Analysis of Alternatives to Incineration for Mercury Wastes Containing Organics

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I. Introduction

The Land Disposal Restrictions (LDR) treatment standards established by the Third Third Rule (55 *FR* 2250, June 1, 1990) allow incineration (IMERC) as a treatment option for organic high-mercury wastes. The rationale for this LDR Best Demonstrated Available Technology (BDAT) treatment standard was that incineration most completely destroys the organic component in the waste, allowing recovery of mercury in the incineration residuals. While incineration destroys the organic component of organomercury complexes, it also generates mercury that enters other waste or emissions streams. Since EPA recognizes mercury as a high priority pollutant, it may be preferable to immobilize mercury rather than recover it. Moreover, the EPA has found that most incineration residuals are not treated for mercury recovery.

This report will characterize IMERC waste streams; evaluate non-combustion treatment technologies; identify facilities that provide non-combustion treatment for high mercury wastes; identify mercury waste streams that will continue to require incineration; and provide performance data for IMERC wastes treated by non-combustion technologies.

II. IMERC Waste Characterization

Table 1 lists the waste descriptions for EPA hazardous waste codes D009, P065, and P092, the mercury wastes that are required to be treated by incineration (IMERC). D009 and P092 may also be treated by roasting or retorting (RMERC). For each of the waste codes shown in Table 1, we discuss available waste characterization data. Following these sections, we provide general data on mercury-bearing wastes.

Table 1: Mercury Waste Codes that Require or Allow IMERC for Non Wastewaters (40 CFR 268.40)

Waste Code	Waste Description	Treatment Technology Code
D009	Nonwastewaters that exhibit, or are expected to exhibit, the characteristic of toxicity for mercury based on the toxicity characteristic leaching procedure (TCLP) in SW846; and contain greater than or equal to 260 mg/kg total mercury that also contain organics and are not incinerator residues. (High Mercury-Organic Subcategory)	IMERC; or RMERC
D009	Hydraulic oil contaminated with mercury radioactive materials. (Note: this category consists of nonwastewaters only.)	IMERC
P065	Mercury fulminate nonwastewaters, regardless of their total mercury content, that are not incinerator residues or are not residues from RMERC	IMERC
P092	Phenyl mercuric acetate nonwastewaters, regardless of their total mercury content, that are not incinerator residues from RMERC.	IMERC; or RMERC

A. D009 Wastes

D009 wastes are characteristic mercury wastes. They are extremely variable in composition, depending on the industry and process which generates the waste. Some of the more common types of D009 wastes include miscellaneous wastes from chlor-alkali production facilities (especially cell room trench sludge and activated carbon for liquid or gas purification), used fluorescent lamps, batteries, switches, and thermometers. D009 wastes are also generated in the production of organomercury compounds for fungicide/bactericide and pharmaceutical uses, or during organic chemicals manufacturing where mercuric chloride catalyst is used (USEPA 1989).

Mercury concentrations in hazardous wastes can range from 0.2 mg/L TCLP to greater than 75 percent of the total waste composition. Therefore, D009 wastes could either fall into the high (greater than or equal to 260 mg/kg total mercury) or the low (less than 260 mg/kg total mercury) mercury subcategory.

According to the 1995 Biennial Reporting System (BRS), the three largest volumes of D009 waste by waste form were reported as a “halogenated/nonhalogenated solvent mixture” (21,743 tons), “other halogenated solids” (8,401 tons), and “concentrated solvent-water solution” (4,700 tons). These waste form descriptions suggest that mercury is not the primary contaminant in these wastes.

Certain D009 waste streams may be incinerated for reasons other than the IMERC incineration requirement. For example, BRS waste streams containing hazardous materials, particularly dioxins and PCBs, as well as certain ignitables and reactives, require incineration treatment. Incineration is the only treatment method that completely destroys dioxins and PCBs. Therefore, many of the waste streams reported to the 1995 BRS may have to be processed using incineration, regardless of the organic and mercury contents. Table 2 shows that many waste streams containing organics and mercury also contain dioxins, PCBs, ignitables, and reactives.

Table 2: D009 Waste Stream Characterization for Organic Waste Form Codes (B0xx, B2xx, B4xx, and B6xx) and Incineration System Codes (M04x) (BRS 1995)

Waste Form Code	Waste Form Description	Total Waste Streams	Quantity Managed (tons)	Number of Waste Streams Containing:			
				Dioxin -- F020-23 or F026-28 [tons]	PCB [tons]	Ignitable -- D001 [tons]	Reactive -- D003 [tons]
B001[1]	Lab packs of old chemicals only	300	104.84	0	0	216 [97.75]	39 [7.43]
B003	Mixed lab packs	313	585.32	0	0	197 [524.93]	133 [471.78]
B004	Lab packs containing hazardous waste	29	41.54	9 [8.00]	0	12 [10.48]	1 [0.75]
B009	Other lab packs	3	0.03	0	0	0	0
B201[2]	Concentrated solvent-water solution	60	4,678.99	1 [7.74]		55 [4,666.68]	2 [30.92]
B202	Halogenated (e.g. chlorinated solvent)	221	553.06	2 [1.47]	0	93 [473.34]	1 [0.10]
B203	Nonhalogenated solvent	22	599.08	0	0	21 [555.55]	0
B204	Halogenated/nonhalogenated solvent mixture	284	21,743.01	0	1 [246.57]	277 [21,676.05]	20 [408.89]
B205	Oil-water emulsion or mixture	18	213.69	0	0	5 [86.21]	0
B206	Waste oil	20	2,329.35	0	0	14 [2,315.79]	3 [1,155.98]
B207	Concentrated aqueous solution of other organics	24	3,069.21	0	0	17 [3066.77]	1 [34.64]
B209	Organic paint, ink, lacquer, or varnish	38	942.33	0	0	37 [940.12]	10 [83.66]
B210	Adhesives of epoxies	3	31.29	0	0	3 [31.29]	0
B211	Paint thinner or petroleum distillates	4	34.76	0	0	3 [24.36]	0
B212	Reactive or polymerized organic liquid	20	1,579.24	0	0	19 [1,578.80]	20 [1,580.24]
B219	Other organic liquids	320	1,104.51	4 [17.62]	3 [40.44]	291 [904.71]	1 [22.05]
B401[3]	Halogenated pesticide solid	754	857.07	2 [0.68]	0	212 [305.29]	22 [22.61]
B402	Nonhalogenated pesticide solids	2	80.07	0	0		
B403	Solid resins or polymerized organics	40	1,797.13	0	3 [54.02]	23 [1,736.80]	3 [28.60]
B404	Spent carbon	12	79.40	0	1[10.53]	4 [47.29]	1 [43.04]

Waste Form Code	Waste Form Description	Total Waste Streams	Quantity Managed (tons)	Number of Waste Streams Containing:			
				Dioxin -- F020-23 or F026-28 [tons]	PCB [tons]	Ignitable -- D001 [tons]	Reactive -- D003 [tons]
B405	Reactive organic solid	35	2,199.07	0	0	27 [2,188.29]	18
B406	Empty fiber or plastic containers	2	152.00	0	0	1 [15.89]	
B407	Other halogenated solids	83	8,401.19	8 [45.78]	4 [47.50]	51 [6,371.87]	1 [20.67]
B409	Other nonhalogenated solids	197	3,782.41	0	1 [2.75]	51 [2,390.20]	8 [1,419.80]
B601[4]	Still bottoms of halogenated (e.g. chlorinated) solvents or other organic liquids	4	240.48	0	0	1 [209.21]	2 [30.89]
B603	Oily sludge	14	1,416.80	0	3 [11.12]	3 [1,328.68]	
B604	Organic paint or ink sludge	24	826.65	0	1 [8.76]	19 [800.11]	1 [113.70]
B606	Reactive or polymerized organics	1	0.80	0	0		0
B609	Other organic sludges	14	433.12	1 [0.10]	3 [24.71]	9 [409.61]	0
	Total	2,861	57,876.39	27 [81.38]	20 [446.39]	1,675 [53,533.42]	289 [7,717.98]

[1] The B000 series of waste form codes are lab packs of mixed wastes, chemical, and lab wastes
[2] The B200 series of waste form codes are organic liquid wastes that are highly fluid with low inorganic solid content and low-to-moderate water content
[3] The B400 series of waste form codes are organic solid wastes that have low-to-moderate inorganic content and water content and is not pumpable
[4] The B600 series of waste form codes are organic sludges that have low-to-moderate inorganic solids content and water content and is pumpable

B. P065 and P092 Wastes

P065 wastes are mercury fulminate wastes. No waste characterization data was found for P065 listed wastes. There are 2 facilities in the 1995 BRS that reported incineration of P065.

