



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JAN 25 1985

MEMORANDUM FOR: Paul H. Lohaus, State Liaison Officer
Region I

FROM: R. John Starmer, Section Leader
Geochemistry Section
Geotechnical Branch
Division of Waste Management, NMSS

SUBJECT: TRANSMITTAL OF GEOCHEMICAL INFORMATION PERTINENT TO
AMERICIUM BEHAVIOR IN A LANDFILL

As we have discussed, I looked into what information is available on the behavior of americium in the environment and how americium might be expected to behave as a component of sewage sludge incinerator ash disposed of in a typical landfill. I was not able to find any information directly applicable to the situation but was able to find information on leaching of incinerator ashes and ash from coal fired generating plants. This information may be of use in making preliminary estimates of the leaching of americium from sewage sludge ash. I was also able to find some general information on the behavior of americium in the environment but again that information is not directly applicable to the environmental conditions existing in a landfill or in the geochemical environment surrounding a landfill. I have enclosed publications on incinerator ash and incinerator ash leaching, on ash leaching methods as practiced by EPRI and the State of Illinois, and some generic chemical/geochemical information on americium.

My thoughts on the situation you have described are summarized below:

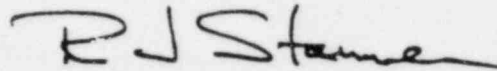
- 1) If rare earth element data were available for leaching of coal ash, that data might be used as an analog of the trivalent actinides such as americium. I have not found any.
- 2) Americium is found in the trivalent state as Am^{3+} under even the most severe environmental conditions. This suggests that there will be little change in behavior between the (strongly) reducing conditions expected in a landfill and the oxidizing conditions expected in the surrounding environment.

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- 3) Most information on the solubility of americium has been developed for neutral to alkaline conditions. Indications are however, that the solubility of americium increases about 1000 fold for every unit decrease in pH below about pH = 6. This might indicate relatively high solubility in the (acidic) landfill environment but also suggests that americium solubility could be reduced significantly if the surrounding soil environment contained sufficient carbonate minerals to effectively neutralize the leachate and buffer the system at higher pH.
- 4) Although americium is not strongly hydrolised or complexed by inorganic ligands under conditions expected in a landfill, the presence of a large variety of poorly characterized organic ligands may pose a potential problem, by increasing solubility and decreasing any tendency for sorption. While this could enhance the potential for migration, most organics are not significantly ionized at the low pH typical of landfill leachates and therefore they may not be very effective complexants.
- 5) Americium has low Kd's at pH = 4 for many earth materials, but moderate Kd's as the pH increases. No information is available to me on Kd's for sediments or similar materials. I will keep looking as time permits for more sorption data.

While we can make some generic predictions of the behaviour of americium loaded sewage sludge incinerator ash in a landfill, in order to assess the behaviour of americium under site-specific conditions, information would be required on the distribution of americium in the ash components, the chemical conditions in the landfill, the groundwater chemistry and the soil mineralogy. A minimum program of field characterization and laboratory work might be expected to yield the desired information however. In fact, some of that information may already be available. With information on the landfill percolate and the groundwater composition, some preliminary geochemical modeling could be performed to make some statements about the behavior of americium under the site-specific conditions of interest. Using this information, a few simple leaching experiments might then be performed to determine the performance of the ash under in-situ conditions. Further, the resulting leachate might be precolated through columns of the site soil to determine leachate behaviour in the surrounding environment. This approach would help produce site-specific information on the behavior of americium over the long term.

If you need to discuss any of the above or the references, please call.



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Enclosures:

1. "Leach Studies of Plutonium-Contaminated Incinerator Ash Incorporated in Cement" by S. L. Nicolosi et al.
2. "Leaching of Solidified TRU-Contaminated Incinerator Ash" by M. Fuhrmann and P. Colombo
3. "Leaching Properties of Solidified TRU-Contaminated Incinerator Ash" (BNL 33671) by P. Colombo et al.
4. "Incineration of a Typical LWR Combustible Waste and Analysis of the Resulting Ash" (NUREG/CR-3087) by R. L. Treat et al.
5. Excerpt from "Physical-Chemical Characteristics of Utility Solid Wastes" (EPRI EA-3236) prepared by Tetra Tech, Inc.
6. "Illinois Basin Coal Fly Ashes 1. Chemical Characterization and Solubility 2. Equilibria Relationships and Qualitative Modeling of Ash-Water Reactions" by W. R. Roy et al.
7. "Extraction Procedure and Utility Industry Solid Waste" (EPRI EA-1667) by S. J. Rose et al.
8. Excerpt from "Solid Phases and Solution Species of Different Elements in Geologic Environments" (PNL-2651) by D. Rai and R. J. Serne
9. Excerpt from "Radionuclide Interactions with Soil and Rock Media, Volume 1." (EPA 520/6-78-007) by L. L. Ames and D. Rai
10. "The Sorption of Actinides in (sic) Igneous Rocks" by B. Allard et al.
11. "Americium Thermodynamic Data for the EQ3/6 Database" (LA-10040-MS) by J. F. Kerrisk
12. "The Geochemistry of Actinides" by B. Allard

NYDL - EAD file

Paul re EAD 2/11/85

GWK call w/ LaFlame
PL " "

Segovia - Name has asked for help on disp.
asked for Chairman's tel. #

GWK disc w/PL:

Segovia not entirely innocent

We shouldn't feel obligated.

PL still feels we have "moral" obligation

LaFlame ask for rdg for NY re return

PL disc w/Karim - doesn't solve problem

DOE needs to be convinced.

A/15