosen. Residual currents and possible concentrating processes will have to be separately assessed at each prospected site.

General Electric Company. Hanford Atomic Products Operation, Richland, Washington

445

COLUMBIA RIVER TRAVEL TIME MEASUREMENTS BY FLOAT METHODS. J. K. Soldat. Jan. 4, 1956. 18p. (HW-41275)

The travel time of the Columbia River between the most upstream reactor effluent discharge point and the Pasco and Kennewick city water plant intakes was measured by float methods. The main object of the studies was to measure the minimum travel time over the course at various river flow rates, but maximum and mean travel times were also obtained. A graph of travel time versus river flow rate was constructed for river flows in the range of 0.9×10^5 to 3.6×10^5 ft^3/sec. Minimum travel times from the most upstream reactor effluent water discharge point to the Pasco-Kennewick area were 22.4 hr at 0.9×10^5 ft^3/sec and 11.2 hr at 3.6×10^5 ft^3/sec. In a few of the tests, measurements of the travel time to points intermediate to Pasco were made and graphs of the results of these tests were constructed to indicate travel time versus distance downstream from the most upstream reactor. Reasonable agreement was obtained when comparisons were made between results of the float measurements and results of studies by the U. S. Corps of Engineers and results of the comprehensive river surveys conducted by J. F. Honstead prior to impoundment of the river by McNary Dam.

446

THE TURBULENT DIFFUSION OF RIVER CONTAMINANTS. H. T. Norton. Mar. 25, 1957. 13p. (HW-49195)

Both a theoretical and an empirical approach were pursued toward defining the turbulent diffusion process encountered in the Columbia River. The merits and limitations of each approach are discussed. Although no solution was obtained for the differential equation encountered in the theoretical development, its derivation is included for the benefit of those interested in further study of this or a similar problem. The empirical approach is completely outlined and gives an adequate fit to the available data. However, it cannot be extended to conditions not defined by the data without additional experimental work which is outlined.

Knolls Atomic Power Laboratory, Schenectady, New York

447

ELIMINATION OF SECOND STAGE HOLD-UP OF LABORATORY LIQUID WASTE TO THE MOHAWK RIVER. W. H. Truran. Aug. 1956. 7p. (KAPL-M-WHT-1)

Certain KAPL liquid wastes, formerly subjected to evaporation, have for the period of June 1955 through June 1956, been released to the Mohawk River. The release procedure has involved 2 stage hold up and analysis followed by dilution with sanitary sewer effluent and storm water flows within the KAPL site. A review of operating procedures and experience suggests eliminating the second stage hold up and sampling. No loss of control over amounts of radioactivity or toxic chemicals in sewer effluent would result. Reduction in operating and maintenance expense would be significant

Mine Safety Appliances Company, MSA Research Corporation, Callery, Pennsylvania

448

SIMULATION OF CONTAINER VENTING UNDER SEA WATER. Technical Report No. 59. M. J. McGoff and S. J. Rodgers. Dec. 31, 1957. 22p. (NP-6541)

The underwater release of radioactive contaminants from a reactor compartment was simulated by ejecting contaminated steam and air from an open end 2 in. pipe submerged in 10 ft of synthetic sea water. Two runs were conducted with Na^{24} and Rb^{86} representing a water soluble contaminant, and I^{131} representing a water soluble or a volatile contaminant, depending upon the oxidation state of the I_2. These runs indicated the efficiency of sea water in removing airborne and steamborne radioactive contaminants. The 10 ft column of sea water removed about 95% of the total contaminant activity escaping from the vapor container. The

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removal distribution among the components was ~100% of Rb^{86}, 96% of Y^{90} and 86% of I^{131}, thus indicating least removal of the volatile contaminant.

North Carolina State College, Raleigh.

School of Engineering

449

SEWERAGE SYSTEM FOR THE LABORATORIES. PAGE 4–5 OF FURTHER DESIGN FEATURES OF THE NUCLEAR REACTOR AT NORTH CAROLINA STATE COLLEGE. Clifford Beck, A. C. Menius, Jr., et al. Jan. 1952. 82p. (AECU-1986; NCSC-46)

The sewerage system for the laboratories in the Reactor Building is described in detail. This system employs separation of long and short-lived fission products, retention in holdup or catch tanks, a unique radiation-level warning system, and ultimate regulated disposal into the city sewer system.

Oak Ridge National Laboratory

450

WATER ACTIVITY COMPUTATIONS. T. H. J. Burnett. Jan. 14, 1958. Changed from OFFICIAL USE ONLY Oct. 3, 1956. 4p. (CF-48-1-175)

The method used in calculating the activity released to the Clinch River from Oak Ridge installations is presented and discussed.

451

RADIOACTIVE FISSION PRODUCT CONTAMINATION IN THE MUD OF WHITE OAK DRAINAGE SYSTEM. J. S. Cheka and K. Z. Morgan. Mar. 20, 1947. Changed from OFFICIAL USE ONLY Aug. 10, 1956. 24p. (MonH-258)

The White Oak Creek drainage basin is used for the disposal of radioactive wastes. The water is purified to a large extent by the precipitation and adsorption on clay and organic material of many of the radioactive isotopes. Deposition of activity has varied with changes in plant processes. During the years when Pu separation was the chief process, deposition ratio between the marsh at the upper end of the basin and the mouth of the White Oak Creek differed by a factor of about 10^4, the marsh having values up to 0.4 $\mu c/g$ of surface mud. Later when Ba separation was the chief process, values at the marsh dropped to less than half of the previous values, but the deposition ratio differed by a factor of <1000 between the above mentioned points. A later assay of total curie content in the basin showed about 70 curies still being retained by the mud. This figure is 13% of the estimated total activity released into the basin between the beginning of operations and the time of the survey. Chemical analyses indicate that the distribution of isotopes also changed; Ba, Sr, and Cs totals being <1% increasing to about 50%, Zr and Nb totals, meanwhile, dropping from about 75 to about 2%.

452

HEALTH PHYSICS DIVISION. STUDIES OF THE WHITE OAK CREEK DRAINAGE SYSTEM. I. DRAINAGE AREA OF THE CREEK AND CAPACITY OF WHITE OAK LAKE. L. R. Setter and O. W. Kochtitzky. Jan. 30, 1950. Changed from OFFICIAL USE ONLY Dec. 21, 1956. (ORNL-562)

The White Oak Creek Drainage System is described as the last step in treatment and control of radioactive wastes from the ORNL before discharge into the Clinch River and Watts Bar Reservoir. Wastes, diluted with runoff from 6 sq miles of drainage area, are impounded in a lake having a capacity (at the top of the coffer-dam) of 1.5×10^7 ft^3. While the pool level is ordinarily maintained at such an elevation as to leave approximately half of the capacity available for storing accidental spills or flash runoff, experience (September 29, 1944) has shown that intense rainfall may in 26 hr produce sufficient runoff to finish filling the lake and then displace the entire volume almost 3 times. Waste discharge to White Oak Creek and the amount of radioactivity contained in the water of the lake may be reduced or controlled by waste treatment or storage with regulated release. An increase in the storage capacity of the lake would serve to minimize the flushing out of material already present in the lake in the form of sediment. The amount of increase possible would depend on engineering studies of the feasibility and cost of structures necessary to provide it.

453

HEALTH PHYSICS DIVISION WASTE DISPOSAL RESEARCH SECTION. STUDIES OF WHITE OAK CREEK DRAINAGE SYSTEM. II. DETERMINATION OF DISCHARGE AT WHITE OAK DAM. L. R. Setter and O. W. Kochtitzky. July 11, 1950. Changed from OFFICIAL USE ONLY Dec. 21, 1956. (ORNL-582)

Discharge rates are calculated for White Oak Dam with lake level at various elevations and with various openings of the upper gate. Tables, curves and description of the dam are given, as well as sampling procedures.

Oak Ridge Operations Office,

Isotopes Division, AEC

454

INTERIM RECOMMENDATIONS FOR THE DISPOSAL OF RADIOACTIVE WASTES BY OFF-COMMISSION USERS; ISOTOPES DIVISION CIRCULAR B-6. [nd]. 10p. (IDB-6)

Basic considerations on disposal by dilution and dispersion, and by confinement and control are covered. The recommended procedure for disposal of I^{131}, P^{32}, and C^{14} is given and consideration of means for disposing any type of radioisotope is presented.

United Kingdom Atomic Energy Authority.

Industrial Group H.Q.,

Risley, Lancs, England

455

THE DISPOSAL OF RADIOACTIVE WASTE TO THE SEA DURING 1956 BY THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY. H. J. Dunster. Jan. 1958. 4p. (IGS-R/R-2)

The United Nations Scientific Committee on the Effects of Atomic Radiation recently asked to be supplied with information about the disposal of radioactivity into the sea. They considered that releases into coastal waters would not be significant unless they exceeded 1,000 curies/yr. In the United Kingdom, only the Atomic Energy Authority discharges wastes approaching this activity, and they do so only from one establishment, Windscale Works, Sellafield, Cumberland. The Works contains reactors, chemical plants, and laboratories which are concerned both with plant control and with the technology of nuclear power, and the wastes therefore contain primarily fission products and nuclear fuels such as U and Pu. This report gives in tabulated form the radioactive wastes discharged to the sea by the above works. The results of marine monitoring off Windscale Works for 1956 are included.

456

A SUMMARY OF THE BIOLOGICAL INVESTIGATIONS OF THE DISCHARGES OF AQUEOUS RADIOACTIVE WASTE TO THE SEA FROM WINDSCALE WORKS, SELLAFIELD, CUMBERLAND. H. J. Dunster and F. R. Farmer. Jan. 1958. 14p. (IGS-R/R-3)

For about 5 yr, experimental discharges of radioactivity have been made from the United Kingdom Atomic Energy Authority's Windscale Works, Sellafield, to the coastal water off Cumberland. Samples of fish, seaweed, sea bed and shore sand have regularly been taken and their activity assessed. This report summarizes the results of that program and concludes that the maximum permissible discharge rate is not <15,000 c/month of total β activity. Specific limitations are necessary for Sr^{90}, Pu, and Ru^{106}.

Porous Formations and Salt Domes

National Research Council.

Committee on Waste Disposal

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THE DISPOSAL OF RADIOACTIVE WASTE ON LAND. Publication No. 519. Sept. 1957. 145p. (NP-6503)

The Committee with the cooperation of the Johns Hopkins University organized a conference at Princeton in September 1955. After the Princeton Conference, members of the committee inspected disposal installations and made individual studies. Two years' consideration of the disposal problems leads to certain general conclusions. Wastes may be disposed of safely at many sites in the United States, but, conversely, there are many large areas in which it is unlikely that disposal sites can be found, for example, the Atlantic Seaboard. The research to ascertain feasibility of disposal has for the most part not yet been done. Disposal in cavities mined in salt beds and salt domes is suggested as the possibility promising the most practical immediate solution of the problem. Disposal could be greatly simplified if the waste could be converted to a solid form of relatively insoluble character. In the future the injection of large volumes of dilute liquid waste into porous rock strata at depths in excess of 5,000 feet may become feasible but means of rendering the waste solutions compatible with the mineral and fluid components of the rock must first be developed. The main difficulties to the injection method recognized at present are to prevent clogging of pore space as the solutions are pumped into the rock and the prediction or control of the rate and direction of movement.

Oak Ridge National Laboratory

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DISPOSAL OF NUCLEAR POWER REACTOR WASTES BY INJECTION INTO DEEP WELLS. Preliminary Report. D. A. Pecsok. July 1954. 24p. (CF-54-10-64)

Experience in the deep well disposal of various chemical wastes has demonstrated certain inherent advantages of this mode of disposal, namely; the comparative low cost of installation, maintenance, and operation and the elimination of the waste from surface waters. To ensure the feasibility of this disposal method for a particular waste, experience in the chemical industry has indicated that the geological area under question must be properly surveyed and found satisfactory and that the chemical compatibility of the waste and underground media must be aptly demonstrated. One of the inherent disadvantages of the method is the loss of contact with the waste material, and, consequently, the possibility of contamination of some underground strata of value to mankind. As to the feasibility of disposing of nuclear power reactor wastes into deep wells, geographical locations must be sought which provide sufficient physical capacity for containment of the waste and which ensure the prevention of health hazard resulting from migration of radioactive materials from the disposal site. Geological and ground water conditions appear most suitable for such disposal areas in the central states, bound by the Applachian Mountains on the east and the great plains region on the west.

United Kingdom Atomic Energy Authority.

Research Group.

Atomic Energy Research Establishment,

Harwell, Berks, England

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THE COOLING OF UNDERGROUND FISSION WASTES. J. K. Perring. Nov. 9, 1953. Decl. Jan. 10, 1956. 12p. (AERE-C/R-1294)

A method suggested for the disposal of waste fission products involves their adsorption in clay and burial in deep bore-holes. Approximate calculations are given by which the temperature of the clay at any time can be found. The results are so arranged that answers can easily be obtained for any mixture of the more common fission products.

Surface

Atomic Energy of Canada Limited.

Chalk River Project,

Chalk River, Ontario

460

THE CHALK RIVER LIQUID DISPOSAL AREA, 1956. I. L. Ophel and C. D. Fraser. June 1957. 42p. (CRHP-709)

Five surface pits in the Chalk River liquid disposal area have been used since December 1952 for the disposal of wastes containing fission products. The liquid disposal area is situated on elevated ground with low-lying swampy areas to the east and south. Since November 1955, the surface water of these swamps has been contaminated by the seepage of water containing several radioisotopes. Investigations show that 3 of the 5 disposal pits are contributing to this surface contamination. The streams and a lake receiving the drainage from these swamps also show low levels of contamination. Examination of the contaminated area shows Sr^{90} to be the most important of the radioisotopes present. The amounts of Sr^{90} present in the stream draining the area are not sufficient to raise the stream water to the drinking water tolerance concentration. Present levels of Sr^{90} in the plants and animals of the area do not constitute a hazard to man, and contamination is entirely confined to the Chalk River exclusion area.

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REFERENCES

University of California, Livermore. Radiation Laboratory

461

COMMENTS ON THE BURIAL OF RADIOACTIVE WASTES IN SOIL. Roy Overstreet. p.81-5 of A CONFERENCE ON RADIOACTIVE ISOTOPES IN AGRICULTURE HELD AT MICHIGAN STATE UNIVERSITY ON JANUARY 12, 13, and 14, 1956. Jan. 1956. 420p. (TID-7512)

This paper delineates the precautions necessary for the safe disposal of radioactive elements in the soil. Two sets of recommendations are outlined: one pertaining to relatively short lived isotopes (half lives of 180 days or less) and the other dealing with the burial of long-lived isotopes.

General Electric Company. Hanford Atomic Products Operation, Richland, Washington

462

NEUTRALIZATION OF ACIDIC DISTILLATES WITH LIMESTONE. H. L. Brandt and R. E. Burns. Dec. 27, 1950. Changed from OFFICIAL USE ONLY Feb. 20, 1956. 7p. (HW-19852)

Laboratory investigations are presented for the suitability of some commercially available limestones for neutralization of slightly acidic waste distillates. Observations were made of flow rates, solution acidities, and temperatures.

463

NATURAL TRITIUM AS A TRACER FOR UNDERGROUND WATER MOVEMENT—A FEASIBILITY REPORT. H. G. Rieck. Nov. 2, 1953. 13p. (HW-30262)

A study was undertaken to determine the feasibility of using tritium present in contemporary water as a tracer to establish the extent of ground water penetration by surface-disposed liquid wastes and to determine, if possible, the rate of underground water movement. Presumably it may prove possible to determine the "age" of water and thereby detect contemporary water in the presence of ground water. Cost, probability of success, preliminary equipment design, and safety of operation must be considered. For the purpose of detecting natural tritium in ground waters, it will be necessary to fabricate an electrolysis apparatus for electrolytic enrichment of the water sample and to develop equipment and technique for low background hydrogen counting. The cost of electrolysis and counting equipment including installation is estimated at $4500. The operating costs are estimated at $33.00 per sample, including labor, electrical power and miscellaneous cost. The time required for processing is about 8 days per sample. Proposed installation of electrolysis apparatus would be in 222-U with due consideration to space and power availability. Safety restrictions would possibly require installation of the electrolysis apparatus external to 222-U. No insurmountable technical obstacle is foreseen from this study. It appears that with only modest outlay of labor and material a valuable contribution can be made to the solution of the problem of ground water movement.

464

ADSORPTION AND RETENTION OF CESIUM BY SOILS OF THE HANFORD PROJECT. J. R. McHenry. Mar. 2, 1954. Decl. Jan. 6, 1956. 41p. (HW-31011)

The adsorption of Cs ion from solution by a composite Hanford soil is a function of Cs ion concentration, pH, time of contact, total salt content, and the nature and concentration of the complementary ions. Adsorption is linear, and nearly complete, for increasing concentrations of Cs until the Cs concentration approaches the saturation capacity of the soil. The percentage adsorption of Cs from solution as the concentration approaches the saturation capacity decreases rapidly. Adsorption from a number of increments of Cs solution by a given unit of soil is progressively less, approaching as a limit the soil saturation capacity. Adsorption at pH 8.0 and higher is relatively unchanged; below a pH 8.0 uptake by the soil decreases rapidly with increasing acidity. Increasing concentrations of complementary ions and total salt provide increasingly greater competition to the adsorption of Cs. A 40% solution of $NaNO_3$ decreases the Cs uptake by one-half for very low concentrations of Cs. Equilibrium adsorption is accomplished in a matter of minutes for a given set of conditions. Removal of adsorbed Cs by leaching with a solution is a function of the nature, concentration, and volume of a given cation, hydrogen ion being the most effective. However, all cations employed, if sufficient volume is employed, are capable of replacing and removing the adsorbed Cs. Replacement is most rapid for solutions of greatest cation concentrations and for soils containing the greatest amount of adsorbed Cs.

465

ADSORPTION AND RETENTION OF STRONTIUM BY SOILS OF THE HANFORD PROJECT. J. R. McHenry. Feb. 1, 1955. 36p. (HW-34499)

The adsorption of Sr ion from solution by a composite Hanford soil was found to be a function of the Sr ion concentration, pH, time of contact, and the nature and concentration of the complementary ions. Increasing concentration of a complementary ion generally decreases Sr adsorption. The influence of monovalent ions on Sr adsorption is in the order: $Cs^+ > NH_4^+ = K^+ > Na^+ > Li^+$, where Cs ion is the most effective in reducing Sr uptake. Increased adsorption is noted in the presence of $C_2O_4^{-2}$ and PO_4^{-3}. The presence of $NaNO_3$ reduces Sr ion adsorption. H ion is the most effective in replacing Sr. Other cations which replace Sr are in order: $La^{+3} > Ba^{+2} < Ca^{+2} > Mg^{+2} > K^+ > Na^+ > Li^+$.

466

AN ELECTRICAL TECHNIQUE FOR GROUND WATER VELOCITY MEASUREMENT. J. R. Raymond. Apr. 11, 1955. Changed from OFFICIAL USE ONLY Aug. 15, 1956. 11p. (HW-36217)

An electrical conductivity technique was developed to determine the dilution-displacement rate of an electrolyte in a well from which data the velocity of the water through the well can be calculated. The electrical current flow between 2 electrodes in a well drops proportionately with the dilution and the displacement of the electrolyte by fresh water entering the well. The drop of electrical current flow over a period of time was applied to a derived equation to obtain a value for ground water velocity. The technique gives results comparable to other methods and some problems of the standard methods of measuring ground water velocity are eliminated. However, a correction factor for porosity of the aquifer must be used in the derived equation. Porosity values are not adequately known in most cases, therefore the ground water velocity figures are generally relative rather than absolute.

467

PUREX COOLING WATER DISPOSAL SCOPE STUDY. J. P. Corley. Sept. 21, 1955. 19p. (HW-38468)

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REFERENCES

Results are reported from a survey of various liquid waste disposal schemes. Recommendations are presented for the disposal of Purex waste cooling water by discharge to a natural depressed area. Advantages and disadvantages of the procedure are discussed.

468

HYDRAULIC CHARACTERISTICS OF HANFORD AQUIFERS. William H. Bierschenk. Mar. 3, 1957. 38p. (HW-48916)

Three analytical techniques were applied to data from aquifer tests at Hanford to determine the hydraulic characteristics of the ground-water reservoirs. These techniques are the nonequilibrium type-curve method, the modified nonequilibrium straight-line method, and the image well technique for analyzing an aquifer of limited areal extent. The selection of equations and their application in the analysis of test data were governed largely by the physical conditions of the aquifers at the test sites studied. Data are presented graphically.

469

EFFECT OF CHEMICALS UPON INFILTRATION OF WATER INTO SOILS. K. C. Knoll. June 4, 1957. 9p. (HW-50600)

The possibility of increasing the infiltration of water into soils by the addition of chemicals was investigated. Beneficial effects were obtained by adjusting the influent to a concentration of 1 ppm Separan 2610, 10 ppm Dow Corning Antifoam A, a common antifoam agent; or 0.1% by volume of Aerosol O. T., a wetting agent. The infiltration also was increased if Krilium was mixed intimately with the upper layer of soil in a column before adding water.

470

CHANGES IN THE HANFORD WATER TABLE, 1944-1957. W. H. Bierschenk and M. W. McConiga. July 9, 1957. 21p. (HW-51277)

Maps showing generalized contours on the water table at Hanford indicate that throughout most of the area the general movement of ground water under natural conditions is from areas of recharge in the Rattlesnake Hills northeastward and eastward to the Columbia River. Open waste disposal swamps at the chemical processing plant areas have received ~26.6 billion gallons of process water since startup through June 1957, and covered disposal cribs and trenches have received ~2.8 billion gallons of low-level radioactive wastes. With artificial recharge of waters from chemical processing plants to underlying aquifers, the water table has undergone significant changes. Of major importance is the formation of 2 separate and distinct ground-water mounds which have raised the water table considerably, increasing and locally reversing the natural hydraulic gradients. Through the years, the eastern mound has risen a known maximum of about 25 ft and the western mound a known maximum of about 90 ft. The size and shape of these mounds have fluctuated depending upon the locations of disposal sites and the rates and total volumes of waste water disposed. The relative size and shape of the mounds reflect differences in the hydraulic characteristics of the receiving aquifers.

471

FLUCTUATIONS OF HANFORD WATER LEVELS. William H. Bierschenk. Nov. 14, 1957. 33p. (HW-53599)

Long-term hydrographs of water levels in 44 wells at Hanford show that water-table fluctuations are controlled primarily by the artificial recharge of aquifers by infiltrating liquid effluents, although locally some natural fluctuation is caused by alternate seepage into and from the Columbia River. In addition, the observed water level in certain wells may fluctuate due to changes in atmospheric pressure or due to earthquake shocks. Between 1944 and 1957 an estimated 4 billion ft^3 of plant effluents have saturated ~62 billion ft^3 of sediments. The average wetted porosity of the affected sediments is thus calculated to be about 6.4%. This newly-saturated zone contains essentially all the infiltrated waste water.

472

DISPOSAL OF RADIOACTIVE LIQUID WASTES FROM THE URANIUM RECOVERY PLANT. D. W. Rhodes and J. L. Nelson. June 3, 1957. 34p. (HW-54721)

A series of laboratory experiments was conducted to estimate disposal volumes for Uranium Recovery Plant (URP) scavenged wastes. The disposal volume was considered to be the maximum volume of waste that could be discharged to a specific disposal site such that no radioisotope with a half-life >3 yr reached the ground water in concentrations >$^1/_{10}$ of the maximum permissible concentration for that radioisotope in drinking water. The results of laboratory equilibrium and soil column tests with synthetic and actual process wastes are presented. Methods used to estimate disposal volumes from the experimental data are largely empirical and in many cases were influenced by operational experiences in the past. The data are considered applicable only to the particular soil-waste liquid system studied in this investigation.

Mound Laboratory, Miamisburg, Ohio

473

FIXATION OF MIXED FISSION PRODUCT ACTIVITY BY SOILS OF THE SAVANNAH RIVER PROJECT. T. C. Tesdahl, C. S. Lowe, F. C. Mead, and E. L. Murphy. Feb. 25, 1952. Decl. with deletions Nov. 19, 1953. 18p. (AECD-3629; MLM-665)

It was found that the rate of downward movement of water through soils is related to the amount and continuity of noncapillary pores, to the hydration of the pores, and to the resistance of entrapped air. In general, the rate of movement is greater in wet soil than in dry soil; the rate is greater in sandy soil than in clayey soils. The physical make-up of the soils tested indicate that the rate of downward movement should be slow due to the generally high clay content (particularly at the surface layers) which would offset the high water-holding capacity. The decline in activity removal with increasing salt content is quite prominent in all the soils tested. The radiochemical analysis of the solutions from the batch adsorption study shows Cs and Sr as not being adsorbed in the presence of 30% salt. The other isotopes are affected to a lesser degree. The soils tested are good adsorbers of fission-product activity in the presence of a low salt concentration, but poor absorbers in high salt concentration.

Oak Ridge National Laboratory

474

GROUND DISPOSAL OF HIGH LEVEL RADIOACTIVE WASTES. STATUS REPORT. E. G. Struxness, Roy J. Morton, Conrad P. Straub, J. W. Thomas, K. E. Cowser, T. W. Bendixen, B. Kahn, R. M. Richardson, and J. M. Warde. Jan. 1, 1955. Decl. Dec. 26, 1956. 27p. (CF-55-1-188)

Progress is reported in research aimed at an evaluation of the suitability of ground disposal of reactor waste effluents. Data are presented on the effectiveness of sand for filtering aerosols at low boil-up velocities; design of an

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aerosol entrainment well; development of a rapid method of aerosol particle size determinations; modifications of a cloud chamber for counting sub-micron particles; aerosol penetration through a lead shot column; the composition of ORNL waste solutions; the properties of soils in the ORNL area; the characteristics of ground water flow and movement; the migration of radioactive and chemical constituents of the waste through the soil; determinations of the exchange and adsorptive capacity of the soil; the effect of chemical composition of both soil and waste materials on retention and fixation; development of procedures for the identification following recovery from soil of radioisotopes of Sr, Y, Zr, Nb, Cs, and Ru; development of methods for the determination of radioactive Sr and Ba in natural waters, sewage, and sludges; the effectiveness of Tennessee ball clay as liners for waste pits; and the effectiveness of gels produced by limestone and dolomite in contact with acid waste solutions as liners for waste pits.