P092 wastes are phenyl mercuric acetate wastes. There is very little data available on the composition of P092 listed wastes. There are 5 facilities in the 1995 BRS that reported incineration of P092.

C. Other Incinerated Mercury Wastes

Although the following mercury-bearing hazardous waste codes are not required to be incinerated, the 1995 BRS indicates that they have also been found in waste streams processed by incineration: K071, brine purification muds from the mercury cell process in chlorine production, where separately prepurified brine is not used; K106, wastewater treatment sludge from the mercury cell process in chlorine production, and U151, mercury.

Based on a review of BRS, most of these waste streams were co-reported with other wastes. For example, the 1995 BRS data list 7 facilities that incinerate U151 wastes. However, based on a review of the specific U151 streams reported as incinerated in the BRS, all U151 is co-reported with other waste streams and often carries a waste form and waste description that suggest that the U151 is part of a larger spent solvent waste stream or contaminated media. Since these waste codes do not comprise a large percentage of the wastes going to incineration, they will not be discussed in this report. For more detailed information about these waste codes, see the report entitled "Waste Specific Evaluation of RMERC Treatment Standard."

D. National Hazardous Waste Constituent Survey

In 1997, EPA conducted a survey of 221 hazardous waste treatment, disposal, and recycling facilities (TDRs) managing the largest waste streams reported to the 1993 BRS within specific categories. The survey instrument requested voluntary reporting of waste characterization data for these waste streams. It requested total and toxicity characteristic leaching procedure (TCLP) concentrations for chemicals present in the waste, physical characteristics of the waste (i.e., BTU, flash point, TOC, TSS, percent oil, percent halogens, percent solids), and general waste information such as whether the waste was derived from a listed hazardous waste. Only streams of greater than 400 tons for nonwastewaters or 40,000 tons for wastewaters were included in the survey. Of the 212 facilities contacted, 158 provided responses, and one facility claimed confidential business information protection of their data.

Several limitations exist in these data. First, the survey was voluntary and was limited to the largest waste streams. As a result, some high mercury wastes with concentrations of greater than 260 mg/kg probably were not captured by the survey due to waste quantities below the survey threshold 4,000 or 40,000 tons. Second, the survey provided recipients with a list of possible constituents that might be found in the wastes. However, some respondents indicated that the concentration of all constituents was zero. Further, while some respondents added chemicals to the list, others did not. Therefore, the data in this section should not be construed to reflect national waste characterization data for mercury bearing wastes.

The National Hazardous Waste Constituent Survey database was searched for all waste streams reported to contain mercury. These streams were then evaluated to identify the full array of waste codes carried by the waste, the form of the waste (e.g., organic or inorganic, liquid, solid, or sludge), the final waste management practice, the total and TCLP concentration of mercury in the waste, and other chemicals present in the waste that would require treatment. In addition, we examined the hazardous waste codes to determine if the waste stream, as reported in the survey, had any waste codes present that would require the use of combustion. See Appendix A, Table 1 of this report for a compete analysis.

Table 3 presents a subset of these data for wastes destined for combustion (i.e., incineration, fuel blending, or energy recovery) that have a total or TCLP mercury concentration greater than zero. Note that a concentration of zero does not necessarily indicate that mercury is not found in the waste. Due to the nature of the survey, some facilities reported no constituent data. Therefore, zero values are entered into the database and these waste streams have been analyzed.

Table 3 also contains a column of notes. Where notes are included, the waste codes for the stream include hazardous wastes that have a specified method of treatment. For nonwastewaters, the specified method of treatment is CMBST (combustion), although some of the waste codes provide an alternative numerical treatment standard. Generally, it is expected that these waste streams will continue to be managed by combustion due to the presence of these waste codes.

The concentrations provided for mercury do not exceed 17.6 ppm. As discussed previously, some respondants to the survey did not report concentrations for any constituents. However, it cannot be assumed that all of the wastes shown in Table 3 fall into the low mercury subcategory. Finally, no waste stream contained P065 (mercury fulminate) or P092 (phenyl mercuric acetate).

Table 3: Chemical Constituents in Mercury-Bearing Waste Streams

Facility EPA ID	SIC	No.	Waste Codes	WasteForm	Waste Mgmt.	Derived-From Waste?	Avg. Conc. ppm - TOTAL	Avg. Conc. ppm - TCLP	Other Constituents	Notes
IND006419212	3241	3	D004 D005 D006 D007 D008 D009 D010 D011 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 F001 F002 F003 F004 F005	Org Liquid	Fuel Blend	Yes	0.55	0	Arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, cyanides, organics	
IND006419212	N/A	5	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D033 D034 D035 D036	Org Liquid	Fuel Blend	Yes	0.55	0	Arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, cyanides, organics	
IND006419212	N/A	8	D001 D009 F001 F002 F003 F004 F005	Org Liquid	Fuel Blend	Yes	0.55	0	Arsenic, barium, chromium, lead, selenium, silver, cyanides, organics	
IND006419212	N/A	15	D001 D004 D005 D006 D007 D008 D009 D018 D019 D025 D026 D035 F001 F002 F003 F004 F005 F019 K022 K024 K048 K049 K050 K051 K052	Org Liquid	Fuel Blend	Yes	0.55	0	Arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, cyanides, organics	
KSD981506025	N/A	2	D001 D004 D005 D006 D007 D008 D009 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D033 D034 D035 D036 D038 D039 D040 F001 F002 F003 F004 F005 K022 K024 K048 K049 K050 K051 K052 K085 K086 K094 K095 U001 U002 U012 U019 U031 U051 U052 U055 U056	Org Liquid	Incin	Yes	1.34	0	PCBs, furans, cyanides (all conc. shown as DK); arsenic, barium, cadmium, chromium, lead, nickel, organics	4
KSD981506025	N/A	3	D006 D007 D008 D009	B301	Incin	No	17.6	0	Cadmium, chromium, lead	
MOD981127319	N/A	3	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D022 D027 D028 D035 D038 D039 D040 F001 F002 F003 F004 F005 F037 F038	Org Liquid	Engy Rec	Yes	0.01	0	Arsenic, barium, cadmium, chromium, lead, silver; organics (NT)	
MOD981127319	N/A	4	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D022 D026 D035 D039 D040 F001 F002 F003 F004 F005 U002 U028 U154 U159	Org Liquid	Engy Rec	Yes	0.01	0	Arsenic, barium, cadmium, chromium, lead, silver; organics (NT)	11
MOD981127319	N/A	5	D001 D005 D006 D007 D008 D009 D019 D026 D035 D040 F001 F002 F003 F004 F005 K001 K027 K048 K049 K050 K051 K060 K083 K086 U002	Org Liquid	Engy Rec		0.01	0	Arsenic, barium, cadmium, chromium, lead; organics (NT)	3
MOD981127319	N/A	6	D001 D004 D005 D006 D007 D008 D009 D010 D011 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 D033 D034 D035 D036	Org Liquid	Engy Rec	Yes	0.01	0	Arsenic, barium, cadmium, chromium, lead, silver; organics (NT)	
MOD981127319	N/A	8	D001 D004 D005 D006 D007 D008 D009 D010 D011 F001 F002 F003 F004 F005	Org Liquid	Engy Rec	Yes	0.01	0	Arsenic, barium, cadmium, chromium, lead, silver, organics	

