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THE WASTE PROPERTIES OF A STRIPPABLE COATING USED FOR THE TMI-2 REACTOR BUILDING DECONTAMINATION*

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*Work carried out under the auspices of the Nuclear Regulatory Commission.

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Strippable coating material considered for use in the TMI-2 reactor building decontamination has been tested for Sr, Cs, and Co leachability, for radiation stability, and for resistance to biodegradation. It was also immersion tested in water, a water solution saturated with toluene and xylene, toluene, xylene, and liquid scintillation counting (LSC) cocktail. Leach testing, performed using a modified IAEA procedure, resulted in all of the Cs and Co activity and most of the Sr activity being released from the coating in just a few days. Immersion resulted in swelling of the coating in all of the liquids tested. Gamma irradiation of the coating did not produce any apparent physical changes in the coating to a dose of 1 x 10^8 rad, however, radiolytic gas generation of H_2, CO, and CO_2 was observed. Biodegradation testing was performed in soil samples from the Barnwell, South Carolina, and Hanford, Washington, low-level waste disposal sites. Progress of the biodegradations was monitored using the CO_2 produced from microbial respiration. Biodegradation of the coating occurs readily in both soils although somewhat faster in Hanford soil. These test results indicate that strippable coating radwaste of itself will not meet the requirements for stabilized Class B waste outlined in 10 CFR 61 (proposed) and the NRC Draft Branch Technical Position on Waste Form.

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Strippable coatings are being considered for use in the decontamination of the TMI-2 reactor building. The liquid coating is normally applied by airless spraying, or by pouring and spreading with a squeegee. After drying, it is stripped off as a rubber-like sheet carrying away loose particles and some physically bound contamination. One advantage of strippable coatings is that the solid waste produced is generally easier to deal with than the liquid solution that would result from decontamination alternatives.

Since the waste strippable coating material contains chelating agents and may be Class B waste under the current draft of 10 CFR 61, BNL has conducted tests on this material as part of a technical assistance program for the NRC. The Draft Branch Technical Position on Waste Form issued by the NRC requires that the waste form for Class B stable waste meet stability requirements which include radiation stability, resistance to biodegradation, resistance to immersion in water (including leach testing), and resistance to thermal degradation. Tests for leachability, resistance to biodegradation, radiation stability, and the effects of immersion were conducted on material purchased from Imperial Professional Coatings, Inc., and actual contaminated coating supplied by Met Ed/GPU from the TMI-2 reactor building gross decontamination testing.

Radiation stability testing to a total Co-60 gamma dose of 1×10^8 rad on uncontaminated coating produced no apparent physical changes. In sealed irradiation tubes, there was a pressure increase due to H_2, CO, and CO_2 production.

Immersion testing was performed in five liquids: water, a water solution saturated with toluene and xylene, toluene, xylene, and liquid scintillation counting (LSC) cocktail. Immersion in all of these liquids produced swelling and weight gain of the coating. Water produced the least swelling and weight gain, approximately 20%, while toluene, xylene, and the water solution registered increases of 40 to 80%. The LSC cocktail had a much larger effect, registering a weight gain of over 700%. The weight gain observed in water and the water solution immersions were unusual in that they reached a maximum and then declined. After thirty-four days of immersion, the samples were air dryed at room temperature and the weight change monitored. This resulted in a net weight loss of 15-20% from the weight before immersion for all of the specimens except those immersed in LSC cocktail. After air drying, these specimens still exhibited a net weight gain of 400%.

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Leach testing was performed for Cs, Co, and Sr using a modified IAEA procedure. These nuclides leached readily from the coating with all of the Cs and Co and over half of the Sr leaching within two weeks.

Biodegradation testing was monitored by measuring the CO_2 produced from microbe respiration using the procedure and apparatus described by Bartha and Pramer.[1] The biodegradation testing was done in soil samples from the Barnwell, South Carolina, and Hanford, Washington, low-level waste disposal sites. The procedure requires collecting CO_2 from biodegradation occurring in a vessel in a standard KOH solution. The KOH solution is contained in a separate compartment. The KOH not neutralized by CO_2 uptake is back titrated with standard HCl, allowing the CO_2 produced to be calculated. The difference in CO_2 produced in a flask containing a specimen of the strippable coating in soil and a flask with soil alone, provides a quantitative measure of sample biodegradation.

Monitoring CO_2 provides a lower limit to the actual amount of biodegradation since part (5-40%, depending on conditions[2]) is utilized for microbe growth or excreted in another chemical form. Results to date show that biodegradation is occurring faster in Hanford soil than in Barnwell soil. Specifically, in 50 days more than 1% of the total carbon content of the coating has been evolved as CO_2 in the Hanford soil while only about half of this amount has come from the Barnwell samples.

In conclusion, the strippable coating material swells upon immersion in water and organic liquids, rapidly leaches its radionuclide inventory and biodegrades readily in soil. At high radiation doses, gas generation from the coating is significant. To dispose of contaminated strippable coating as Class B stable waste would require that it be incorporated in a matrix or container that enables the waste to meet the stability requirements.

References

1. R. Bartha and D. Parmer, Soil Science, 100, 68-70 (1965).

2. P. A. Gilbert, "Biodegradation Tests: Use and Value," pp. 35-45 in Biotransformations and the Fate of Chemicals in an Aquatic Environment Procedures Workshop, 1980.