475

EVALUATION OF THE WATER-TIGHTNESS OF AN ASPHALT, TAMPED-CLAY PIT LINER. K. E. Cowser, R. J. Morton, and T. W. Bendixen. Mar. 23, 1955. 25p. (CF-55-3-128)

Experimental results are given on the effectiveness of an asphalt, tamped-clay lined experimental pit for waste retention. The sprayed asphalt liner improved retention characteristics of the pit by a factor of $\sim 10^2$. The potential effectiveness of the field-applied asphalt liner for retaining water was reduced by a factor of $\sim 10^3$. Non-uniformity of the asphalt liner thickness and puncturing of the liner with tamped shale are deemed responsible for the reduction in its water tightness. The asphalt employed is not a suitable liner material for elevated temperatures, due to its low softening point. Creeping of the asphalt at temperatures of 90°F was observed in the laboratory, which could result in the formation of liner defects.

476

HEAT TRANSFER IN WASTE BASINS. S. H. Jury. Aug. 11, 1955. Decl. with deletions Mar. 11, 1957. 16p. (CF-55-8-76(Del.))

Estimates are made of the heat transfer in proposed out-of-door radioactive waste basins. Calculations are outlined, and complete numerical results are included in appendices.

477

A CHEMICAL REPROCESSING PLANT FOR A NUCLEAR POWER ECONOMY. R. A. Charpie, J. Halperin, R. J. Klotzbach, J. R. McWherter, F. Nelson, E. L. Nicholson, C. H. Odom, R. W. Stoughton, E. P. Wigner, and H. R. Zeitlin. Feb. 5, 1954. Decl. with deletions Feb. 25, 1957. 165p. Project Hope. (ORNL-1638(Del.))

A new concept of waste storage is given on pages 66-79. The system envolves a large open pit, lined with an impermeable material, and filled with sand or stone in which the waste solution is allowed to boil to dryness by use of the decay heat. The amount of liquid is controlled by addition of water so that the last increment of liquid boils away when the heat losses to the ground equal the heat evolved. Schematic drawings and tables describe the system in detail. A comparison of other systems now in use is also included. Cost estimates are given.

478

RADIOACTIVE WASTE DISPOSAL REPORT ON SEEPAGE PIT LIQUID WASTE — SHALE COLUMN EXPERIMENT. William J. Lacy. Nov. 12, 1957. 22p. (ORNL-2415)

Seepage pits excavated from Conasauga shale have been used at ORNL for over 5 yr as a method for disposing of large volumes of intermediate level radioactive liquid waste. Results are reported from a study of the adsorption capacity of the shale. From the results of laboratory studies, an attempt was made to predict when the breakthrough of large quantities of radionuclides may occur, the order of occurrence for radionuclides present, and when the leaching action of rain and ground water may be expected to remove dangerous quantities of radioactivity from the saturated shale in the event the pits are abandoned as disposal units.

Recovery of Materials

Fission Products

Atomic Energy of Canada Limited.

Chalk River Project, Chalk River, Ontario

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THE ACETIC ANHYDRIDE METHOD FOR THE REMOVAL OF AMMONIUM NITRATE AND THE CONCENTRATION OF FISSION PRODUCTS FROM THE WASTE SOLUTIONS OF THE PLUTONIUM PLANT. J. G. MacHutchin. July 16, 1947. Decl. Oct. 10, 1957. 20p. (CRC-335)

The waste solutions from the Pu extraction plant will be saturated with NH_4NO_3 and will be intensely radioactive. A method for the concentration of these fission product solutions has been developed which involves the destruction of the NH_4NO_3 with acetic anhydride. The process has been tested on laboratory scale and works satisfactorily. A flow sheet is appended.

Brookhaven National Laboratory,

Upton, New York

480

USE OF KILOCURIE RADIATION SOURCES. Bernard Manowitz. July 10, 1951. 7p. (AECU-1597)

Studies are now being made on possible applications of radioactive waste materials from reactors to determine whether their processing is justified. Brookhaven is producing 1000 to 2000 curie sources to simulate radiations from these wastes. The sources are Co^{60} and Ta^{182}. They will be used in research and will be made available to industry for testing.

General Electric Company.

Hanford Atomic Products Operation,

Richland, Washington

481

A RADIOCHEMICAL SEPARATION FOR COBALT-60 IN AQUEOUS WASTE SOLUTIONS. R. A. Schneider. Jan. 1, 1957. 26p. (HW-47896)

Several methods of chemically separating Co^{60} from aqueous waste solutions and interfering nuclides were investigated. In the most suitable method, Co^{60} is carried from solution as a mixture of insoluble cobaltous and ferrous cobalticyanides after the cobaltic amine complexes have been destroyed by reduction and acid deammoniation. Removal from solution is ~99.9% complete. An average radiochemical yield of 98.1% is obtained for the complete separation procedure. The procedure involves no precise

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techniques or exacting measurements, and has been adopted for routine use.

482

FISSION PRODUCT RECOVERY FROM CHEMICAL PROCESSING PLANT WASTE SOLUTIONS. G. B. Barton, J. L. B[illegible]orth, E. D. McClanahan, Jr., R. L. Moore, and H. H. Van Tuyl. Feb. 26, 1957. Decl. July 25, 1957. 25p. (HW-48776-RD)

A process is described for the recovery of potentially valuable long lived fission product activities from the first cycle acidic waste solutions which result from the solvent extraction processing of nuclear reactor fuel elements. The metal ferricyanides and ferrocyanides were extensively investigated as scavenging agents for Cs^{137}, and the effects of process variables are reported. Cesium zinc ferrocyanide ($Cs_2ZnFe(CN)_6$) was found to be the most effective and is used for purposes of concentration and isolation. Subsequent chemical processing results in either a mixed chloride ($2CsCl \cdot ZnCl_2 \cdot {}^1/_2\ Fe_2O_3$) or pure CsCl product suitable for use in high intensity radiation sources. Ce^{144}, rare earth, and Sr^{90} activities are recovered by a series of process steps which depend on coprecipitation on $Fe(OH)_3$ and on the solubility behavior of the rare earth oxalates, of $Ce(IO_3)_4$, and of $SrCO_3$.

Knolls Atomic Power Laboratory,

Schenectady, New York

483

AN INVESTIGATION OF THE $KMnO_4 - MnO_2$ HEAD-END PROCEDURE FOR THE REMOVAL OF RUTHENIUM AND NIOBIUM-ZIRCONIUM. I. A PILOT-SCALE STUDY OF THE PROCEDURE WITH NATURAL URANIUM. J. K. Davidson, J. H. Holmes, and J. F. LaBonte. Aug. 22, 1952. Decl. with deletions Mar. 6, 1957. 30p. (KAPL-795(Del.))

A program for investigation of the variables in the Purex head-end treatment, directed toward possible simplification of the present procedure has been started. The results of the first part of the program, a pilot-scale study with natural U are: (1) $KMnO_4$ is stable during the standard simmer procedure in acid-deficient natural U solutions compared to 40% decomposition in acid solution. (2) Acid-deficient strikes resulted in poor centrifugation characteristics in contrast to good characteristics obtained with acid strikes. Acidifying the solution after an acid-deficient strike did not improve the centrifugation properties. (3) The centrifuging characteristics of the feed are independent of the mechanism by which the cake is formed. Manganous, H_2O_2, and chromic strikes all centrifuged in the same way. and (4) The centrifuging characteristics and cake volume of large-scale, high-activity-level operations should be predictable with reasonable accuracy from the results of large-scale cold studies.

Oak Ridge Gaseous Diffusion Plant

484

SEPARATION OF CESIUM FROM SODIUM BY MEANS OF FULLERS EARTH. H. L. Bench and H. B. Weisblatt. July 15, 1949. Decl. May 25, 1956. 14p. (K-443)

The adsorptive capacity of Fullers earth for Cs in solutions containing high concentrations of Na salts was found to be >0.04 g of CsCl/g of earth. The optimum removal of Cs from these solutions was found to occur at a pH of 11. A feasible process for the decontamination of these solutions from Cs^{137} was developed using Fullers earth.

485

REMOVAL OF RUTHENIUM FROM WASTE. G. A. Eaton, J. J. Finley, H. G. Hunter, F. Mills, and R. W. Vogel. Feb. 22, 1950. Decl. Jan. 6, 1956. 18p. (K-570)

Several insoluble compounds have been investigated as scavengers for removing radioactive Ru from solution. None were adequate from the standpoint of decontamination. The removal of Ru from solution by distillation of the tetroxide is much more promising. Although optimum conditions for this operation have not been established, 85 to 99% removal of Ru was effected by using strong oxidants such as Cl_2, O_3, $KMnO_4$, and $NaBiO_3$. Chlorine was most effective in alkaline solution, ozone in the pH range of about 3 to 10, and permanganate and bismuthate at still lower pH values. The distillation of RuO_4 can be used as a method to separate Ru from other fission-product radioisotopes which exist in aged metal waste.

486

SEPARATION OF RUTHENIUM FROM URANIUM HEXAFLUORIDE. R. A. Gustison, S. S. Kirslis, T. S. McMillan, and H. A. Bernhardt. Apr. 26, 1950. Decl. Jan. 6, 1956. 33p. (K-586)

In the UAP process for recovery of U from Hanford waste, Ru^{106} is an undesirable radioactive contaminant in the phosphate precipitate. Ru forms a very reactive volatile fluoride which is carried along with the UF_6 when $UO_2NH_4PO_4$ is fluorinated. It was found that passing the UF_6 through a distillation column effectively reduces the Ru activity in UF_6 to an acceptable level. It was shown that the decontaminating effect of the distillation operation was due largely to the scrubbing of ascending gases by refluxing liquid UF_6. To a lesser extent, absorption of Ru on the column packing and the distillation action contributed to the decontamination.

Oak Ridge National Laboratory

487

THE RECOVERY OF Cs^{137} FROM ORNL RADIOCHEMICAL WASTE. A. T. Gresky. Oct. 12, 1950. 11p. (AECD-2999: ORNL-742)

A process has been demonstrated on a 1-liter scale for the recovery of Cs^{137} from alkaline radiochemical wastes. The process involves co-crystallization, or carrying, of Cs on potassium alum at a pH of 4.5. Yields of 95 to 100% have been obtained. It is recommended that the process be developed further as an initial step in the production of carrier-free tracer or as a method for removing Cs from waste solutions before storage.

488

THE PREPARATION OF Ru-106 TRACER FROM WASTE METAL SOLUTION. A. T. Gresky. July 22, 1949. Decl. Jan. 6, 1956. 14p. (ORNL-275)

A process is presented for the recovery of 290 day Ru^{106} from waste metal solutions. This process is based on the carrying of Ru on $Fe(OH)_2$ and subsequent distillation from $KMnO_4 - H_2SO_4$.

489

THE REMOVAL OF FISSION PRODUCTS FROM AN ACID ALUMINUM NITRATE SOLUTION BY CO-PRECIPITATION METHODS. Herman L. Krieger, Bernd Kahn, and Conrad P. Straub. Oct. 20, 1955. 19p. (ORNL-1966)

The removal of the major long-lived fission products by co-precipitation from an acid $Al(NO_3)_3$ solution has been studied. Of the methods investigated the most efficient and economical treatment was found to be the co-precipitation of Ru and Cs with $Cu_2Fe(CN)_6 \cdot xH_2O$; of Sr with $BaSO_4$; of

Zr and Nb with $ZrO_3(PO_4)_2$; and of the rare earths and Y with $Ce_2(C_2O_4)_3 \cdot 9H_2O$. Approximately 95% of the added tracers and carriers were removed from solution in a precipitate of about 50 g/l at a cost of $0.015/l.

490

REMOVAL OF FISSION PRODUCTS FROM REACTOR WASTES: LABORATORY STUDIES OF LIQUID-LIQUID EXTRACTION FROM AN ACID ALUMINUM NITRATE SOLUTION. Herman L. Krieger, Bernd Kahn, and Conrad P. Straub. May 24, 1957. 36p. (ORNL-2297)

Liquid-liquid extraction of the major long-lived fission products was evaluated as a method for decontaminating an acid $Al(NO_3)_3$ waste. Tributyl phosphate, di-2-ethylhexyl phosphoric acid, tridecyl phosphine oxide, tri-n-octyl amine and thenoyl trifluoroacetone were found to be effective in extracting one or more of the Ce, Y, Zr, Nb, and Ru tracers used in this study. After converting Ru and Nb to an extractable form, >99% of the tracers was extracted into undiluted tributyl phosphate. Cs was not extracted, and Sr very slightly extracted. The extracted radionuclides were stripped from tributyl phosphate with water, dilute HF and HNO_3, permitting reuse of the organic phase.

United Kingdom Atomic Energy Authority.

Research Group.

Atomic Energy Research Establishment,

Harwell, Berks, England

491

THE EXTRACTION, PURIFICATION AND INDUSTRIAL USES OF KRYPTON-85. E. J. Wilson, C. Evans, J. Chadwick, J. Eakins, and K. J. Taylor. Apr. 25, 1955. Decl. Jan. 9, 1957. 18p. (AERE-I/R-1653)

A method of purification, extraction and measurement of Kr^{85} on a curie scale is described. Potential industrial uses of the isotope are also discussed.

Vitro Laboratories,

West Orange, New Jersey

492

HOMOGENEOUS REACTOR FUEL REPROCESSING BY CaF_2 ADSORPTION OF RARE EARTHS. Job 1087. Dec. 31, 1954. Decl. Mar. 22, 1957. 30p. (KLX-1739)

It was found that contacting simulated spent reactor fuels with a packed bed containing CaF_2 would selectively remove mixed rare earths added to the feed solutions in amounts which corresponded to their expected concentration under reactor conditions. Optimum operating temperatures appear to be 100°C or slightly less. At temperatures over 100°C, more fluoride is dissolved than is necessary for rare earth deposition. Temperatures <100°C are accompanied by relatively slow adsorption rates and would be difficult to maintain, practically, because of the heat of fission product decay, both in solution and in the solids deposited on the adsorber bed. Effluent from a CaF_2 column operating at 100°C would contain about 0.4 g each of dissolved Ca^{++} and F^-/liter. Because of the scaling and corrosive effects respectively of these ions, post-treatment of the effluent is required to reduce their concentration in the reprocessed fuel. Three alternative schemes for accomplishing this removal were developed and are listed.

Uranium

Atomic Energy of Canada Limited.

Chalk River Project,

Chalk River, Ontario

493

SURVEY OF METHODS OF CONCENTRATION OF FISSION PRODUCT LIQUORS FROM PLUTONIUM CHEMICAL EXTRACTION PLANTS. E. E. Winter. Feb. 28, 1950. Decl. Mar. 23, 1956. 41p. (CRCE-442)

This report discusses the treatment of active effluents which result from triglycol dichloride (Trigly) process and considers other chemical extraction processes from the point of view of effluent handling. The process recommended is a solvent extraction of U by a countercurrent batch process followed by NH_4NO_3 destruction by the thermal decomposition process.

General Electric Company.

Hanford Atomic Products Operation,

Richland, Washington

494

THE EXTRACTION OF URANIUM IN THE TRIBUTYL PHOSPHATE METAL RECOVERY PROCESS. Robert Lee Moore. Sept. 1, 1949. Decl. Feb. 20, 1957. 18p. (HW-15230)

Several solvents were investigated as diluents for tributyl phosphate. A correlation was found between the polarizability or dipole moment of the diluent and the extraction coefficient, E_a^0, of U into the mixture, those diluents with lowest dipole moments giving the greatest extraction. Solvents such as CCl_4 (heavier than water) and kerosene (lighter than water) appeared most attractive on the basis of high extraction coefficients and low inflammability (high flash point) of the resultant mixture. Extraction studies were made on a feed prepared from Hanford current metal waste (CMW) acidified to 5M HNO_3. 99.9% U recovery was indicated in <4 counter current extraction stages with either 20% TBP-CCl_4 or 20% TBP-hexane. The extraction of U and HNO_3 into 20% TBP-CCl_4 from aqueous UHN, HNO_3 solutions was studied. The results indicated that the mechanism of U extraction is one of simple complex formation. The extraction of HNO_3 involves the formation of a weak complex containing one molecule of HNO_3 and one molecule of TBP. The equilibrium constant for this reaction is 0.177. HNO_3 is displaced from the organic phase by U due to the more stable complex formed by the latter with TBP.

495

SOLUBILITY RELATIONSHIPS OF ACIDIFIED STORED METAL WASTES. M. H. Curtis. Mar. 24, 1950. Decl. Feb. 20, 1957. 16p. (HW-17226)

The preparation of feed (RAF) solution for the TBP solvent-extraction process from aged neutralized metal waste relies upon acid dissolution of the solid phases (Na uranyl carbonates and Na uranyl phosphates) which are present in the storage tanks. Through experimental investigation it has been found possible to define the solubility relationships of the 2 solid phases (uranyl hydrogen phosphate and $NaNO_3$) which occur in the acidified system as a function of the acidity in a system containing the com-

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ponents (UO^{-2}, Na^{+1}, H^{+1}, PO_4^{-3}, SO_4^{-2}, and NO_3^{-1} ions) of the feed solution formed in the manner indicated. The range of the acid concentrations studied is believed to embrace all those of interest in the preparation of the feed stream (RAF) and those of the aqueous phase at any point within the extractant (RA) column or its effluent aqueous (RAW) stream.

496

EQUILIBRIA OF URANIUM AND NITRIC ACID BETWEEN WASTE METAL SOLUTIONS AND TRIBUTYL PHOSPHATE IN HYDROCARBON DILUENTS. Fred Clagett. March 24, 1950. Decl. Feb. 20, 1957. 52p. (HW-17339)

The equilibrium points were determined by single batch contacts of a TBP-solvent solution with an aqueous phase containing varying concentrations of PO_4^{-3}, SO_4^{-2}, NO_3^{-1}, Na^{+1}, $Fe(NH_2SO_3)_2$, HNO_3, and UNH. Equilibrium concentrations were then obtained by analyses of the equilibrated phases. The values for U in the 0.0005$\underline{M}$ range were poor due to great difficulty experienced in obtaining accurate U analyses at low concentrations in the presence of large quantities of interfering ions. U distribution ratios, E_a^0, and extraction equilibrium constants, K, were calculated for all points. Plots illustrate the effects of variations in concentrations of PO_4^{-3}, SO_4^{-2}, and HNO_3 on U and HNO_3 distribution. Since the U equilibrium constant, K for the proposed extraction mechanism, was found to vary with U concentration, other factors being held invariant, a study was carried out to determine the effect quantitatively. A few points were determined indicating the variation of U and HNO_3 distribution with TBP concentration. Little effect on U distribution was shown by the different hydrocarbon diluents or by the $Fe(NH_2SO_3)_2$ at the concentrations studied.

497

SLUDGE ACIDIFICATION. Progress Report. M. K. Harmon. June 23, 1950. Decl. Feb. 19, 1957. 12p. (HW-18149)

Problems of sludge-supernate acidification applicable to the TBP Process were surveyed and available information was summarized. Data are tabulated from a study on the acidification of a synthetic incubated metal waste, free of product and fission products. The physical properties of the slurry before and after acidification, and the effects of heat evolved during acidification, and rate of slurry addition were studied.

498

pH MONITORING OF METAL RECOVERY NEUTRALIZED WASTE. C. E. Michelson. Sept. 24, 1954. Decl. Feb. 27, 1957. 23p. (HW-33148)

In order to ensure adequate control of pH in the continuous neutralization of Metal Recovery Process wastes, a continuous recording pH meter has been successfully applied. The mechanical difficulties of a pH sensing system working in a relatively inaccessible location with a continuously operated jet sampler have been overcome using a replaceable unit with provisions for standardizing the pH meter and automatically acid flushing the cell and sampler. A unique feature of the unit is that the acid flush which is introduced at regular intervals provides, by means of the pH meter response, a positive indication on the recorder chart that both the sampler and the pH meter are functioning properly. The close pH control made possible by this installation has been shown to be adequate for the successful scavenging of radiocesium from process wastes and has also reduced the frequency of over-neutralization of the waste.

Oak Ridge Gaseous Diffusion Plant

499

RECOVERY OF URANIUM FROM HANFORD WASTE BY PRECIPITATION AS URANIUM TETRAFLUORIDE AND SUBSEQUENT FLUORINATION. H. A. Bernhardt, S. Bernstein, and F. D. Rosen. June 10, 1949. Decl. Dec. 27, 1955. 16p. (K-416; KLO-107)

U may be recovered from Hanford waste by precipitation as UF_4 and subsequent fluorination to UF_6. This treatment has been used to obtain separation of all the fission products, except Ru^{106}, from the U. Activity due to the Ru was reduced to a value of 1 mc/kg of U.

500

HIGH TEMPERATURE HYDROGENATION-HYDROFLUORINATION OF URANYL AMMONIUM PHOSPHATE TO URANIUM TETRAFLUORIDE. H. A. Bernhardt, W. Davis, Jr., J. R. Flanary, and R. J. Heus. July 15, 1949. Decl. Jan. 6, 1956. 26p. (K-425)

Recovery of U from waste solutions by precipitation as $UO_2NH_4PO_4$ and conversion of the latter to UF_4 has necessitated further study of the conversion reaction. UF_4 was formed by the reaction of $UO_2NH_4PO_4$ with a mixture of H and HF in the temperature range 500 to 700°C. At 500°C the conversion to UF_4 is slow and incomplete; at 700°C conversion is nearly complete within 1 hr for samples of 4 to 5 g. Within the fairly large experimental errors, the reduction reaction follows a first order rate law with an apparent activation energy of about 18 kcal/mole.

501

SEPARATION OF COPPER, IRON, NICKEL AND URANYL IONS BY ION EXCHANGE COLUMNS. H. L. Bench, R. H. Capps, M. R. Skidmore, H. B. Weisblatt, and R. H. Winget. July 20, 1949. Decl. Dec. 27, 1955. 32p. (K-447; KLO-127)

The feasibility of recovering U from plant waste solutions containing large amounts of Fe, Cu, and Ni by separation on an ion exchange resin column (Dowex 50) was investigated. The characteristics of these ions with various elutriants were studied on small columns. It was found possible to separate Cu and Ni from U adsorbed on a column using 5% ammonium citrate as an elutriant at pH 7, followed by the same elutriant at pH 3. Of the total U in the mixture, 83% was recovered in 160 ml of eluate. 66% was recovered free of contamination in 70 ml, 60% being concentrated in a 20 ml fraction of eluate.

502

LABORATORY DEVELOPMENT OF THE UAP PROCESS. J. C. Barton and R. H. Rainey. Aug. 4, 1950. Decl. Dec. 27, 1955. 79p. (K-621)

The laboratory research and development of a process for the recovery of U from aged Hanford metal waste by precipitation as uranyl ammonium phosphate (UAP) is described.

Oak Ridge National Laboratory

503

RECOVERY OF 7500 AREA SALVAGE MATERIAL. S. Mann, J. E. Bigelow. Sept. 24, 1953. Decl. Feb. 13, 1957. 18p. (CF-53-9-188)

Salvage material from the 7500 Area, consisting mostly of ground-up concrete and other waste in HNO_3 was processed for recovery of its U content. The U^{235} content was originally estimated at 825.8g, with an estimated isotopic purity of 92%. Of the total U actually present in pilot plant feed (1098.3g) 97.9% was recovered, 1.16% was lost to

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samples and low activity waste streams, and 0.91% was lost to waste due to equipment failure. Processing rate was limited by the low flooding rate of this material, at times as low as 24 gal/hr/ft^2 for some batches of feed. Column on stream time efficiency was 87%. The material was processed by solvent extraction using 5% tributyl phosphate (TBP) in Amsco diluent. The chemical flowsheet prescribed by the Chemical Development Section was based principally on a previous similar operation. In the present case, the U product was collected by ion exchange on 2 resin columns. Elution of the resin columns provided the final recovery figures: 1074.07g of total U, including 945.66g of U^{235} according to the average isotopic purity of 88.04% determined by mass spectrograph analysis. Analysis of adjusted pilot plant feed indicated 1322.2g of total U; subtracting known operating losses and recycle material, the total U produced should be 1074.2g, which is in good agreement with the actual amount obtained from the resin columns.

504

URANIUM RECOVERY FROM METAL WASTES. p.130-134 of CHEMICAL SEPARATIONS PROCESSES. PART I. CHAPTERS 1-11. Sigfred Peterson, comp. and ed. Dec. 1953. Decl. with deletions Mar. 20, 1957. 137p. (CF-53-12-150(pt.1)(Del.2))

The uranyl ammonium phosphate (UAP) and the tributyl phosphate (TBP) processes for the recovery of U^{235} from metal waste solutions are described in detail. The process for the recovery of Pu from old $BiPO_4$ waste by the modified Purex process is also given.

505

PILOT PLANT DESIGN REPORT; TBP PROCESS. R. P. Milford. Jan. 27, 1950. Decl. Mar. 1, 1957. 39p. (ORNL-543)

A set of stainless steel columns and accompanying process equipment, including a product evaporator were installed to demonstrate the TBP process for recovering U metal waste. Tributyl phosphate, diluted with Varsol, is used as an extractant in one cycle of continuous liquid-liquid counter-current extraction scrubbing and stripping. Flowsheets, and assembly of columns are included.

Vitro Corporation of America, New York

506

LIQUID WASTE TREATMENT (23C). Summation Report for the Period February 1950 through April 1951. Job 23. Nov. 21, 1951. Decl. Feb. 28, 1957. 14p. (KLX-1220)

On the basis of results given, it appears that U can be removed economically from MCW main sewer liquor, using Dowex-2 resin. It is possible to recover U from MCW C-3 discard liquor by adsorption on aminized cotton and from MCW acid raffinate and MCW acid sewer liquor by adsorption on phosphorylated cotton cloth. The recovery of U from Peterson discard liquor by ion exchange appears impractical because of formation of precipitates within the column. It does not appear economically feasible to recover U from sump recovery liquor. Two composites representing the proposed "new refinery" waste streams were investigated. With one composite, representing a plant operating with C-3 process and no acid sewer, adsorption by ion exchange is questionable, since a precipitate which forms slowly on mixing the components would probably interfere with column operation. With the other composite, representing the combined sewers from a plant using the "Slurex" process, the volume of waste treated/ft^3 of resin and the column loading are low, which would make the cost/lb of U_3O_8 recovered unduly high. From the health physics point of view, adequate decontamination of the liquor is obtained and for this reason operation of the process may be warranted.