Facility EPA ID	SIC	No.	Waste Codes	WasteForm	Waste Mgmt.	Derived-From Waste?	Avg. Conc. ppm - TOTAL	Avg. Conc. ppm - TCLP	Other Constituents	Notes
MOD981127319	N/A	11	D001 D004 D005 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 D033 D034 D035 D036	Org Liquid	Engy Rec	Yes	0.01	0	Arsenic, barium, chromium, lead, silver; organics (NT)	
MOD981127319	N/A	14	D001 D002 D005 D006 D007 D008 D009 D010 D011 D018 D019 D022 D028 D035 D037 D038 D039 D040 F001 F002 F003 F005 K086 U007 U041	Org Liquid	Engy Rec	Yes	0.01	0	Barium, cadmium, chromium, lead, silver; organics (NT)	4
MOD981127319	N/A	15	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 D033 D034 D035	Org Liquid	Engy Rec	Yes	0.01	0	Arsenic, barium, cadmium, chromium, lead, silver; organics (NT)	
MOD981127319	N/A	18	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D035 D037 D039 D040 F001 F002 F003 F004 F005 K001	Org Liquid	Engy Rec	Yes	0.01	0	Arsenic, barium, cadmium, chromium, lead, silver; organics (NT)	
OHD987048733	N/A	1	D001 D005 D006 D007 D008 D009 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D031 D032 D033 D034 D035 D036 D037 D038 D039 D040 D041 D042 F001 F002 F003 F004 F005 K022 K048 K049 K052 K086 U001 U002 U003 U019 U031 U051 U052 U055 U056 U057		Engy Rec	Yes	ND	0	Barium, cadmium, chromium, lead, nickel, cyanides, pesticides, furans (all conc. shown at ND); organics	4, 7, 8
PAD083965897	N/A	1	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 D033 D034 D035	Org Liquid	Engy Rec	Yes	0.28	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver	
PAD083965897	N/A	2	D001 D002 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D020 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D031 D032	Org Liquid	Engy Rec	Yes	1.05	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver	
PAD083965897	N/A	5	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D026 D027 D028 D029 D033 D034 D035 D036 D039 D040 F001 F002	Org Liquid	Engy Rec	Yes	0.64	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver, organics	
PAD083965897	N/A	6	D001 D002 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D025 D026 D028 D029 D032 D033 D034 D035 D036 D039 D040	Org Liquid	Engy Rec	Yes	1.7	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver	
TXD000838896	4953	7	D001 D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D012	Inorg Solid	Incin	No	0.003	0	Barium, cadmium, chromium, lead, selenium; pesticides, cyanides, arsenic, silver (conc. shown as ND)	
TXD000838896		14	D004 D005 D006 D009		Incin	No	0.25	0	Arsenic, barium, cadmium, lead, organics	

Facility EPA ID	SIC	No.	Waste Codes	WasteForm	Waste Mgmt.	Derived-From Waste?	Avg. Conc. ppm - TOTAL	Avg. Conc. ppm - TCLP	Other Constituents	Notes
TXD000838896		18	D007 D008 D009 F001		Incin	No	0.03	0	Chromium, lead, organics	
TXD007330202	2869	2	D018 D019 D020 D021 D022 D023 D024 D025 D026 D027 D028 F001 F002 F003 F005 K009 K010 U001 U002 U003 U019 U028 U031 U037 U044 U056 U070 U107 U108 U112 U113 U115 U117 U122 U140 U147 U151 U154 U159 U161 U169 U190 U196 U211 U213 U226 U239 U359	Org Liquid	Incin	Yes	0.0515464	0	Organics, pesticides	4, 6, 7, 9, 10, 11
TXD007330202	2869	6	D001 D018 D019 D020 D021 D022 D023 D024 D025 D026 F001 F002 F003 F005 K009 K010 U001 U002 U003 U019 U028 U031 U037 U044 U056 U070 U107 U108 U112 U113 U115 U117 U122 U140 U147 U151 U154 U159 U161 U169 U190 U196 U211 U213 U226 U239 U359	Inorg Sludge	Incin	Yes	0.095	0	Antimony, barium, beryllium, cadmium, chromium, cobalt, copper, lead, nickel, selenium, thallium, tin, vanadium, zinc, organics	4, 6, 7, 9, 10, 11
UTD981552177	N/A	3	D001 D002 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D032 D035 D036 D039 D040 F001 F002 F003 F004 F005 F037 K001 K009 K010 K015 K016 K017 K018 K019 K020 K022 K023 K024 K025 K026 K030 K036 K042 K048	Org Liquid	Incin	Yes	0.0555556	0	Barium, cadmium, chromium, lead, selenium, silver, organics; cyanides (conc. shown as 0)	1, 2

Source: National Hazardous Waste Constitutent Survey, 1997 and Biennial Report, 1993

Abbreviations: DK - Don’t Know; NA - Not Available and not expected to be present; ND - Not Detected; NT - Not tested, but could be present

Notes for Table 3:

1) F024, K026: CMBST for WW and NWW
2) K025: LLEST fv SSTRP fb CARBN; or CMBST for WW. CMBST for NWW
3) K027, K039, P062: CARBN; or CMBST for WW. CMBST for NWW.
4) U001, U006, U007, U008, U021, U041, U055, U056, U113, U122, U124, U147, U197, U213, P001, P002, P005, P007, P008, P014, P017, P018, P023, P028, P045, P046, P047(salts only), P049, P054, P057, AND P058: (WETOX or CHOXD) fb CARBN; or CMBST for WW. CMBST for NWW
5) U133: CHOXD; CHRED; CARBN; BIODG; or CMBST for WW. CHOXD; CHRED; or CMBST for NWW.
6) U359 AND P009: CMBST; or CHOXD fb (BIODG or CARBN); or BIODG fb CARBN for WW. CMBST for NWW.
7) U003: 5.6 mg/L acetonitrile for WW. CMBST or alternative standard of 38 mg/kg acetonitrile for NWW.
8) U057: 0.36 mg/L cyclohexanone for WW. CMBST or alternative standard of 0.75 mg/L cyclohexanone for NWW.
9) U108: (WETOX or CHOXD) fb CARBN; or CMBST for WW. CMBST or alternative standard of 170 mg/kg 1,4-Dioxane for NWW.
10) U115: (WETOX or CHOXD) fb CARBN; or CMBST or alternative standard of 0.12 mg/L ethylene oxide for WW. CHOXD; or CMBST for NWW.
11) U154: (WETOX or CHOXD) fb CARBN; or CMBST or alternative standard of 5.6 mg/L methanol for WW. CMBST or alternative standard of 0.75 mg/L TCLP methonol for NWW.

We further evaluated the data for each mercury-bearing waste stream (including those reported to have a zero mercury concentration) to assess physical parameters. Table 4 presents a summary of the data contained in Appendix A, Table 1 (chemical constituents) and Table 2 (physical parameters) for all mercury-bearing wastes contained in the National Hazardous Waste Constituent Survey. In calculating averages shown in Table 4, we transformed numbers reported as >x or <x to x and we omitted values reported as NA or NT. We also converted flash points to Fahrenheit. Averages were calculated when facilities reported ranges.

Table 4: Summary of Survey Data for Mercury-Bearing Wastes Managed by Burning

Parameter	Value	No. of Non-Zero Values
Total Number of Waste Streams That Contain Mercury	120	
Total Number of Waste Streams That Contain Mercury and are Destined for Burning	77	
Average Total Mercury Concentration	0.98 ppm	26
Average TCLP Mercury Concentration	0 ppm	77
Number of Streams Reported as Derived-from Hazardous Waste	23	77
Number of Streams Having One or More Hazardous Waste Codes That Require CMBST as LDR or Allow CMBST as Alternative LDR	27	77
Average Percent Solids Range	19.1% - 22.0%	34
Average Total Suspended Solids Range	12.3% - 14.79%	4
Average Percent Ash Range	8.13% - 8.83%	52
Average Percent Water Range	14.86% - 16.86%	50
Average Percent TOC	55.9%	9
Average Percent Oil	5%	4
Average pH Range	6.5% - 7.3%	32
Average Flash Point Range	98.2°F - 99.3°F	24
Average BTU/Lb Range	10,753-11,713/Lb	50
Average BTU/Gal Range	10,800-123,000/Gal	2

Average Percent Halogen	1.61%	45

E. Waste Treatment Cost

Incineration prices for bulk and drummed solids and sludges range from $990 to $1,265 per metric ton. If the bulk and drummed solids and sludges or contaminated soils are treated off-site, transportation costs must be added.

Soil treatment costs at off-site incinerators range from $200 to $1,000 per ton. This includes all project costs. Mobile units that can operate on site will reduce transportation costs. Soils contaminated with PCBs or dioxins cost between $1,500 to $6,000 per ton to incinerate.

