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GEOCHEMISTRY OF TRENCH LEACHATES FROM MAXEY FLATS DISPOSAL SITE *

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Information on the chemical and radionuclide composition of trench leachates and on the processes that control radionuclide mobility is important in predicting radionuclide transport at shallow land burial sites. During the past several years, Brookhaven National Laboratory has been involved in a field and laboratory program to study the source term characteristics of existing commercially operated low level radioactive waste disposal sites.(1-3) In this report, we present the results of the analysis of trench leachates collected at Maxey Flats in October 1981 and a discussion of the geochemical factors controlling the trench water chemistry. In addition, results of laboratory oxidation experiments performed on trench leachates, simulating the behavior of anoxic trench waters as they encounter upon migration an oxidizing environment, are presented.

Most trench leachates from Maxey Flats exhibit low redox potential, low dissolved oxygen and sulfate, and high alkalinity, which are characteristic of anoxic waters. In contrast to naturally occurring anoxic waters, the trench leachates also exhibit enrichments to varying degrees of waste-derived components such as dissolved iron, organic carbon, chloride, fluoride, sodium, strontium, barium, and several radionuclides (H-3; Cs-134,-137; Co-60; Pu-238, 239,240; Am-241; Sr-90). Low-level concentrations of some organic chelating agents such as NTA, DTPA, and EDTA have also been observed in the trench leachates.(4)

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The observed trench leachate chemistries reflect the extent of modification of infiltrated rainwater by a combination of processes, occurring simultaneously, such as bacterial degradation and leaching of buried waste. Given the variability and complexity of the trench leachate geochemical systems under investigation, it is not possible to quantitatively evaluate the magnitude of these processes without a knowledge of the characteristics and reactivity of the buried waste and the residence time of the leachates in the trenches. These are the key factors controlling the rate and extent of solute production in terms of radionuclides, cations and anions, and dissolved organics which, in turn, determine the extent of modification of infiltrated rainwater composition in a trench, resulting in the observed leachate chemistries.

Laboratory oxidation experiments performed on several leachates, spiked with Sr-85, Co-60, and Cs-137, provide generic information on the behavior of anoxic trench leachates as they encounter a less reducing environment along the groundwater flow paths. The experiments demonstrated that, upon oxidation, a series of chemical changes were initiated which results in the oxidation of Fe^{2+} to ferric oxyhydroxide, a decrease in alkalinity, a slight increase in pH, and a drastic increase in Eh. The experiments further demonstrated that, even though precipitation of ferric oxyhydroxide occurred in most cases, coprecipitation or scavenging of Co-60, Sr-85, and Cs-137 was minimal. It appears that some of the radionuclides may have formed complexes with chelating agents sufficiently stable to withstand ferric oxyhydroxide scavenging. A further experiment confirms this hypothesis showing that decreasing amounts of Co-60 are removed from solution upon oxidation of Maxey

Flats leachate 33L8 spiked with increasing amounts of EDTA, with the maximum Co-60 solubilization occurring at an EDTA concentration of ~2 ppm. If such is the case, one can conclude that radionuclide mobility would not be substantially retarded by authigenic ferric oxyhydroxide, which occurs in geochemical systems where anoxic waters encounter an oxidizing environment.

References

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