Other

Argonne National Laboratory,

Lemont, Illinois

507

RECOVERY OF NEPTUNIUM-237 FROM SPECIAL HANFORD WASTES. H. B. Evans, W. B. Seefeldt and H. H. Hyman. Mar. 27, 1950. Decl. Feb. 27, 1957. 26p. (ANL-4442)

A method is presented for the recovery of Np^{237} from special Hanford Pu waste solutions by a batch solvent extraction process. This procedure which is moderately successful utilizes the behavior of Np^{+4} to form highly solvent-soluble nitrate complexes in the presence of certain organic amines or quaternary salts under conditions where Pu^{+3} can be stabilized. A discussion of the feasibility of continuous countercurrent extraction for the separation of Np from Pu is given.

General Electric Company.

Hanford Atomic Products Operation,

Richland, Washington

508

CHLORIDE REMOVAL FROM METAL WASTE SOLUTIONS. L. H. Clark. Oct. 10, 1950. Decl. Feb. 19, 1957. 13p. (HW-19105)

Chloride ion in the RAW waste stream from the TBP metal recovery process would excessively corrode the stainless steel in a HNO_3 recovery step. The conditions under which peroxysulfate ($K_2S_2O_8$) will oxidize quantitatively the Cl^- to Cl_2, which may be removed by air sparging, are presented in detail. A preliminary survey of other oxidants was made. The results of this survey are tabulated, as are the per cent decomposition of $S_2O_8^{-2}$ by synthetic RAW, and formation of ClO_3 and ClO_4 during Cl^- removal.

Knolls Atomic Power Laboratory,

Schenectady, New York

509

RECOVERY OF ALUMINUM NITRATE FROM REDOX AQUEOUS WASTE STREAMS. J. A. Syres, G. E. McCullough, W. F. McKeehan, and R. H. Simon. July 20, 1949. Decl. with deletions Feb. 28, 1957. 24p. (KAPL-213(Del.))

The precipitation of $Al(NO_3)_3$ from Redox waste streams with HNO_3 was studied. Experiments in small scale glass apparatus and in a stainless steel pilot plant show that precipitation with 80 to 85% HNO_3 has several advantages, but the use of constant boiling HNO_3 (68 to 70%) is more attractive.

Oak Ridge Gaseous Diffusion Plant

510

PYROHYDROLYSIS OF PRECIPITATES DERIVED FROM

MOCK HL-45. H. A. Bernhardt, W. Davis, Jr., and M. R. Skidmore. Oct. 27, 1948. Decl. Feb. 8, 1956. 10p. (K-292; KLO-42)

Pyrohydrolysis as a method of removing phosphate from mock HL-45 material was tried on the following solids: (1) NaOH precipitate of dissolved mock HL-45 (UAP waste); (2) NH_4OH precipitate of dissolved mock HL-45; (3) filtered mock HL-45; (4) UO_2HPO_4. In the case of the filtered mock HL-45, 53% phosphate removal has been accomplished, but only after prolonged reaction at 1275°C. The extent of removal of phosphate from the other solids is negligible, even at this temperature. As a plant method of removing phosphate from the 4 solids tested, pyrohydrolysis is of little value.

511

HYDROGENATION OF PRECIPITATES DERIVED FROM SYNTHETIC HANFORD WASTE. H. A. Bernhardt, W. Davis, Jr., and R. J. Heus. Apr. 11, 1949. Decl. Jan. 6, 1956. 13p. (K-383)

The removal of P from certain solids derived from Hanford waste would yield residues contaminated only by very small amounts of elements that form volatile fluorides. Therefore, dry fluorination might be used to recover U as relatively pure UF_6. High-temperature (800 to 1000°C) hydrogenation was tried as a method of phosphate removal from three solids derived from synthetic Hanford waste and also from uranyl monohydrogen phosphate. Extensive removal of P was achieved at 1000°C, but only after relatively long exposures (10 hr) of small samples (5 to 10 g). It is concluded that the high-temperature hydrogenation of solids derived from Hanford waste would be an inefficient and expensive method for removing P from such solids.

Oak Ridge National Laboratory

512

THOREX SOLVENT RECOVERY: DEVELOPMENT OF CALCIUM HYDROXIDE SLURRY PROCESS. P. A. Haas and A. Carleton Jealous. Feb. 16, 1955. Decl. Mar. 2, 1957. 30p. (ORNL-1784)

$Ca(OH)_2$ slurries, ~360 g of $Ca(OH)_2$/liter of water, effectively removed impurities from Thorex process solvent (42% tributyl phosphate in Amsco 123-15) which had been used in non-radioactive pulse column studies, so that it could be reused in extraction columns. Contact between solvent and slurry was made in mixer settlers. The volume of waste from this recovery process was 1% or less of the volume of solvent treated. An equipment diagram and a flowsheet are given.

Vitro Corporation of America, New York

513

RECOVERY OF RADIUM FROM K-65 RESIDUE (23-E). Summation Report for period March 1950 through September 1950; May 1951 through November 1951. Job 23. Feb. 12, 1952. Decl. with deletions Nov. 15, 1955. 46p. (AECD-4026)

Methods for recovering Ra from K-65 residue have been investigated. A process using Versene was developed and demonstrated on a laboratory scale. In this process K-65 residue is leached with Versene solution and Ra is adsorbed from the leach liquors and purified by the use of cation exchange resin.

514

THE FEASIBILITY OF CONTINUOUS CHELATION. H. H. Willis. Apr. 29, 1949. Decl. Mar. 28, 1957. 52p. (KLX-44)

Recovery of Pu from $BiPO_4$ waste solutions by continuous chelation appears feasible with either of the 3 feed solutions: (a) solutions of Na diuranate ppt., (b) the IAW stream of the Redox process with a Pu reducing agent present, and, (c) IAW solution with $Al(NO_3)_3$ removed.

515

PROJECT SUMMARY D_2O RECOVERY (57-B). Period [Covered]: April 1, 1952 – January 31, 1953. Job 57. Apr. 1, 1953. Decl. Feb. 26, 1957. 68p. (KLX-1611)

Several proposed alternate methods for recovery of D_2O from a UO_2SO_4 homogeneous reactor fuel solution have been investigated and compared economically for normal to slightly enriched U (1% U^{235}). Of the alternate methods, all of which were tested on a laboratory scale, the most efficient and economically attractive consists of evaporating and drying UO_2SO_4 solution in pans to a final temperature of 500°C. Less attractive alternates were drum drying, ion exchange demineralization, and evaporation over a high boiling immiscible liquid.

Physical Characteristics

Brookhaven National Laboratory,

Upton, New York

516

STUDIES OF CHARACTERISTICS OF SAVANNAH RIVER WASTES. Final Report. B. Manowitz, C. W. Pierce, and S. Zwickler. Apr. 1957. 31p. (BNL-446)

Pilot plant and laboratory studies have been made at BNL in support of the Savannah River program of storage and concentration of wastes. A pilot plant test tower was constructed as a representative section of a Savannah River waste tank. Purex-type wastes with varying settling characteristics were cooled, concentrated, and stored under conditions simulating proposed operation of the regular tank farm. Vertical temperature distribution, decontamination factors, over-all heat transfer coefficients, and foaming characteristics were observed. Operating procedures were studied to determine means for slurrying and transferring settled wastes. A procedure was also developed for measuring sludge heights in tanks. Observations were made in the laboratory of the settling characteristics of waste stream sludges. Corrosion of 1020 mild steel by the various waste streams was investigated. Attempts were also made to create steam surges in typical Savannah River and Hanford wastes due to fission product heat generation. The foaming and scaling characteristics of low level wastes were followed for evaluation of waste concentration criteria. The radiation stability of the gluconic acid complexed scavenger cake was examined. Finally, the use of the IAW stream in the dissolver solution was investigated.

General Electric Company.

Hanford Atomic Products Operation,

Richland, Washington

517

APPARENT VISCOSITY OF SIMULATED UNDERGROUND METAL WASTE SLURRIES. A. W. Allen. June 20, 1950. Decl. Dec. 8, 1955. 19p. (HW-17775)

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Apparent viscosity data of sufficient accuracy for pipe line design were obtained for fission product and Pu free slurries, consisting of simulated $BiPO_4$ Process wastes, in 0.5 and 1 in. ips iron pipes 21 ft long. Slurries having supernate/settled sludge volume ratios from 0.44 to 5.85 were used. Apparent viscosities of the slurries ranged from 1.72 centipoises at 3.79 ft/sec velocity and 4.15 supernate/sludge volume ratio in 1 in. ips iron pipe to 6.45 centipoises at 3.39 ft/sec velocity and 1.17 supernate/sludge volume ratio in 0.5 in. ips iron pipe. The apparent viscosities of the slurries approach that of the supernate with velocities above 3.5 ft/sec in 1 in. ips pipe and 7 ft/sec in 0.5 in. ips pipe. The apparent viscosity of the slurries increases with decrease of velocity below 3.5 ft/sec in 1 in. ips pipe and 7 ft/sec in 0.5 in. ips pipe. The sludge consisted of two distinct types of solids, one finely divided and slow settling, and the other of large chunks somewhat crystalline in nature and difficult to break up and disperse by agitation.

518

REFRACTIVE INDEX MEASUREMENTS. L. L. Burger. May 17, 1950. Changed from OFFICIAL USE ONLY July 6, 1956. 4p. (HW-17822)

Current physical studies of Redox solutions and current metal waste solutions have included a number of refractometric investigations. Aside from information pertinent to the structural nature of solutions these data have revealed that the refractions of a number of constituents in process streams are sufficiently different from those of the solvents that analytical application is possible. The purpose of this note is to summarize some of these data and to point out a few limitations of the method. Refractometric methods for analysis and control in organic chemistry are well known. Lack of extensive use in analysis of inorganic solutions has resulted probably from the lack of specificity for individual ions and to the fact that other methods were available.

519

PROPERTIES OF NEUTRALIZED AND CONCENTRATED AQUEOUS WASTE — LOW ACID FLOWSHEETS TBP-HW-NO. 4 AND NO. 5. M. H. Curtis, M. K. Harmon, and V. R. Cooper. July 18, 1950. Decl. Apr. 4, 1957. 13p. (HW-18404(Rev.))

In order to determine the maximum reduction in waste volumes that may be realized after neutralization of RAW, an experimental determination of freezing point versus degree of concentration is required. The ability of the plant to handle and transfer the wastes of the desired degree of concentration requires information on such physical properties as pH, density, viscosity, and heat capacity.

520

APPARENT VISCOSITY OF NEUTRALIZED AND CONCENTRATED RAW SLURRY-TBP HW-NO. 4 FLOWSHEET. A. W. Allen. Aug. 15, 1950. Decl. Dec. 3, 1955. 13p. (HW-18476)

Viscosity data for flow in 1-in. iron pipe were obtained for a fission-product and Pu-free slurry, consisting of simulated TBP Waste Metal Recovery Process waste (TBP-HW No. 4 Flowsheet), concentrated to a saturation point of 82.5 to 85°C. The apparent viscosity appeared to increase rapidly with decreased flow rate when in viscous flow. The slurry consisted of two distinct types of solids, one finely divided, flocculent, slow settling $Fe(OH)_3$, and the other a white crystalline, rapidly settling material composed of Na_2SO_4, Na_3PO_4, and $NaNO_3$. Although the crystalline material settled rapidly, it was easily and quickly dispersed by agitation.

521

SETTLING AND DISSOLUTION CHARACTERISTICS AND COMPOSITION OF HANFORD WASTE METAL SLUDGE. H. L. Brandt and W. A. Burns. June 23, 1950. Decl. Feb. 20, 1957. 16p. (HW-18492)

Results are presented on U waste dissolution and analysis and of settling rates of sludge suspended in synthetic supernatant at 25 and 82°C.

522

VISCOSITY AND SETTLING RATES OF TBP WASTE METAL SLURRIES AS A FUNCTION OF SHEAR. L. P. Varga and M. K. Harmon. Jan. 2, 1951. Decl. Feb. 25, 1957. 41p. (HW-19933)

The settling rate and viscosity of Hanford waste metal slurry as a function of prolonged agitation and shear were compared with the settling rate and viscosity of a synthetic slurry. The settling rate of the synthetic slurry increased sharply in the first hour of agitation, dropped slowly, but with wide fluctuation during the next four hour's agitation, and then remained constant for the duration of the experiment. The initial settling rate of the Hanford "hot" slurry dropped rapidly during the first hour's stirring, and gradually declined for an additional 20 hr before it leveled off. The viscosity of the synthetic slurry changed little with agitation. The viscosity of the Hanford slurry rose sharply after little more than one hour's agitation time, then increased gradually, leveling off after 10 hr.

Oak Ridge National Laboratory

523

PHYSICAL PROPERTIES OF HANFORD METAL WASTE. C. E. Schilling. June 29, 1950. Decl. Mar. 5, 1957. 32p. (ORNL-724)

The Hanford metal wastes were divided into four categories: supernate – the liquid waste; hard sludge – dense agglomerates of poorly defined crystalline carbonates approximating the hardness of soft blackboard chalk; soft sludge – an easily slurried semi-solid consisting chiefly of needle-like phosphates; and recombined sludge – a representative sample of the solid wastes as received from Hanford, shown to be a mixture of hard and soft sludges in the ratio $^2/_3$ by weight. The density of supernate, in the temperature range 24 to 74°C, varied from 1.130 to 1.103 g/ml. Hard sludge density averaged 3.0 g/ml and that of soft sludge averaged 1.84 g/ml. The consistency, or apparent viscosity, as a function of temperature, shear rate, and solids content was measured individually on slurries of recombined, soft, and hard sludges using supernate as the suspending medium. Settling rates were also run on these 3 slurries as a function of solids content.

Equipment and Auxiliaries

University of California, Berkeley. Radiation Laboratory

524

DISCONNECTING "HOT" HOSE LINES. Herbert P. Cantelow. June 26, 1956. 5p. (UCRL-3454)

A safe method of disconnecting radioactively contaminated hose lines is described in detail.

REFERENCES

Ferguson (H.K.) Company.

Atomic Energy Division, New York

525

MANUALS FOR BROOKHAVEN NATIONAL LABORATORY: BOOK NO. 6: LABORATORIES MANUAL: SECTIONS 1 AND 2. July 1949. 230p. (M-4419)

Detailed description is presented of the Pile Bldg., Pile Lab., Hot Lab., and Waste System, including floor plans, service lines, air conditioning systems, fire control systems, hoods, hot cells, and auxiliary equipment and instructions for its operation.

General Electric Company.

Hanford Atomic Products Operation, Richland, Washington

526

CORROSION RATES OF MILD AND STAINLESS STEELS EXPOSED IN REDOX STREAM IAW (ANL, JUNE 1, 1948 FLOWSHEET). W. W. Koenig Nov. 1, 1949. Decl. Feb. 20, 1957. 12p. (HW-14923)

A test program has been carried out to determine the relative corrosion resistance of welded mild and stainless steels in Redox Stream IAW neutralized to pH 0, 2, and 10. Stainless steel types T-304 and T-347 show excellent resistance to Redox Stream IAW neutralized to pH 0, 2, and 10. Mild steel type SAE 1020 shows good resistance to this stream at pH 10 and very poor resistance at pH 2 and 0.

527

CORROSION OF AUSTENITIC STAINLESS STEELS IN MJ-4 RAW STREAMS. W. W. Koenig. April 25, 1950. Decl. Feb. 19. 1957. 14p. (HW-17626)

The corrosion resistance of several austenitic stainless steels in the RAW stream of the Tributyl Phosphate Waste Metal Recovery Process was studied. Carpenter 20 and T-309 SCb steels showed good resistance, while T-304 ELC showed good to fair resistance, and T-347 showed fair resistance.

528

PROTECTION OF EXTERIOR BURIED WASTE LINES. Engineering Study No. 6. G. U. Udine. Sept. 24, 1952. Changed from OFFICIAL USE ONLY May 22, 1957. 43p. (HW-24500)

The protection of buried waste lines leading from radiochemical plants at Hanford is discussed. Methods in general use and methods presently used at Hanford are evaluated. Proposed types of waste line encasements, cathodic protection, and hazards from possible leaks in existing lines are discussed. A comparison of costs of existing and proposed methods is made and recommendations are given.

529

FACTORS AFFECTING THE CONCENTRATION OF TBP PLANT WASTES. D. F. Shepard. Mar. 25, 1953. Decl. Feb. 19, 1957. 11p. (HW-27489)

Control of neutralized waste pH at 9.5 has relieved the process difficulty of line plugging in the TBP plant waste disposal.

530

CATHODIC PROTECTION OF STAINLESS STEEL WASTE LINES. INTERIM REPORT NO. 1. UNDERGROUND PIPELINE AND STRUCTURE CORROSION STUDY PROGRAM. R. T. Jaske. Nov. 15, 1954. Changed from OFFICIAL USE ONLY Nov. 26, 1956. 26p. (HW-33504)

The advantages of cathodic protection are summarized. Comparative costs/ft are given for waste lines, encased waste lines, and net cost of cathodic protection. Included are photographs and figures describing pipe lay-outs and corrosive attacks.

531

AN EVALUATION OF BURIED WASTE LINE DESIGN FRACTURE. UNDERGROUND PIPELINE AND STRUCTURE CORROSION STUDY PROGRAM. Interim Report No. 2. R. T. Jaske. Apr. 1, 1955. Changed from OFFICIAL USE ONLY Jan. 23, 1957. Included reprint: EXAMINATION OF 335 MILES OF ASPHALT MASTIC COATED PIPE. Donald E. Miltner. *Corrosion* 9, 210-15 (1953). 43p. (HW-35009)

Economic comparison between bare and encased piping systems and the advantages of somastic coated pipe are outlined.

532

STUDY OF WASTE FACILITIES. H. W. Stivers. June 30, 1955. Changed from OFFICIAL USE ONLY Nov. 26, 1956. 19p. (HW-37680)

The purpose of this report is to develop an economic selection of conventional reinforced concrete structures of various shapes to establish a design criteria for intermediate level radioactive liquid waste facilities. The vault and the cavern type of storage facilities could be economically supplemented with the present tanks or used separately to meet the demands of present and future intermediate level radioactive wastes. The bare tank costs of these facilities for intermediate level waste storage are, respectively, $0.08 and $0.065/gal less than present conservative circular tanks used for intermediate and high level waste storage. This represents a 60 to 50% cost saving potential. The design criteria and the general shape of the facilities reduce the construction materials and earthwork quantities to achieve these lower unit costs.

533

FIELD CORROSION TESTS IN PUREX ACID URANIUM AND WASTE CONCENTRATORS. N. D. Groves and K. M. Haws. June 28, 1956. 10p. (HW-42884)

Field corrosion test heat exchangers have been installed in the F-6, F-11, H-4, J-8, and K-4 concentrator overflow chambers in the Purex facility. The test units are sealed down, single tube calandria type heat exchangers operating in parallel and under the same conditions as the production units. These units will be removed for examination just before or just after failure. The tests are designed to provide corrosion data on 304-L and 347 stainless steel, 308-L and 347 welding alloys, plus 3 candidate construction materials: 312 stainless steel, Ta, and Ti in Purex acid, U, and waste concentrators.

Los Alamos Scientific Laboratory

534

DESIGN AND PERFORMANCE OF AN EFFLUENT PLANT FOR RADIOACTIVE WASTES. J. A. Leary, R. A. Clark, and R. P. Hammond. Jan. 20, 1954. 20p. (AECU-2818)

The design and process efficiency of a kilocurie waste gas and liquid processing and disposal plant are described. Provisions were made for storage and handling of high-level γ-emitting liquids, dusts, and fumes, typical of wastes from a radiochemical processing laboratory. Separate waste streams for α emitters are employed. Design capacity of the system is 2 gpm of liquid and 30,000 cfm of air.

REFERENCES

Oak Ridge Gaseous Diffusion Plant

535

CORROSION OF VARIOUS METALS IN HYDROFLUORIC-SULFURIC ACID SOLUTIONS OF SYNTHETIC HANFORD WASTE. H. A. Bernhardt, W. Davis, Jr., and J. R. Flanary. Mar. 18, 1949. Decl. Dec. 23, 1955. 20p. (K-373; KLO-87)

The precipitation of U as UF_4 from $HF-H_2SO_4$ solutions of Hanford waste as a method of U recovery has imposed the problem of determining the type of metal that can be used for reactors. Ni, Monel metal and four stainless steels have been tested for their resistance to corrosion by such acid solutions. Ni and Monel corrode at rates of 0.019 and 0.062 in./yr. The former shows extensive flaking after about 20 days exposure. The stainless steels are quite corrosion resistant, varying in the ranges of 0.0032 in./yr for 302 stainless, about 0.001 in./yr for 304 and 316 stainless steels, and 0.00007 in./yr for 25-12 (Nb stabilized) stainless steel. A comparison of observed corrosion rates with an estimated maximum allowable corrosion rate of 0.01 to 0.05 in./yr suggests that all the stainless steels tested would meet this requirement while Monel and Ni would not. Welding has little effect on the corrosion rates of 304 and 316 stainless steels, the only welded steels tested.

Oak Ridge National Laboratory

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CORROSION OF TYPES 347 AND 309 SCb STAINLESS STEELS BY SIMULATED "25" PROCESS WASTE SOLUTIONS AT VARIOUS TEMPERATURES. Arnold R. Olsen. June 1, 1954. Decl. Feb. 14, 1957. 40p. (CF-54-6-7)

Corrosion tests on stainless steels Type 347 and Type 309 SCb exposed to concentrated simulated first cycle raffinate (predominantly $2.5\underline{M}$ $Al(NO_3)_4$) from "25" Process at Arco at temperatures from 120°F to boiling have been made. The corrosion rates are distinctly temperature dependent. Severe intergranular attack occurred at temperatures above 180°F disappearing at 150°F for Type 347 stainless steel and at 120°F for Type 309 SCb stainless steel. From the results of these tests it appears that successful storage of this waste for long periods of time will require that the solution temperature be maintained below 150°F.

537

THE CORROSION OF VARIOUS STAINLESS STEELS IN SYNTHETIC WASTE SOLUTIONS. James L. English. Feb. 12, 1951. Decl. Jan. 6, 1956. 25p. (ORNL-848)

Types 309, 316, and 347 stainless steel were tested for a total of 779 to 828 hr in 3 different synthetic waste solutions ($TBP-HNO_3-NaNO_3-PO_4^{-}-SO_4^{-}$). The NaCl content of these solutions ranged from $0.007\underline{M}$ to $0.028\underline{M}$. The test specimens were checked under conditions of total immersion, liquid-vapor exposure, and exposure to the vapor phase. Tests were run at boiling temperatures. The best all-around corrosion resistance to the test conditions was exhibited by 316 stainless steel, although in one solution 347 stainless steel was slightly more resistant. The tests were run at 105 to 108°C.

Phillips Petroleum Company.

Atomic Energy Division,

Idaho Falls, Idaho

538

IDO LIQUID WASTE PLANT, CPP 604 BUILDING OPERATING EQUIPMENT MANUAL. S. F. Fairbourne, V. W. Irvine, A. M. Larson, B. H. Macklin, L. G. Pearson, and H. L. Sexton, comps. May 22, 1952. Changed from OFFICIAL USE ONLY May 29, 1956. 164p. (IDO-14079)

A manual is presented dealing with information on some of the equipment in building CPP 604. The equipment is arranged according to number and a brief description and function are given. WM equipment is used in storage of liquid waste and WL is used in treating liquid wastes in the 604 area. A sketch of the vessels, heat exchangers and instruments is shown, giving nozzle arrangement and size. Additional information can be found from the fabricators or reference drawing numbers that are given.

Westinghouse Electric Corporation.

Bettis Plant, Pittsburgh

539

GENERAL SPECIFICATION FOR THE PWR COMMERCIAL NUCLEAR POWER PLANT WASTE DISPOSAL EQUIPMENT. E. Spec.-566210-A. [Dec. 12, 1955]. 6p. (WAPD-PWR-PMA-206)

Westinghouse Electric Corporation.

Commercial Atomic Power Activity,

Pittsburgh

540

PROPOSED 80,000 KILOWATT PRESSURIZED WATER REACTOR PLANT. PLANT DESIGN AND COST ESTIMATE. Feb. 1955. Changed from OFFICIAL USE ONLY May 17, 1956. 77p. (WIAP-7)

A brief description is given of stainless steel tanks used for storage of liquid wastes from the hot laboratory, back wash of the filters, water drained from the border loop, and the decontamination solutions.

Interim or Cooling Storage

General Electric Company.

Hanford Atomic Products Operation,

Richland, Washington

541

NEUTRALIZATION OF REDOX AQUEOUS WASTE STREAMS. M. K. Harmon. Feb. 15, 1949. Decl. Feb. 20, 1957. 10p. (HW-12566)

A study of waste solutions such as IAW showed that it will be necessary to raise the pH of the solutions to 10 or 11 with NaOH before the resultant thin slurry can be stored in underground steel or concrete tanks. The factors which are considered in the neutralization step are summarized.

542

CORROSION OF REDOX WASTE STORAGE TANK CONSTRUCTION MATERIALS. W. W. Koenig and K. L. Sanborn. Aug. 21, 1950. Decl. June 21, 1957. 43p. (HW-18595)

1960 342

REFERENCES

Austenitic stainless steel showed excellent corrosion resistance to the IAW Redox stream (synthetic) at pH = 0, 2, and 10, and should equal or better its performance in the present separations process. The resistance of the mild steel was primarily a function of the pH of the waste streams. None of the protective coatings gave completely satisfactory results under all the test conditions which were employed.

543

FIELD CORROSION TESTS—SAE 1020 STEEL IN BISMUTH PHOSPHATE PROCESS WASTE SOLUTION TANKS. N. Endow. Jan. 25, 1954. 17p. (HW-30641)

Field test results show that the SAE-1020 steel suffers severe general and pitting type attack in vapors over the metal waste solution, and that the attack is much less severe in the first cycle waste solution and in the vapors over this solution. The corrosion rate, in the case of severely attacked specimens, is not dependent upon the surface finish of the steel. Polished and fine-sand-blasted coupons exhibited approximately the same weight losses and pits of the same depths. Tables and photomicrographs included.