III. Technical Evaluation of Non-Combustion Treatment Technologies

In this section, we evaluate the alternative treatment technologies that are currently commercially available and those that could be used to treat mercury wastes currently requiring incineration. The goal of an alternative treatment technology would be to achieve the same degree of destruction of the organic compounds, but maintain control over the residual mercury. Mercury waste streams that are currently incinerated can be divided into four subcategories:

- organomercury compounds (e.g., phenylmercuric acetate);
- elemental mercury mixed in with organic wastes;
- inorganic mercury compounds mixed in with organic wastes; and
- any mixture of the preceding groups.

Because mercury cannot be destroyed, treaters have to rely on various treatment process steps to treat or recover the mercury, depending on the mercury species present in the waste, its concentration, and the overall waste form. Alternative treatment processes have been used to treat mercury in nonwastewaters (e.g., BDAT for K071 is acid leaching followed by chemical oxidation followed by sulfide precipitation). For wastewaters, technologies such as ion exchange and carbon adsorption have been used to remove the mercury. These methods of treatment can also be incorporated as a later stage for treating nonwastewater forms of mercury wastes mixed with organics. Selecting the appropriate treatment formula depends on the degree of organic destruction required prior to further mercury treatment, the degree of mercury speciation control required by the waste form, and other operating procedures to ensure mercury extraction from nonwastewaters and wastewaters. The final treatment step in nonthermal processes for mercury wastes generally involves either precipitation to produce a waste that may be retorted or immobilization prior to disposal.

A. Chemical Oxidation

1. Process Description

The purpose of chemically oxidizing elemental mercury and organomercury compounds is to destroy the organics and to convert mercury to a soluble form, such as $HgCl_2$ or HgI_2, which can then be separated from the waste matrix and subsequently treated. Oxidizing reagents used in these processes include sodium hypochlorite, ozone, hydrogen peroxide, chlorine dioxide, free chlorine (gas), and proprietary reagents. Chemical oxidation may be conducted as a continuous or a batch process in mixing tanks or plug flow reactors. Complete mixing of the waste with the oxidizing agent is essential, either by mechanical agitation, pressure drop, or bubbling into the tank. Complete mixing optimizes the contact time between the contaminants and the oxidizing agent, which also reduces the chemical dosage required to obtain a specific effluent concentration. Typical retention times are in the range of 60 to 120 minutes. Oxidation of some organics may require several hours at an elevated temperature in continuous processes, and it may be more feasible to conduct oxidation in batches, or at a minimum, in three to five continuous stirred reactors to reduce reaction times.

Using oxidation to form mercury halide compounds is effective in treating mercury-containing wastes. Mercuric chloride and mercuric iodide have large formation constants (K_f), a low oxidation potential, and are stable and soluble when not subject to reducing conditions (i.e., in the presence of sulfide or high pH). Oxidation using chlorine-reagents typically is conducted at slightly alkaline conditions. Reaction products from the oxidation of organic-mercury wastes and destruction of organics by chlorine-oxidants include carbon dioxide (CO_2), water, salts (e.g., NaCl), acid (HCl) and aqueous mercury-halide. Mercuric halides formed in the oxidation process partition to the liquid phase, where they are separated and sent for subsequent treatment, which can include acid leaching and precipitation. Sulfides present in the waste are converted to sulfate ion. The presence of organonitrogen compounds and excess sulfide may result in the formation of nitrogen oxide (NO_x) and sulfide gases, instead of forming nontoxic nitrogen and sulfates. Residual aqueous organic content that is not destroyed may be filtered with the aqueous mercury, which would contaminate further treatment steps. Residual solid organic content that is not destroyed, such as organomercury compounds, may contaminate the filter cake and require further treatment. Therefore, the selection of appropriate reagents and treatment formulas is important in achieving complete organic destruction.

Important factors that affect the oxidation process include the water content of the waste, filterable solids, total organic carbon, the presence and difficulty of other oxidizable organic compounds in addition to the constituents of concern, the presence of metal salts that consume excessive amounts of reagents, retention time, type and amount of oxidizing agent, degree of mixing, pH, and temperature.

Chemical oxidation processes are generally used to treat aqueous wastes but it may also be applied to solids, provided a treatable slurry can be achieved. Chemical oxidation is also used to treat sulfide wastes by converting the sulfide to sulfate.

Reagents have been used to oxidize many organic contaminants, including phenols, benzene, pesticides, chlorinated solvents, and polycyclic aromatic hydrocarbons (PAHs). With the exception of wet air oxidation and combustion processes, oxidation processes are usually effective only on dilute wastes (COD<5000 mg/l). This is due to the high costs of oxidants used to treat very contaminated wastes (Freeman, 1997).

The capability of a "cold" oxidation process to destroy the organic content of wastes depends on the difficulty associated with treating the organics present. Three general treatability groupings may be considered for determining the degree of oxidation required to destroy organics.

- Difficult to oxidize: requires strong reagents to ensure complete organic destruction; larger amounts of reagents; long retention times; excessive energy input (i.e., UV or thermal); or doesn't oxidize with commercial reagents.
- Moderate to oxidize: oxidizable using commercial reagents capable of completely destroying the organic content; may require some energy input (i.e., UV or thermal); treatment formulas need to be carefully set; retention times may be long.

- Easy to oxidize: requires minimal amount of reagents; does not require any energy input; operates at standard temperature and pressure (stp); strong reagents may not be necessary to achieve complete destruction of organics.

Table 5 shows general treatability groups and provides examples of organic compounds that have been found to occur in wastes that contain mercury reported in 1995 BRS.

Table 5: Oxidation Treatability Groups of Organic-Mercury Wastes

Difficult	Moderate	Easy
alkenes	cyanides	chlorophenols
nonhalogenated solvents (i.e., hexane and cyclohexane)	aromatics	phenols
fully saturated organic compounds (i.e., petroleum ether)	chlorinated aliphatics	chlorinated aromatics
oily and greasy wastes	substituted polyaromatic hydrocarbons	halogenated solvents
isooctane (gasoline)	amines	alcohols
		ethers
		ketones
		substituted organic compounds
		epoxides
		unsaturated organic acids
		alkenes

Ozone is a powerful oxidant and readily reacts with most toxic organics. Most of the reaction products are less toxic and many are biodegradable. The principal disadvantages of using ozone are the cost and the inability to inject the gas efficiently. Ozone generation costs are about $2,400 per kg per day for plants producing 900 kg per day, but are dramatically higher for smaller systems.

Hydrogen peroxide is similar to ozone in that, in the presence of an iron catalyst, it produces the hydroxyl radical. This radical reacts with organic compounds to produce a reactive organic radical. The organic radical can react again with peroxide to produce an additional hydroxyl radical. Hydrogen peroxide has been shown to be effective in oxidizing organics in soil through in situ treatment. The effectiveness of hydrogen peroxide is greatly enhanced by ultraviolet (UV) light. The application of hydrogen peroxide and UV light is a well-established technology with operating costs ranging from $1 to $10 per thousand gallons treated. Reaction products from the complete oxidation of organics using hydrogen peroxide are CO_2 and H_2O. Maintaining slightly alkaline pH allows for the formation of soluble mercuric hydroxide which is filtered and sent for further treatment.

Although chemical oxidation is typically applied to liquid hazardous wastes and contaminated groundwater, soils and sludges may also be amenable to this process. Contaminated soils can be excavated and treated in a slurry form in reaction vessels. Since excavation is expensive, the trend in soil cleanup technology is to use an *in-situ* oxidation process and stabilize the mercury. Chemical oxidaiton *in-situ* is dependent upon getting the reagents in contact with the contaminants, which is a function more of the soil properties than of the process chemistry.

Reactive organomercury wastes require deactivation involving careful dissolution of explosive solids in water, combined with oxidation treatment of the dissolved waste. In the case of mercury fulminate, the dissolved cyanate ions can be completely oxidized to carbon dioxide and nitrogen using strong aqueous oxidizing agents such as sodium hypochlorite.

