

F. What Treatability Studies Are the Subject of Today's NODA?

The studies we just described did not focus on two types of mercury waste that we thought were important to address: (1) High mercury (containing greater than 260 mg/kg total mercury) waste sludges that contain multiple forms of mercury; and (2) bulk elemental mercury.

We collaborated with DOE to evaluate the ability of commercially available treatment processes to reduce the solubility of mercury in these two types of waste and to identify stable disposal conditions as a potential alternative to current regulations which require the reclamation of mercury via roasting or retorting before treatment and disposal of the residuals. Because this potential alternative (of treatment/disposal as opposed to roasting/retorting) would result in much higher concentrations of mercury potentially being land disposed, and because of the toxic nature of mercury (see section II.A of this notice) and the difficulty of treatment, we decided to evaluate treated waste forms using the Toxicity Characteristic Leaching Procedure (TCLP),¹⁰ as well as a constant pH leaching procedure that addresses the range of pH conditions that could be expected in hazardous waste landfill disposal environments. Because the TCLP only evaluates one pH condition that results from the interaction of the waste and the fixed acid content of the TCLP leaching solution, we thought it was important to supplement the TCLP with the constant pH leaching procedure to assess the performance of the treatment residuals over the range of normal landfill operating conditions. Using this procedure, we examined waste solubility over a pH range from 2 to 12. Even though more extreme conditions have been observed in landfills,¹¹ a recent compilation of landfill data finds that approximately 95 percent of all hazardous waste landfills

are in the 2 to 12 pH range, and more than 90 percent are less than pH 10.¹² By maintaining the pH constant at each level, the test simulates the potential for metals to be extracted or mobilized from the treated waste form by a large volume of landfill leachate passing through and around the waste at the set pH level. This also allows treatment performance to be compared at the set conditions. An exposure period of 14 days, rather than the 18 hours of the TCLP, was chosen to allow all samples time to reach near-equilibrium before measurement of the release potential of mercury from the treatment residuals. Other factors, such as leachate to solids ratio, oxidation/reduction potential (eH), particle size, exposure period, and the major ions present all affect metal solubility. However, the studies presented here primarily focused on the effects of varying pH conditions because the solubilities of metals and metal complexes are highly pH dependent and the pH conditions of hazardous waste landfills are known to vary widely.

The results of these two studies are provided in two reports: "Technical Background Document: Mercury Wastes—Evaluation of Treatment of Mercury Surrogate Waste" and "Technical Background Document: Mercury Wastes—Evaluation of Treatment of Bulk Elemental Mercury," available in the docket for today's notice. In this section, we provide an overview of these studies.

The first study evaluated the effectiveness of four technologies to stabilize a "difficult-to-treat" mercury waste, representing the wide range of high mercury wastes that could require treatment. A surrogate waste was designed for the study, which included an organic form of mercury, elemental mercury, and several mercury salts in an inorganic matrix. The surrogate waste was treated by each technology vendor. The treated waste was then evaluated for mercury leachability, using both the TCLP and an automated, constant-pH leaching protocol. Prior to leach testing, waste form particles were reduced in size to 9.5 mm or less. The waste forms were exposed to the leaching medium at a 20:1 liquid to solids ratio, and the pH was monitored and adjusted as

necessary by computer-controlled addition of acid or base. Constant pH leaching was conducted at pH 2, 4, 6, 8, 10, and 12 for 14 days at each pH. This leaching procedure and the waste surrogate are described in detail in the Technical Background Documents, available in the docket for today's notice.

The second study evaluated the ability of three technologies to convert elemental mercury into a stable waste form. The study was designed to assist in evaluation of options for disposition of the inventory of mercury in the Defense Logistics Agency (DLA) stockpile. Bulk elemental mercury was treated by each technology vendor, and the treated waste residuals were evaluated for mercury leachability, using the same protocols and conditions as those used in the first study.

In both studies, the total concentration of mercury was measured in samples of the untreated starting material (either surrogate waste or bulk elemental mercury), in the treated waste form, and in leachates (both TCLP and constant pH leaching). In addition, samples of the untreated and treated material were characterized, including measurements of bulk density, moisture content, percent organic matter, cation exchange capacity and particle size distribution.

Each of the technologies evaluated in these studies relies on chemical reactions to minimize volatilization and solubility, rather than on recovery or separation technologies which generate a near mercury-free residual in addition to concentrated or purified mercury. These treatment processes are summarized below.

G. What Were the Treatment Technologies Included in Our Treatability Studies?

Four commercial treatment vendors participated in studies of the treatability of the surrogate waste. Because the actual commercial amalgamation processes are proprietary, we refer to the aforementioned treatment technologies as "vendors" to mask their identity. Each of the four vendors' processes utilized reagents to bind the mercury forms present as various sulfides. The following table presents a comparison of these technologies.

and Radioactive)" http://www.cee.vanderbilt/cee/research_projects.html.

¹⁰ See 55 FR 11798, March 29, 1990 for more information on the TCLP. The TCLP was originally developed to assess the plausible, worst case mismanagement scenario for evaluating industrial waste codisposed in a municipal solid waste landfill.

¹¹ 65 FR 37945, June 19, 2000.

¹² Characterization and Evaluation of Landfill Leachate (Draft), SAIC, September 2000, page 3–33.