544

FIELD CORROSION TEST-SAE 1020 CARBON STEEL IN REDOX PROCESS WASTE SOLUTION TANK NO. 104, 241-S. N. Endow and K. L. Sanborn. Aug. 11, 1954. Decl. Jan. 6, 1956. 24p. (HW-32755)

Data collected in corrosion tests on SAE 1020 steel specimens exposed in the radioactive waste solution from the Redox plant indicate that the corrosion rates do not differ significantly under conditions of self-concentration of wastes, from those measured in similar solutions at temperatures less than boiling. This observation may be considered valid for Redox waste up to 250°F and may apply at temperatures somewhat above 300°F. The maximum temperature recorded for the waste solution in the tank in which the specimens were exposed was 250°F, although temperatures in excess of 300°F may have been attained during the test. One stressed specimen was included in the test for the purpose of evaluating possible effects of stress corrosion cracking, but no evidence of stress corrosion cracking was observed after 9 months exposure.

545

STRUCTURAL EVALUATION OF UNDERGROUND WASTE STORAGE TANKS. Edgar F. Smith. June 23, 1955. 39p. (HW-37519)

Present waste storage tanks were analyzed in accordance generally with the rational approach of the Portland Cement Association for circular concrete tanks. Certain basic assumptions were made, relating to load conditions, temperature effects and increased allowable unit stresses. The reinforcing steel was permitted to approach a tensile stress of 20,000 psi for sustained hydrostatic pressures and 27,000 psi when transient vapor pressures were imposed in addition to the liquid loading. This compares with a normal design stress of 14,000 psi. On the basis of these assumptions, limiting values of effective specific gravity and vapor pressure within the tanks have been estimated and plotted graphically. The maximum effective specific gravity and simultaneous allowable internal vapor pressure for liquid wastes at elevated temperatures in each of the present tank farm types was summarized. When specific gravity is reduced an increased vapor pressure would be permitted up to a limit of 10 psig beyond which the dome of the tank would be in jeopardy. Although actual structural collapse due to hydrostatic head is difficult to conceive, it is believed that the limiting values presented cannot be exceeded without endangering the integrity of the structure from the standpoint of splitting open and permitting leakage through wide cracks.

546

FIELD CORROSION TESTS IN REDOX AND PUREX UNDERGROUND WASTE STORAGE TANKS. N. D. Groves, M. C. Fraser, and W. L. Walker. June 28, 1955. Changed from OFFICIAL USE ONLY Mar. 22, 1957. 11p. (HW-37642)

A corrosion-testing program has been initiated in Purex and Redox storage tanks to obtain corrosion data on carbon steel, and 3 associated materials in neutralized process wastes.

547

WELDABILITY TESTS OF FOUR HIGH STRENGTH STRUCTURAL STEELS. G. W. Riedeman. Aug. 9, 1955. 8p. (HW-37956)

As part of a design program for HAPO waste storage tanks, a study was made of possible fabrication materials. This study revealed that the steels which were tested can be welded without the benefit of preheat and/or postheat treatment for structural applications involving materials about one-half inch in thickness using low-hydrogen, iron-powder-coated electrodes.

548

OPERATIONAL CHARACTERISTICS OF SUBMERGED GAS-LIFT CIRCULATORS. M. W. Cook and E. D. Waters. Dec. 1, 1955. 130p. (HW-39432)

Performance tests have shown that totally submerged gas-lift circulators offer an economic and effective means for achieving mild liquid agitation in large tanks.

549

PRODUCTION OF ACIDITY IN STORED WASTE. L. L. Burger. Oct. 26, 1955. 3p. (HW-39658)

The contemplated use of air-lift pumps to promote liquid circulation in waste storage tanks has raised the question of N fixation in the air by the high radiation. This production of oxides of N, known to occur primarily in the gas phase rather than through dissolved N, would result in a continued rise in acidity in the waste solution with attendant corrosion problems. A parallel question concerns the neutralization produced by the CO_2 present in atmospheric air. N fixation in the air by radiation, highest in the case of Purex wastes, should contribute at most a few millimoles of acid per liter of solution per yr. An air rate of 5×10^{-4} cfm/l of waste would introduce acidity from the CO_2 present at a rate of 1.7 millimoles/l/yr, also an insignificant rate. More acidity may conceivably be produced by radiation decomposition of organic matter present.

550

PUREX WASTE STORAGE. PART 1. 241-A WASTE STORAGE FACILITIES. G. L. O'Neill and W. H. Swift. Mar. 7, 1956. 20p. (HW-41791(Pt.1))

Storage of the fission products separated from the product streams of the Purex process is being accomplished using a smaller volume of accompanying solution than any other process here-to-fore used at HAPO. The operating technique and control mechanisms which are needed to store large quantities of these highly radioactive wastes are not as yet fully understood, but considerable insight into the problem has been gained from the experience at Redox during the last 36 months. The basic intentions of the 241-A Storage Facility design is to control the boiling wastes by providing suitable tanks to contain the liquid and a vapor system provided with suitable seals to control the vapors. This document (Part I) will present a somewhat detailed description of the Purex Storage Facility, and a review of the activities there before plant start-up. Part II, published under separate cover, contains a description of Waste Farm technology including a process description as a recommended plan for operation.

551

FISSION PRODUCT HEAT GENERATION TABLES. W. H. Swift and G. L. O'Neill. Apr. 10, 1956. 57p. (HW-42488)

The heat generation by the radioactive decay of fission products associated with one ton of irradiated U was calculated by the IBM 702 computer for several irradiation histories and for cooling time of 60 to 4000 days. Only those fission products of interest in separations plant waste storage were considered. These fission products are listed along with pertinent data.

552

THE DESIGN AND APPLICATION OF A HEAT TRANSFER ANALOGUE FOR RADIALLY SYMMETRICAL PROBLEMS. M. W. Cook. Jan. 30, 1957. 39p. (HW-47088)

An electrical heat transfer analogue of a typical HAPO waste tank has been designed, constructed, and tested. A typical steady state temperature profile obtained from this analogue is reported. A complete summary of both steady and transient state temperature profiles is presented and discussed in HW-47087. The analogue, which was constructed of Teledeltos conductive paper, is shown. Design and Construction details are discussed and this particular type of analogue is compared with other methods of solving the problem. The analogue comprises ~3000 individual resistance elements which were made by drafting techniques. Approximately 125 drafting hr were required, and about 400 man hr were required to design, assemble, and test the analogue. Although the materials used in the analogue were very inexpensive, the large costs of man power would indicate that future analogues of this kind could be constructed more economically from standard carbon resistors. Such an analogue would also be more compact. With either type of conductor, satisfactory accuracy is obtainable.

553

DECONTAMINATION OF BISMUTH PHOSPHATE FIRST CYCLE WASTE SUPERNATANTS. R. E. Burns, H. S. Gile, C. R. McMullen. Sept. 10, 1953. Decl. Oct. 2, 1956. 17p. (TID-10142)

First decontamination cycle wastes from the Hanford Atomic Products Operations Bismuth Phosphate process are made alkaline and stored in large underground tanks. Settling of solids produced on making the wastes alkaline effects considerable decontamination but not enough that very large volumes of the supernatants can be discharged to ground. The effectiveness of tannic acid, $Ca_3(PO_4)_2$, CaC_2O_4, $Fe_4[Fe(CN)_6]_3$, and $Fe_2Fe(CN)_6$ as carrier precipitates, and CaC_2O_4, Attaclay, and Attapulgus clay as solid adsorbents for the decontamination of supernatants from aged first cycle wastes has been studied. Pu, fission-product, and gross salt content of supernatants from several waste tanks are given along with decontamination factors for Pu and fission products obtained when these supernatants were treated under varying conditions with the adsorbents and carrier precipitates noted above.

Knolls Atomic Power Laboratory,

Schenectady, New York

554

A SURVEY OF THE LIQUID WASTE STORAGE FACILITIES AT KAPL WITH RESPECT TO COSTS AND FUTURE REQUIREMENTS. J. D. Evans and F. N. Schell. Nov. 28, 1951. Decl. Feb. 8, 1956. 14p. (KAPL-M-FNS-3)

This study showed that there are ample storage facilities for high level wastes at KAPL for the next $2\frac{1}{2}$ yr providing the present accumulation rates are not exceeded. The concentration of the contents of the tanks would provide an additional 3 yr of storage space. The cost for the storage of these wastes was computed to be ~$8.90/gal which can be broken down as follows:

Operations		$5.30
Process Costs	$1.56	
Overhead	3.74	
Storage		2.00
Concentrator Investment		1.60

The Concentrator costs are included in the over-all costs because a particular concentrator is used only for processing one category of waste. Some information was presented for the benefit of installations similar to KAPL pertaining to possible savings that could result through modification of some of the existing mechanical and construction features of the Waste Processing plant. It was found that the major factor influencing the process costs was the operating expenses and these would not vary appreciably at other installations. Modification of the construction features could provide a possible cost reduction of $0.54/gal. This figure includes a $0.32/gal reduction for the neutralizer or concentrator investment and a $0.22 reduction for the tank farm.

North American Aviation, Incorporated.

Atomics International Division,

Canoga Park, California

555

WASTE DISPOSAL. p.10-11 of THE KINETIC BEHAVIOR OF WATER BOILER TYPE REACTORS. Marlin E. Remley, John W. Flora, David L. Hetrick, and Leo P. Inglis. Apr. 1, 1956. 32p. (NAA-SR-1618)

The waste disposal system for the Kinetic Experiments on Water Boilers (KEWB) consists of three underground tanks and a 60 ft exhaust stack with a 2000-cfm blower system. A 300 gal tank, initially at vacuum, is used to collect gas directly from the reactor system. A second 1000 gal capacity storage tank is buried below floor level of the test building and will retain all liquid from the facility. The third underground tank has a 1000 gal capacity and will retain the reactor cooling water so that it may be checked for activity before being released to ground drainage. A diagram of the Reactor Test Bldg. is included.

556

PROCEEDINGS OF THE SRE-OMRE FORUM HELD AT LOS ANGELES, CALIFORNIA, NOVEMBER 8 AND 9, 1956. Jan. 15, 1957. 313p. (TID-7525; NAA-SR-1804)

A brief description is given on p.19, 39, and 40 of the SRE gaseous and liquid waste disposal systems. The system accepts vented gases from many of the components serviced by the N_2 and He systems, in the event that radioactivity levels in the vented gas are above some predetermined magnitude. The radioactive gas is then stored in either of two shielded tanks of 5400 ft^3 at 100 psig capacity. If, at some later time, the radioactivity level is determined to be sufficiently low, the gas may be bled from these storage tanks, diluted, and discharged out the building stack. The liquid waste is principally from fuel cleaning and hot cell operations. It is pumped from a sump to one or more of ten

50-gal "hold-up" tanks. If long half-life activities are involved, the waste is eventually stored in two shielded 5000-gal tanks.

Oak Ridge Gaseous Diffusion Plant

557

SAMPLING OF SITE "W" SUPERNATANT LIQUOR. A. A. Abbatiello, D. H. Stewart, and J. L. Waters. May 20, 1948. Decl. Feb. 8, 1956. 15p. (K-218)

The procedure and equipment used to remove a 28 gal sample of liquid from the Site "W" storage tanks are described. Radiation data taken during the sampling and recommendations for future liquid sampling programs are included in this report.

558

PROPOSAL FOR SAMPLING OF SITE "W" LIQUID AND SOLID WASTE. A. A. Abbatiello, R. N. Drucker, W. M. Wallace, and J. L. Waters. June 8, 1948. Decl. Feb. 8, 1956. 28p. (K-226)

A proposal for determining some of the physical properties of liquid and solid waste by means of a specially designed densitometer is presented. The data thus gathered would be used in determining the feasibility of two types of samplers described. Operating procedures and drawings of the devices are included. The equipment was built and tested on "cold runs."

559

A PROPOSAL FOR TAKING SAMPLE OF UNNEUTRALIZED WASTE. A. A. Abbatiello. Sept. 17, 1948. Decl. Dec. 27, 1955. 10p. (K-273)

A description is given of a proposed method for taking a 100 ml sample of 60 day unneutralized high level waste from a sampling station. Design and testing of equipment are described.

560

SLUDGE SAMPLING SYSTEM. A. A. Abbateillo. Dec. 9, 1948. Decl. Dec. 27, 1955. 16p. (K-316)

A clamshell-type sludge sampler was designed and built at K-25 and used at Hanford to obtain specimens of radioactive materials, at predetermined depths from the metal waste tanks T-101, T-102, and T-103. Construction of the device and experience in its use at Hanford are described.

Oak Ridge National Laboratory

561

CLINTON LABORATORIES PROCESS MANUAL. SECTION 8. WASTE DISPOSAL—WET B PROCESS. W. E. Kirst. [1943]. Decl. Feb. 12, 1957. 21p. (A-3789(Sect. 8))

All waste solutions and slurries containing varying amounts of radioactive materials which require permanent storage are neutralized to a pH of 7 to 7.5 by the addition of caustic and held indefinitely in underground concrete tanks. If the contents are not too greatly contaminated by radioactive material, they are discharged through the retention ponds to the river. If sufficiently contaminated, they are diverted to the underground tanks for permanent storage. All cooling water is collected in one of two retention ponds and analyzed for radioactivity. If satisfactory, it is discharged to the river. By proper control, radioactive materials in these ponds should never reach a concentration where their discharge to the river is not possible, although it may be necessary infrequently to choose an optimum time, or discharge in portions. Storage facilities are described in detail.

562

A STUDY OF THE EFFECT OF COOLING WATER TEMPERATURE ON HEAT TRANSFER BY NATURAL CONVECTION IN FIRST CYCLE WASTE TANKS WM-100, WM-101, AND WM-102. W. L. Carter. Mar. 7, 1952. Decl. Dec. 15, 1955. 20p. (CF-52-3-34)

Results are presented from a study of the effect of cooling water temperature on heat transfer by natural convection in first cycle waste tanks. A cooling coil designed by the Foster Wheeler Corporation is described.

563

MODIFICATIONS TO UNDERFLOW POT AND COOLING SYSTEM. H. O. Weeren. Oct. 17, 1955. Decl. Feb. 20, 1956. 8p. (CF-55-10-83)

Design information is presented on the underflow retention tank which is used for the temporary storage of the concentrated wastes separated from reactor solution by the hydroclone. Modifications in the temperature regulating system of the tank are also outlined.

Vitro Corporation of America, New York

564

RECOMMENDATIONS FOR THE STORAGE OF RADIUM CAKE. George White, Jr. and W. P. Lamb. May 20, 1949. Decl. with deletions Dec. 5, 1955. 27p. (AECD-3793)

Shipping of Wastes

Oak Ridge National Laboratory

565

RADIOACTIVE WASTE ECONOMICS: OPTIMUM STORAGE TIME PRIOR TO SHIPPING TO DISPOSAL SITE. H. R. Zeitlin and J. W. Ullmann. Oct. 24, 1955. 20p. (CF-55-10-101)

Optimum cooling times were determined for 250 gal batches of waste (800 gal/ton) from fuel irradiated 400 days to 10,000 MWD/T. The conclusions that can be drawn are that as the storage cost increases it becomes economical to ship shorter cooled waste. As the shipping distance increases, it becomes economical to store waste longer. In the case of $0.30/gal/yr storage, for 200 miles shipment, essentially no storage should be provided beyond that required for surge in filling carriers. The above conclusions are based on 10,000 MWD/T fuel. For less highly irradiated material, the optima would shift in the direction of shorter cooling times.

566

COMMENTS ON THE TRANSPORTATION OF IRRADIATED FUEL AND RADIOACTIVE WASTES FOR M. LOUIS ARMAND, EURATOM GROUP. F. L. Culler. May 6, 1957. 32p. (CF-57-5-24)

General considerations involving the transportation of irradiated fuel and radioactive wastes are reviewed. It is assumed that many reactors will supply feed to a few large multipurpose chemical plants which ultimately send radioactive waste to a few disposal sites. General economic considerations of irradiated fuel reprocessing, economic aspects of the nuclear economy complex, growth predictions of the nuclear power economy in the U. S., general requirements for the shipment of fuel and waste, regulations applicable to fuel shipment, and permissible radiation levels are discussed.

Vitro Corporation of America, New York

567

BULK STORAGE OF RADIUM CAKE—PRELIMINARY COST ESTIMATES. June 15, 1949. Decl. with deletions Feb. 26, 1957. 30p. (KLX-015(Del.))

Two alternates were considered for transferring Ra cake from the point of manufacture to the place of storage. The cake produced in drums should be emptied individually into a storage basin, and the slurry should be put in a tank car for future pumping into a storage basin. As a result of this cost study, it is recommended that bulk storage loading be accomplished by the tank car transfer of Ra cake in slurry form. The tank car transfer method is more attractive from an engineering viewpoint than the drum transfer method, but the capital investment of this system is much higher.

Gaseous Wastes

Treatment and Disposal

Aerosols and Particulates

Argonne National Laboratory, Lemont, Illinois

568

REMOVAL OF HALOGENS, CARBON DIOXIDE, AND AEROSOLS FROM AIR IN A SPRAY TOWER. R. C. Liimatainen and W. J. Mecham. Feb. 28, 1955. 37p. (ANL-5429)

The purification of air from laboratory exhausts by the absorption of possible impurities (halogen compounds, CO_2, and aerosols) in multiple-nozzle spray towers has been investigated. The absorptive properties of the spray towers were compared to those of packed towers.

569

EFFICIENCY STUDIES OF A HIGH-EFFICIENCY, HIGH-TEMPERATURE FILTER AGAINST FRESHLY GENERATED URANIUM OXIDE FUME. Edward W. Conners, Jr. and Donald P. O'Neil. June 1954. 19p. (ANL-5453)

Results of an investigation of the efficiency of a high-efficiency high-temperature filter against freshly generated U oxide are given. Efficiencies ranged from 95.5 to 99.5% against an aerosol having a count median diameter of 0.12 μ and a geometric standard deviation of 3.29. Factors affecting the performance of this filter and the effect on permissible stack emissions are discussed.

570

PRODUCTION AND ANALYSIS OF RADIOACTIVE AEROSOLS. Richard Abrams, A. M. Potts, C. E. Beilman, I. Wender, W. Lohr, S. Postel, L. L. Forker. July 2, 1946. Decl. Mar. 11, 1947. 80p. (MDDC-795)

The study includes: procedures for production of aerosols; measurement of particle size and concentration; carrier-free materials used; exposure of animals to the aerosols; and remote control handling techniques.

Atomic Energy of Canada Limited. Chalk River Project, Chalk River, Ontario

571

THE ANNULAR IMPACTOR. G. W. C. Tait. June 22, 1955. 14p. (CR-HP-577; AECL-130)

An air sampling device is described based on the impaction principle. It differs from previous instruments in being capable of sampling at very high rates of the order of 700 l/min. This has been achieved by using a very simple arrangement of the impactor parts with the jet in the form of an annular ribbon. It appears particularly useful for application to the sampling of dusts containing long lived α emitters. Such dusts heretofore had been difficult to assess due to the presence of appreciable concentrations of natural Rn decay products. The impaction device differentiates sharply between most relatively coarse industrial dusts and the finer natural dust on the basis of a separation between particles greater than and those <0.5 μ diam. Good discrimination is achieved since dusts arising from most technical processes have a mass median well over 1 μ whereas Rn decay products have been found elsewhere to be preferentially associated with particles less than 0.04 μ diam. Results of field testing are given.

Battelle Memorial Institute, Columbus, Ohio

572

DEVELOPMENT OF A RADIOACTIVE-DUST COLLECTOR. FINAL REPORT. W. A. Spraker and R. D. Ellsworth. Sept. 23, 1954. 59p. (NP-5489; ETF-760.92-2/Final)

A portable battery powered radioactive dust collector has been developed that samples air at a rate proportional to the velocity of the prevailing wind over a range of 5 to 20 mph. The sampler retains particles in the range from 0.1 to 100 μ. It has a timing system to control the frequency and duration of sampling and is shock and corrosion resistant.

Bureau of Mines

573

INVESTIGATION OF A PHOTOELECTRIC DEVICE FOR THE DETERMINATION OF LOW CONCENTRATIONS OF DUST. D. E. Stone, L. J. Kane, T. E. Corrigan, H. W. Wainwright, and C. B. Seibert. Mar. 1951. 13p. (BM-RI-4782)

An apparatus is illustrated which was developed for testing instruments designed for continuously determining low concentrations of dust in air. A photoelectric device which continuously compares the intensity of a light beam passing through the gas with a similar beam passing through clean air, although satisfactory in other respects, had a sensitivity of only 0.75 grain/100 ft^3. Work is continuing with the object of improving this factor. The calibration curve is similar to the anode-voltage curve of the phototube. Greatest sensitivity was obtained at an illumination of 0.5 ft-c.

1960 346

REFERENCES

University of California, Berkeley.

Radiation Laboratory

574

A FILTRATION STUDY OF A SPARK GENERATED AEROSOL OF THE TRANSPLUTONIUM ELEMENTS. J. G. Conway, G. T. Saunders, and M. F. Moore. June 7, 1951. Decl. July 30, 1951. 9p. (AECD-3221; UCRL-1355)

A description is given of a closed-system type filter train which was developed for protection against the radioactive aerosol produced by sparking in spectrographic analysis of transplutonium elements. Samples in the range 1 to 50 μg with an activity level of $\sim 10^8$ cm were involved. The equipment is described and diagramed, and report is made of analytical experiments performed to test it. Incorporated into the filter system are check points that are utilized to establish a material balance within the train. The final check point, an evacuated cylinder, shows that 1 part in 10^{10} passes through the filtering train.

University of California, Los Angeles.

Atomic Energy Project

575

DEVELOPMENT OF CONTINUOUS JET IMPACTION METHOD FOR DETERMINING AIR BORNE CONTAMINANTS. L. Baurmash, L. Curtis, F. A. Bryan, and B. Cassen. Apr. 21, 1949. 13p. (AECU-206; UCLA-13)

A continuous method of air sampling based on impaction methods has been used with excellent results. The collecting cycle can be varied so that the sampling unit can be used for various types of collections. Variations due to changes in air-borne dust concentrations are readily visible.

576

A METHOD FOR PARTICLE SIZE DETERMINATIONS OF DUSTS COLLECTED ON MEMBRANE FILTERS. W. C. Burke, Jr. July 6, 1953. 16p. (UCLA-262)

A method for size determinations of dust collected on membrane filters has been developed. Results indicate that the reproducibility and accuracy are good. The membrane filter is dissolved in an organic solvent, and the resultant suspension is analyzed turbidimetrically. Determinations by this method are rapid and easily carried out.

Chemical Corps, Camp Detrick, Maryland

577

THE DETERMINATION OF VIABLE PARTICLE SIZE DISTRIBUTION. A NEW APPLICATION OF THE CONIFUGE. INTERIM REPORT NO. 73. Frank R. Olson and John F. Lee. June 1954. 29p. (AD-41950)

The conifuge is a conical centrifuge with the internal air flow so arranged that particles are deposited on the inner surface of the outer cone according to their mass, with the heavier particles deposited at the upper end. Application is described of the conifuge to determining viable particle size distribution of a biological aerosol. Experiments are described which demonstrate the usefulness of the new method in studying the performance of various atomizers and the effects of various suspending fluids on particle size of biological aerosols.

Army Chemical Center, Maryland.

Chemical Warfare Laboratories

578

DEPOSITION OF AIRBORNE PARTICLES ON A LARGE HEATED SURFACE. Martin Harwit. Feb.1956. 35p. (CWLR-2046)

The effect of a large heated surface on the deposition pattern from a polluted atmosphere is studied. It is concluded that the use of heat to avert the deposition of particulate matter 20 to 300μ is not practical.

579

ADSORPTION OF VAPORS ON SOLID AEROSOLS (DUSTS). V. Alexander Gordieyeff. Aug. 17, 1956. 59p. (CWLR-2051)

Results are presented of the first part of a study on the mechanism of interaction of vapors and aerosols, and deals with adsorption of vapors on airborne porous dusts. The essential mechanism of adsorption by bulk dust and its airborne fraction is identical. The peculiarities of the aerosol state are responsible for the extremely fast rates of adsorption and desorption, differential sorbate transfer between particles of different sizes, tendency to a decreasing sorptivity as a decreasing particle volume decreases pore volume, cloud effects interfering with adsorption and causing an increase of sorptivity with an increased concentration of the airborne mass, and relatively low sorptivity and vapor retentivity in saturated atmospheres. Generally, airborne dusts may be regarded as poor carriers of volatile toxic substances.

580

ABSORPTION OF VAPORS BY LIQUID AEROSOLS. V. Alexander Gordieyeff. Aug. 17, 1956. 53p. (CWLR-2052)

Results are presented of the second part of the study on interaction of vapors and aerosols, i.e., absorption of vapors by airborne droplets. The absorption mechanism by airborne droplets does not differ significantly from that by the stationary bulk of absorbent. The peculiarities of the aerosol state are responsible for extremely fast rates of absorption and desorption, differential sorbate transfer between particles of different sizes, differential growth of particles of different sizes, and cloud effects interfering frequently with the process of absorption. Airborne droplets may generally be regarded as poor carriers of volatile toxic vapors.

Columbia University, New York.

Central Aerosol Laboratories

581

PART B. THE METHODS OF FORMING, DETECTING AND MEASURING THE SIZE AND CONCENTRATION OF LIQUID AEROSOLS IN THE SIZE RANGE OF 0.01 TO 0.25 MICRONS DIAMETER. p.18-65 of FINAL REPORT ON NAVY CONTRACT; JUNE 29, 1948-JUNE 28, 1949. Victor K. La Mer, Edward C. Y. Inn, and Irwin Wilson. [nd]. 65p. (NP-3805)

The objective of this research was to develop methods of producing, detecting, and measuring rapidly and easily the size and concentration of liquid aerosol droplets in a range (0.01 to 0.08 μ) smaller than those at present available.

1960 347

The new contribution to the method of measurement of particle size consists in growing quantitatively exceedingly small aerosol droplets to a size range where they can be measured by established optical methods.

582

STUDIES ON FILTRATION OF MONODISPERSE AEROSOLS. Victor K. La Mer. Mar. 31, 1951. 128p. (NYO-512)

A detailed report is presented of an extensive study of aerosols with particular regard to (1) production, (2) the growth method of determining particle size, and (3) the filtration of fine monodisperse particles. Both experimental results and theoretical concepts are included.