Chemical oxidation is applicable mainly to the treatment of aqueous wastes containing organomercury constituents (e.g., P092). Chemical oxidation is demonstrated for the treatment of high mercury wastewaters containing mercury concentrations up to 1,000 mg/L. Although this technique typically is applied to liquid hazardous wastes and contaminated groundwater, it can also be used to treat solid hazardous wastes. This method has also been applied to treat brine purification muds from the mercury cell process in chlorine production (K071). Aqueous chemical deactivation is also applicable for wastes containing reactive mercury constituents (e.g., mercury fulminate, P065).

2. Limitations

Chemical oxidation processes are most economical and feasible when wastes containing organics and mercury can be treated using the same reaction formula while at the same time completely destroying the organic content and transforming the mercury to a soluble form. Reactions between certain oxidizing agents and organics may result in chlorine substitution rather than destruction of the organic components. Non-thermal chemical oxidation systems typically function under narrowly defined operating ranges and have limited waste treatment variability. It is important for reaction formulas to achieve results in order to avoid the formation of reaction side products such as chlorinated organics that may result when using hypochlorite as the oxidizing agent. The resulting chlorinated hydrocarbon may be more toxic than the original waste. Depending on the organic content of the mercury waste, a high degree of oxidation may be required to achieve organic destruction and phase separation of mercury. Certain wastes cannot be destroyed by chemical oxidation (e.g., dioxins, furans, and PCBs). There are also potential safety problems with mixing strong oxidizers with certain organics. Chemical oxidation reactions should be used in conjunction with other processes to ensure complete removal and final treatment of mercury. Technology development issues include determination of chemical oxidation effectiveness, flexibility, and operability. Other issues to be evaluated include the expense of constructing and operating such systems.

3. Cost

Chemical oxidation has an estimated cost range of $190 to $660 per cubic meter. The large range is due to the large variation in prices for selected reagents. For example, ozone is extremely expensive to produce. Ozone costs are about $2,400 per kg per day for plants producing 900 kg per day and are drastically higher for smaller systems. However, if hydrogen peroxide, hypochlorites, chlorine or other chemical compounds are selected as the reagent, costs can be reduced. Chemical oxidation is not cost-effective for high concentrations because large amounts of oxidizing reagents are required.

B. Chemical Leaching/Acid Leaching

1. Process Description

Chemical leaching is an aqueous process that depends on the ability of a leaching solution to solubilize mercury and remove it from the waste matrix. The solubilized mercury ideally partitions to the liquid phase, which is filtered off for further treatment (e.g., precipitation, ion exchange, carbon adsorption). This process is successful for removing inorganic forms of mercury from inorganic waste matrices. It is less effective for removing nonreactive elemental mercury unless the leaching formula is capable of ionizing mercury to an extractable form. Acid leaching is capable of removing inorganic mercury species from an organic matrix. The organic content, however, is not destroyed by acid leaching and it may partition to the liquid phase with mercury compounds. Any organic content present in the filtrate will contaminate any subsequent treatment.

A chemical leaching process brings mercury-contaminated materials into contact with a leaching solution that generates an ionic soluble form of mercury. It is better used as a second step following the destruction of organics and/or conversion of mercury to a acid soluble species (i.e., mercuric chloride). Nonwastewaters can be processed in a way to ensure sufficient contact of the waste with the leaching solution. The mercury-containing leachant is typically removed from the contaminated materials for further treatment (e.g., precipitation). Precipitates can be either disposed or the mercury can be recovered by retorting or roasting. When acidic leachant solutions are used, the processed materials may require neutralization prior to disposal. There are two basic types of leaching processes: acid leaching and oxidative-acid leaching.

Acid leaching is most commonly used to remove mercury from inorganic media. For solids and sludges, an aqueous slurry must be prepared to ensure thorough contact of the acid with the wastes. Acid leaching typically uses strong acids such as sulfuric, hydrochloric, or hydrobromic. The mercury compounds most suited for acid leaching are inorganic mercury compounds such as oxides, hydroxides, halides, and sulfides. The removal of mercury from aqueous media may be performed using one or more acid washes. The leaching solution is typically at a pH of 2 to 3, especially when mercury is present as a sulfide. Acid leaching renders mercury soluble so that it partitions to the liquid phase. The wastewater generated is then separated and sent for further treatment, which is commonly sulfide precipitation. This process is used to treat K071 wastewaters.

Waste characteristics that affect the acid leaching process include solid particle size, neutralizing capacity of the waste being treated, type of chemical form of the hazardous metal constituents in the waste, contact time between the solid and the acid, choice of acid used, pH, type of contactor used, and oil and grease content.

The purpose of oxidative acid leaching is to achieve both conversion of mercury to a soluble form and then to partition it to a liquid phase for separation from the feed stream. When the mercury waste stream includes organic constituents, the reaction formula must include sufficient oxidizing reagent to destroy the organic content. Some of the most commonly used oxidative-acid leaching solutions are oxidizing acids such as nitric acid and hypochlorous acid, which are capable of oxidizing elemental mercury and solubilizing inorganic mercury. It is relatively easy to oxidize inorganic mercury compounds for removal. It is more difficult to oxidize elemental mercury, so the strength and quantity of the oxidant must be sufficient to convert Hg^0 to Hg^{2+}. Reaction with a strong acid and a source of chlorine will transform the less soluble mercuric oxide into the more soluble mercuric chloride and ais in the mercury removal. The separation process operates on the same principal as acid leaching since mercury-bearing wastewaters require further treatment prior to disposal.

The chemical leaching process usually consists of a solid/liquid or liquid/liquid contacting system followed by phase separation. Separation of the liquids from the treated solids is accomplished by settling, centrifuging or filtration, and frequently involves washing the residue. The two chemical leaching processes for solids are percolation and dispersion. Percolation occurs in batch tanks or in a continuous system. The solids are placed in the tank and acid is fed into the solids. The acid percolates through the solids and drains out through screens or porous media in the tank bottom. The acid may flow counter-currently through a series of tanks, with fresh acid added to the tank containing the most nearly exhausted solids. The solids are removed at completion of treatment. Continuous percolation is carried out in moving-bed equipment, where the acid normally flows counter-currently to the solids. The acid drains from each solids bed to the solids bed beneath. Dispersed-solids processes are carried out by leaching fine solids into the acid in batch tanks or in one of several possible continuous devices. In the batch and continuous systems, the untreated waste and the acid are mixed in the reaction tank. Following mixing, the treated solids are separated from the acid. Separation is accomplished through settling or filtration, depending on the type and concentration of solids involved. In both systems, sufficient acid must be supplied to maintain a low pH to leach the metals from the waste effectively.

2. Limitations

Acid leaching alone generally does not separate elemental mercury and organomercury from wastes. Elemental mercury is essentially nonreactive in acid and will remain mostly entrained in the waste. Organomercury bonds often are not destroyed in acidic media and the mercury is not liberated from the organic matrix. Two alternative treatment methods must be employed for the successful removal of mercury from organic matrices and for the removal of elemental mercury from wastes: pretreatment of oxidation (discussed in the oxidation section) or oxidative-acid leaching. No information is readily available that characterizes the performance of an combination oxidative-acid leaching step on treating organic-mercury wastes. An oxidation step prior to acid leaching may be necessary in order to destroy organics and convert mercury to mercuric chloride ($HgCl_2$) which is soluble, partitions to a liquid phase, and can be separated for further treatment. Oxidative leaching may be more appropriate for treating elemental and organomercury bearing wastes. This process, however, is dependent on the capability of the oxidant to sufficiently transform mercury to a soluble form, and on the presence of a selective ion (e.g., chloride or iodide) with which mercury can form a stable and soluble complex capable of partitioning to the liquid phase. Mercury-bearing residuals generated from acid leaching processes and that are free of organic content require further treatment such as neutralization, precipitation, or amalgamation, and may be retorted or roasted.

3. Cost

Acid leaching is sometimes an integrated process with chemical oxidation and therefore the cost of redox may be added to the cost of chemical leaching in some cases. The cost range for chemical leaching ranges from \$110 to \$440 per metric ton, depending on the volume of media treated. This price range is large because capital costs can be relatively high and the technology may be more economical at larger sites.

