

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

SUBJECT: Materials Research Society Symposium on the Scientific Basis for Nuclear Waste Management XXIX
Project Numbers 20.06002.01.212 and 20.06002.01.322
AI # 20.06002.01.212.503

DATES OF TRAVEL AND COUNTRIES/ORGANIZATIONS VISITED:

September 12 –16, 2005; Belgium

AUTHORS, TITLE, AGENCY AFFILIATION:

Roberto Pabalan, Institute Scientist, Center for Nuclear Waste Regulatory Analyses
Darrell Dunn, Principal Engineer, Southwest Research Institute® (SwRI®)

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BACKGROUND AND PURPOSE:

The Symposium on the Scientific Basis for Nuclear Waste Management XXIX, as part of the 2005 Materials Research Society symposia, was held this year in Ghent, Belgium. The purpose of the trip was to attend the Symposium and present two papers on issues related to the near-field environment and waste package corrosion. Another purpose was to facilitate contact with scientists and technologists working on high-level nuclear waste management, mainly from Europe, where several national programs are moving forward.

ABSTRACT—SUMMARY OF PERTINENT POINTS AND ISSUES:

The symposium comprised four days of technical sessions on a variety of topics relevant to the scientific basis for nuclear waste management. The fifth day comprised a trip to Mol, Belgium, to visit some facilities of the radioactive waste conditioning and storage company, Belgoprocess, and the SCK•CEN underground research laboratory, HADES. The symposium attracted 200 international participants, including 10 from the United States. The authors of this trip report presented two NRC-funded papers in well-attended poster sessions that provided an opportunity to discuss the recent findings with an international audience. Four Department of Energy-funded papers were presented that discussed waste package corrosion, salt deliquescence, neptunium solubility, and spent fuel alteration. The authors of this trip report participated in the meeting of the Steering Committee that was planning future scientific basis for nuclear waste management symposia. Attendance at the conference provided an excellent opportunity to keep current with a variety of topics relevant to the NRC high-level waste program.

DISCUSSION:

A total of 58 oral and 162 poster presentations were made on scientific and technical issues relevant to radioactive waste management. The topics in the 10 oral sessions and 9 poster sessions were (i) international/national overviews; (ii) glass waste forms; (iii) spent fuel;

(iv) ceramic waste forms; (v) container materials; (vi) analogs; (vii) intermediate level waste forms; (viii) radionuclide behavior; (ix) integrated processes; and (x) performance assessment and safety case.

The authors of this trip report presented two NRC-funded papers. The first was a poster titled "Modeling Corrosion Processes for Alloy 22 Waste Packages," co-authored by D. Dunn O. Pensado, Y. Pan, L. Yang, and X. He. The localized corrosion susceptibility of the outer Alloy 22 container was evaluated based on corrosion potential and repassivation potential measurements. Crevice corrosion propagation rate tests suggest that penetration of the outer container by crevice corrosion is unlikely even in aggressive solutions at elevated temperatures. The second NRC-funded poster was titled "Experimental Determination and Thermodynamic Calculation of the Deliquescence Relative Humidity of Multicomponent Salt Mixtures," co-authored by M. Juckett, R. Pabalan, and L. Yang. This poster presented the results of experiments and thermodynamic calculations designed to determine the deliquescence relative humidity of salt mixtures, a process that could form potentially corrosive brines on the surface of engineered barriers. A comparison of experimental data and values calculated using a thermodynamic model showed good agreement. Both studies were conducted to develop technical bases for assessing the risk significance of near-field and waste package corrosion processes important to reviewing a potential repository license application.

The opening session on International/National Overviews featured six keynote presentations. An overview of underground characterization for a spent fuel repository in Finland was presented by J. Vira (Posiva Oy, Finland). The proposed repository site is located in Olkiluoto on the west coast of Finland. Excavation started in 2004 and about 700 m of tunnel length have been completed. The spent fuel container will be made of copper, which will be emplaced along with buffer material inside a steel canister. Several fabrication and closure methods for the copper container have been evaluated, including forging, drawing, electron beam welding, and friction stir welding. Backfill materials also are being evaluated. A repository license application is planned to be submitted in 2012, with operation to begin in 2020.

H. Umeki (JNC, Japan) provided information on the research program in Japan designed to enhance the reliability of disposal technologies and safety assessment methodologies. A repository feasibility study was conducted from 1976 to 1999. The implementation phase was started in 2000. The current time line indicates detailed investigations of proposed sites will commence in 2010, construction will start in 2020, and an operating facility will be in place in 2030. Current studies are being conducted in two underground research laboratories located in crystalline rock (Mizunami site) and in sedimentary rock (Horonobe site).

J. Bel (ONDRAF, Belgium) presented a new container concept, referred to as a supercontainer, for the disposal of high-level radioactive waste in Belgium. The supercontainer is designed to be used in a Boom clay repository with concrete-lined drifts. The supercontainer has a carbon steel overpack surrounded by Portland cement and an outer container of stainless steel. Backfill will be used between the stainless steel and the concrete lining of the drift. Performance of the proposed repository design is divided into several phases. Physical containment is proposed for the first 1,000 to 10,000 years. Slow release will likely occur from 1,000 to 10^5 years. Diffusion and retention will occur from 10^5 to 10^6 years. Composition of the concrete and several concerns, such as corrosion of glass and spent fuel in alkaline environments, were also discussed.

The Glass session featured a presentation by the conference organizer, P. Van Iseghem (SCK•CEN, Belgium) on glass stability studies. The main conclusion was that the corrosion rate of glass is slow. Although the initial forward rate was relatively fast at 1 g/m²/day, the dissolution rate in 90 °C water was reduced over time to 0.0005 g/m²/day. L. De Windt (Ecole des Mines de Paris, France) described a study that assessed the durability of nuclear waste glass in a clay host rock of an underground disposal site. The study indicated that glass dissolution is enhanced by steel corrosion products and by the host rock, which serves as a long-term sink for silica.

