PROGRESS REPORT

on

DISPOSAL OF CANAL WASTES

Research and Development Section
Bloomsburg Division
United States Radium Corporation

July 7, 1960
Bloomsburg, Pa.

J. G. MacHutchin

REPORT ON DISPOSAL OF CANAL WASTES

Introduction:

Over the course of the past 12 years, the sections of the canal located behind the Bloomsburg plant have accumulated various wastes and debris and have become a very undesirable eyesore. During the spring season and after periods of wet weather, a considerable amount of surface water collects in the canal. As the hotter summer weather approaches, evaporation occurs and algae formation ultimately results. Complaints made by residents of nearby areas on the stench emanating from the canals demanded that immediate action be taken to eliminate these bodies of stagnant water.

Survey of Canal Waters:

Prior to attempting to dispose of the water in the various canal sections, a survey was made to determine if radioactivity could be detected in the water.

A series of water samples was taken at random locations and at various depths in each of the canal sections involved. Counting samples were prepared by evaporating 100 ml. aliquots on stainless steel trays. The trays were then counted in the Health Physics internal proportional counter where low backgrounds exist. The averaged results of the measurements are summarized in Table I.

TABLE I

Summary of Data for Various Canal Sections

Canal No.	pH	Averaged Activities in uc/ml. Alpha	beta-gamma
2	6.4	2.9×10^{-7}	1.8×10^{-6}
3	6.5	9.6×10^{-8}	2.5×10^{-6}
4	6.5	6.5×10^{-8}	2.5×10^{-6}
5	6.5	4.7×10^{-8}	2.2×10^{-6}
Tap water	6.6	2.6×10^{-9}	2.3×10^{-8}
River water	6.8	1.5×10^{-9}	3.7×10^{-9}

Radiochemical analysis of samples of concentrated canal water was undertaken by I. Allam utilizing the analytical scheme of Lundell and Hoffman (as suggested by the AEC). Since the activity levels involved were extremely low, rough quantitative estimates only could be made. Based on the results of these tests, it was concluded that at least 70% of the beta-gamma activity was contributed by Cs^{137}. The alpha activity present, as well as that beta-gamma activity not associated with Cs^{137}, probably resulted from trace amounts of radium, natural uranium and thorium etc., contained in tap water, surface drainage, etc., which have been collected and concentrated in the canal by natural evaporation over the past years.

Disposal Procedures

(A) Canals Nos. 4-5:

River water was pumped into these sections of the canal which ultimately became one pond as the water level rose. Dilution with river water was continued until the level in the pond was just below the point of overflow. After allowing the diluted water to mix for a period of approximately 24 hours, representative samples were taken for radioactive content determination as described previously. The results of the analyses are summarized in Table II.

Based on the prior evidence that the activity in the water was predominantly Cs^{137} (for which the maximum permissible concentration in unrestricted areas is listed in Title 10, CFR-20 at 1.5×10^{-4} microcuries/ml), the water in the pond was then pumped to the river over a period of approximately 48 hours. At the time of discharge, the river level was several feet above normal due to recent heavy rains.

TABLE II

SUMMARY OF DATA FOR CANALS NOS. 4-5

Averaged Activities Prior to Discharge (uc/ml)		pH of Water	Est. Max. Total Vol. Discharged to River Gal.	Est. Max. Total Activities Discharged to River in mc.	
Alpha	Beta-gamma			Alpha	Beta-gamma
4.2×10^{-9}*	5.7×10^{-7}**	6.7	300,000	0.005*	0.7**

* assumed due to Ra (plus daughters), natural uranium, thorium etc.

** assumed at least 70% due to Cs^{137} Ba^{137}.

After emptying of Canals Nos. 4-5, the bottom and sides were checked for residual activity and, since none was detected, the area was filled in with earth and levelled to prevent further accumulation of surface drainage.

(b) Canal No. 2:

Scavenger precipitation tests were made by I. Allam on a series of 50 gallon water samples taken from Canal No. 2. The precipitation procedure consisted of adding small amounts of inactive Bi and Pb nitrates as 'carriers' for long-lived Ra daughters, plus Sr and Ba chlorides as 'carriers' for any radioactive Sr and Ra which might be present. This was followed by the addition of sulfates of Al and Fe (ferric) as flocculating agents. The pH of the solution was then adjusted to 7.0-7.5 by the addition of $Na_2 CO_3$ solution. The flocculant precipitate formed settled quickly to the bottom of the container leaving a very clear supernatant liquid.

Aliquot samples of the supernatant liquid were deposited on stainless steel trays and the activity in each was determined as described previously. The results of the tests indicated that satisfactory alpha and beta-gamma decontamination factors were achieved.