C. Chemical Precipitation

1. Process Description

Precipitation reactions are typically the final step in the mercury treatment process after all organic content has been destroyed. The treatment process demonstrated for K071 non-wastewaters (brine purification muds from the mercury cell process in chlorine production, where separately pre-purified brine is not used) involves precipitating mercurous sulfide (HgS) from the wastewater containing $HgCl_2$ generated during prior oxidation and/or chemical leaching steps. Polyelectrolyte coagulants/filter aids may also be used to optimize mercury immobilization. Precipitation reagents include lie ($Ca(OH)_2$), caustic (NaOH), sodium sulfide (Na_2S), and, to a lesser extent, soda ash (Na_2CO_3), phosphate, and ferrous sulfide (FeS). Sulfide is preferred because it forms the most stable complex. It is important, however, that alkali constituents, such as sodium, do not precipitate in the mercury-sulfide matrix because they contaminate the matrix, which makes it more susceptible to the effects of acid-oxidative leaching. Sulfide precipitation is preferable to hydroxide precipitation using hydrazine because mercury hydroxide is susceptible to matrix dissolution over a wide range of pH under oxidizing conditions. Although mercury sulfide precipitates are capable of leaching mercury, other advantages of sulfide precipitation over hydroxide precipitation include:

- sulfide precipitation reactions may occur at pH levels as low as 2 or 3;
- lower detention times because of sulfides' higher reaction rates;
- metal sulfide sludge has better thickening and dewatering characteristics;
- feasibility of selective metal removal and recovery exits;
- metal sulfide precipitation is less influenced by the presence of chelating agents;
- metal sludge is less subject to leaching at pH 5; and
- metal sulfide sludges have smaller volumes and are easier to dewater.

2. Limitations

Chemical precipitation cannot occur unless mercury is in an ionic state (e.g., Hg^{2+}). Since precipitation reactions are usually the final step in the mercury waste treatment process, the mercury must be "prepared" prior to chemical precipitation. Although sulfide precipitation can occur at a pH of 2 to 3, precipitation solutions typically need to be adjusted to pH ranges of 6 to 8 prior to sulfide addition in order for the mercury sulfide precipitate to settle out. Acidic wastewaters separated from chemical leaching would thus require further treatment to neutralize the acidic residuals. Precipitation works best on wastewaters but is applicable to slurries of sludge and solid mercury wastes that have been pretreated prior to precipitation. High concentrations of total dissolved solids, however, can interfere with precipitation reactions and inhibit settling of precipitates. Oil and grease content in mercury sulfide wastes also inhibit precipitation due to the formation of emulsions. Sulfide precipitation has the potential for hydrogen sulfide (H_2S) gas evolution. This process is also more complicated and expensive than hydroxide precipitation.

3. Cost

Precipitation can be costly depending on the reagents used, the required system controls and the required operator involvement. Operating costs are typically in a range from $0.30 to $0.70 per 1,000 gallons of groundwater containing up to 100 mg/L of metal. Chemical cost varies depending on the chemical selected as the reagent. Finally, disposal costs need to be considered. Sludge disposal may add approximately $0.50 per 1,000 gallons of groundwater treated.

D. Train of Oxidation-Leaching-Precipitation

1. Process Description and Limitations

As described in the previous sections, each of these processes has specific applications to mercury treatment and may be combined into two or three step processes, depending on the form of the mercury-bearing waste and if organic content needs to be destroyed. Leaching followed by precipitation is the generally acceptable treatment for strictly inorganic mercury such as oxides and hydroxides. For elemental and organomercury wastes, however, a higher degree of waste matrix digestion must be achieved because neither leaching nor precipitation, alone or together, is sufficient to destroy organics and isolate mercury in a form at concentrations acceptable for disposal. Because organomercurials are generally not destructible by acid digestion, they may mobilize in the liquid phase sent for precipitation. Any organic residual in a precipitate is undesirable because it undermines the integrity of the waste matrix and may be readily leached from the matrix. This three-step process train would be necessary if the organics of concern cannot be destroyed in an oxidative-acid step followed by precipitation. The treatment train has been demonstrated as an alternative to incineration, but cannot destroy dioxins, furans, or PCBs.

Data supporting the BDAT determination for K071 wastes demonstrate that acid leaching, chemical oxidation, and precipitation are capable of achieving acceptable mercury treatment for inorganic forms of mercury, as shown in Tables 6 and 7.

Table 6: Acid Leaching, Chemical Oxidation and Sludge Dewatering/Acid Washing of Low Level Mercury Nonwastewaters (BDAT for K071)

Mercury	untreated waste		treated waste	
	total (mg/kg)	TCLP (mg/l)	total (mg/kg)	TCLP (mg/l)
Sample set 1	17.0	0.44	2.7	0.0003
Sample set 2	17.0	0.44	4.8	<0.0002
Sample set 3	22.1	20	1.8	2.0
Sample set 4	22.1	20	1.7	0.0002
Sample set 5	22.1	20	1.2	0.0005
Sample set 6	20.6	2.1	1.8	0.0016
Sample set 7	20.6	2.1	1.7	<0.0002

Other data showed that this process regularly achieved EP treated mercury concentrations as low as <0.002. Some elevated concentrations were reported, none higher than 0.150 mg/l. This reflects a well-designed and well-operated system. Different plants achieve a range of different treated mercury concentrations depending on the process parameters and reagents.

Table 7: Chemical Precipitation and Filtration Data for K106 Filter Cake

Mercury	Untreated wastewater (mg/l)	Filter cake (K106)		Treated wastewater (mg/l)
		Total (mg/kg)	TCLP (mg/l)	
Sample set 1	23.7	25,900	0.01	0.028
Sample set 2	9.25	25,900	0.01	0.027
Sample set 3	77.2	25,900	0.01	0.028

E. REMERC Process

1. Process Description and Limitations

The Universal Dynamics REMERC process is a non-thermal hydrometallurgical process for the treatment of contaminated wastes from mercury cell chlor-alkali plants. Currently, REMERC is used by three chlor-alkali facilities: Pioneer in St. Gabriel, LA; Georgia Pacific in Bellingham, WA; and B.F. Goodrich in in Calvert City, KY. It is a two-step leach procedure. The first leach stage is conducted at a slightly acidic pH and uses sodium hypochlorite to extract the mercury. A vertical wash tower (thickener) washes the leach product. The overflow solution from this tower is transferred to the cementation step. The thickened leach residue from the tower contains about 300 ppm mercury and continues on to the second leach stage.

The second leach step is identical to the first, except it is conducted at a more acidic pH. A second vertical wash tower washes the second leach product using either waste brine solution or solution from the cementation stage. The resulting residue consistently contains less than 100 ppm mercury, increasing total mercury recovery to greater than 99 percent. A conventional rotary vacuum filter dewaters this residue. The tower overflow solution returns to the first wash tower for use as washing fluid.

The overflow from the first wash tower contains 1,000 to 2,000 milligrams of mercury per liter. The pH of the solution is reduced to between 2 and 4 before it enters the cementation step. The cementation step mixes the solution with ground scrap iron in a rotary contactor. Mercury cements onto the surface of the iron, reducing the concentration in the solution to under 1 mg of mercury per liter in under 30 minutes of contact time. The tumbling action of the contactor causes the soft mercury amalgam formed on the surface of the iron to detach and overflow the vessel. A filter press dewaters and washes the cement before it is packaged in polyethylene drums. The residual solution from the cementation step can be oxidized, treated to remove iron, and returned to the second vertical wash tower. Alternatively, it can be discharged to the sulfide treatment process that generated K106.

Mercury forms entering this treatment process are usually mercuric sulfide, but mercuric and mercurous chloride, and elemental mercury may also be present.

F. Ion Exchange

1. Process Description and Limitations

Ion exchange resins have proven to be useful in removing mercury from aqueous streams, particularly at concentrations on the order of 1 to 10 parts per billion. Ion exchange applications usually treat mercuric salts, such as mercuric chlorides, found in wastewaters. This process involves suspending a medium, either a synthetic resin or mineral, into a solution where suspended metal ions are exchanged onto the medium. The anion exchange resin can be regenerated with strong acid solutions, but this is difficult since the mercury salts are not highly ionized and are not readily cleaned from the resin. Thus the resin would have to be treated or disposed. In addition, organic mercury compounds do not ionize, so they are not easily removed by using conventional ion exchange. If a selective resin is used, the adsorption process is usually irreversible and the resin must be disposed in a hazardous waste unit.