In the Spent Fuel session, C. Poinssot (DPC/SECR, France) discussed mechanisms governing the release of radionuclides from spent nuclear fuel in a geological repository. Spent fuel alteration was demonstrated to be linked to the production of oxidants resulting from water radiolysis, but studies indicated that hydrogen gas generated by corrosion of waste containers inhibits spent fuel alteration by scavenging the radiolysis oxidants. In the same session, K. Ollila (VTT Processes, Finland) described dissolution experiments using samples of uranium dioxide doped with U-233. The experiments were conducted in an inert atmosphere glove box in a dilute groundwater and in the presence of an iron strip to induce a reducing condition. The total amount of uranium recovered in each test was used to calculate an expected lifetime for the samples. Lifetimes of 0.3 to 0.6 million years were calculated based on short term tests, whereas experiments conducted at 129 to 140 days resulted in calculated lifetimes of 7 to 10 million years.

The Container session was opened with a presentation by D. Feron (CEA, France) on predicting long-term corrosion behavior of waste containers in nuclear waste systems. The presentation was focused on carbon steel container materials and, essentially, was a summary of information presented at the corrosion workshop held in Cadarache, France, in 2001 and at the subsequent Eurocorr 2004 symposium held in Nice, France. The uniform corrosion rate of carbon steel materials can be conservatively estimated using a linear extrapolation. The pitting corrosion damage can be estimated by examining the dependence of the pitting factor with time. In general, for carbon steels, the pitting factor decreases with time.

Also in the Container session, J. Payer (Case Western Reserve University), a consultant to the Department of Energy Office of Science and Technology and International, made a presentation titled "The Proposed Yucca Mountain Repository from a Corrosion Perspective." The corrosion resistance of the waste package at the potential Yucca Mountain repository was reviewed and a framework for the analysis of localized corrosion processes was presented. Much of the information presented was similar to his presentation at the May 2004 Nuclear Waste Technical Review Board meeting. Corrosion was stated to be the most likely degradation mode of the waste package. Repository performance and corrosion of the waste package were related to the thermal profile of the repository. During the preclosure period, stated to be 50 years, the repository will be ventilated and temperatures will be below boiling. After repository closure, the repository will heat up for 15 years. During the subsequent 700 years, the temperature of the drift wall will remain above boiling and dripping of water on the engineered barriers is not expected. During the period from approximately 750 to 1,375 years after the start of waste emplacement, the temperature of the drift wall will be below boiling and dripping of water will be possible. After 1,375 years, the temperature of the waste packages will be below the critical temperature for localized corrosion and only slow uniform corrosion is expected. No additional

information on the drip shield design was presented. A brief overview of the Materials Performance Program of the Office of Science and Technology and International also was given.

Three other Department of Energy-funded papers were presented. D. Sassani (Management and Technical Support Contractor/Golder Associates) presented a poster paper titled "Neptunium Solubility in the Near-Field Environment of a Proposed Yucca Mountain Repository." The paper described alternative models for solubility controls on dissolved neptunium concentrations, including models based on precipitation of neptunium as separate oxide minerals or as trace amounts of neptunium incorporated into secondary uranyl phases from waste form alteration. The tetravalent neptunium solid (NpO_2) is believed to be more stable than pentavalent (Np_2O_5) phases, resulting in low dissolved concentrations of neptunium species.

C. Bryan (Sandia National Laboratories) presented a poster paper titled "Evaluation of the Corrosivity of Dust Deposited on Waste Packages at Yucca Mountain, Nevada." The poster provided technical bases for the Department of Energy conclusion that dust deliquescence is of low consequence with respect to repository performance. Information that was summarized in the poster was taken from a Department of Energy report titled "Analysis of Dust Deliquescence for FEP Screening (ANL-EBS-MD-000074)."

J. Fortner (Argonne National Laboratory) presented a poster paper titled "The Microchemistry of Spent Uranium Oxide Nuclear Fuel." X-ray absorption spectroscopy and microscopy showed that plutonium and neptunium in spent fuel are tetravalent, with a local environment consistent with solid-solution in the uranium oxide matrix. The study suggests that as long as uranium in the spent fuel is predominantly in the tetravalent state, neptunium also would be in the tetravalent state, which has low solubility.

The conference organizers also arranged a technical visit to Mol, Belgium where radioactive waste is processed and stored. The site also has an underground research facility intended to evaluate the feasibility of siting a high-level waste disposal repository in Boom clay. The underground tunnel is located at a depth of 220 meters in the center of a 100 meter thick Boom clay deposit. The construction of the concrete-lined facility and the scientific investigations conducted in it were described. The tour of the low- and intermediate-level waste facility included a visit to the receiving area, the incinerator for combustible waste, the supercompactor for compressing 200-liter drums, and a storage facility for the 400-liter drums. The tour guide indicated that once the waste drums have been packed and marked, they are placed in storage. Periodically, representative drums are removed from the storage facility and inspected.

A book of conference abstracts was published by the organizers. A complete list of the conference papers is provided as an appendix of this trip report.

At the end of the conference, R. Pabalan and D. Dunn participated in the meeting of the Steering Committee that was planning future Scientific Basis Symposia. D. Dunn will co-chair the next symposium to be held next fall in Boston, Massachusetts. The committee endorsed that the symposium in 2007 be held in Sheffield, U.K.

PENDING ACTIONS AND PLANNED NEXT STEPS FOR NRC:

None.

POINTS FOR COMMISSION CONSIDERATION AND ITEMS OF INTEREST:

None.

