CHAPTER 50

Mixed Waste—A Review from a Generator's Perspective

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The production of radioactive labeled compounds generate a variety of waste streams for research applications. Aggressive programs of segregation, compaction, and process improvements have reduced volume. From 1982 to 1988, the volume of waste generated and prepared for disposal by the manufacture of labeled chemicals declined by nearly 70%.

LOW LEVEL WASTE REDUCTION STRATEGIES

The DuPont NEN low level waste is segregated into six categories to facilitate handling the volume reduction. A variety of management techniques and physical methods have been developed to minimize the waste volume designated for shipment.

For example, jugs and containers comprise 10 to 12% of the prepared waste. Freezing the plastic ware with liquid nitrogen and pulverizing it while in a friable state reduces this waste stream. Aqueous waste, generated from the operation of stack scrubbers and chemical processing, is adsorbed in cement, in a ratio of 33 gal of water per 55 gal drum. Laboratory trash, i.e., gloves and lab coats are compacted at a pressure of 19,000 psi by a commercially available press to achieve a 6- to 15-fold reduction in volume. These physical methods of volume reduction are based on a management program to create awareness and good practices among the workforce. Feedback on waste generation within the working group and rewards for novel solutions create the incentive to participate in waste reduction programs.

In addition to the waste designated for shallow land burial, waste containing short-lived nuclides, ^{32}P, ^{35}S, and ^{125}I, is held for decay. Nearly 60% of the total waste volume generated from the manufacture of labeled chemicals is held for decay.

The most effective radioactive waste reduction strategy is recycling, which

for our waste stream means isotopic separation. Approximately 20kCi per year of tritium gas are purified and returned to the process.

Recently, we embarked on a program of crushing scintillation vials for bulk disposal of scintillation fluid. Spent scintillation cocktail is disposed in 55 gal containers at a cost of approximately $10/gal of liquid, in contrast to the $167/gal incurred when vials were merely layered with adsorbent in drums for disposal. Vial crushing is achieved with a VYLEATER, manufactured by S & G Enterprises, Milwaukee, WI.

MIXED WASTE IN THE MANUFACTURE OF LABELED CHEMICALS

Mixed waste, low-level waste with hazardous waste properties, comprises approximately 25% of the waste barrel volume generated in the manufacture of labeled chemicals. Currently, there is no site licensed to dispose of this waste form. Mixed waste, originating from the manufacture of labeled compounds, is organic solvents contaminated with tritium and ^{14}C. In the case of tritium, the radioactivity is often incorporated directly into the solvent by chemical exchange and does not exist as part of a chemically distinct species. In contrast, carbon-containing waste is usually constituted of low concentrations of radioactive solute in cold hazardous carrier. This waste stream is the inevitable by-product of organic syntheses conducted with radioactive compounds. Mixed waste originates from the solvents used to mediate the reactions and as effluent from chromatographic purifications. Even the product itself, i.e., labeled benzene or toluene is classified as a mixed waste.

This particular waste stream, hazardous organics chemically indistinguishable from the radioactive component, is unique to the manufacture and application of labeled chemicals. No other process produces low level mixed waste of this composition and chemical form. Preventive steps are constantly being taken to reduce the volume of this waste stream, but the mixed waste generated from the synthesis of tritium and ^{14}C compounds cannot be completely eliminated. Minimization can be achieved by segregation and reduction at the source. Where possible nonhazardous solvents are used. Analysis of the chemical composition of the waste stream indicates that 30% is aqueous and can be segregated in the laboratory for disposal adsorbed on cement. Process changes influence the generation of mixed waste. Higher yields, improved product stability, and alternate purification procedures impact the synthesis frequency and concomitantly the solvent volume used. Despite minimization programs, mixed waste is an inevitable result of the manufacture of labeled chemicals. An approved disposal or treatment plan is mandatory.

ALTERNATIVE PROCESSES

In addition to the standard waste reduction methodologies of minimization and recycling, innovative approaches to render the mixed waste nonhazardous

have been considered. These approaches are based on the principle of converting the waste stream to radioactive carbon dioxide and water, chemical substances that are nonhazardous and can be collected and disposed of in accord with regulatory guidelines in an environmentally responsible manner. Among the techniques that have been considered are microwave pyrolysis, both conventional and catalytic combustion, supercritical fluid oxidation, and electrochemical destruction. These techniques require minimal external fuel and can be run as closed systems, facilitating the required containment of the radioactive effluent.

None of these treatment protocols has been developed for disposal of radioactive waste. Considerable engineering and development effort is required to verify the technical efficacy of these alternatives. Unfortunately, successful development of these techniques from an engineering viewpoint is only half the battle. Evaluation of these "delisting" techniques, involves more than simple technical issues. Processing of mixed waste by any of these techniques may well require sanction by both the EPA and the public. An institution seeking to implement any of these technical processes may be required to obtain a RCRA Class B permit, a procedure that because of its political nature will be costly, slow, and characterized by low probability of success. Compounding the engineering uncertainty with a political uncertainty limits the successful outcome of a responsible technical solution. Through minimization and recycling programs, the labeled chemical industry has demonstrated a commitment to environmentally sound waste practices. The EPA and their equivalent state agencies are frustrating this pursuit by their restrictive definition of waste.

RECOMMENDATIONS

Dual regulation of mixed waste by both the NRC and the EPA leads to redundancies and technical inconsistencies. Technical inconsistencies arise in the definitions of site design specifications accepted by the two agencies. The EPA favors a dual liner and leachate collection system. The NRC discourages use of trench lines. Agency policies also conflict on waste package inspection.

The effects of NRC regulation, which controls the potential radiological hazard, provide the necessary protections to the environment and public health and safety. Safe radiological management practices extend to waste management. A system of proper management does exist.

The complexity of licensing a facility to meet requirements of two agencies has resulted in having no facility licensed for disposal of mixed low-level waste. Interim storage at institutional facilities is creating a practice of "second-best" waste management. Continued accumulation of mixed waste is making an eventual solution much more complex. The inability to agree upon licensing criteria is frustrating the process of siting low level waste compacts in accord with the federal Low-Level Radioactive Waste Policy Act. The judi-

cious resolution of this conflict is for the NRC with the agreement of state agencies, to adopt sole jurisdiction for the disposal of mixed waste.

Ultimate resolution of the mixed waste issue lies in a technical, not a political solution. The labeled chemicals industry needs support in identifying and implementing innovative technical schemes for rendering mixed waste nonhazardous. Let us regard treatment of radioactive organic waste as a logical extension of the manufacturing process, not as a waste treatment requiring additional licensing. Development and implementation of environmentally sound, technical programs cannot be encumbered by political barriers.