583

FILTRATION OF MONODISPERSE ELECTRICALLY CHARGED AEROSOLS: PART I. FILTRATION OF CHARGED AND UNCHARGED AEROSOL PARTICLES. PART II. THE EFFECT OF DROPLET CURVATURE ON THE GROWTH AND SIZE DISTRIBUTION OF AEROSOLS. PART III. EFFECT OF CHARGING ON LIQUID DROPLET RADII. June 30, 1952. 100p. (NYO-514)

The effect of the presence of electric charges on the filtration characteristics of aerosols through various filter media was investigated. The net effect of electrical charges is to reduce the penetration uniformly as a function of radius. It is shown that some of the generally accepted results indicating the dependence of size distribution on growth occur for only special types of growth. The effect that charging of aerosol droplets has on their size is compared with the predicted effects of charged nuclei on the condensation of vapor.

Convair, Fort Worth, Texas

584

AERIAL SAMPLING OF EFFLUENT FROM WASTE FIRES. H. G. Bradbury and M. J. Young. Dec. 15, 1957. 36p. (NARF-57-56T; MR-N-188)

This airborne sampling device makes it possible to obtain representative samples of air and particulate matter at altitudes up to 1000 ft and in winds up to 25 mph. The sampling apparatus consists of 2 model airplane engines which draw air through filters for continuous sampling of particulate matter; and 2 one gal jugs containing ballons which, by deflation, take volumetric samples of air. The sampling apparatus is carried aloft by means of a helium-filled kite balloon. The equipment is used at Convair to obtain samples of effluent from waste fires, for the purpose of studying diffusion in the NARF area. This report also explains how the apparatus has been used in the field. Although the experimental effort so far has been concentrated mainly on developing the equipment, sampling data have been obtained and are presented to demonstrate the feasibility of the equipment.

Du Pont de Nemours (E.I.) and Company.

Savannah River Laboratory,

Augusta, Georgia

585

SAVANNAH RIVER PLANT STACK GAS DISPERSION AND MICROCLIMATE SURVEY. L. L. Falk, C. B. Cave, W. R. Chalker, J. A. Greene, and C. W. Thorngate. Jan. 1953. 155p. (DP-19)

Atmospheric-diffusion and microclimate studies at Savannah River are reported. A new simple method was developed enabling operating personnel to establish the downwind concentration and dispersion pattern of materials released from stacks. A statistical study of atmospheric temperature inversions was made because of their influence on atmospheric diffusion. The microclimate of the plant site is compared with Augusta.

586

DESIGN OF A REGIONAL SURVEY PROGRAM. J. Henry Horton, Jr. Nov. 1957. 20p. (DP-253)

The fundamental principles of a Regional Survey program are discussed, and a sampling program for airborne and waterborne radioactivity is suggested. Laboratory analyses of α, β, and γ radiation are outlined, and appropriate counting equipment is suggested for the analyses.

Evans Signal Laboratory,

Belmar, New Jersey

587

A PORTABLE AIR SAMPLER FOR THE COLLECTION OF RADIOACTIVE DUST. Bernard Reich. Oct. 27, 1952. 21p. (ATI-187510; Technical Memo M-1472)

A unit is described which will determine the amount of airborne contamination in an area occupied or to be occupied by military personnel.

General Electric Company.

Hanford Atomic Products Operation,

Richland, Washington

588

FILTRATION OF RADIOACTIVE AEROSOLS BY GLASS FIBERS: PART ONE. A. G. Blasewitz, R. V. Carlisle, B. F. Judson, M. F. Katzer, E. F. Kurtz, W. C. Schmidt, and B. Weiderbaum. April 16, 1951. 126p. (HW-20847(Pt.I))

The disposal of radioactive waste gases from the plant-scale processes at the Hanford Works presents a problem that is of considerable importance in plant operation. This report is concerned with the intensive removal of the particulate matter suspended in the gas streams. In order to develop a filter unit having better performance characteristics than those of the presently employed sand filters, an extensive investigation of the filtration properties of glass fibers was undertaken. The program was divided into 4 portions consisting of (1) a study of the physical characteristics of glass fibers; (2) the determination of the size distribution and concentration of the particulate matter suspended in the gas streams at Hanford; (3) the correlation of pressure drop and collection efficiency under start-up conditions with superficial air velocity, the bed depth, and the packing density of the various types of glass fibers; and (4) a study of the expected service life of glass fiber filters. The results of the development program led to the design of glass plant sand filters with greater efficiency, a lower flow resistance, and a greater life expectancy. Such filters have been constructed and are presently employed at the Hanford Works. From the operational standpoint, the performance of fixed-bed filters at this plant has been highly satisfactory. Part II of this report is composed of 5 appendices each of which pertains to a separate phase of the program. Four of the appendices contain experimental data presented in graphical form. The remaining appendix consists of a series of nomographs summarizing the permeability and efficiency characteristics of 3 types of glass fibers.

REFERENCES

589

FILTRATION OF RADIOACTIVE AEROSOLS BY GLASS FIBERS; PART TWO. APPENDICES. A. G. Blasewitz, R. V. Carlisle, B. F. Judson, M. F. Katzer, E. F. Kurtz, W. C. Schmidt, and B. Weidenbaum. Apr. 16, 1951. 120p. (HW-20847(Part II))

This report is composed of five appendices each of which pertains to the separate phases of the development program that led to the design of highly efficient, glass fiber filters. Four of the appendices contain experimental data presented in graphical form. The remaining appendix consists of a series of nomographs summarizing the permeability and efficiency characteristics of three types of glass fibers.

590

A STUDY OF EFFICIENCIES AND PRESSURE DROP CHARACTERISTICS OF AIR-FILTERING MEDIA. F. E. Adley, R. H. Scott, and W. E. Gill. Aug. 10, 1953. Changed from OFFICIAL USE ONLY July 6, 1956. 21p. (HW-28065)

Removal of particles from air is discussed in terms of 3 classes of filtering media — air-sampling, respirator, and air-cleaning. Of 11 filters having actual or possible application at Hanford Atomic Products Operation, 7 have uses in air-sampling, 4 in respirators, and 4 in air-cleaning. Their efficiencies in filtration were tested with a fume of U_3O_8 having a median particle size, by count, of 0.07 μ. Plots of efficiency versus filtering velocity are presented. The pressure drop characteristics of the filters are discussed in terms of initial pressure drops of the clean filters, variations in pressure drop of the individual filters, and comparison of loading rates. In a range of filtering velocities from 14 to 180 fpm, filters for air-sampling varied in efficiency from 28 to 99%, for respirators from 71 to 97%, and for air-cleaning from 96 to 99.9%. Among the more efficient filters, efficiency tended to decrease with increasing velocity. Initial pressure drops of these filters ranged from 0.04 to 3.0 in. of water at 14 fpm and from 0.5 to 38 in. at 180 fpm. A three-fold increase in the original pressure drops resulted from fume loads varying from 11 mg/ft^2 for low-capacity filters to 2800 for high-capacity filters.

591

COMPARATIVE STUDY OF ALTERNATIVE FIBROUS GLASS AND SAND EXHAUST VENTILATION AIR FILTER INSTALLATIONS FOR PUREX. Lyle L. Zahn, Jr. Dec. 14, 1953. Changed from OFFICIAL USE ONLY July 6, 1956. 18p. (HW-30142)

Results are presented from a study of the relative merits of fibrous glass and sand filter installations for the Purex Plant ventilation air system. Data are presented on both the economics and operating characteristics of the two installations. Reasons are given for the superiority of fiber glass.

592

FIBERGLAS AIR FILTERS FOR HOT LABORATORIES. L. E. Kattner and J. F. Gifford. June 18, 1954. 23p. (HW-30781)

Three sizes of disposable fiberglas filters have been used in Hanford laboratories over the past 3 yr for filtration of hot exhaust air from hoods and gloved boxes. The outstanding characteristics of these filters are their low cost and their ready disposability due to low weight and due to the seal method used. This report presents pictures and operating characteristics for the 3 filters and compares the hood filter with a corresponding Chemical Warfare Service filter in some detail.

Harvard University, Boston.

Air Cleaning Laboratory

593

HANDBOOK ON AIR CLEANING (PARTICULATE REMOVAL). Sheldon K. Friedlander, Leslie Silverman, Philip Drinker, and Melvin W. First. [nd]. Decl. Apr. 18, 1952. 114p. (AECD-3361; NYO-1572)

This handbook is a collection of current information on methods of removing particulate matter from gases and criteria for judging their effectiveness. It is divided into 4 chapters dealing with behavior of aerosols in air cleaning, air-cleaning equipment, performance and evaluation of air-cleaning equipment, and special problems involved in the cleaning of radioactive aerosols.

594

AN INVESTIGATION OF SPECIFICATIONS AND RATINGS OF COMMERCIAL AIR CLEANERS. PROGRESS REPORT. G. S. Reichenbach, Jr., Leslie Silverman, and Philip Drinker. July 1, 1949. 20p. (NYO-1517)

This report presents a study made to determine the scope of information available from manufactures of air cleaning and dust collection equipment. Data reported by manufacturers of air cleaning devices is tabulated.

595

FINAL PROGRESS REPORT: FEBRUARY 1, 1950: AEC CONTRACT NO. AT-30-1-gen-238. Leslie Silverman, Melvin W. First, G. S. Reichenbach, Jr., and Philip Drinker. Feb. 1, 1950. 65p. (NYO-1527)

Results of basic laboratory research on methods of increasing particle size and aggregation by condensation from sprays or other suitable means are given. Data and techniques used for a limited number of field studies of the performance of various dust and fume collectors are also presented.

596

A PRELIMINARY FIELD SURVEY OF AIR CLEANING ACTIVITIES AT ATOMIC ENERGY COMMISSION FACILITIES, SEPTEMBER-NOVEMBER 1950. August T. Rossano, Jr., Leslie Silverman, and Melvin W. First. Feb. 1, 1951. Decl. Feb. 28, 1957. 51p. (NYO-1580)

This report contains information on air and gas cleaning methods and equipment now in use at various sites. Performance data, pertinent comments, and recommendations are included on present and proposed installations. The sites surveyed are Mound Lab., Argonne National Lab., Los Alamos Scientific Lab., Univ. of California Radiation Lab., Knolls Atomic Power Lab., Hanford Atomic Products Operations, Ames Lab., Oak Ridge National Lab., Westinghouse Atomic Power Div., Mallinckrodt Chemical Works, and Brookhaven National Lab.

597

AIR CLEANING STUDIES; PROGRESS REPORT FOR FEBRUARY 1, 1950 TO JANUARY 31, 1951. Melvin W. First, Leslie Silverman, Richard Dennis, Glenn A. Johnson, August T. Rossano, Jr., Ralph Moschella, Charles Billings, Edward Berly, Sheldon Friedlander, and Philip Drinker. June 30, 1951. 222p. (NYO-1581)

This report covers the correlation and study of air and gas cleaning activities at the sites and among the AEC contractors and provides for consultation on problems that arise. A major consideration is the research and development on new methods and devices for air and gas cleaning. The program has as its basic objectives the following items; methods of collection and evaluation of samples, evaluation of commercial air cleaners, correlation and collation of in-

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formation on air and gas cleaning in all activities, research and development of new equipment, preparation of a practical handbook and training and educational activities for personnel.

598

EFFICIENCY STUDIES OF FIBERGLAS PREFILTERS FOR CHEMICAL AND LABORATORY HOODS (Argonne National Laboratory Type). Leslie Silverman, Melvin W. First, and Philip La Torre. June 6, 1952. 17p. (NYO-1584)

An evaluation was made of 3 types of chemical hood filters composed of ½-in.-thick preformed resin-bonded glass fiber batts, pleated into 16 × 20 × 2-in. steel frames. On the basis of the National Bureau of Standards discoloration tests, using atmospheric dust, and the American Society of Heating and Ventilating Engineers weight efficiency tests, it was concluded that the 3 different designs were equivalent in retention and in air flow resistance.

599

REMOVAL OF SOLUBLE GASES AND PARTICULATES FROM AIR STREAMS (With special reference to fluorides). Edward M. Berly, Melvin W. First, and Leslie Silverman. Apr. 18, 1952. 48p. (NYO-1585)

High-efficiency absorption of soluble or reactive gases can be obtained with available equipment using wetted fiber beds. Wetted fibers are 5 to 10 times more efficient than Raschig rings or Berl Saddles when compared on the basis of equal volumes. When compared on the basis of weight of packing, 1 lb of 78-μ-diam. Saran fibers are about 150 times more efficient for the absorption of HF gas than 1 lb of ½-in. Raschig rings. This reduction in weight and bulk can be utilized to realize important savings in construction and maintenance of gas-absorbing systems. A 5-stage system of concurrently wetted fiber beds and countercurrent stages can produce 70% HF from 19.8% HF gas and give a gaseous effluent which is hygienically safe. Scrubbing of lean gas concentrations for control of atmospheric pollution may be accomplished in one or, at most, 2 stages containing bed depths not >4 in.

600

AIR CLEANING STUDIES; PROGRESS REPORT FOR FEBRUARY 1, 1951 TO JUNE 30, 1952. Melvin W. First, Leslie Silverman, Richard Dennis, August T. Rossano, Charles Billings, Edward Conners, Ralph Moschella, Edward Berly, Sheldon Friedlander, and Philip Drinker. Dec. 16, 1952. 132p. (NYO-1586)

Progress of the work is reported on methods of collection and evaluation of gas samples, evaluation of commercial dust collector performance, research and development of air cleaning methods and equipment, and consulting and training services to the AEC.

601

PERFORMANCE CHARACTERISTICS OF WET COLLECTORS. Melvin W. First, Glenn A. Johnson, Richard Dennis, Sheldon Friedlander, and Leslie Silverman. Mar. 11, 1953. 76p. (NYO-1587)

The performance characteristics of an experimental cyclone scrubber and a commercial dynamic inertial-type wet collector were investigated to obtain information concerning the fundamental principles of wet collection and to develop criteria for predicting and improving the performance of practical collecting devices. Photographs of the scrubber and its allied components are shown and its efficiency characteristics are presented in graphic form.

602

PERFORMANCE OF COMMERCIAL DUST COLLECTORS. (REPORT OF FIELD TESTS). Richard Dennis, Glenn A. Johnson, Melvin W. First, and Leslie Silverman. Nov. 2, 1953. 45p. (NYO-1588)

An investigation was made of the performance of common types of commercial aircleaning equipment for the collection of a variety of industrial aerosols. Test results are reported for dry inertial type collectors, cloth screen and tube filters, reverse jet filters, wet scrubbers, and low-voltage electrostatic precipitators.

603

LABORATORY PERFORMANCE OF FABRIC DUST AND FUME COLLECTORS. Charles E. Billings, Melvin W. First, Richard Dennis, and Leslie Silverman. Aug. 31, 1954. 129p. (NYO-1590)

Three representative commercial fabric dust collectors have been investigated to determine fundamental operating characteristics. These characteristics include resistance, collection efficiency, type of fabric, effectiveness of cleaning mechanism as related to aerosol characteristics, dust loading, and filtering velocity. One collector tested employed intermittent cleaning of sateen weave cotton filter bags by mechanical shaking without air flow. Another collector utilized continuous cleaning of a wool felt filter bag by means of a high-velocity jet of reverse flow air blown through the media from a traversing ring on the clean air side. No interruption of primary air flow occurred during cleaning. The third collector tested contained 4 compartments with provision for automatic cleaning by rapping each compartment separately while back flow air was admitted to the bags (sateen weave cotton). During rapping of bags in one compartment primary air flow was maintained by the other three. Comparison of performance of these 3 collectors showed that the intermittently cleaned unit had high collection efficiencies with low resistance and filtering velocity but had large variations in resistance with heavy dust loadings; the reverse-jet unit had moderately high collection efficiencies, was capable of high filtering velocities, and its resistance was relatively independent of dust loading; the periodically cleaned collector had the lowest collection efficiencies and the highest operating resistances at moderate filtering velocities.

604

AIR CLEANING STUDIES. PROGRESS REPORT FOR JULY 1, 1952 TO JUNE 30, 1953. Melvin W. First, Leslie Silverman, Richard Dennis, Charles Billings, August T. Rossano, Edward Conners, Richard Coleman, and Philip Drinker. Aug. 5, 1954. 37p. (NYO-1591)

Studies are reported on the principles of cloth filtration and applications in wet dust collection; studies of the efficiency of fibrous media as air filters; and studies of the role of electrostatic charge in aerosol filtration.

605

PERFORMANCE OF THE MODEL K ELECTRO-POLAR FILTER. (Report of Laboratory Tests). Charles E. Billings, Richard Dennis, and Leslie Silverman. July 15, 1954. 30p. (NYO-1592)

Results of performance tests are presented for the Model K Electro-Polar Filter, a high efficiency, low-loading dust collector developed by the Western Precipitation Corporation. Collecting mechanisms in this device combine the filtration characteristics of fine Fiberglas mats with the electrostatic effects produced by placing the mats between a positively charged (15 kv) screen and a grounded screen.

606

ELECTROSTATIC MECHANISMS IN FIBER FILTRATION OF AEROSOLS. August T. Rossano, Jr. and Leslie Silverman. May 11, 1955. 60p. (NYO-1594)

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A detailed evaluation is presented of the magnitude of the electrostatic factor in the efficiency of aerosol filtration through fibrous filters. Data are presented from a series of tests in which methylene blue spheres were used as the test aerosol and all collection parameters, excepting electrostatic extraction, were maintained constant through the test series. Aerosol charge measurements were based on the Faraday Ice Pail principle. Test equipment is described, and results are presented graphically. Quantitative information is included on the role of electrostatics as a removal mechanism in aerosol filtration.

607

AIR CLEANING STUDIES. Progress Report for July 1, 1953 to June 30, 1954. Richard Dennis, Leslie Silverman, Charles E. Billings, August T. Rossano, Jr., Edward Conners, Jr., Richard D. Coleman, David M. Anderson, William R. Samples, and Philip Drinker. Jan. 15, 1956. 58p. (NYO-4608)

Investigations on the principles of cloth filtration, the role of electrostatic forces in gas cleaning, and studies on resistance and filtration characteristics of fiber beds were continued during the period. New projects included rating of several types of roughing filters, evaluation and testing of stain efficiency techniques, and a study of blast damages to and re-entrainment from high efficiency filters.

608

ELECTROSTATIC MECHANISMS IN AEROSOL FILTRATION BY MECHANICALLY CHARGED FABRIC MEDIA AND RELATED STUDIES. Leslie Silverman, Edward W. Conners, Jr., and David M. Anderson. Sept. 4, 1956. 61p. (NYO-4610)

Test results are presented in which a mechanically induced electrostatic charge on certain fabrics is employed as an aid in the removal of particulate matter (atmospheric dust) from air at room temperature. The theory of mechanically induced static charges and some experimental data are presented.

609

AIR CLEANING STUDIES. Progress Report for July 1, 1954 to June 30, 1955. Richard Dennis, Leslie Silverman, Charles E. Billings, David M. Anderson, William R. Samples, Harry M. Donaldson, Jr., and Philip Drinker. Oct. 15, 1956. 56p. (NY 4611)

Progress on the air and gas cleaning project conducted by Harvard University for the Engineering Division of the Atomic Energy Commission is reported. Primary objectives of this project include research and development on air and gas cleaning devices and methods for their testing and evaluation, training and education of Commission and contractor personnel, collection and correlation of information on air and gas cleaning techniques, and consultation services. Investigations on the role of electrostatic forces in gas cleaning, studies on resistance and filtration characteristics of fiber media, a study of dust re-entrainment from filters exposed to shock waves, and rating of high efficiency roughing filters were continued. New projects included determination of gas cleaning requirements for a pilot model institutional incinerator, a theoretical study of the behavior of null-type sampling probes, evaluation of miniature cyclones for gas sampling and laboratory testing of a new type wet scrubber and 2 commercial collectors employing electrified fiber mats.

610

EVALUATION OF AN EXPERIMENTAL FRENCH WET SCRUBBER "SOLIVORE." Edward Kristal, Richard Dennis, and Leslie Silverman. Mar. 29, 1957. 57p. (NYO-4612)

Performance tests were conducted on an experimental model of a French wet scrubber called the "Solivore." This unit (600 cfm capacity) consists of 4 similar collection stages in series, each containing two $1\frac{1}{2}$ hp spray generators rated at 9 gpm and 7 psi, and a special Venturi tube. A distinctive feature of this device is the spray generator which uses a rotating mechanical interrupter to disintegrate small liquid jets. Weight collection efficiencies were obtained with several aerosols for inlet dust loadings ranging from 0.02 to 2 grains/ft^3, water rates of 6 to 12 gpm per spray generator and for one, two, and three stage operation. Efficiencies determined for a single stage varied from 99% for resuspended fly ash to 22% for iron oxide fume. Coarse and fine H_2SO_4 mists were collected at efficiencies of 95 and 5%, respectively. Collection efficiency for SO_2 in low concentrations (130 mg/m^3) averaged 91% with three stages. Efficiency varied directly with the number of collection stages and water rate and inversely with the gas flow through the unit. Total pressure loss for one stage operation (including droplet eliminator) was 4.5 in. of water at rated capacity. An additional pressure loss of 2 to 3 in. of water per collection stage was observed for multi-stage operation.

University of Illinois, Urbana.

Engineering Experiment Station

611

IMPACTION OF DUST AND SMOKE PARTICLES ON SURFACE AND BODY COLLECTORS. W. E. Ranz and J. B. Wong. [nd] 49p. (AECU-1859)

An investigation of the mechanism of collection of dust and smoke particles of submicron size was undertaken from the standpoint of a fundamental study of the impaction of aerosol particles on elementary collectors. The systems analyzed were (1) rectangular and round aerosol jets impinging on flat plates (jet impactors and impingement separators); and (2) cylindrical and spherical collectors placed in aerosol streams (fibrous filters and wet scrubbers). Experimental data are presented on impaction efficiencies of glycerol and H_2SO_4 aerosols of nearly uniform size under various flow conditions. Rates of collection were determined for impaction on wires and spheres in aerosol streams moving at various velocities, and for impingement on flat plates from rectangular and round aerosol jets of different sizes. The results were correlated in terms of impaction efficiencies as a function of the particle diameter, a characteristic dimension of the jet or collector, and the velocity of the aerosol stream. Theories for the physical motion of small particles and for impaction on collectors were compared with the experimental results. Electrostatic effects were also taken into consideration. Application to practical processes are shown.

612

COLLECTION OF AEROSOL PARTICLES IN THE PRESENCE OF ELECTROSTATIC FIELDS. Herbert F. Kraemer and H. F. Johnstone. [1954]. 44p. (AECU-2972)

A fundamental study of the deposition of particles on stationary spherical and cylindrical obstacles from a moving aerosol stream in the presence of electrostatic forces is of value in predicting the performance of new types of dust removal equipment. Theoretical equations were derived for the fraction of the aerosol deposited. An electronic digital computed, the ILLIAC, was used to solve the equations. The deposition of homogeneous dioctyl phthalate aerosols on a spherical collector was measured experimentally with various combinations of charged and uncharged collectors and aerosol particles. The experimental results agree with those predicted by the theory within the accuracy of the analytical methods used to measure the deposition. As a result of the investigation, 2 new types of dust collection equipment are proposed for pilot plant study.

613

PROPERTIES OF ELECTRICALLY CHARGED AEROSOLS. TECHNICAL REPORT 12. H. F. Kraemer. Mar. 31, 1954. 90p. (COO-1013)

A fundamental study has been made of the deposition of particles on stationary spherical and cylindrical obstacles from a moving aerosol stream in the presence of electrostatic forces. Theoretical equations were derived for the amount of aerosol deposited. The deposition of homogeneous dioctyl phthalate aerosol on a spherical collector was measured experimentally with various combinations of charged and uncharged collector and aerosol particles. The results are presented graphically. Within the accuracy of the analytical methods used to measure deposition, the experimental results agree with those predicted by the theory. As a result of the investigation, 2 new types of dust collection equipment are proposed.

Industrial Hygiene Foundation of America, Incorporated, Pittsburgh, Pennsylvania

614

MEASUREMENT AND CONTROL OF RADIOACTIVE PARTICULATE CONTAMINATION. Summary Report. Theodore F. Hatch. [nd]. Decl. with deletions Jan. 13, 1956. 22p. (AECD-4096)

The measurement and control of radioactive particulate matter by AEC installations are summarized. Accepted atmospheric tolerance levels are listed. The methods and requirements for sampling particulate contamination are surveyed. Devices such as the cascade impactor and the multi-stage impinger are described. Control requirements for particulate contamination are also listed.

Knolls Atomic Power Laboratory, Schenectady, New York

615

KAPL AIR CLEANING PROGRAM. L. J. Cherubin and J. J. Fitzgerald. Jan. 4, 1954. Changed from OFFICIAL USE ONLY June 3, 1957. 44p. (KAPL-1014)

A brief description of the air-cleaning requirements at the Knolls Atomic Power Laboratory is given. A total of 407,600 cfm of air is cleaned. The CWS-6 filter units are used to clean ~80% of the air at the Laboratory. Caustic scrubbers and an electrostatic precipitator are utilized in specific air-cleaning operations. The efficiency of the air-cleaning units is indicated by the low concentrations of radioactive and toxic materials in the environs. The data are tabulated. The collection efficiencies of 6 filter media used for air cleaning and air sampling are tabulated as a function of face velocity and particle size.

616

EVALUATION OF KAPL SEPARATIONS PROCESS STACK EFFLUENT. J. J. Fitzgerald. Jan. 5, 1954. Decl. Nov. 27, 1957. 29p. (KAPL-1015)

The KAPL separations process stack effluent is evaluated. The adequacy and the efficiency of all the sampling instruments are determined. The size of the particles entrained in the stack is studied under both the light and the electron microscope. The mean particle size is $<0.5\ \mu$. Autoradiographs of the particulate material indicate that the majority of the activity is deposited on these submicronic particles. Chemical separations of the material deposited on the Hollingsworth and Vose, H-70 filter papers and the caustic scrubber are made. The rare earths comprise the largest portion of the particulate activity while Ru^{106} is given off in relatively large quantities during the head-end operation. The relative percentages of the activities given off during the most important phases of the separations process are tabulated. The KAPL stack effluent is then evaluated on the basis of the maximum permissible concentrations recommended in the Bureau of Standards Handbook 52.