ATTACHMENT:

Appendix I: Program MRS 2005
Appendix II: Business Cards

SIGNATURES:



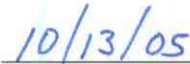
Roberto Pabalan
Institute Scientist



Date



Darrell Dunn
Principal Engineer



Date

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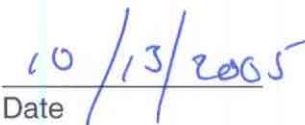
Vijay Jain, Manager
Corrosion Science & Process Engineering Element



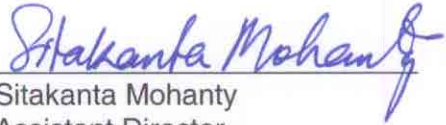
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English C. Percy, Manager
Geochemistry Element

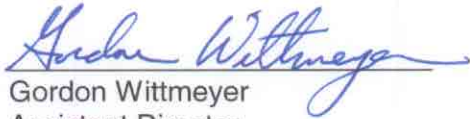


Date



Sitakanta Mohanty
Assistant Director
Engineering and Systems Assessment

10/13/2005
Date



Gordon Wittmeyer
Assistant Director
Earth Sciences

10/13/2005
Date

APPENDIX I: PROGRAM MRS 2005

Sunday, September 11, 2005

18:00-20:00 Registration at "Het Pand"

Monday, September 12, 2005

09:00 Introduction

09:20-12:50 Session: International/National Overviews

Chair: McMenamin Thomas (European Commission), Van Iseghem Pierre (SCK.CEN, Belgium)

09:20 001 Key-note: Further steps towards licensing: underground characterisation started for the spent fuel repository in Finland.

Vira J. and Oy P.

09:50 002 Key-note: The JNC Generic URL Research Programme - Providing a Knowledge Base to Support both Implementer and Regulator in Japan

Umeki H., Shimizu K., Seo T., Kitamura A. and Ishikawa H.

10:20 003 Key-Note: Development of the Supercontainer Design for Deep Geological Disposal of High-Level Heat Emitting Radioactive Waste in Belgium

Bel J. and Gens R.

10:50 Coffee Break

Special Poster Viewing:

- The activities of the NEA (Nuclear Energy Agency)
- The new EC projects NF-PRO (Integrated Project) and ACTINET (Network of Excellence)
- FUNMIG project

11:20 004 Key-note: IAEA's Coordinated Research Programmes on Performance of High Level Wastes in Deep Geological Repositories.

Gonzales J. L. and Van Iseghem P.

11:50 005 Key-note: Integration of the Engineered Barrier System in a Safety Case for a Geological Repository: An EC-NEA Initiative.

Bennett D.G., Hooper A.J., Voinis S. and Umeki H.

12:20 006 Key-Note: Chemical Processes in the Near Field overview

Grambow B.

12:50 Lunch

14:10 Poster Viewing

Poster Session: Glass

Chair: Vernaz Etienne (CEA Valrhô, France)

059 Optimisation of solubility constants to describe the incongruent dissolution of SON68 waste glass by an equilibrium ideal solid solution model approach

Jacques D. and Lemmens K.

- 060 Immobilisation of Simulated Plutonium-Contaminated Material in Phosphate Glass: An Initial Scoping Study
P.A. Bingham, R.J. Hand and C.R. Scales
- 061 Cold Crucible Vitrification of Defense Waste Surrogate and Vitrified Product Characterization
Kobelev A.P., Stefanovsky S.V., Knyazev O.A., Lashchenova T.N., Holtzscheiter E.W. and Marra J.C.
- 062 HLW-Glass dissolution and co-precipitation studies
Luckscheiter B. and Nesovic M.
- 063 Alteration of SON68 glass in deep geological disposal: integrated experiments and reactive transport modelling
de Combarieu G., Barboux P., Godon N. and Minet Y.
- 064 Influence of V₂O₅ content on the sulphates incorporation in radioactive waste glasses: a systematic study
Manara D., Grandjean A., Pinet O. and Dussossoy J.L.
- 065 Kinetics of Aqueous Alteration of P0798 Simulated Waste Glass in the presence of bentonite
Yamaguchi K., Inagaki Y., Saruwatari T., Idemitsu K., Arima T., Yoshikawa H. and Yui M.
- 066 Durability studies of simulant UK high level waste glass
McLoughlin S.D., Hyatt N.C. and Lee W.E.
- 067 An overview of simple basic equations used in glass dissolution modeling: consequences for long term leaching, element profiles and agreement with simulations
Aertsens M.
- 068 Study on HLW-glass leaching behavior under low oxygen repository condition
Zhang H. and Luo S.
- 069 High-Level Waste Glass Melt Dynamics
Sundaram S.K., Woskov P.P. and Daniels W.E.

Poster Session: Integrated Processes

Chair: Yui Mikazu (JNC, Japan), Volckaert Geert (SCK.CEN, Belgium)

- 070 Thermal Response of Bentonite to Permafrost - A Simulation Study
Cedercreutz J. and Marcos N.
- 071 Gas generation due to gamma radiolysis in the concrete buffer of a supercontainer for HLW disposal
Bouniol P.
- 072 Field Test of Ethanol/Bentonite Slurry Grouting into Rock Fracture
Asada M., Nakashima H., Ishii T. and Horiuchi S.
- 073 A study on Gas Migration Behavior in Buffer Material using X-ray CT Method
Tanai K. and Yui M.
- 074 Determining the Transport Properties of Rock Specimens by Using Improved Laboratory Through-Diffusion Technique
Zhang M., Takeda M. and Nakajima H.
- 075 Sorption of molybdenum(VI) on synthetic magnetite
Rovira M., de Pablo J., Casas I., Giménez J., Clarens F. and Martínez X.
- 076 Studies on Sealing Performance of Clay Plug by the Tunnel Sealing Experiment
Kawakami S., Fujita T., Masumoto K. and Yui M.
- 077 Development of low alkaline cement considering pozzolanic reaction for support system in URL construction