Based on the results of the above tests, the water in Canal No. 2 was treated in a similar fashion, as described below. Circulation of the water in the canal and of the feed solutions was accomplished by pumping water (rate=approx. 7000 gal/hr) from one end of the canal and discharging the effluent into the center of the canal. The chemical solutions were added at the pump inlet in the following order:

Carriers:

(1) $Bi(NO_3)_2$ - 1 lb. dissolved in 2 gal. 1N HNO_3

(2) $Pb(NO_3)_2$ - 100 lb. dissolved in 50 gal. H_2O

(3) $SrCl_2$ - 25 lb. dissolved in 50 gal. H_2O

(4) $BaCl_2$ - 25 lb. dissolved in 50 gal. H_2O

Flocculating Materials:

(5) Al $(SO_4)_3$ - 400 lb. dissolved in 150 gal H_2O.

(6) Fe $(SO_4)_3$ - 1000 lb. dissolved (slurried) in 300 gal. H_2O.

Neutralizing Solution:

(7) Na_2CO_3 - 1200 lbs. dissolved in approx. 500 gal. H_2O.

Continuous circulation of the resultant mixture was maintained for a period of 24 hours. Circulation was then halted and the precipitate was allowed to settle over a period of 24 hours. The precipitate settled cleanly to the bottom of the canal and the resultant supernatant liquid was extremely clear in appearance.

Twenty random samples of the supernatant liquid were taken from the canal and combined to form a composite sample. Aliquot samples (100 ml.) were deposited on stainless steel trays and the activity in each determined as described previously. The results of the activity analyses indicated that the residual activity in the canal water was extremely low.

The water was then pumped to the river at a controlled rate over a period of approximately 48 hours. At the time of discharge, the river water level was abnormally high as a result of recent heavy rains. A summary of the data for Canal No. 2 is shown in Table III.

TABLE III

SUMMARY OF DATA FOR CANAL NO. 2

Averaged Activities Prior to Discharge (uc/ml)		pH of Water	Est. Max. Total Vol. Discharged to River	Est. Max. Total Activities Discharged to River in mc.	
Alpha	Beta-gamma		Gal.	Alpha	Beta-gamma
7.5×10^{-10}	n.d.	7.0	280,000	7.9×10^{-4}	n.d.

n.d. = not detectable above background

Fifteeen samples of the precipitate were taken at various locations and slurried in distilled water to form a well-mixed slurry. Samples of the slurry mixture were then deposited and dried on tared counting trays. The weight of the precipitate on the trays was determined and its activity content measured. The averaged results were as follows:

Alpha activity : 1.7×10^{-7} uc/mgm. ppt.

Beta-gamma activity : 1.7×10^{-7} uc/mgm. ppt.

The thin, moist layer of precipitate residual on the sides and bottom of the container was removed and loaded into a series of 55 gallon drums for disposal as radioactive waste.

Half of Canal No. 2 was then filled with earth and levelled off.

(c) Canal No. 3:

Present plans call for diverting all plant effluents presently being discharged into Canal No. 3 to Canal No. 2. The liquid in Canal No. 3 will then be pumped into the recently-completed waste storage vault, diluted appropriately with upstream river water, analysed for activity, and if found satisfactory, it will be discharged to the river at a controlled rate. When empty, Canal No. 3 will be filled with earth and levelled off. A report on this operation will be issued when the work has been completed.

At a later date, the laboratory effluents being discharged into Canal No. 2 will be diverted to the laboratory effluent disposal system, the design of which has now been essentially completed.

ACKNOWLEDGEMENT

The valuable assistance provided in this program by Messrs. I. Allam, F. Buck, D. Cowan, E. Fisher and members of the Health Physics Group is gratefully appreciated.

Exhibit H

DATE: September 2, 1960

TO: C. C. Carroll

FROM: J. G. MacHutchin

SUBJECT: Disposal of Liquid Wastes

Dear Clayt:

Attached hereto please find two (2) copies of a report summarizing the work done since July 7th on liquid waste disposal.

I believe you plan to visit us during the week of September 12th for the purpose of discussing the final plans for the proposed waste disposal system.

Please do not hesitate to call me if you have any questions concerning the attached report.

JGM:ar

JGm.

cc: H. A. Vaughn
W. E. Umstead
E. M. Burtsavage ✓

E. B. Fisher
C. W. Wallhausen
H. H. Dooley

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PROGRESS REPORT

on

DISPOSAL OF CANAL WASTES

Research and Development Section
Bloomsburg Division
United States Radium Corporation

August 22, 1960
Bloomsburg, Penna.

W. F. Buck
J. G. MacHutchin

REPORT ON DISPOSAL OF CANAL WASTES

Following completion of the operations outlined in the July 7, 1960 Progress Report, work was initiated on the disposal of the liquid wastes contained in Canal No. 3.