2. Cost

DOE has conducted a few preliminary studies on using of soil washing plus ion exchange to treat wastewater. Those studies concluded that these technologies can be used successfully at an estimated cost of about $300 per ton of contaminated soil. Ion exchange technology can also be used on contaminated media. Highly concentrated diethylbenzene can be used for production of ionic-exchange resins, which are used in water treatments, wastewater purification and hydrometallurgy. This chemical compound costs approximately $1,710 per metric ton.

G. Pretreatment Technologies

There is a group of technologies that could potentially be used to remove mercury from wastes before they are incinerated. This group includes polymer filtration, self-assembled mercaptans on mesoporous silica (SAMMS), and the General Electric Mercury Extraction Process (GEMEP).

Polymer filtration removes mercury with peroxide, sonic agitation, and polymer reduction. A brief description of the process: shredded material is slurried and sonic agitated with peroxide nad polymer present; the slurry is then filtered, followed by an ultrafiltering of the filtrate; the mercury is then chemically removed from the polymer, and amalgamated for disposal. Polymer filtration bench results are promising, but the future of this research depends on the Department of Energy’s budget.

SAMMS material consists of a monolayer of functional groups that aggregate on an active surface inside the pores of a stable oxide (i.e., SiO_2). The powdered form of SAMMS material has successfully removed mercury from organics. On an Oak Ride National Laboratory mixed waste oil, the mercury concentration was reduced from 1.6 mg/kg to less than 0.2 mg/kg. Again, further SAMMS research is on hold pending additional funding.

The GEMEP process removes mercury using potassium iodide/iodine (KI/I_2). GEMEP has been used on a bench-scale to treat three wastes (one crushed fluorescent light bulb waste and two soils), and all three treated wastes achieved a TCLP of 0.2 ppm or better. However, this process requires large waste streams to justify up-front expenses, and also requires a lot of pretreatment. Therefore, further funding is not likely.

H. Alternative Oxidation Technologies (AOTs)

AOTs are organic destruction technologies that avoid the use of open-flame reactions with gas-phase oxygen. Thermal AOT occurs at temperatures greater than 350 Celsius, nonthermal AOT at temperatures less than 350 Celsius. Some technology development requirements include operation at temperatures that minimize volatility of radionuclides and metals, and essentialliy preclude formation of dioxins and furans; oxidants must be universally effective, readily available, and behave in a controllable and predictable manner; the process must be flexible in accepting feed materials, minimizing characterization and pretreatment; and gaseous emissions other than CO_2, H_2O, O_2, and N_2 should be minimized.

The Mixed Waste Focus Area is involved in studies of both thermal and nonthermal AOTs. The nonthermal technologies include Delphi DETOX, Direct Chemical Oxidation, and Acid Digestion. The thermal technologies include Steam Reforming and Catalytic Chemical Oxidation.

IV. Identifying Facilities that Provide Non-Combustion Treatment for High Mercury Wastes

Several sources were researched to identify facilities and companies that provide alternative treatment for organomercurial wastes. These sources include BDAT capacity background documents, the 1995 Biennial Reporting System (BRS), Alternative Technology Treatment Information Center database (ATTIC), Vendor Information System for Innovative Treatment Technologies database (VISITT), technical background documents, online web searches for company and treatment technology profiles, and the Risk Reduction Engineering Laboratory (RREL) database. Limited information was available that produced the following lists of vendors and facilities that treat organomercurial wastes using methods other than incineration or retorting. BRS data indicate that there are numerous facilities that treat organomercurial wastes. The BRS waste management code, the code used to report the final treatment of the waste, in a few cases indicated there was acid leaching or oxidation used to treat the organomercurial waste stream. This may be because the final treatment step was the only management code reported, and does not indicate if a multiple step process was used. The predominant treatments reported in BRS were stabilization/chemical fixation using cementitious and/or pozzolanic materials and phase separation. There are several data gaps that require further investigation on a process and waste stream specific level. In addition, the BRS data do not adequately describe the organic content of the actual waste stream being treated, especially where multiple waste form codes are reported together with the D009 code.

The majority of the technologies described by VISITT and ATTIC have been applied to remediation. These processes, shown in Table 8, were selected because they are non-combustion processes. Some of the technologies are expected to be applicable to D009 mixed wastes, including organic-mercury wastes.   Tables 9 and 10 present facilities that are treaters receiving mercury-containing organic wastes and generators who treat mercury-containing organic wastes on site, respectively. The facilities in Tables 9 and 10 were generated using the 1995 BRS database. The query design used to identify these facilities was done by searching on *all* the non-combustion management codes for the categories of organic sludges, organic liquids, and organic solids in combination with the mercury hazardous waste codes.

Table 8: Companies that Perform Non-Combustion Treatment of Mercury Wastes

Company	Treatment Technology	Description of residual	Contact Name	Waste Acceptance Criteria	Waste Codes Accepted
Environmental Technologies International	Acid leaching (physical separation-chemical extraction-liquids processing) Mobile unit.	Purity of recovered metal varies from 50 to 99 percent.	Troy Duguay 3 Park Plaza Suite 215 Wyomissing, PA 19610 T:(610)376-4104 F:(610)796-9102 E-mail: ietc@prolog:net	Soils contaminated with Hg, Pb, Cr, Cd, Cu, Ni, and Zn. The presence of non-friable porous material and organic compounds are of concern, but do not make the process impossible.	
IT Corporation	Acid extraction	Metals removed as a sludge and treated soil returned to site.	Edward Alperin Stuart Shealy 312 Directors Dr. Knoxville, TN 37923 T:(423)690-3211 F:(423)694-9573	Soils contaminated with organics and heavy metals	
Advanced Recovery Systems, Inc.	Chemical treatment-Oxidation/ Reduction Low temperature process. Technology trade name: DEHG Destroys organics using a proprietary reagent.	Treated solids form an amalgam that have a TCLP leachate mercury less than 0.05 mg/L. Treated filtrates TCLP less than 0.02 mg/L.	Steve Schutt 1205 Banner Hill Road Erwin, TN 37650 T:(423)743-2500 F:(423)743-2514 E-mail: 102604.1711@ compuserve.com	Solid wastes containing elemental mercury and mercury salts. Mercury in organic-bearing wastes must be converted to a solid non-leachable form using a proprietary reagent and dewatered.	D009 mixed waste, mercury/ thiocyanate complexes, and elemental mercury contaminated with tritium.
Delphi Research, Inc.	Chemical Treatment-Oxidation/ Reduction DETOX^{SM} Nonthermal process.	Destruction efficiencies for many organics >99.9999%. Products are CO2, H2O, inert solids, and concentrated residue of metals as oxides or salts.	Terry Rogers 701 Haines Avenue, N.W. Albuquerque, NM 87102 T:(505)243-3111 F:(505)243-3188 E-mail: delphi@indirect. com	Best applied to bulk organic wastes containing toxic and/or radioactive metals. Not good for great amounts of soils or water containing small amounts of contaminants.	
General Electric Company (GE)	KI/I_2 Leaching Process		Washington	Applied to HgO, Hg^0, HgS	
Nuclear Fuel Services, Inc.	DeHg^{SM} Acid leaching-sulfide precipitation	0.05 mg/L Hg sulfide-cement		Mixed wastes containing elemental mercury (don't know if they accept organics)	
Sybron Chemicals, Inc.	Ion Exchange Resins (IONAC)		F. McGarvey Birmingham, NJ 08011 (609)893-1100		

Table 9: Facilities Performing ONSITE Non-Combustion Treatment of Organic Mercury-Bearing Waste (BRS 1995)