- Nakayama M., Fujishima A., Hatanaka K., Yui M., Iriya K. and Kurihara Y.*
 078 Experimental determination and thermodynamic calculation of the deliquescence relative humidity of multicomponent salt mixtures
Juckett M.R., Pabalan R.T. and Yang L.
 079 Sorption of silicates species on iron oxyhydroxides
Jordan N., Lomenech C., Marmier N., Ehrhardt J.J. and Giffaut E.
 080 Silica sorption onto container corrosion products siderite and magnetite
Ferrand K., Abdelouas A., B.Grambow B. and Giffaut E.
 081 Effects of Calcium Ion in Highly Alkaline Plume on Permeability Change of Flow-Path
Usui H., Niibori Y., Tanaka K., Tochiyama O. and Mimura H.
 082 Experimental Study on Mechanism of Ethanol/Bentonite Slurry Grouting
Ishii T., Iwasa K., Shiraishi T., Sakurai H., Saito A. and Nakashima H.
 083 Consolidation of Bentonite-Ethanol Slurry Injected in a Planar Fracture; Mathematical Modelling and Experiments
Takase H., Iwasa K., Ishii T., Ueda H., Sakaba Y. and Ishiguro K.
 084 Evaluation of the Corrosivity of Dust Deposited on Waste Packages at Yucca Mountain, Nevada
Bryan C., Jarek R., Wolery T., Shields D., Sutton D., Hardin E. and Barr D.

Poster Session: Performance Assessment and Safety Case

Chair: Umeki Hiroyuki (JNC, Japan), Lalieux Philippe (NIRAS/ONDRAF, Belgium)

- 085 A Study on Mechanical Effect of Engineering Barrier System by Simulated Fault Movement
Nishimura M., Hirai T. and Yui M.
 086 Repository performance assessment and advanced fuel cycle models for input to decision making of options for nuclear waste and resource management
Small J.S., Zimmerman C.H., Parker D., Robbins C., Bond A. and Stevens G.
 087 Modeling of Groundwater Flow and Radionuclide Transport in a High-Level Radioactive Waste Repository with Multiple Canisters
Lim D.
 088 A study of the in-situ formation factor in the Swedish site investigations
Löfgren M. and Neretnieks I.
 089 Epistemic and Aleatory Uncertainty in Recommended, Generic Rock Kd Values used in Performance Assessment Studies
Crawford J.N., Neretnieks I. and Moreno L.
 090 Development and application of knowledge-based source-term models for radionuclide mobilisation from contaminated concrete
Deissmann G., Bath A., Jefferis S., Thierfeldt S. and Wörlen S.
 091 Modelling of transport in fractures with different matrix properties
Moreno L., Crawford J. and Neretnieks I.
 092 A probabilistic methodology to determine acceptance criteria for defects and failure probabilities for the KBS-3 ductile cast iron inserts
Nilsson K.-F., Andersson C.-G., Nilsson F., Dillström P., Andersson M. and Minnebo Ph.
 093 Chemical durability and performance of assessment of spent fuel and high level waste forms under simulated repository conditions – Spanish contribution to IAEA Project
Martínez-Esparza A., Gago J.A., Quiñones J., Iglesias E., Cera E., Merino J., de Pablo J. and Casas I.

14:40 Poster Discussion

Coffee Break

15:40-18:10 Session: Glass

Chair: Vernaz Etienne (CEA Valrhô, France)

15:40 007 Key-Note: GLASTAB and GLAMOR projects: Main Conclusions and Remaining Uncertainties

Van Iseghem P., Ribet I., Grambow B. and Gin S.

16:10 008 Modelling the long term alteration of the nuclear glass-corrosion products system

Ribet S. and Grambow B.

16:30 009 SON68 Glass Dissolution Kinetics at High Reaction Progress: Mechanisms accounting for the residual alteration rate

Frugier P., Gin S., Lartigue J.E. and Deloule E.

16:50 010 Assessing the durability of nuclear glass with respect to silica processes in a clayey underground disposal

De Windt L., Leclercq S. and van der Lee J.

17:10 011 Temperature Dependence of Long-Term Alteration Rate for Aqueous Alteration of P0798 Simulated Waste Glass under Smectite Forming conditions

Inagaki Y., Saruwatari T., Idemitsu K., Arima T., Shinkai A., Yoshikawa H. and Yui M.

17:30 012 Validation of glass dissolution and Si diffusion parameters with a combined glass dissolution-diffusion experiment in Boom Clay

Lemmens K.

17:50 013 Role of ion exchange in the corrosion of nuclear waste glasses

Ojovan M.I., Lee W.E. and Hand R.J.

Tuesday, September 13, 2005

08:30-12:30 Session: Spent Fuel

Chair: Grambow Bernd (SUBATECH, France), Spahiu Kastriot (SKB, Sweden)

08:30 014 Key-note: Mechanisms governing the release of radionuclides from spent nuclear fuel in geological repository: major outcomes of the European Project SFS

Poinssot Ch., Grambow B., Kelm M., Spahiu K., Martinez A., Johnson L., Cera E., de Pablo J., Quinones J., Wegen D., Lemmens K. and McMenamin T.

09:00 015 Prediction of the spent fuel dissolution rate evolution for repository conditions Matrix Alteration Model results and sensitivity analysis

Quiñones J., Iglesias E., Martínez-Esparza A., Merino J., Cera E., Bruno J., de Pablo J., Casas I., Giménez J., Clarens F. and Rovira M.