617

COLLECTION EFFICIENCY OF AIR-CLEANING AND AIR-SAMPLING FILTER MEDIA. J. J. Fitzgerald and C. G. Detwiler. Mar. 15, 1954. 55p. (KAPL-1088)

The collection efficiency of several air-cleaning and air-sampling filter media was studied at face velocities of 0.5 to 250 cm/sec. The Millipore Filters used to test the filter media were analyzed under both the light and the electron microscope. Collection efficiency was expressed as a function of particle size and face velocity. Solid duraluminum particles with a density of 2.7 g/cm^3 were used as the test material to determine the collection efficiency of the Whatman-40 and 41, the Hollingsworth and Vose H-70, the AEC-1, the CC-6, and the AAA-1106-B filter media. The collection efficiency of these filter media was investigated for particles in the size range of 0.18 to 2.1 μ by a light microscope analysis. Atmospheric dust was used as the test material for the efficiency studies in the particle size range from 0.005 to 0.2 μ. A silica replication of Millipore Filter medium was made to prepare the test air samples for analyses under the electron microscope. This replication method minimizes the opportunity of forming agglomerates during the process of preparing the Millipore Filters for an electron microscope analysis.

618

COLLECTION EFFICIENCY OF AIR CLEANING AND AIR SAMPLING FILTER MEDIA IN THE PARTICLE SIZE RANGE OF 0.005 TO 0.1 MICRON. J. J. Fitzgerald and C. G. Detwiler. Dec. 9, 1955. 51p. (KAPL-1463)

The Hollingsworth and Vose-70 filter medium and the air cleaning filter media (CC-6, MSA-1106-B, AEC-1) tested in these experiments are significantly more efficient in the collection of submicron particles than the Whatman-40 and -41 filter papers. However, with a proper selection of the face velocity, relatively high collection efficiencies can be achieved even with the use of the Whatman filter papers. In these filter efficiency studies, all air sampling filter media investigated were more efficient for the collection of liquid KMnO$_4$ particles in the size range of 0.01 to 2.1 μ than for corresponding sizes of solid duraluminum particles. In the size range of 0.005 to 0.1 μ, the Whatman-40 and -41 filter papers are more efficient in the collection of solid duraluminum particles than in the collection of KMnO$_4$ particles. The optimum particle size for penetration through air cleaning and air sampling filter media was detected or indicated in each of the studies conducted. The optimum particle sizes for penetration through Whatman-40 and -41 filter papers occurred at approximately 0.03 and 0.02 μ, respectively, at a velocity of 150 cm/sec (the minimum efficiency under these conditions was 90%). These results are in good agreement with the theory of Davies and Green.

REFERENCES

Little (Arthur D.) Incorporated, Cambridge, Massachusetts

619

INVESTIGATION OF STACK GAS FILTERING REQUIREMENTS AND DEVELOPMENT OF SUITABLE FILTERS; REPORT NO. 8. Feb. 28, 1950. 38p. (ALI-23)

A description is given of the work undertaken to provide a suitable paper filter for the high efficiency removal of air-borne dust particles. A general study of air filtering media is also presented as well as the application of suitable methods of evaluating the performance of efficient air filters and filter media necessary to implement the work.

620

PROPERTIES OF VARIOUS FILTERING MEDIA FOR ATMOSPHERIC DUST SAMPLING. Walter J. Smith and Norman F. Surprenant. July 1, 1953. 25p. (NP-5007)

A group of atmospheric dust sample media has been studied for performance characteristics. The media were selected to represent those in use in a number of laboratories. Test methods used were di-octyl phthalate (DOP) smoke penetration, atmospheric dust penetration, efficiency by particle size, and plugging rate on atmospheric dust. A wide range of properties were shown. The filtering properties have been discussed, and the suitability of the media for various applications has been indicated. It has been demonstrated that efficiency measurements by the DOP smoke test follow very closely the results given by atmospheric dust counts. This suggests that the fast DOP method can be used to rate any filter medium on per cent of atmospheric dust penetration by particle count.

621

INVESTIGATION OF STACK GAS FILTERING REQUIREMENTS AND DEVELOPMENT OF SUITABLE FILTERS; SUMMARY REPORT. June 30, 1951. 48p. (NYO-1575)

Air filters and media suitable for use in AEC laboratories and operating areas were investigated. Pile ventilation studies, atmospheric dust studies, an economic study of capillary air washers versus dry filters for radioactive laboratories, sampling surveys at various points in experimental air cleaning layouts, and evaluation studies of high speed impactors as a practical means of rating efficiency of filters on atmospheric dust are discussed. Development is reported on high efficiency filters for use where air temperatures are moderate. These filters are now in production. Preliminary work is reported to be well advanced on filters for high temperature work or for filtering air containing chemical fumes or mists, where glass media must replace cellulose.

622

DEVELOPMENT OF A HIGH TEMPERATURE – HIGH EFFICIENCY AIR FILTER: SUMMARY REPORT. Aug. 18, 1953. 48p. (NYO-4527)

A high-efficiency air filter made of noncombustible materials, suitable for use at temperatures of 500°F or higher and resistant to corrosive gases and fumes, has been developed. The filter medium (or paper) is a felt-like material similar in form and appearance to the low-temperature media now in use. It is composed of all-mineral fibers bonded together with a small amount of synthetic resin. Glass fibers of about 3 μ diam provide 80% or more by weight of the fiber composition. Either asbestos fibers or very fine glass fibers are used with the coarser fiber. Two formulations are recommended, the choice being governed by economics and availability of materials. For low-temperature use the binder does no harm in the filter, and there is not enough present to be a fire hazard. When the filter is used at high temperature the binder decomposes harmlessly. Practical manufacture of the filter media on commercial equipment has been demonstrated by full-scale paper mill runs, and this report contains recommended mill procedures. A steel-frame filter unit design, using mineral fiber medium and a high-temperature cement, gives a finished product fulfilling the requirements to be met. Filter manufacturers have demonstrated that the unit is a practical production item. The new filter has the same high-efficiency performance and low air-flow resistance as the present low-temperature filters, performance is as good or better at 500°F, it will stand frequent wetting and drying, and it is resistant to many chemicals. Cost will be somewhat higher than for present filters.

Los Alamos Scientific Laboratory

623

DECONTAMINATION OF RADIOACTIVE WASTE AIR. I. R. Philip Hammond. [nd]. Decl. Oct. 3, 1949. 20. (AECD-2711)

Descriptions and photographs of a pilot plant consisting of a baffle-plate tower of 42 plates along with methods of operation, sampling, and sample counting are presented. Variables studied include feed concentration, air and water rate, etc.

624

PARTICLE SIZE DETERMINATION IN RADIOACTIVE AEROSOLS BY RADIO-AUTOGRAPH. J. A. Leary and Francis J. Fitzgibbon. June 7, 1949. 14p. (AECD-2791)

A radioautographic technique has been used to study particle size distribution in an aerosol of an α emitting compound. By counting the number of tracks in the emulsion for a given exposure time, the size of each emitting particle was calculated from the following formula:

$$d = \left(\frac{KC}{t}\right)^{1/3}$$

where C = number of tracks in emulsion from particle of diameter "d" microns
t = autograph exposure time
K = constant

Particles as small as 0.2μ have been accurately determined in aerosols containing as little as 0.8μμ g active material per liter of air.

625

AIR DECONTAMINATION TESTS WITH BAFFLE PLATE TOWERS, CAPILLARY WASHERS, AND FIBERGLAS PA
R. Philip Hammond and Joseph A. Leary. Sept. 1950. 8
(LA-1145)

In this study tracer techniques were used throughout, with a few checks by other methods. The study centered around wet methods of collection because of the advantage of such methods in final disposal of collected radioactivity. Furthermore, continuous removal of the scrubber liquid permits control of the contamination level in the equipment. The glass-pad collectors, which are described, exhibited high efficiency which for small particles is surprising in view of their high operating velocity, low pressure drop, and loose construction. The results of collection efficiency measurements are reported in terms of "per cent passage," (100 minus per cent efficiency). For high efficiencies the "passage" reflects more significantly small changes in performance. Details of the baffle-plate tower pilot plant, the capillary-washer pilot plant, methods of sampling and

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counting, particle size measurements, and a sample calculation, are included with graphs.

626

DECONTAMINATION OF RADIOACTIVE WASTE AIR. II. R. Phillip Hammond and Joseph A. Leary. Oct. 1949. Decl. July 18, 1956. 17p. (LAMS-970)

Information is given on the following: experiments with cascade scrubbers for decontamination of radioactive waste air; effect of removing Fiberglas spray eliminators; effects of changes in air velocity and water circulation rate; effect of operating conditions on particle size in discharge air; particle size data; and studies of particle penetration of filter paper.

Massachusetts Institute of Technology, Oak Ridge, Tennessee. Engineering Practice School

627

REMOVAL OF RADIOACTIVE PARTICLES FROM GASES BY THE TRION ELECTROSTATIC PRECIPITATOR. T. F. Furlong, H. C. Harrison, J. F. O'Donnell, and R. P. Webb. June 23, 1950. 27p. (K-615)

Operational tests were made on a Trion electrostatic precipitator to determine its effectiveness in removing radioactive dust from cell vent gases and its activity buildup characteristics. The effects of flow rate variation on decontamination efficiency, pressure drop, and the activity of the unit during buildup and washdown were determined.

Massachusetts Institute of Technology, South Dartmouth. Round Hill Field Station

628

FINAL REPORT [ON] RESEARCH ON TURBULENCE AND DIFFUSION OF PARTICULATE MATTER IN THE LOWER LAYERS OF THE ATMOSPHERE [FOR] NOVEMBER 1, 1948—NOVEMBER 30, 1951. E. Wendell Hewson, H. E. Cramer, G. C. Gill, and F. A. Record. [nd]. 129p. (NP-4075)

An investigation was made of the turbulent flow of air in which both the mixing-length theory and the statistical theory were investigated. New types of instruments developed for the study include a fast-response instrument to measure rapid turbulent fluctuations of wind speed, wind direction, and temperature. Instrumentation for measuring mean wind speed, mean wind direction, and mean air temperature was developed and installed at six levels on a permanent 144 ft steel tower. A portable 40 ft steel tower which moves on wheels was constructed and similar instrumentation installed at 4 levels. Sets of grouped field observations were made and each set of data was analyzed intensely by statistical and other means. The development of theoretical concepts resulted in a theoretical model of the process of eddy diffusion in turbulent flow which postulates that diffusion is a direct result of dynamic entrainment of air in a steady state of flow. Included is a summary of the present trends in research on atmospheric turbulence in the boundary layer and recommendations for further research.

Mine Safety Appliances Company, Pittsburgh, Pennsylvania

629

AN INVESTIGATION OF SAMPLERS FOR THE COLLECTION AND CLASSIFICATION OF RADIOACTIVE AIRBORNE PARTICULATE MATERIALS. PROGRESS REPORT. Apr. 9, 1954. 32p. (NP-5423)

The objective of this investigation was the design, construction, and testing of prototype samplers which would collect all particles in a dust cloud and would separate the particles into fractions representative of those collected in the upper and lower human respiratory tracts. This report describes 3 samplers and gives the results of tests made with them. In all 3 devices impingement was used to collect the larger particles. In 2 of the samplers, the remaining airborne particles were collected by thermal precipitation, while filtration was used in the third. The results presented indicate that the samplers perform the desired separation. Methods for using similar samplers in determining the relative radioactivity of various size fractions of dusts are suggested.

Ministry of Supply, Great Britain

630

AN IMPROVED DOUBLE CONE FILTER FOR SAMPLING PARTICULATE CLOUDS. D. Thorp. Mar. 29, 1951. 3p. (NP-3293)

A short account is given of the redesign of a double-cone filter (using filter paper, asbestos paper, or other material) for atmospheric sampling.

Mound Laboratory, Miamisburg, Ohio

631

REMOVAL OF SUBMICRON AEROSOL PARTICLES FROM A MOVING GAS STREAM BY THE CONDENSATION CENTER EFFECT. P. J. Schauer. [nd]. Decl. Aug. 2, 1950. 30p. (AECD-2986; MLM-[illegible]50(Rev.))

In the disposal of radioactive solid wastes from laboratories and plants by incineration, the flue gases may be assumed, in most cases, to contain the radioactivity in the form of particulate matter. The gas volume to be handled is small, probably > 100 ft^3/min. Efficiencies of practically 100% are required. After a survey of known methods of removal of submicron particles from gas streams, a new method using the condensation-center effect was investigated. This method consists of introducing the gas stream into a steam exhauster, the condensing water droplets forming on the particles and growing to such size that they can be removed completely by conventional equipment. Various designs of nozzles were tested, and the value of double condensation effects was shown. A penetration as low as 0.35% was achieved.

632

THE APPLICATION OF TYPE 6 FILTER PAPER FOR THE REMOVAL OF AIRBORNE ALPHA EMITTING CONTAMINATION. R. Endebrock. Apr. 18, 1947. Decl. Dec. 7, 1955. 35p. (MLM-188)

A determination was made of the efficiency of paper filters in removing airborne α-emitting contamination at various levels of contamination and of the operational pressure differentials of Type 6 filter paper. Other pertinent data were also collected. Results given the average efficiency of Type 6, single-thickness paper, for 21 runs as 94.5% and for 12 runs on double thickness paper as 96.6%.

National Gas Turbine Establishment, Farnborough, Hants, England

633

SOME TESTS ON A HIGH EFFICIENCY AIR CLEANER. D. R. Whittet. July 1953. 40p. (NGTE-R-139)

Performance tests were conducted on a special form of Cottrell precipitator in which a moving film of water forms the receiving electrode. The tests were conducted mainly on 3 different lengths of 3 in. tube with length-to-diameter ratios ranging from 13.1 to 33.5 and at air velocities ranging from 3 to 10 ft/sec. Blackness test efficiencies as high as 99.99% were recorded in the laboratory when using air polluted with C smoke as a test atmosphere, and up to 99.94% when cleaning a typical industrial atmosphere. The performance of the cleaner at differing conditions of air velocity, applied voltage, wire diameter, tube diameter, and tube length is examined, and a comparison is made between the actual test results and those forecast by application of certain commonly used expressions for efficiency and field strength. An examination is also made of the power requirements of this type of cleaner, and recommendations are made concerning the most economical form of construction and the choice of tube dimensions.

Naval Radiological Defense Laboratory, San Francisco, California

634

AN AUTORADIOGRAPHIC METHOD OF DETECTING AND IDENTIFYING BETA-ACTIVE PARTICLES IN A HETEROGENEOUS MIXTURE. Philip D. LaRiviere and Stephen K. Ichiki. Mar. 27, 1952. 18p. (USNRDL-342)

An autoradiographic-optical method of determining the sample statistics of the β-γ emitting members of a mixed radioactive and inert aerosol is presented. The aerosol components may be heterogeneous with respect to size, shape and composition. The aerosol sample is deposited on microscope cover slips and covered with autoradiographic stripping film in gelatin, forming a permanent, sealed assembly. The exposed and processed assembly is placed under the microscope in such a manner that the particles are above the emulsion. The autoradiographs under the radioactive particles are then found with conventional substage illumination and the active particles producing the autoradiographs revealed by vertical illumination. The method permits positive identification of radioactive particles down to the limit detection of the optical system employed. Concentrations of 300 active particles/mm^2 of collection slide were easily resolvable in the first application of the method.

635

REPRESENTATIVE SAMPLING OF DUST PARTICLES IN HIGH VELOCITY AIR STREAMS. T. C. Goodale, B. M. Carder, and E. C. Evans, III. May 1, 1952. 11p. (USNRDL-343; U-221518)

A high-altitude aerosol sampler was developed for use on aircraft in flight. The device maintains air flow into its inlet isokinetic with the flow of the air stream sampled over a wide range of altitudes and air velocities.

636

DUST SAMPLING BY THERMAL PRECIPITATION. I. G. Poppoff. Dec. 8, 1952. 18p. (USNRDL-382)

The theory of thermal precipitation is summarized and its applicability to the operation of aerosol collectors is considered. The essential characteristics of thermal precipitators are discussed. Results from limited investigations of the operating characteristics of one type of thermal precipitator are included.

New Mexico Institute of Mining and Technology, Socorro

637

A THERMAL PRECIPITATOR FOR SPARSE DISPERSIONS OF AEROSOLS. E. R. Harrington and W. D. Crozier. December 1948. 17p. (NP-1091)

A thermal precipitator has been built which is capable of almost 100% collection of aerosols from 1 liter of air/min. The collection is deposited on a metal or glass plate in an area of a few square centimeters. It still is not as effective as desired for the very sparse dispersions sometimes met. The greatest value of the device probably will be in collection of particles the sizes of which are below the effective range of impingement devices and as a standard in laboratory studies of the performance of impingement, and other equipment.

New York Operations Office, Health and Safety Laboratory, AEC

638

SOME TECHNIQUES AND EQUIPMENT FOR TRACE QUANTITY SAMPLING OF INDUSTRIAL AEROSOLS. W. B. Harris and H. D. LeVine. Nov. 29, 1950. 24p. (NYO-1534)

The use of filter paper collection of air samples is compared with other methods and the advantages of filtration are discussed where gravimetric or radiometric analysis is desired. The design and construction of two reliable light-weight air samplers is given. One of these is for the range to 0.03 m^3/min where the other will operate to 2.0 m^3/min. Filter paper characteristics, cascade impactor characteristics, and field techniques for microgram aerosol concentrations are discussed.

639

EXPERIMENTAL COLLECTION EFFICIENCY OF A STRATOSPHERIC AIR SAMPLER. Peter Loysen, Alfred J. Breslin, and Hugo J. DiGiovanni. June 1956. 28p. (NYO-4708)

The Health and Safety Laboratory built an electrostatic precipitator for stratospheric air sampling. The instrument has been in use over a period of 2 yr. This report describes the sampler and an experimental study of its dust collection efficiency. The tests were conducted in a low pressure, walk-in chamber. Efficiency values were based on the relative quantities of aerosol collected by the sampler and on a following filter. The test medium was an NH_4Cl aerosol with a count median of 0.2μ and a standard deviation of 2.5. Initial runs at a simulated altitude of 90,000 ft indicated an average collection efficiency of 27.1%.

REFERENCES

Oak Ridge Gaseous Diffusion Plant

640

AIR-BORNE CONTAMINATION RESULTING FROM TRANSFERABLE CONTAMINATION ON SURFACES. J. C. Bailey and R. C. Rohr. Nov. 24, 1953. Changed from OFFICIAL USE ONLY Sept. 6, 1955. 12p. (K-1088)

A comparison of air-borne activity with transferable surface activity in two contaminated plant locations during normal operation indicates that the ratio of air activity to surface activity is in the range of about 0.25 to 1.9 (dis/min/m^3 air)/(dis/min/cm^2 surface). This latter figure is considered to be the maximum value of this ratio which might exist for long continued operations at K-25. However, a test designed to indicate the maximum activity which might result from plant operations included the combined action of air circulating fans and equipment vibrations and gave a corresponding ratio of about 20 (dis/min/m^3 air)/(dis/min/cm^2 surface) for short periods.

Oak Ridge National Laboratory

641

POLAROGRAPHIC DETERMINATION OF URANIUM IN DUST SAMPLES. Stanton B. Smith. Aug. 30, 1943. Decl. Oct. 15, 1948. 17p. (AECD-2381)

Information is included on the following topics: collection of atmospheric dust samples with an electrostatic precipitator; analysis for U with a dropping Hg electrode apparatus; preparation of cell solution and operation of polarograph; and experimental data for sample analyses.

642

EVALUATION OF A COTTRELL ELECTROSTATIC PRECIPITATOR ON A RADIOCHEMICAL PROCESS OFF-GAS SYSTEM. J. C. Suddath. Nov. 26, 1951. Decl. Jan. 14, 1952. 39p. (AECD-3295; ORNL-1082)

A Cottrell Electrostatic Precipitator, installed on an off-gas system of the ORNL I_2 recovery operation and the ORNL special isotope recovery operation, was evaluated to determine its radioactivity-removal efficiency. It was shown that the Cottrell Electrostatic Precipitator would collect more than 99.9% of the solid radioactivity in the off-gas, when the voltage was 50 to 55 Kv, and the concentration of radioactivity as solids was greater than 5.0×10^{-4} $\mu c/cm^3$ of off-gas.

643

HRP-HYDRAULIC CYCLONE STUDY FOR LIQUID-SOLID SEPARATION. P. A. Haas, E. O. Hurmi, M. E. Whatley, and J. R. Engel. Aug. 7, 1956. 19p. (CF-56-8-132)

The results of this study indicate that hydroclones are practical for separating particles in the 1 to 10 μ range from reactor coolants or fuel solutions. Even in high-temperature, high-pressure, corrosive systems hydroclones are more durable and trouble-free than present equipment. Heavy phase concentration factors up to 4,500 were obtained in the studies.

644

EVALUATION OF FILTERING EFFICIENCY AND OPERATING LIFE OF FG MATERIAL USED IN PILE COOLING AIR FILTER HOUSE. H. C. Savage. Dec. 1, 1949. Decl. Jan. 6, 1956. 19p. (ORNL-500)

An experimental investigation of the relative efficiencies and operating life of 3 combinations of American Air Filter Company's FG filter media as used in the pile cooling air filter house at Oak Ridge National Laboratory is reported.

645

ORNL X-PILE FILTER HOUSE. F. M. Tench and M. E. Ramsey. May 21, 1952. Decl. Jan. 28, 1954. 17p. (ORNL-1417)

The filter house is designed to filter radioactive dust particles from the cooling air of the ORNL Graphite Reactor before the air is released to the atmosphere. Design and efficiency of the filter house are reported.

646

THE DIFFUSION BATTERY METHOD FOR AEROSOL PARTICLE SIZE DETERMINATION. Jess W. Thomas. Jan. 5, 1954. 68p. (ORNL-1648)

Two parallel plate diffusion batteries were made and used for particle size determination in the 0.1 μ radius range. The aerosol particle size as determined by the batteries was compared with the size as determined by a standard light scattering method. Results agreed to within 30%. Circular tube batteries were made and used to check the applicability of the method to diffusion of particles as small as gas molecules. The diffusion coefficients of gas molecules obtained by this method agreed well with the literature values. It was concluded that the diffusion battery is a valuable instrument for study of the particle size of aerosols from atomic sizes up to particle radii of about 0.5 μ. Two batteries, with graphs of operating parameters, are now available for use in filter efficiency studies.

647

CLOUD CHAMBER FOR MEASURING THE PARTICLE DENSITY OF AN AEROSOL. Bernard G. Saunders. Feb. 19, 1954. 28p. (ORNL-1655)

This report summarizes the work performed in setting up and calibrating a continuous-action cloud chamber which determines the number of particles in a unit volume of aerosol. Every particle on the order of 10^{-13} μ in radius or larger serves as the nucleus of a water droplet which can be photographed and counted. When a total of 500 droplets can be counted, the accuracy of the measurement amounts to 5.2% standard deviation. Aerosol concentrations can be measured from 5×10^4 to 2×10^6 particles/cm^3.

648

ELECTROSTATIC PRECIPITATOR FOR MEASURING PARTICLE-SIZE DISTRIBUTION IN AEROSOLS. Bernard G. Saunders. Feb. 8, 1954. 24p. (ORNL-1656)

An electrostatic precipitator has been constructed that sorts smoke particles according to size. Attempts to calibrate it for size distribution have so far been unsuccessful.

649

A SERVOMECHANISM FOR MEASURING AEROSOL PARTICLE SIZE AND A SERVOMECHANISM FOR CONTROLLING PARTICLE SIZE IN THE DIOCTYL PHTHALATE AEROSOL GENERATOR. R. Louis Bradshaw. Jan. 29, 1954. 36p. (ORNL-1660)

A servomechanism is described which continuously measures and records particle size of homogeneous aerosols in the range from approximately 0.1 μ to 0.2 μ radius. The principles of operation are explained, and limitations of the instrument are discussed with suggestions for improving the operation. Circuit diagrams and pictures of the instrument are shown. A servomechanism for controlling particle size in the dioctyl phthalate aerosol generator is described. The principles of operation are explained, and results of tests of the mechanism on an analog of the generator are discussed. Reasons are advanced for the unsatisfactory operation of the instrument on the actual generator and suggestions for improvement are given.

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REFERENCES

650

SOLID AEROSOL GENERATION. W. D. Cottrell. Feb. 5, 1954. 26p. (ORNL-1666)

The problem under investigation was that of generating a solid homogeneous aerosol in sufficient concentration to permit its use as a test aerosol. The method of approach was that of generating an aerosol of homogeneous liquid droplets from a suitable solution and drying the droplets to form solid particles of the solute. Several types of generators were investigated with the most promising being a high speed air top. The air top was rotated at speeds up to ~ 100,000 rpm and gave liquid droplets as small as 20 μ in diam. The minimum size of solid particles that could be produced from these liquid droplets was not determined.

Oak Ridge Operations Office, AEC

651

INDUSTRIAL TECHNICAL INFORMATION MEETING ON COLD PROCESSING OF ENRICHED URANIUM, OAK RIDGE, SEPTEMBER 13-15, 1956. September 1956. 96p. (TID-7518(Pt.1))

Air sampling and water sampling equipment are described on p. 86-89.

University of Rochester,

Rochester, New York.

Atomic Energy Project

652

EFFICIENCY OF FILTRATION METHODS FOR THE COLLECTION OF ATMOSPHERIC IMPURITIES. Sidney Laskin, Paul B. Frank, and Robert H. Wilson. Apr. 25, 1950. 2p. (AECU-860)

The efficiency of filter paper sampling trains in collecting atmospheric impurities was determined from a series of experiments using aerosols of NaCl. The NaCl passing the filters was determined with a flame photometer. Efficiency vs. flow rate is discussed.

653

THE MODIFIED CASCADE IMPACTOR. Sidney Laskin. Aug. 8, 1950. 31p. (UR-129)

The Modified Cascade Impactor is a multiple-stage aerosol sampling device used for the characterization of atmospheric contaminants in terms of particle size and concentration. Excellent results are obtained in the range 0.2 to 50μ. The design permits interchangeable jets, accurate slits, and the sturdiness and duplication of construction required for practical use. In principle, the instrument employs a series of 4 jets of decreasing areas and collecting slides arranged in tandem. These are followed by a fifth sampling stage in the form of a filter paper. The special advantage of the Modified Cascade Impactor has been in the development of a procedure whereby particle size-mass distributions can be determined by a chemical or physical analysis of the total particulate mass collected at each stage without resorting to counting the particles or measuring their diameters. The Impactor has been applied in the characterization of dust and mist atmospheres of U and Be compounds. The instrument may also be used for the size-distribution analysis of a mixture of dusts such as is frequently encountered in many industrial atmospheres.