As reported previously, activity determinations were made on a series of samples taken from Canal No. 3 at random locations and at various depths. The averaged results are summarized in Table I.

TABLE I

Summary of Data for Canal No. 3

Samples Taken from	pH	Averaged Activities in uc/ml. Alpha	Beta-gamma
Canal 3	6.5	9.6×10^{-8}	2.5×10^{-6}
Tap Water	6.6	2.6×10^{-9}	2.3×10^{-8}
River Water	6.8	1.5×10^{-9}	3.7×10^{-9}

Based on radiochemical tests described in the July 7th Progress Report, it was concluded that:

(a) At least 70% of the beta-gamma activity was contributed by Cs^{137}.

(b) The beta-gamma activity not associated with Cs^{137}, as well as the alpha activity present, probably resulted from the presence of trace amounts of natural radium, uranium, thorium, etc., contained in tap water, surface drainage, etc., which were collected and concentrated in the canal by natural evaporation for many years.

DISPOSAL PROCEDURES

Liquid from Canal No. 3 was pumped, in separate batches, to our concrete storage vault. Each batch was then diluted with river water and allowed to mix thoroughly. After each dilution step, 8 samples were taken for analysis and combined. Three 100 ml. aliquots from each sample were evaporated onto stainless steel counting planchets. The activity on each planchet was then determined using the Health Physics internal proportional counter located in a low background area.

Based on the prior evidence that the activity in the water was predominantly Cs^{137} (for which the maximum permissible concentration in unrestricted areas is listed in Title 10, CFR-20, at 1.5×10^{-4} uc/ml), and that the concentration of Cs^{137} in the diluted batches of waste was well below the above limit, the diluted wastes were pumped to the river at a controlled rate over a 24-48 hour period. During the waste discharge period, due to a series of previous heavy rains, the river level was several feet above its normal level.

The volumes of liquid involved, the activity in the diluted batches, etc., are listed in Table II.

TABLE II

SUMMARY OF DATA FOR

Date	Gallons Pumped into Vault			Av. Activity (uc/ml) in Final Solution Prior to Discharge	
	Canal Water	River Water	Total	Alpha	Beta-gamma
7/18-7/22	18,000	36,000	54,000	3.9×10^{-9}	1.2×10^{-8}
7/25-7/29	9,000	45,000	54,000	1.8×10^{-9}	1.6×10^{-7}
8/1-8/3	18,000	54,000	72,000	3.9×10^{-9}	1.8×10^{-7}
8/4-8/8	36,000	54,000	90,000	1.2×10^{-9}	5.8×10^{-7}
8/8-8/11	36,000	54,000	90,000	3.5×10^{-9}	1.5×10^{-7}
				TOTALS --	

After Canal No. 3 had been pumped dry, 16 samples of surface soil were taken from random locations along the sides and bottom of the canal. The samples were combined, mixed well and turned over to Health Physics Group for activity checks. The results were reported later as follows:

Alpha : 6.4×10^{-9} uc/mgm. of earth
Beta-gamma: 6.4×10^{-8} uc/mgm. of earth

Following the above sampling procedure, the canal was immediately filled with earth before a predicted period of wet weather could result in partial filling of the canal with fresh waste liquid.

Present Liquid Waste System:

Present laboratory liquid wastes, considerably reduced in total volume, are being collected in the concrete storage vault. When the liquid level in the vault reaches a predetermined height its activity will be checked. If found to be below tolerance levels it will be pumped to the river at a controlled rate; if above tolerance levels, it will be diluted appropriately with river water, checked for activity levels, and then pumped to the river.

The above arrangement is a temporary one and will be replaced by a distillation type concentration system. Design completion of this system is scheduled for mid-September and quotation requests will be sent out immediately thereafter. It is anticipated that the unit will be in operation by December 1st of this year.

ACKNOWLEDGEMENT

The valuable assistance provided in this program by the Health Physics and Maintenance groups is gratefully acknowledged by the authors of this report.

Exhibit "G"

DATE: July 11, 1960

TO: C. C. Carroll

FROM: J. G. MacHutchin

SUBJECT: Disposal of Liquid Wastes

Dear Clayt:

Attached hereto for your files are two (2) copies of a report summarizing the work done to date on eliminating the canal sections located behind the Bloomsburg plant.

I understand that you plan to visit us this week to discuss this program and also to review the plans for the proposed laboratory effluent distillation system.

Please let me know if you need any further information.

JGM:ar

cc: H. A. Vaughn
W. E. Umstead
E. M. Burtsavage ← COPY FOR
E. B. Fisher
C. W. Wallhausen
C. C. Carroll
H. H. Dooley