09:20 016 Testing of uranium dioxide doped with ²³³U under reducing conditions *Ollila K., Oversby V.*

09:40 017 Electrochemical, SECM, and XPS Studies of the Influence of H₂ on UO₂ Nuclear Fuel Corrosion

Broczkowski M.E., Noël J.J. and Shoosmith D.W.

10:00 Coffee Break

Special Poster Viewing:

- The activities of the NEA (Nuclear Energy Agency)

- The new EC projects NF-PRO (Integrated Project) and ACTINET (Network of Excellence)
- FUNMIG project

10:30 018 Oxidation kinetics of high burn-up UOX fuel: the influence of the grain boundaries
Fournet A., Desgranges L., Rousseau G., Aubrun I., Delion P., Lamontagne J., Roure I. and Blay Th.

10:50 019 Influence of alpha radiolysis of water on UO₂ matrix alteration: Chemical/Transport Model

Poulesquen A. and Jégou C.

11:10 020 Radiation-induced decomposition of U₆₊ alteration phases of UO₂

Utsunomiya S. and Ewing R.C.

11:30 021 The Effect of Near Field Constraints on the Corrosion Behavior of High Burnup Spent Fuel

Loida A., Kelm M., Kienzler B. and Geckeis H.

11:50 022 Static dissolution tests of alpha-doped UO₂ under repository relevant conditions: Influence of Boom Clay and alpha-activity on fuel dissolution rates.

Cachoir C., Salah S., Lemmens K. and Maes N.

12:10 023 The Microchemistry of Spent Uranium Oxide Nuclear Fuel Fortner.

Kropf A.J., Finch R.J. and Cunnane J.C.

12:30 Lunch

13:40 Poster Viewing

Poster Session: Ceramics

Chair: Lee Bill (University of Sheffield, U.K.), Hart Kaye (ANSTO, Australia)

094 Phase Relations in the Systems Based on Yttrium, Gadolinium, Manganese, Titanium, and Uranium Oxides Doped with Calcium, Aluminum and Iron Oxides

Stefanovsky S.V., Stefanovsky O.I., Yudintsev S.V. and Nikonov B.S.

095 A cradle to grave approach for the partitioning of cesium and strontium from legacy intermediate level liquid waste arising from ⁹⁹Mo production

Griffith C.S., Luca V., Sebesta F., Drabarek E. and Yee P.

096 Porous alumina-silica (GUBKA) as matrix for TUE-REE strip solution immobilization

Aloy A.S., Kol'tsova T.I., Sapozhnikova N.V. and Strelnikov A.V.

097 The transformation of Gd₂Zr₂O₇ from fluorite to pyrochlore – a question of ordering

Whittle K., Rios S. and Lumpkin G.

098 Processing and characterisation of fluorite-related ceramic wasteforms for immobilisation of actinides

Stennett M.C., Hyatt N.C., Maddrell E.R. and Lee W.E.

099 Investigating the durability of zirconotitanate pyrochlores under aqueous conditions

Harvey E.J., Redfern S.A.T. and Lumpkin G.R.

100 Crystal Chemistry and Cation Ordering in Zirconolite 2M

Lumpkin G.R., Whittle K.R., Howard C.J., Zhang Z., Berry F.J., Oates G., Williams C.T., and Zaitsev A.N.

101 Behaviour of zirconolite glass-ceramic and zirconolite-based ceramics and in the clayey, underground geological laboratory at Mol (Coralus 2 Project)

Advocat T., Valcke E., Smith K., Godon N., McGlenn P.

102 Mechanical integrity of yttria-stabilised zirconia doped with Np oxide

Kinoshita H., Kuramoto K., Uno M., Yamanaka S., Mitamura H. and Banba T.
103 Molten ceramic solidification during molten state processing of HLW
Kinoshita H., Uno M., Yamanaka S. and Lee W.E.
104 Advantages of Glass-Ceramics for Impure Plutonium Wastes
Day R.A., Begg B.D., Moricca Ansto S., Scales C.R., Maddrell E.R. and Gawthorpe N.R.

Poster Session: Container Materials

Chair: Werme Lars (SKB, Sweden)

105 Creep of the copper canister in the Swedish programme
Bowyer W.H.
106 A model for predicting stress corrosion cracking behaviour of copper containers in a deep geologic repository
Maak P. and King F.
107 Atmospheric Stress Corrosion Cracking (ASCC) Susceptibility of Stainless Alloys for Metallic Container
Nakayama G.
108 Modeling Corrosion Processes for Alloy 22 Waste Packages
Dunn D.S., Pensado O., Pan Y.-M., Yang L.T. and He X.
109 Corrosion of copper canisters through microbially mediated sulphate reduction
Sidborn M. and Neretnieks I.
110 The Electrochemistry and Corrosion of Copper in Aqueous Sulphide Solutions for the Purpose of High-Level Nuclear Waste Disposal
Smith J., Qin Z., Shoesmith D.W., King F. and Werme L.
111 Carbon steel canister performance assessment: iron transfer study
Vokál A., Lukin D., Vopálka D.
112 Corrosion monitoring of carbon steel in pasty clayey mixture as function of temperature
Bataillon C. and Roy M.
113 Creep performance of OFP copper for the overpack of repository canisters
P. Auerkari, S. Holmström, J. Salonen and P. Nenonen

Poster Session: Spent Fuel

Chair: Grambow Bernd (SUBATECH, France), Spahiu Kastriot (SKB, Sweden)

114 Assessment of the relevance of coffinite formation within the near-field environment of spent nuclear fuel geological disposal
Robit V., Poinssot Ch., Grambow B., Catalette H., Cui D. and Spahiu K.
115 Leaching behaviour of irradiated and non-irradiated HTR UO₂-ThO₂ fuel particles under reducing conditions
Alliot C., Grambow B. and Landesman C.
116 Role of hydroxyl radicals during oxidative dissolution of UO₂ by hydrogen peroxide
de Pablo J., Clarens F., Casas I., Giménez J. and Rovira M.
117 Determination of alpha dose rate profile at the UO₂/water interface
Poulesquen A. and Jégou C.
118 Evolution of the spent nuclear fuel during the confinement phase in repository conditions: Major outcomes of the French research
Ferry C., Piron J.P. and Poinssot Ch.
119 Assessment of the radionuclide release from the near-field environment of a spent nuclear fuel geological repository
Poinssot Ch., Poulesquen A., Radwan J. and Ferry C.