654

DESIGN OF AN OSCILLATING THERMAL PRECIPITATOR. K. E. Lautherbach, R. H. Wilson, S. Laskin, and D. W. Meier. Apr. 25, 1952. 24p. (UR-199)

In a thermal precipitator the deposit is uniform lengthwise, but variable with respect to average particle size and particle number in traversing the width. By means of a linear-motion cam in the unit described here, the collection slide can be oscillated during sampling in a direction parallel to the air flow path, thus effectively mixing large and small particles as they are deposited. The resulting specimen is in the form of a rectangle, ⅝ in. by ½ in. In parallel determinations, the collection efficiency of the instrument has been evaluated as 99.9^+% for all particles below 1.0 μ. This applies for sampling rates up to 20 ml/min.

655

EFFICIENCY STUDIES OF THE ELECTROSTATIC PRECIPITATOR. K. E. Lauterbach, T. T. Mercer, A. D. Haynes, and P. E. Morrow. Oct. 15, 1953. 16p. (UR-287)

Tests of the electrostatic precipitator in collecting a radioactive aerosol have shown that the instrument retains a uniformly high percentage of airborne particulate material. The percentage of dust penetration through the precipitator was calculated from the original aerosol activity and the activity of the deposit collected on 3 molecular filters in series following the test instrument. The method of testing has been found to give reproducible results in estimating penetration values as low as 0.005%. On the basis of a number of tests of molecular filters in series, the efficiency of this filtering medium appears to be extremely high.

Union Carbide Nuclear Company,

Y-12 Plant, Oak Ridge

656

RECOVERY OF URANIUM FROM FIBERGLAS AIR FILTERS. R. H. Adams, J. A. Rogers, and K. B. Brown. Aug. 5, 1946. Decl. Feb. 21, 1956. 9p. (AECD-4224; C-2.320.6)

Various procedures for extracting U from Fiberglas air filters have been tested and compared. Satisfactory results which involve the least amount of handling are obtained by simply washing the material with hot 1 : 1 HCl.

United Kingdom Atomic Energy Authority.

Research Group.

Atomic Energy Research Establishment,

Harwell, Berks, England

657

A STUDY OF THE MOTION OF SOLID PARTICLES IN A HYDRAULIC CYCLONE. D. F. Kelsall. Apr. 21, 1952. 34p. (AERE-CE/R-913)

Using an optical method involving suitable ultramicroscope illumination and a microscope fitted with rotating objectives, tangential velocity components of fine Al particles were measured directly at selected positions within a transparent hydraulic cyclone. Vertical velocity components at the same positions were obtained by measuring the angle of inclination of particle tracks to the horizontal, and water radial velocity components were calculated from continuity considerations. The results are presented as tangential, vertical and radial velocity profiles from which a picture of the flow patterns can be obtained. By applying Stokes' Law to the settling process, equilibrium envelopes were derived for particles of several sizes and a measure of the particle separation efficiency was obtained.

Vitro Corporation of America, New York

658

DECONTAMINATION OF WASTE GASES. Detailed Project Status Report. Job 11. Sept. 23, 1949. Decl. Jan. 11, 1956. 60p. (KLX-55)

The results of a laboratory investigation of possible procedures for removing radioactive particulate material entrained in gas streams has indicated that, by use of a steam injection technique, removal efficiencies approaching those currently being obtained by CWS-6 filter paper and sand filters can be realized in a commercial wet impingement plate scrubber operating on a nonradioactive dust suspension which approximates actual plant conditions. Operating the scrubber alone proved unsatisfactory. A preliminary investigation of the effect of sonic agglomeration on a nonradioactive dust suspension has revealed appreciable, though not completely satisfactory, improvement in the separation efficiency of the wet scrubber Methods were developed for generating and analyzing both radioactive and nonradioactive air-borne particulate matter and were successfully applied to the evaluation of various types of filter papers and to a pilot-plant gas-cleaning system. The investigation demonstrated the feasibility of operating a pilot plant system for the evaluation of air cleaning equipment using laboratory-generated test suspensions.

Gases

Argonne National Laboratory, Lemont, Illinois

659

DEVELOPMENT OF EQUIPMENT FOR DETECTION OF ATMOSPHERIC XENON. S. A. Kline. Jan. 19, 1945. Decl. Feb. 14, 1956. 21p. (CE-2674)

A process and equipment, for determining whether the concentration of Xe^{133} which escapes from the stacks at ORNL constitutes a health hazard, were developed. The separation unit had an efficiency of about 40% while that of the collecting and separation units combined was about 20%.

Brookhaven National Laboratory, Upton, New York

660

THE FORECASTING OF MICROMETEOROLOGICAL VARIABLES. Maynard E. Smith. [nd]. 13p. (AECU-702)

The current status of the forecasting program developed for nuclear reactor operations at BNL is discussed in some detail. In the examination of the forecasting method emphasis is placed on the use of relationships between synoptic and micrometeorological variables as they have been determined by observation and climatological studies. The practical application of this type of program to industrial problems, both in the field of atomic energy and otherwise, is considered.

661

THE THEORETICAL GROUND-LEVEL DOSE-RATE FROM THE RADIOARGON EMITTED BY THE BROOKHAVEN REACTOR STACK. Philip H. Lowry. July 1950. 33p. (BNL-81)

By a combination of theory and experimental data obtained from oil-fog concentration measurements, an approximate solution to the problem of determining dose rate from the A^{41} emitted by the Brookhaven Laboratory reactor stack has been obtained. The solution is believed to be valid under nearly all meteorological conditions. It is in the form of isodose templates which give the mean value of the dose rate over an area 1 km by 10 deg, extending from the chimney base for a radial distance of 15 km, and averaged for 1 hr. The templates have been constructed for a wide range of weather conditions, including all the major types expected to occur in the Laboratory area.

662

A COMPARISON OF COMPUTED AND MEASURED GROUND-LEVEL DOSE RATES FROM RADIOARGON EMITTED BY THE BROOKHAVEN REACTOR STACK. Irving A. Singer. May 1954. 42p. (BNL-292)

By a combination of theory and experimental data obtained from oil fog concentration measurements, an approximate solution to the problem of determining dose rates from the radioargon under various meteorological conditions has been obtained. The calculated values are compared with measured weekly and hourly values of A^{41} at 8 stations.

663

METEOROLOGICAL FACTORS IN ATMOSPHERIC POLUTION PROBLEMS. Maynard E. Smith. Apr. 26, 1951. 14p. (BNL-1070)

The influence of meteorological parameters in the dispersion of cooling air from the Brookhaven nuclear reactor stack has been under investigation for 3 yr. The empirical results obtained with an oil-fog test effluent are compared with theoretical expectations, and the apparent causes of the discrepancies are analyzed. Two methods of obtaining engineering estimates of ground-level concentrations arising from elevated sources are briefly described, together with an assessment of their probable limitations.

664

THE USE OF AVERAGES IN AIR POLLUTION METEOROLOGY. Irving A. Singer and Maynard E. Smith. May 15, 1953. 13p. (BNL-1513)

The literature on the meteorology of stack dispersion contains references to "average" conditions, suggesting that such conditions are common and that dispersion calculations based on them will be representative. Studies made at Brookhaven National Laboratory show that the conditions usually described as "average" are in fact uncommon at that location, and probably in most locations in the United States. The variability of wind gustiness, an index of dispersion conditions, is described and related to other meteorological parameters to illustrate the desirability of determining the most probable conditions, rather than the average. A study of dispersion from an individual stack should reveal the conditions under which the effluent will have undesirable effects, and describe the seasonal and diurnal frequencies of those conditions. Hypothetical examples are used to show how different stack and effluent characteristics may result in wholly different pollution problems under identical meteorological conditions.

REFERENCES

665

ATMOSPHERIC DIFFUSION FORMULAE AND PRACTICAL POLLUTION PROBLEMS. Maynard E. Smith. Mar. 2, 1955. 14p. (BNL-2242)

A systematic evaluation of a typical industrial air pollution problem does not presuppose the necessity of any particular method of analysis or testing. It should begin with careful evaluation of source parameters and pollutant effects to determine precisely what estimates will be valuable. Behavior of the effluent near the source involves the joint consideration of 2 factors, aerodynamics and jet-density effects. The latter can be calculated, but the former is a wind tunnel problem. Calculation of turbulent diffusion of gaseous or small particulate effluent in the natural atmosphere is undertaken subsequent to the evaluation of local effects. Results of usable accuracy can generally be obtained, although a formidable list of modifying and qualifying factors must be considered. Reliability of the results is too variable for a single specification, but it certainly approaches ±50% for simpler cases. The treatment of typical particulate deposition, if such a process exists, is a far more complex problem in which our knowledge is severely limited. The reliability of theoretical estimates for small particles is unknown.

University of California, Berkeley. Radiation Laboratory

666

OFF-GAS TREATMENT IN BERKELEY ENCLOSURES. M. D. Thaxter, H. P. Cantelow, and C. Burk. Jan. 7, 1957. 16p. (UCRL-3635)

Developments at UCRL in off-gas treatment are reviewed. A multiple-purpose gas scrubber and a total capture system for slug-dissolver off gas are described.

University of California, Los Angeles. Atomic Energy Project

667

RADIOARGON EFFLUENT FROM THE STACK OF THE MEDICAL RESEARCH REACTOR. M. A. Greenfield, A. Norman, and D. P. Gamble. Sept. 26, 1955. 12p. (UCLA-344)

The maximum concentration of radioargon in the effluent from the stack of the Medical Research Reactor will give a γ ray dose rate, measured at the stack, of 1.9 mr/year. This is about 1% of the dose rate due to the natural background radiation.

Colorado Agricultural and Mechanical College, Fort Collins

668

ATMOSPHERIC DIFFUSION FROM A POINT SOURCE. C. S. Yih. Aug. 1951. 11p. (NP-3525; Report No. 4; U-19167)

The differential equation of diffusion when the wind velocity and the vertical and lateral diffusivities are power functions of height is given. Exact solution of this equation for the case of a point source is presented. In the systematic search for this solution, dimensional analysis has been utilized to the optimum advantage.

Defence Research Chemical Laboratories, Ottawa, Canada

669

APPLICATION OF DIFFUSION THEORY TO DISPERSION OF STACK GAS IN THE ATMOSPHERE. Morris Katz. Sept. 1952. 37p. (DRCL-110)

A considerable mass of data on measured ground concentrations of SO_2 in the Trail, B. C., and Sudbury, Ont., smelter areas have been utilized to test the atmospheric-diffusion theories of Sutton and of Bosanquet and Pearson. Effective stack heights have been employed which take into account the rise of the smoke above the source in various wind speeds due to the velocity and temperature of the gases issuing from the stack. Data are also presented on the vertical distribution of smoke in the Sudbury area from gas samples collected by apparatus transported at various altitudes in aircraft flights. It is clear that the Bosanquet-Pearson equation of diffusion cannot apply to these cases. Good correlation between predicted and measured gas concentrations is obtained by application of Sutton's diffusion theory.

Department of Commerce, Weather Bureau, Washington, D.C.

670

METEOROLOGY AND ATOMIC ENERGY. July 1955. 182p. (AECU-3066)

The application of meteorology to the air-pollution problem of the atomic industry is discussed. Methods and suggestions for the collection, analysis, and use of meteorological data are included. Topics discussed include: meteorology in site operations, meteorological fundamentals for air pollution studies, atmospheric diffusion theories, behavior of stack effluents, behavior of explosion debris clouds, fall-out from airborne clouds, radioactive cloud dosage calculations, graphical solutions to atmospheric diffusion problems, reactor hazard analyses, meteorological equipment and records, and climatological data for site selection and planning. Selected equations, parameters, and conversion factors are included.

General Electric Company. Aircraft Nuclear Propulsion Project, Cincinnati, Ohio

671

CLOUD DOSAGE CALCULATIONS. R. L. Waterfield. Apr. 5, 1954. 11p. (APEX-179; XDC-54-4-12)

The dosage from a radioactive cloud formed by a sudden release of fission products from a stack is calculated by means of Sutton's diffusion equation.

General Electric Company. Hanford Atomic Products Operation, Richland, Washington

672

THE EFFECT OF THE SPEED OF EMISSION ON THE

1960 359

REFERENCES

RISE OF A PLUME OF STACK GASES. Problem 694.55. M. L. Barad. Nov. 20, 1950. Changed from OFFICIAL USE ONLY Jan. 23, 1957. 8p. (HW-20008)

Studies of atmospheric pollution were made to determine the level at which effluents will level off after emission from the tops of stacks. The maximum height of the plume is important because it enables one to speak of the "effective" height of the stack. An attempt is made to summarize the results of recent research on the effective height of smoke stacks. In this summary attention is paid only to the case in which the density of the stack effluent is the same as that of the surrounding air. The results of this investigation indicated that the experimental results of Bryant and Bosanquet, Carey, and Halton are not in agreement. The lack of agreement suggests the need for further wind-tunnel work on this subject. A parabolic relationship between the penetration and the horizontal distance of the plume satisfies the Bryant observation in the range m = 2 to m = 4.

673

REMOVAL OF IODINE VAPOR FROM GAS STREAMS BY SORPTION ON CHARCOAL. J. W. Finnigan, R. E. Peterson, H. W. Lefevre, J. W. Culvahouse, and W. J. Friesen. Nov. 4, 1952. 12p. (HW-26113)

Three methods for measuring the I_2 which passes through a charcoal trap in a stream of He are discussed. The first two methods indicated small I_2 transmission through the trap, but were not sensitive enough to detect one part in 10^5 under the desired flow conditions. The third method indicated that <1 part in 10^7 of the initial I_2 passed through the trap at room temperature. It was also shown that the I_2 was stopped in the first few millimeters of trap length and was not appreciably eluted even when the flow rate was increased by a factor of 20 and the charcoal was heated to about 80°C.

674

DIFFUSION OF STACK GASES IN VERY STABLE ATMOSPHERES: CASE II. M. L. Barad and B. Shorr. Aug. 10, 1953. 11p. (HW-28917)

Numerical calculations were made of the solutions to the diffusion equation for the case where the vertical diffusion coefficient is equal to zero. Complete results are presented graphically.

675

METEOROLOGY AS RELATED TO WASTE DISPOSAL AND WEAPONS TESTS. J. J. Fuquay. Jan. 15, 1957. 39p. (HW-47721-A)

Meteorological factors affecting the atmospheric dispersal of radioactive particles, whether stack effluent or fall out following weapons tests are discussed. Factors include atmospheric stability, basic smoke plume patterns, atmospheric dilution, fall out and rainout deposition, wind structure, and others. (This report supersedes HW-47721.)

676

TREATMENT OF GASEOUS EFFLUENTS. W. C. Schmidt. Apr. 10, 1957. 26p. (HW-49549-A)

Equipment for the removal of noxious radioactive waste gases from chemical processing facilities is described. The report is divided into 2 parts, (1) the equipment necessary for the removal of particulate radioactivity present as an aerosol and (2) radioactivity which is present as a true gas. Data on waste gas decontamination and empirical equations for design calculations are presented. A short section on the difficulties experienced in operating the equipment is also included. (This is also available in TID-7534, Symposium on the Reprocessing of Irradiated Fuels Held at Brussels, Belgium, May 20-25, 1957.)

Goodyear Atomic Corporation, Portsmouth, Ohio

677

DISPERSAL PATTERNS AND EFFECTS OF FLUORINE VENT GASES. H. L. Burkhardt, H. C. Caterson, R. A. Manning, and B. Kalmon. June 29, 1956. 11p. (GAT-165)

The Goodyear Atomic Corporation program to follow the offsite movement of fluorine compound waste gases, which are vented directly to the atmosphere in the course of production operations, is presented. The program includes routine monthly vegetation, air, water, and mud sampling, aerial and ground photographic studies in color, and compilation of meteorological data. Results indicate no appreciable F_2 uptake in surrounding water, soil, or vegetation. It is concluded that dispersal of F_2 vent gases is in accordance with an inverse square law. This fact makes it improbable that damaging concentrations could move from the plant site without leaving widespread evidence of damage to onsite foliage, or without causing immediate complaints from GAT personnel of oppressive F_2 odor.

University of Illinois, Urbana.

Engineering Experiment Station

678

PRINCIPLES AND PROCESSES FOR REMOVING NITROGEN OXIDES FROM GASES. M. S. Peters. Aug. 31, 1955. 93p. (COO-1015)

The fundamental principles involved in the removal of nitrogen oxides from gases were studied, and experimental tests were conducted to develop improved methods for accomplishing the removal operation. The important factor in determining the rate of removal of NO_2 and N_2O_4 from gases was found to be the rate of the chemical reactions involved in the removal process. The roles of gas-phase and liquid-phase reactions, as well as mist formation, were investigated, and the results were interpreted on the basis of chemical reaction rates as the controlling mechanism. The information from the fundamental studies was applied to a study of improved methods for removing nitrogen oxides from gases. Experimental tests were conducted with bubble-cap towers, packed towers, fritted bubblers, Venturi atomizers, wetted-wall towers, and spray towers. Water, silica gel, and aqueous solutions of NaOH, NaCl, and HNO_3 were examined as the removal media. Venturi atomizers were found to be very inefficient for removing nitrogen oxides from gases, while fritted bubblers and silica-gel adsorbers were the most efficient of the various types of equipment tested.

North Carolina State College, Raleigh.

School of Engineering

679

OBSERVATIONS ON THE METEOROLOGICAL DISPERSAL OF STACK GASES AT THE RALEIGH REACTOR STACK (thesis). James Asbury Downey, III. 1954. 105p. (NP-5506)

The dispersal patterns of smoke clouds in the atmosphere, and meteorological conditions affecting the dispersal, were determined for smoke from the stack of the Raleigh reactor. Horizontal and vertical observations were made and the average dispersal index under various conditions is tabulated. On the basis of the tests, recom-

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mendations are presented for the discharge of radioactive gases into the atmosphere.

Oak Ridge National Laboratory

680

STACK GAS DILUTION IN CROSS WINDS; FINAL REPORT. A. F. Rupp. May 20, 1944. Decl. Mar. 11, 1948. 25p. (AECD-1811)

Experiments with small stacks discharging into gentle cross winds were conducted to determine the path, rise, distribution, etc., of stack gas. Empirical relationships were derived.

681

RECOMMENDATION FOR IMMEDIATE SOLUTION TO AIRBORNE HAZARDS FROM THE PILE STACK. J. W. Gost. Sept. 8, 1948. Decl. Feb. 16, 1956. 3p. (CF-48-9-126)

682

PRODUCTION OF GASEOUS FISSION PRODUCTS IN HOMOGENEOUS REACTOR. H. E. Goeller. Aug. 25, 1949. Decl. Apr. 8, 1957. 23p. (CF-49-9-114)

Calculations were made to determine the activity and volumes of the gaseous fission products, Br, Kr, I and Xe, produced in the homogeneous reactor and adsorbed in a set of off-gas adsorbers. The maximum reactor power level was assumed to be 200 kw. Calculations were made for degassing rates of 2 and 20% of the reactor recycle rate of 30 gpm, resulting in degassing cycles of 27 and 2.7 min, respectively. The over-all results for equilibrium in the reactor are tabulated.

683

ARGON ACTIVITY IN REACTOR COOLING AIR. J. A. Lane. Nov. 17, 1949. Decl. Feb. 14, 1956. 4p. (CF-49-11-180)

Calculations are presented that indicate the activity of the reactor cooling air due to neutron capture in A and resulting A^{41} decay for the existing design of the graphite reflector.

684

DESIGN DATA FOR HRE CHARCOAL ADSORBERS. I. Spiewak. Nov. 9, 1951. Decl. Dec. 16, 1955. 4p. (CF-51-11-59)

Arbitrary specifications for the HRE charcoal adsorbers are listed. An evaluation is made of the performance of the bed on the basis of previously published data. The temperature of the bed is also analyzed.

685

DESIGN CALCULATIONS FOR THORIUM DISSOLVER GAS COOLING AND SCRUBBING EQUIPMENT. R. J. Klotzbach. Dec. 3, 1951. Decl. Feb. 15, 1957. 24p. (CF-51-12-16)

Design calculations for a dissolver reflux condenser for handling Th slugs and a NaOH scrubbing tower for the removal of NO_2 from the dissolver off-gas are given.

686

ABSORPTION OF WASTE HYDROGEN FLUORIDE. V. J. Reilly. Dec. 7, 1951. Decl. Feb. 15, 1957. 10p. (CF-51-12-50)

Experiments on 4 methods of disposal of HF from the Pu peroxide hydrofluorination furnace in a waste gas stream are discussed, namely: (1) condensation as a liquid for reuse or disposal, (2) venting the filtered gas to the stack, (3) absorption in a lime slurry, and (4) absorption in a limestone bed. Although no definite choice of one method to the exclusion of the others was made, it was felt that venting to the stack merited serious consideration.

687

DETERMINATION OF THE FEASIBILITY OF USING A YORK MESH ENTRAINMENT SEPARATOR IN THE I.S.H.R. James A. Luker. Aug. 4, 1953. Decl. Feb. 9, 1956. 29p. (CF-53-8-77)

The effectiveness of York Mesh Packing for removing entrainment was calculated for two types of packing, i.e., 110µ diam. wire and 279.4µ diam. wire. Several particle size distribution spectra of the entrained liquid leaving the gas separator were postulated. Calculations were made to show how effectively the York Mesh Packing would remove the assumed entrainment spectra. Estimates were made also of the probable average entrainment size. The problems of flooding velocities, liquid load, and refluxing of the entrainment separator were considered. Performance charts for the York Mesh Packing are presented. The investigation led to the conclusion that York Mesh Packing will satisfactorily reduce the UO_2SO_4 concentration to one part per billion in the gas phase. Recommendations were made for experimental work to study the problems of U accumulation in the entrainment separator, and refluxing.

688

DECOMPOSITION GASES RELEASED DURING A DUMP OF HRT. R. E. Aven. June 25, 1954. Changed from OFFICIAL USE ONLY Dec. 7, 1956. 4p. (CF-54-6-222)

The problem of excessive decomposition gas in mixture with D_2O vapor creating a highly exothermic reaction is considered. It is desirable to keep the temperature of the gas leaving the bed below 700°C and to do this the decomposition gases should be diluted to about 15 mol % or below.

689

USE OF HRE CHARCOAL ADSORBERS IN THE HRT. I. Spiewak. July 8, 1954. Decl. Feb. 14, 1957. 5p. (CF-54-7-26)

An evaluation of the performance of the beds during HRE operation and suggested maintenance prior to use are given.

690

OPERATION OF HRT CHARCOAL BEDS AT 10 MW REACTOR POWER. I. Spiewak. Dec. 20, 1954. Decl. Dec. 20, 1955. 5p. (CF-54-12-143)

The use of the Homogeneous Reactor Experiment charcoal absorbers for gas disposal from the Homogeneous Reactor Test is described. Heating for the charcoal beds, based on 10 Mw reactor operation, and the maximum heating of the charcoal beds were calculated. Two possible dump situations were considered: the first in which the reactor is not operating at power and only O_2 is released, and the second where power operation has been in progress and considerable quantities of radiolytic gas are dumped.

691

RADIOLYTIC GAS GENERATION RATES IN THE HRT. R. E. Aven and P. N. H[illegible]eich. Aug. 31, 1955. Decl. Sept. 20, 1956. 28p. ([illegible]-77)

Estimates were [illegible] gas production rates in the core, circulating [illegible] or circulating system, core pressurizer, fuel dump tanks, and thermal shield, when the HRT was operating at 10 Mw with a D_2O reflector.

692

DESIGN OF CHARCOAL ADSORBERS FOR THE HRT. T. W. Leland. Sept. 6, 1955. Decl. Feb. 15, 1957. 38p. (CF-55-9-12)

The design specifications for the HRT fission product adsorption system are outlined. The calculations up[illegible] which the design is based are summarized, and a sample calculation is presented. The calculations solve approximate equations for the depletion of isotopes from the gas stream produced by isothermal increments of the adsorption bed after steady state conditions have been attained and for the radial temperature distribution in the bed at steady state conditions.

693

LET-DOWN SYSTEM DESIGN FOR HOMOGENEOUS REACTORS. R. E. Aven. Nov. 7, 1955. 25p. (CF-55-11-45)

A study has been made to determine the feasibility of designing a gas let-down system for homogeneous reactors, in which the pressure is taken through a fairly long tube rather than across a throttling valve. A schematic design of such a system is shown for the HRT in which the let-down stream passes through parallel tubes. Control is effected by the cutting in or out of tubes as is needed. Various calculations indicate such a design is feasible.

694

REMOVAL OF IODINE FROM HOMOGENEOUS REACTORS. D. E. Ferguson. Feb. 16, 1956. Decl. Mar. 16, 1957. 29p. (CF 56-2-81)

Two suggested methods look both feasible and attractive for the removal of I_2 from the fuel of a two-region reactor. The first consists of stripping I_2 from the fuel with O_2 and D_2O vapor, scrubbing I_2 from the gas with about 4 gpm D_2O, and finally letting down this small stream of D_2O for removal and storage of the I_2. For a 5 ft core operating at 360 Mw, this method involves circulating a calculated 275 gpm of fuel solution countercurrent to 4.2 lb moles/min of $O_2 - D_2O$ gas to maintain a Xe^{135} poison level of 0.5%. The second method consists of a radiolytic gas let-down system similar to that designed for the HRT, which would take advantage of the stripping of both I_2 and the rare gases by allowing the radiolytic gas to form. This method would require a gas let-down rate of 2600 ml/sec with a liquid let-down rate of about 10 gpm to maintain the Xe^{135} poison level of the TBR at 0.5%.

695

AFTER RECOMBINERS FOR THE HRT. H. A. McLain. Aug. 15, 1957. 6p. (CF-57-8-78)

Installation of small recombiners at the vapor outlets of the present HRT recombiners is described.

696

HRT IODINE REMOVAL BED. E. H. Gift. Sept. 10, 1957. 39p. (CF-57-9-50)

An I_2 removal bed primarily for the purpose of preventing poisoning of the recombiner catalyst has been designed for operation in the HRT. The bed will consist of a 12 in.-ID, 36 in.-long cylinder filled with ½ in. silvered alundum Raschig rings. During operation, the steam gas mixture entering the bed is dried by a steam coil preceding the bed. During shutdown, decay heat must be removed for the first 10 hr by a combination of steam flow from the dump tanks and internal cooling of the bed by water jacketed annuli. After about 10 hr the cooling capacity of the water jacketed annuli will be sufficient to remove the heat.