- 120 Leaching of cesium and uranium from spent fuel in the gel-state clays
Kim S.S., Chun K.S., Choi J.W., Cho W.J. and Han P.S.
- 121 Numerical modeling of spent fuel dissolution
Nielsen F., Eriksen T. and Jonsson M.
- 122 On the chemical behaviours of spent fuel and canister materials under strong gamma radiation
Cui D. and Pan J.
- 123 Reaction path modelling of spent fuel corrosion in Brines: comparison with experimental results
Metz V., Loida A. and Kienzler B.
- 124 Estimates of Failure Pressures in Spent Fuel Fission Gas Bubbles due to Alpha-Decay Helium Production
Stout R., Ferry C., Poinssot Ch. and Piron J-P.
- 125 UO₂/H₂O Interfaces Properties under 2-10 MeV He²⁺ Beam Radiolysis at Flux in the Range 10⁷-10¹¹ He²⁺ cm⁻² s⁻¹ Electrochemical behaviour, U Release and Disc Alteration
Mendès E., Mennecart T., Simon P., Peridicakis M., Jegou C., Miserque F. and Corbel C.
- 126 Effects of alpha self-irradiation on spent fuel analogue matrix doped with actinides
Roudil D., Jégou C., Deschanel X., Peugeot S., Raepsaet C., Gallien J.-P. and Broudic V.
- 127 Modelling experimental results on radiolytic processes at the spent fuel water interface. II. Radionuclides release
Cera E., Grivé M., Bruno J., Eriksen T.E. and Spahiu K.

14:10 Poster Discussion

Coffee Break

15:30-18:00 Session: Ceramics

Chair: Lee Bill (University of Sheffield, U.K.), Hart Kaye (ANSTO, Australia)

15:30 024 Key-note: Radiation Damage in Pyrochlore and Related Compounds

Lumpkin G.R., Whittle K.R., Rios S., Trachenko K., Pruneda M., Harvey E.J., Redfern S.A.T., Smith K.L. and Zaluzec N.J.

16:00 025 Phase Composition of the Ceramics Based on Rare Earth, Manganese and Titanium Oxides

Stefanovsky S.V., Yudintsev S.V., Nikonov B.S. and Stefanovsky O.I.

16:20 026 Immobilization and Behavior of Technetium in a Magnesium Titanate Matrix for Final Disposal

den Exter M.J., Neumann S. and Tomasberger T.

16:40 027 Leaching behaviour of Zirconolite in 0.001M citric acid at 90°C under various flow regimes

McGlinn P.J., Advocat T., Leturcq G., McLeod T.I., Aly Z. and Yee P.J.

17:00 028 The structure and ordering of zirconium and hafnium containing garnets – studied by neutron diffraction and electron channeling

Whittle K., Lumpkin G., Smith K., Yudintsev S. and Zaluzec N.

17:20 029 Synthesis, microstructure and durability of the titanate hollandites:

Ba_{1.2}M₂+1.2Ti_{6.8}O₁₆ (M = Co, Mg, Mn, Ni, Zn) and Ba_{1.2}M₃+2.4Ti_{5.6}O₁₆

(M = Al, Fe, Cr)

Hyatt N.C., Stennett M.C., Welling J.S., Maddrell E.R., Dutton S. and Lee W.E.

17:40 030 Porous materials based on cenospheres of coal fly ash for fixation of Cs-137 and Sr-90 in mineral-like aluminosilicates

Vereshchagina T.A., Vasilieva N.G., Vereshchagin S.N., Paretskov E.N., Zykova I.D., Kruchek D.M., Manakova L.F., Tretyakov A.A. and Anshits A.G.

Wednesday, September 14, 2005

09:00-10:50 Session: Container Materials

Chair: Werme Lars (SKB, Sweden)

09:00 031 Key-Note: Prediction of long term corrosion behaviour in nuclear waste systems
Féron D. and Macdonald D.D.

09:30 032 The proposed Yucca Mountain repository from a corrosion perspective.
Payer J.H

09:50 033 A Review of Corrosion Considerations of Container Materials Relevant to Underground Disposal of High-Level Radioactive Waste in Belgium
Kursten B. and Druyts F.

10:10 034 Further Studies of the Anaerobic Corrosion of Steel in Bentonite
Smart N.R., Rance A.P., Carlson L. and Werme L.O.

10:30 035 Development of a rapid screening test for SCC susceptibility of copper in disposal vault Conditions

Bojinov M., Heinonen J., Kinnunen P., Lilja C. and Saario T.

10:50 Coffee Break

Special Poster Viewing:

- The activities of the NEA (Nuclear Energy Agency)
- The new EC projects NF-PRO (Integrated Project) and ACTINET (Network of Excellence)
- FUNMIG project

11:05-12:05 Session: Analogs

Chair: Ewing Rod (University of Michigan, USA)

11:05 036 Long-term behavior of Embiez archaeological glass: Results after 1800 years of alteration in a marine environment

Gin S., Chouchan J.-L. and Foy D.

11:25 037 Investigation of natural Zr-P-U-Ti-silicate gels as unusual barriers to the migration of radionuclides

Burakov B.E., Smetannikov A.Ph., Anderson E.B. and Alexeev A.Yu

11:45 038 2000 to >10,000 Year Preservation of Archaeological Materials in Arid Environments: Analogues Relevant to Yucca Mountain

Chapman N., Dansie A. and McCombie C.

12:05 Lunch

13:30-15:30 Session: Intermediate Level Waste Forms

Chair: Gens Robert (NIRAS/ONDRAF, Belgium), Gonzales de la Huebra Angel (CIEMAT, Spain)

13:50 039 Key-Note: Conclusions of an International Workshop on Cement/Waste Interactions
Wieland E.

13:50 040 Reactions in cemented nuclear waste forms – the need for a toolbox of different cement types

Milestone N.B., Bai Y., Borges P., Collier N.C., Gorce J.-P., Gordon L., Setiadi A., Utton C. and Zhou Q.

14:10 041 Bituminized waste leaching in confined conditions (restricted swelling): potential mechanisms and modeling

Sercombe J., Lefebvre X., Adenot F.

14:30 042 Ageing of Eurobitum bituminised radioactive waste under gamma radiation

Rorif F., Valcke E., Boven P., Ooms H., Peeters J., and Smets S.

14:50 043 Bituminous media processing by incineration-vitrification

Girold C., Pinet O. and Lemort F.

15:10 044 The Diffusion of Radionuclides Through Waste Encapsulation Grouts

Chambers A.V., Green A., Harris A.W., Heath T.G., Hunter F.M.I., Manning M.C. and Williams S.J.

15:30 Poster Viewing

Coffee Break

Poster Session: Intermediate Level Waste Forms

Chair: Gens Robert (NIRAS/ONDRAF, Belgium)

Gonzales de la Huebra Angel (CIEMAT, Spain)

128 Kinetics of mixed low-level waste incapsulation using iron phosphate chemically bonded cement

Aloy A.S., Koltsova T.I., Kovaskaya E.N. and Silin M.Yu.

129 Long-term behaviour of concrete in water saturated media experimental and modelling approach

Peycelon H., Blanc C. and Mazoin C.

130 40-years performance of cemented radioactive waste in a mound type repository

Sobolev I.A., Dmitriev S.A., Barinov A.S. and Varlakova G.A.

131 Immobilization of simulant ILW actinide wastes containing halides: effect of process parameters on wasteform properties

Metcalfe B.L., Fong S.K. and Donald I.W.

132 A mechanistic model of the immobilization of nickel radioisotopes in the cementitious near field of an ILW repository

Wieland E., Vespa M., Tits J., Scheidegger A.M., Dähn R. and Bradbury M.H.

133 Nitrate release from EUROBITUM bituminised waste: scoping calculations

Weetjen, E., Sillen X. and Valcke E.

134 Bituminised waste re-treatment: replacement of the bitumen matrix by SON 68

Tennstedt I., Impens N., Lemmens K., Gielen B., Van Laer J., Fonteyne A., Vos L., Vos B., Leenaers A., Van den Berghe S. and Van Bree P.

135 The Role of C-S-H Phases in the Immobilization of Strontium and Radium by Cementitious Materials

Tits J., Iijima K., Wieland E., Tomura T. and Kamei G.

136 Interaction swelling bitumen – host rock: scoping calculations

Li X.L., Bernier F. and Valcke E.

137 Sodium Sulphate Activated GGBS/PFA and Its Potential as a Nuclear Waste Immobilisation Matrix

Bai Y., Milestone N.B. and Yang C.H.

138 Probing the Water Phases and Microstructure in Hardened Cement Blend Composites used for the Encapsulation of Low and Intermediate Level Nuclear Wastes

Gorce J.-P. and Milestone N.B.

139 Silver Zeolites: Iodide Occlusion and conversion to Sodalite - A possible waste form for I129?

Sheppard G.P., Hriljac J.A., Hyatt N.C. and Maddrell E.R.

Poster Session: Radionuclide Behaviour

Chair: Fanghänel Thomas (FZK-INE, Germany), Wersin Paul (NAGRA, Switzerland)

140 Effects of the Orientation of Clay Particles and Ionic Strength on Diffusion and Activation Enthalpies of I⁻ and Cs⁺ Ions in Compacted Bentonite (II)

Sato H.

141 Heavy metals migration in argillaceous rocks: on the use of micro laser-induced breakdown spectroscopy (micro LIBS) as a microanalysis tool

Menut D., Descostes M., Meier P., Radwan J., Mauchien P. and Poinssot Ch.

142 Cathodoluminescence study of americium incorporation into calcite single crystals

Zamoryanskaya M.V., Burakov B.E., Kolesnikova E.V. and Zuykov M.A.

143 The Sorption of Thorium and Americium onto Fresh and Degraded Ordinary Portland Cement and onto Green Tuff

Cowper M.M., Chambers A.V., Heath T.G., Mihara M. and Williams S.J.

144 Selenium Sorption in a Sedimentary rock/saline groundwater System and Spectroscopic Evidence

Xia X., Kamei G., Iijima K. and Shibata M.

145 The effect of binding sites of humic acid for the complexation with Np (IV)

Tobitsuka S., Iijima K. and Kohara Y.

146 Experimental study and modelling of Cs(I), U(VI) and Se(IV) sorption onto biotite

Missana T., García-Gutiérrez M., Quiñones J. and Maffiotte C.

147 Influence of humic substances on kinetic of Pu(V) sorption onto lowtemperature hematite

Blinova O.A. and Novikov A.P.

148 Migration Behavior of Cesium in Compacted Bentonite Under Reducing Conditions Using Electromigration

Idemitsu K., Yamamoto M., Yamasaki Y., Inagaki Y. and Arima T.