697

A METHOD FOR THE DISPOSAL OF VOLATILE FISSION PRODUCTS FROM AN ACCIDENT IN THE OAK RIDGE RESEARCH REACTOR. F. T. Binford and T. H. J. Burnett. Aug. 2, 1956. 11p. (ORNL-2086)

The Oak Ridge Research Reactor is a fully enriched, heterogeneous, light-water-moderated and -cooled, beryllium-reflected reactor of the MTR-BSF type. It is designed to operate at a power level of 20 to 30 Mw with a thermal-neutron flux of the order of 10^{14}. In this paper the maximum credible accident is postulated to be that situation in which the reactor suffers from a deficiency in cooling capacity sufficient to cause melting of the fuel elements and subsequent release into the building of all the volatile fission products. It is shown that with properly engineered ventilating and gas-scrubbing equipment the radioactive gas can be disposed of in such a way as to prevent harmful exposure to persons in the surrounding area. Direct radiation from the large mass of gas initially present in the building will be extremely intense in the immediate vicinity of the building. It is possible, however, through the use of a suitable alarm system, to evacuate this area in a time short enough to prevent serious over-exposure to personnel.

698

MEASUREMENT AND ANALYSIS OF THE HOLDUP OF GAS MIXTURES BY CHARCOAL ADSORPTION TRAPS. W. E. Browning and C. C. Bolta. Aug. 10, 1956. 23p. (ORNL-2116)

The holdup behavior of gaseous fission products in charcoal traps was investigated as a function of trap geometry, type and amount of charcoal, trap temperature, flow rate, and type of inert gas used as purging agent. An analytical expression is presented for the calculation of holdup curves for gases when trap geometry and the adsorption isotherm for the gases on charcoal are known.

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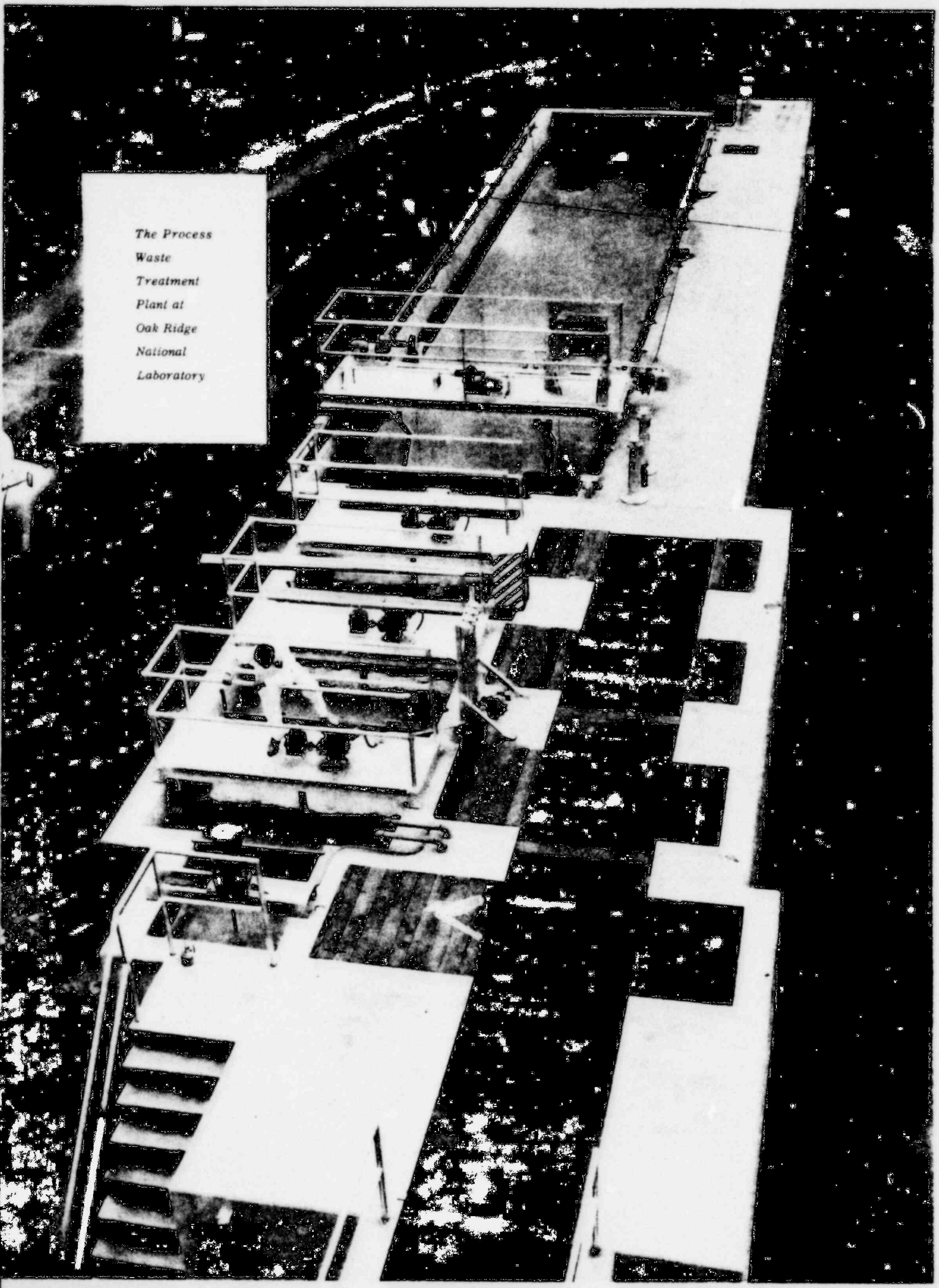

The Process Waste Treatment Plant at Oak Ridge National Laboratory

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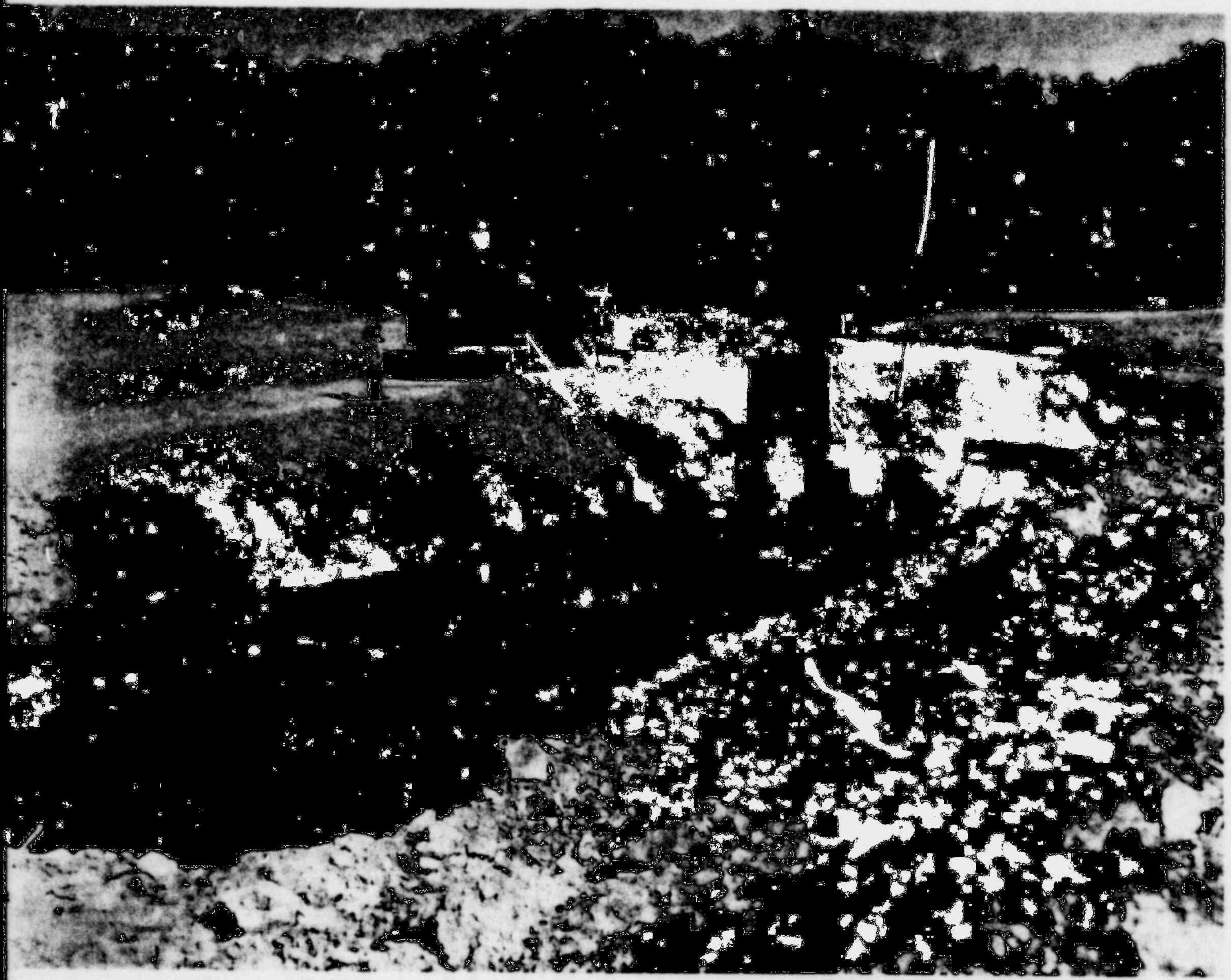

Unloading wastes at burial grounds of the Oak Ridge National Laboratory

Photographs courtesy Oak Ridge National Laboratory

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206	575	*
702	660	Meteorol. Monographs 1, 50-5 (1951)
800	202	Nucleonics 6, No. 4, 44-7(1950)
836	427	Ind. Eng. Chem. 43, 1509-16 (1951)
837	302	In NSA in entirety
860	652	In NSA in entirety
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1008	335	Ind. Eng. Chem. 43, 1516-19 (1951)
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1837	13	$0.15
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355	83	$10.80(ph); $3.90(mf)
380	84	$0.55
388	85	$0.40
446	516	$1.00
447	348	$0.15
453	349	p.372-9 in "Advances in Nuclear Engineering," Vol. I. John R. Dunning and Bruce R. Prentice, eds. New York, Pergamon Press, 1957. 530p.
1070	663	Am. Ind. Hyg. Assoc. Quart. 12, 151-[illegible] (1951)
1091(Del.)	3	$4.80(ph); $2.70(mf)
1187	328	Nucleonics 10, No. 10, 40-2 (1952)
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1513	664	Proc. Air Pollution Control Assoc. 3, 201-4(1953)
1639	358	Chem. Eng. Progr. 51, 313-19 (1955)
1736	4	"Radiation Dosimetry." Gerald J. Hine and Gordan L. Brownell, eds. New York, Academic Press, 1956.
1781	391	Nucleonics 12, No. 12, 14-18 (1954)
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54-7-26	689	$1.80(ph); $1.80(mf)
54-10-64	458	$4.80(ph); $2.70(mf)
54-12-143	690	$1.80(ph); $1.80(mf)
55-1-188	474	*
55-1-200	409	Ind. Eng. Chem. 49, 1725-6 (1957)
55-3-128	475	$4.80(ph); $2.70(mf)
55-4-25	21	$0.25
55-5-171	410	$3.30(ph); $2.40(mf)
55-6-152	22	$0.15
55-7-42	374	$1.80(ph); $1.80(mf)
55-8-76(Del.)	476	$3.30(ph); $2.40(mf)
55-8-77	691	$4.80(ph); $2.70(mf)
55-8-97	252	$3.30(ph); $2.40(mf)
55-9-12	692	$0.40
55-10-83	563	$1.80(ph); $1.80(mf)
55-10-101	565	$3.30(ph); $2.40(mf)

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Report No.	Reference	Availability
55-11-45	693	$4.80(ph); $2.70(mf)
55-11-97	437	$3.30(ph); $2.40(mf)
55-11-143	375	$1.80(ph); $1.80(mf)
56-1-131	395	$4.80(ph): $2.70(mf)
56-1-162	23	$3.30(ph); $2.40(mf)
56-2-81	694	$4.80(ph); $2.70(mf)
56-5-186	24	$9.30(ph); $3.60(mf)
56-8-132	643	$3.30(ph); $2.40(mf)
56-10-15	25	$3.30(ph); $2.40(mf)
56-10-16	376	$1.80(ph); $1.80(mf)
57-1-139	438	$1.80(ph); $1.80(mf)
57-1-172	158	$1.80(ph); $1.80(mf)
57-2-20(Del.)	26	$6.00
57-3-114 (Rev.)	27	$36.30(ph); $10.20(mf)
57-3-113 (Rev.) (Suppl.)	28	$7.80(ph); $3.30(mf)
57-5-24	566	$6.30(ph); $3.00(mf)
57-7-31	253	$3.30(ph); $2.40(mf)
57-8-78	695	$1.80(ph); $1.80(mf)
57-8-118	37	$6.30(ph); $3.00(mf)
57-9-50	696	$6.30(ph); $3.00(mf)
58-3-67	411	$1.80(ph); $1.80(mf)
CN		
2049	424	$4.80(ph); $2.70(mf)
COO		
1013	613	*
1015	678	$15.30(ph); $5.40(mf)
CRD-T1		
184		See LWS-24632
DP		
5	327	$0.10
19	585	*
129	208	$0.10
145	209	$3.30(ph); $2.40(mf)
197	210	$0.15
253	586	$0.75
DRCL		
110	669	*
GAT		
185	677	$0.15
GeL		
67	93	$7.80(ph); $3.30(mf)
HW		
12566	541	*
14923	526	$3.30(ph); $2.40(mf)
15230	494	*
15743	282	$1.80(ph); $1.80(mf)
15802	283	$3.30(ph); $2.40(mf)
16076	95	$6.30(ph); $3.00(mf)
17226	495	$3.30(ph); $2.40(mf)
17339	496	$9.30(ph); $3.60(mf)
17626	527	$3.30(ph); $2.40(mf)
17775	517	$3.30(ph); $2.40(mf)
17822	518	$1.80(ph); $1.80(mf)
18034	266	$4.80(ph); $2.70(mf)
18149	497	$3.30(ph); $2.40(mf)

Report No.	Reference	Availability
18404(Rev.)	519	$3.30(ph); $2.40(mf)
18476	520	$3.30(ph); $2.40(mf)
18492	521	$3.30(ph); $2.40(mf)
18595	542	$7.80(ph); $3.30(mf)
19105	508	$3.30(ph); $2.40(mf)
19852	462	$1.80(ph); $1.80(mf)
19933	522	$3.30(ph); $2.40(mf)
20008	672	$1.80(ph); $1.80(mf)
20847(Pt.I)	588	$16.50(ph); $4.75(mf)
20847(Pt.II)	589	$0.75
21415 & Suppl.	214	$6.30(ph); $3.00(mf)
23352(Rev.)	244	$0.50
24500	528	$7.80(ph); $3.30(mf)
25191	267	$3.30(ph); $2.40(mf)
25994	96	*
26113	673	$3.30(ph); $2.40(mf)
26502	294	Nucleonics 12, No. 5, 55(1954)
26523	97	*
27489	529	$3.30(ph); $2.40(mf)
27620	268	*
27781	215	$3.30(ph); $2.40(mf)
28065	590	$4.80(ph); $2.70(mf)
28491	360	$1.80(ph); $1.80(mf)
28636	99	$28.80(ph); $8.40(mf)
28892	98	*
28917	674	$3.30(ph); $2.40(mf)
29298	269	$1.80(ph); $1.80(mf)
29576	295	$2.50(ph); $1.75(mf)
30142	591	$6.30(ph); $3.00(mf)
30262	463	$3.30(ph); $2.40(mf)
30437	100	$25.80(ph); $7.80(mf)
30641	543	$3.30(ph); $2.40(mf)
30781	592	Nucleonics 12, No. 11, 54 (1954). (Condensed)
31011	464	$6.30(ph); $3.00(mf)
32755	544	$4.80(ph); $2.70(mf)
33148	498	$0.35
33504	530	$4.80(ph); $2.70(mf)
34499	465	$6.30(ph); $3.00(mf)
35009	531	$7.80(ph); $3.30(mf)
35174	270	$3.30(ph); $2.40(mf)
35917	101	$28.80(ph); $8.40(mf)
36217	466	$3.30(ph); $2.40(mf)
36301(Del.)	102	$4.80(ph); $2.70(mf)
36734	271	*
37519	545	$0.30
37642	546	$1.80(ph); $1.80(mf)
37680	532	$4.80(ph); $2.70(mf)
37956	547	$1.80(ph); $1.80(mf)
38198	103	$4.80(ph); $2.70(mf)
38218(Rev.)	296	$0.20
38468	467	$4.80(ph); $2.70(mf)
39273	216	$0.20
39432	548	$19.80(ph); $6.30(mf)
39624	104	$0.55
39658	549	$1.80(ph); $1.80(mf)
40180	425	See TID-7517(Pt.1). $3.10
40289	272	$0.15
40460	217	$4.80(ph); $2.70(mf)
41026(Del.)	105	$4.80(ph); $2.70(mf)
41275	445	$3.30(ph); $2.40(mf)
41295	361	$6.30(ph); $3.00(mf)
41500	106	$1.00
41791(Pt.1)	550	$4.80(ph); $2.70(mf)
42181	107	$1.80(ph); $1.80(mf)
42403	108	$0.40
42488	551	$9.30(ph); $3.60(mf)

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Report No.	Reference	Availability
4608	607	$0.40
4610	608	$0.40
4611	609	$0.40
4612	610	$1.50
4641	342	$7.80(ph); $3.30(mf)
4644	250	$3.30(ph); $2.40(mf)
4708	639	$4.80(ph); $2.70(mf)
4861	221	$0.10
4990	299	$0.80
5214	285	$1.80(ph); $1.80(mf)
7927	347	$7.80(ph); $3.30(mf)

ORNL

Report No.	Reference	Availability
224	377	$0.40
275	488	$3.30(ph); $2.40(mf)
301(Rev.)	412	$0.40
332 (1st Rev.)	224	$1.25
393	378	$12.30(ph); $4.50(mf)
500	644	$3.30(ph); $2.40(mf)
543	505	$7.80(ph); $3.30(mf)
562	452	*
582	453	*
600	310	$1.80(ph); $1.80(mf)
602	225	*
602 (Suppl. 1)	226	*
722	379	$3.30(ph); $2.40(mf)
724	523	$6.30(ph); $3.00(mf)
742		See AECD-2999
848	537	$4.80(ph); $2.70(mf)
873	159	*
932	439	$4.80(ph); $2.70(mf)
1031	274	$6.30(ph); $3.00(mf)
1048	275	*
1064	289	$4.80(ph); $2.70(mf)
1082		See AECD-3295
1086	160	*
1144	413	$3.30(ph); $2.40(mf)
1155	227	Nucleonics 11, No. 8, 34-7 (1953)
1174	161	*
1277	162	*
1352	163	$7.80(ph); $3.30(mf)
1353	164	
1417	645	$3.30(ph); $2.40(mf)
1420	165	*
1472(Del.)	380	$3.30(ph); $2.40(mf)
1488	166	*
1513	381	$4.80(ph); $2.70(mf)
1596	167	*
1638(Del.)	477	*
1648	646	$10.00(ph); $3.50(mf)
1655	647	$4.80(ph); $2.70(mf)
1656	648	$4.80(ph); $2.70(mf)
1660	649	$6.30(ph); $3.00(mf)
1666	650	$0.25
1684	168	*
1763	169	*
1784	512	$0.35
1839	312	$0.35
1860	170	$6.30(ph); $3.00(mf)
1942	171	$6.30(ph); $3.00(mf)
1966	489	$3.30(ph); $2.40(mf)
1984	414	$0.20
1993(Rev.) (Del.)	382	$12.30(ph); $4.50(mf)
2049	172	$10.80(ph); $3.90(mf)
2058	313	$4.80(ph); $2.70(mf)
2078(Del.)	396	$0.65
2081	173	$1.25
2086	697	$0.15
2116	698	$0.25
2151	174	$0.55
2297	490	$0.30
2384	175	$3.50
2410	276	$1.25
2415	478	$0.75
2432	176	$5.50
2475	440	$1.00

ORO

Report No.	Reference	Availability
148	346	$0.25

R

Report No.	Reference	Availability
52GL167	213	$1.80(ph); $1.80(mf)

TID

Report No.	Reference	Availability
388	314	$0.75
5031	254	$1.75
5098	257	$1.25(GPO)
5360	242	$0.45
5360(Suppl.)	243	$1.00
7020(Vol.II) (No.24)	31	$55.80(ph); $11.10(mf)
7512	47 48 60 219 461	$3.00(GPO)
7513(Pt.1)	51	$1.50
7513(Pt.2)	52	$0.35
7517(Pt.1a)	53	$3.10 (Pts. 1a and 1b)
7517(Pt.1b)	54	
7518(Pt.1)	651	$0.50
7525	556	$1.50
7534	44 58 61 62 63 255	$10.50
7539	206	$3.50
7550	394	$2.50
7551	55	$2.00
8017	17	$0.50
10081	49	$0.50
10126	218	$0.60
10142	553	$0.30

UCLA

Report No.	Reference	Availability
13		See AECU-206
260	91	$15.30(ph); $5.40(mf)
262	576	Am. Ind. Hyg. Assoc. Quart. 14, 289-93(1953)
272	261	$6.30(ph); $3.00(mf)
282	393	Soil Sci. 81, 317-26(1956)
286	92	$18.30(ph); $6.00(mf)
293	280	J. Am. Water Works Assoc. 46, 643-54(1954)
344	667	$1.80(ph); $1.80(mf)

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Report No.	Reference	Availability
349	262	Soil Sci. 82, 307-18(1956)
350	233	Soil Sci. 81, 359-69(1956)
368	316	$3.30(ph); $2.40(mf)
380	264	$0.40
UCRL		
1355		See AECD-3221
3454	524	Chem. Eng. 64, No. 5, 294 (1957)
3635	666	P. 78-83 in "Hot Laboratory Operation and Equipment," Vol. III. John R. Dunning and Bruce R. Prentice, eds. New York, Pergamon Press, 1957. 306p.
4556	263	*
4891	34	$4.80(ph); $2.70(mf)
5068	35	$3.30(ph); $2.40(mf)
UR		
129	653	In "U. S. Technical Conference on Air Pollution, Washington, 1950." New York, McGraw-Hill Book Co., 1952. p. 656-71.
139	259	Science 111, 103-9(1950)
180	229	Nucleonics 9, No. 5, C-16-C-20(1951)
189	180	*
199	654	*
287	655	Arch. Ind. Hyg. and Occupational Med. 9, 69-75 (1954)
310	260	*
WAPD-CTA-IH		
87	234	$1.80(ph); $1.80(mf)
WAPD-PWR		
970	32	$3.75
WAPD-PWR-CP		
2126	421	$6.30(ph); $3.00(mf)

Report No.	Reference	Availability
2164	405	$3.30(ph); $2.40(mf)
WAPD-PWR-PMA		
206	539	$1.80(ph); $1.80(mf)
WAPD-SFR-PD		
105	420	$3.30(ph); $2.40(mf)
WAPD-T		
436	33	$4.80(ph); $2.70(mf)
WASH		
4(and Suppl) (Del.)	325	$9.30(ph); $3.60(mf)
8	10	$4.00(ph); $2.25(mf)
129	56	$1.00
149	45	$37.80(ph); $11.10(mf)
170(Del.)	50	$59.40(ph); $11.10(mf)
275	57	$1.50
408	11	P. 344-7 in "Advances in Nuclear Engineering," Vol. I. John R. Dunning and Bruce R. Prentice, eds. New York. Pergamon Press, 1957. 530p.
734	326	$0.20
742	12	$1.25
WIAP		
7	540	$12.30(ph); $4.50(mf)
XDC		
54-4-12		See APEX-179
Y		
471	290	$1.80(ph); $1.80(mf)
532	177	$6.30(ph); $3.00(mf)
605	178	$6.30(ph); $3.00(mf)
638	179	$9.30(ph); $3.60(mf)
964	38	$6.30(ph); $3.00(mf)

NON-AEC REPORTS

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337(C)	305	
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33893		
41950	577	
ADZ		
77	20	

AECL		
344		See CRB-658
356	8	
AERE-CE/M		
200	402	
AERE-C/R		
340	441	
958	65	$3.00(BIS)
1294	450	
1686	398	
1708	415	J. Inorg. and Nuclear Chem. 2, 403-14(1956)

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UK/C

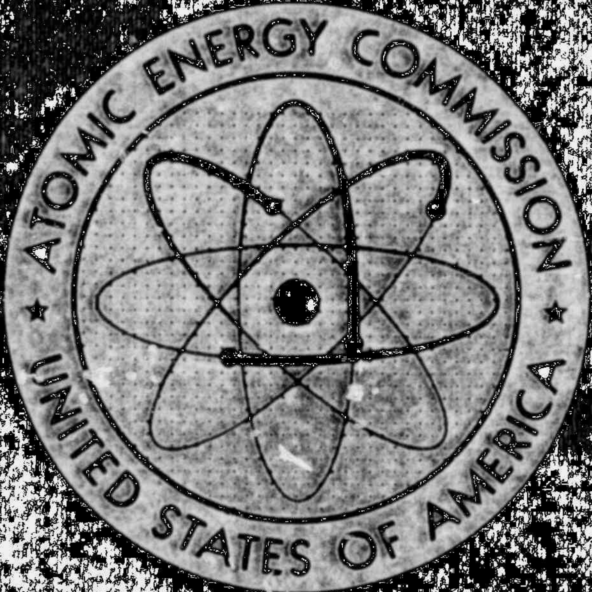
Report No.	Reference	Availability
4/113	387	P. 354-8 in "Advances in Nuclear Engineering," Vol. I, John R. Dunning and Bruce R. Prentice, eds. New York, Pergamon Press, 1957. 530p.
5/19	403	

USNRDL

Report No.	Reference	Availability
342	634	Nucleonics <u>10</u>, No. 9, 22-5 (1952)
343	635	Am. Ind. Hyg. Assoc. Quart. <u>13</u>, 226-31(1952)
382	636	

XDC

Report No.	Reference	Availability
54-4-12		See APEX-179


ATOMIC ENERGY COMMISSION
UNITED STATES OF AMERICA