149 An Experimental Approach on the Effect of Rock Alteration on Sorption Behavior

Niibori Y., Kasuga Y., Tanaka K. and Tochiyama O.

150 Studies on Metal-Gluconate Complexes

Warwick P., Evans N. and Vines S.

151 Influence of different batch laboratory design tests on 99Technetium specification and pathways under Boom clay reducing conditions and their coupling with migration and percolation experiments

Maes A., Bruggeman C. and DeCannière P.

152 Kinetics of the reduction of Selenium by Iron Corrosion Products

Puranen A., Cui D., Jonsson M., Scheidegger A.M., Wersin P. and Spahiu K.

153 Sorption of selenium on minerals mixtures: role of minor phases in the modelling part

Hurel C. and Marmier N.

154 Determining sorption coefficients in intact rock using an electrical potential gradient as a driving force for migration

Magnus A., Neretnieks I. and Malmström M.

155 Some Methodological Modifications of Determination of Diffusion Coefficients in Compacted Bentonite

Vopálka D., Filipská H. and Vokál A.

156 Neptunium solubility in the near-field environment of a proposed Yucca mountain repository
Sassani D.C., Van Luik A. and Summerson J.

157 Radionuclide migration from alpha-active HLW glass in underground disposal conditions (CORALUS)

Valcke E., Van Iseghem P., Gysemans M., Van Bree P., Moors H., Godon N. and Jollivet P.

Poster Session: Analogs

Chair: Ewing Rod (University of Michigan, USA)

158 The Boom Clay geochemistry: Natural evidence

De Craen M., Wang L., Van Geet M. and Moors H.

159 Direct alpha-Recoil as a process to generate U-234/U-238 Disequilibrium in groundwater
Rasilainen K.

160 Radiation stability of natural britholites

Yudintseva T.

161 Modelling uranium leaching from agricultural soils to groundwater as yardstick in comparison with complementary safety indicators

Jacques D., Mallants D., Simunek J. and van Genuchten M.Th.

162 Corrosion of buried glasses from Ballidon: results after 32 years and implications for nuclear glasses

McLoughlin S.D., Hyatt N.C., Hand R.J. and Lee W.E.

16:00 Poster Discussion

17:00-18:10 Session: Radionuclide Behaviour

Chair: Fanghänel Thomas (FZK-INE, Germany), Wersin Paul (NAGRA, Switzerland)

17:00 045 Key-Note: Research in actinide geochemistry: Do we need speciation information at the molecular level ?

Geckeis H.

17:30 046 Selenite reduction in Boom clay: investigation of geochemical phases which play the most important role in governing the reduction kinetics, specification and solubility

Bruggeman C. and Maes A.

17:50 047 Laser-Induced Breakdown Investigations on the Stability of Background Colloids in Natural Groundwater

Hauser W., Geckeis H., Götz R., Fanghänel T. and Morales T.

Thursday, September 15, 2005

08:30-10:40 Session: Integrated Processes

Chair: Yui Mikazu (JNC, Japan), Volckaert Geert (SCK.CEN, Belgium)

08:30 048 Key-Note: Design and operation of an integrated in situ corrosion test on alpha-active HLW glass (CORALUS)

Valcke E., Smets S., Labat S., Peeters J., Boven P., Thomas P., Dupuis E., Van Iseghem P., Godon N., Jollivet P., Parisot G., Jockwer N. and Wieczorek K.

09:00 049 Quantitative evaluation of the geochemical / microbiological processes within extended storage repositories

West J.M., McKinley I.G., Neall F.B., Rochelle R.A., Bateman K. and Kawamura K.

09:20 050 Importance of the Excavated Damaged Zone (EDZ) in the General Performance of the Near Field of a Geological Disposal; Input of the EDZ Component to the EC Integrated Project on the Near Field (NF-PRO)

Aranyossy J.F., Blumling P., Alheid H.J., Van Geet M., Mayor J.C., Marshall P. and Plas F.

09:40 051 Impact of iron released from steel components on the performance of the bentonite buffer: a preliminary assessment

Wersin P., Johnson L.H. and Snellman M.

10:00 052 The Belgian demonstration programme for the disposal of high level and long lived radioactive waste

Bernier F., Demarche M. and Bel J.

10:20 053 Testing of a near-field biogeochemical model against data from a large scale gas generation experiment

Small J.S., Nykyri M., Paaso N., Hovi U., Itävaara M. and Sarlin T.

10:40 Coffee Break

Special Poster Viewing:

- The activities of the NEA (Nuclear Energy Agency)
- The new EC projects NF-PRO (Integrated Project) and ACTINET (Network of Excellence)
- FUNMIG project

11:00-12:50 Session: Performance Assessment and Safety Case

Chair: Umeki Hiroyuki (JNC, Japan), Lalieux Philippe (NIRAS/ONDRAF, Belgium)

11:00 054 Key-Note: Evaluating R&D Progress in the Context of the Safety Case

Johnson L.H. and Zuidema P.

11:30 055 Analysis of fluid flow and solute transport through a single fracture intersecting a canister: comparison between fractal and Gaussian fractures

Liu L. and Neretnieks I.

11:50 056 Application of geochemical modelling in performance assessment: the quasi closed system Approach

Metz V., Lützenkirchen J., Korthaus E. and Kienzler B.

12:10 057 Waste Package Scenario Modelling

Hodgkinson D., Robinson P., Watson S., Bailey L. and Poole M.

12:30 058 Development of an Uncertainty Analysis Methodology Associated with the Characterization of the Geological Environment: Study on its Applicability in the Tono area

Yanagizawa K., Takeda S., Osawa H., Suyama Y., Takase H., Toida M. and Furuichi M.

APPENDIX II: BUSINESS CARDS



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