EPA ID	Site/Company Name	Location	Waste Category	Treatment
AL3210020027	Anniston Army Depot	Anniston	Organic solids	M125-Other treatment (specify in comments)
FLD980729610	Laidlaw Environmental Services of Bartow	Bartow	Organic sludges	M021-Fractionation/distillation
GA1570024330	Robins Air Force Base	Warner Robins	Organic liquids	M021-Fractionation/distillation
IND072051394	Purdue University	West Lafayette	Organic liquids	M125-Other treatment (specify in comments)
NYD096297544	CONAP Inc.	Olean	Organic liquids	M021-Fractionation/distillation
OKD065438376	U.S. Pollution Control, Inc.	Waynoka	Organic sludges Organic solids	M111-Stabilization/Chemical fixation using cementitious and/or pozzolanic materials
OKD987087913	Hardage Superfund Site	Lindsay	Organic liquids	M124-Phase separation (e.g., emulsion breaking, filtration) only
ORD041265372	3M Medical Imaging Systems	White City	Organic liquids	M022-Thin film evaporation
TN2170022600	Naval Air Station Memphis	Memphis	Organic liquids	M079-Aqueous organic treatment - type unknown
TX4890110527	US Doe Pantex Plant	Amarillo	Organic solids	M125-Other treatment (specify in comments)
TXD046844700	Southdown Environmental Systems	Avalon	Organic solids	M021-Fractionation/distillation
TX7170022787	Corpus Christi Naval Air Station	Corpus Christi	Organic liquids	M021-Fractionation/distillation
TXD008092793	The Dow Chemical Company	Freeport	Organic liquids	M032-Other recovery: e.g., waste oil recovery, nonsolvent organics recovery, etc. (Specify in comments) M124-Phase separation (e.g., emulsion breaking, filtration) only
VAD003111416	Prillaman Chemical Corp.	825 Fisher St., Martinsville	Organic sludges	M022-Thin film evaporation
VTD982762619	Central Vermont Hospital	Berlin	Organic solids	M125-Other treatment (specify in comments)
WA8214053995	US Army Yakima Training Center	Yakima	Organic solids	M125-Other treatment (specify in comments)

Table 10: Facilities Performing OFFSITE Non-Combustion Treatment of Organic Mercury-Bearing Wastes (BRS 1995)

EPA ID	Site/Company Name	Location	Waste Category	Treatment
ALD000622464	Chemical Waste Management, Inc.	Mile Marker 163 State Hwy 17, Emmelle, AL	Organic sludges Organic liquids Organic solids	M111-Stabilization/Chemical fixation using cementitious and/or pozzolanic materials M125-Other treatment (specify in comments)
CAD008364432	RHO Chem Facility	Inglewood	Organic solids	M119-Stabilization, type unknown
CAD008302903	Chemical Waste Management Azusa Facility	Azusa, CA	Organic liquids	M125-Other treatment (specify in comments)
CAD009452657	Romic Environmental Technologies	East Palo Alto, CA	Organic liquids	M021-Fractionation/distillation M022-Thin film evaporation
CAD059494310	Solvent Service Co, Inc.	San Jose, CA	Organic liquids	M129-Other treatment (type unknown)
CTD000604488	Clean Harbors of Connecticut, Inc.	51 Broderick Rd, Bristol	Organic sludges Organic solids	M111-Stabilization/Chemical fixation using cementitious and/or pozzolanic materials M077-Chemical precipitation
CTD072138969	Environmental Waste Resources	130 Freight Street, Waterbury	Organic sludges Organic solids	M111-Stabilization/Chemical fixation using cementitious and/or pozzolanic materials
FLD980729610	Laidlaw Environmental Services of Bartow	Bartow	Organic liquids	M021-Fractionation/distillation
GAD033582461	Alternate Energy Resources, Inc.	Augusta, GA	Organic liquids	M121-Neutralization only
GAD093380814	Chemical Conservation of Georgia	Valdosta, GA	Organic liquids Organic solids	M022-Thin film evaporation
IDD073114654	Envirosafe Services of Idaho	Grand View	Organic solids	M111-Stabilization/Chemical fixation using cementitious and/or pozzolanic materials
IND093219012	Heritage Environmental Services, Inc.	Indianapolis, IN	Organic liquids Organic solids	M032-Other recovery: e.g., waste oil recovery, nonsolvent organics recovery, etc. (Specify in comments) M077-Chemical precipitation M071-Chrome reduction followed by chemical precipitation
KYD985073196	LWD Sanitary Landfill, Inc.	Calvert City	Organic liquids Organic solids	M111-Stabilization/Chemical fixation using cementitious and/or pozzolanic materials
LAD09841902	Safety-Kleen Corporation	Kenner	Organic liquids	M125-Other treatment (Specify in comments)
LAD981057706	Marine Shale Processors, Inc.	9828 Highway 90 East, Amelia	Organic sludges Organic liquids Organic solids	M032-Other recovery: e.g., waste oil recovery, nonsolvent organics recovery, etc. (Specify in comments)
LAD981055791	Laidlaw Environmental Services, Inc.	Colfax	Organic solids	M125-Other treatment (Specify in comments)

EPA ID	Site/Company Name	Location	Waste Category	Treatment
MAD053452637	Clean Harbors of Braintree, Inc.	Braintree	Organic liquids	M022-Thin film evaporation M121-Neutralization only
MDD980555189	Clean Harbors of Baltimore	Baltimore	Organic liquids	M032-Other recovery: e.g., waste oil recovery, nonsolvent organics recovery, etc. (Specify in comments) M077-Chemical precipitation M085-Other aqueous organic treatment (Specify in comments)
MID980615298	Petro-Chem Proc. Grp., Nortru, Inc.	Detroit	Organic liquids Organic solids	M125-Other treatment (Specify in comments)
MID980684088	Solvent Distillers Grp./Nortru, Inc.	Detroit	Organic liquids	M022-Thin film evaporation
MND006224612	Pennzoil Products Co.	Fridley	Organic liquids	M021-Fractionation/distillation
NCD000648451	Laidlaw Environmental Services (TS), Inc.	208 Watlington Industrial Dr., Reidsville	Organic sludges Organic liquids	M124-Phase separation (e.g., emulsion breaking, filtration) only M125-Other treatment (Specify in comments)
NCD121700777	Heritage Environmental Services, Inc.	Charlotte	Organic liquids	M121-Neutralization only
NYD049836679	CWM Chemical Services, Inc.	Model City	Organic liquids Organic solids	M094-Other organic/inorganic treatment (Specify in comments) M111-Stabilization/Chemical fixation using cementitious and/or pozzolanic materials
OHD066060609	Chemtron Corp.	Avon	Organic liquids	M014-Other metals recovery for reuse: e.g., ion exchange, reverse osmosis, acid leaching, etc. (Specify in comments)
OHD000816629	Spring Grove Resource Recovery, Inc.	Cincinnati	Organic solids	M111-Stabilization/Chemical fixation using cementitious and/or pozzolanic materials
OKD065438376	U.S. Pollution Control, Inc.	Waynoka	Organic sludges Organic solids	M111-Stabilization/Chemical fixation using cementitious and/or pozzolanic materials
PAD980707087	Envirotrol Inc. Beaver Falls	Beaver Falls	Organic solids	M125-Other treatment (Specify in comments)
PAD987367216	AERC	Allentown	Organic solids	M014-Other metals recovery for reuse: e.g., ion exchange, reverse osmosis, acid leaching, etc. (Specify in comments)
TXD000719518	Disposal Systems, Inc.	Deer Park	Organic liquids	M112-Other stabilization (Specify in comments)
TXD102599339	Allwaste Recovery Systems, Inc.	Dallas	Organic liquids	M081-Biological treatment
VAD003111416	Prillaman Chemical Corp.	Martinsville	Organic liquids	M022-Thin film evaporation
WAD02057945	Burlington Environmental, Inc-Tacoma	1701 E Alexander Ave	Organic sludges	M111-Stabilization/Chemical fixation using cementitious and/or pozzolanic materials

EPA ID	Site/Company Name	Location	Waste Category	Treatment
WAD991281767	Burlington Environmental, Inc-Kent	20245 77th Ave S	Organic sludges Organic liquids Organic solids	M111-Stabilization/Chemical fixation using cementitious and/or pozzolanic materials
WAD000812909	Burlington Environmental, Inc-Geor	Seattle	Organic liquids	M021-Fractionation/distillation
WAD058367152	Northwest Enviroscience, Inc.	Seattle	Organic liquids Organic solids	M111-Stabilization/Chemical fixation using cementitious and/or pozzolanic materials

When identifying companies that perform non-combustion treatment on mixed mercury-organic wastes, efforts were made to characterize the waste streams being treated using BRS. Looking at the waste streams is important not only to aid with identifying the D009 universe of wastes treated using alternative processes, but also because several facilities reported management techniques that were not identified as demonstrated processes for treating organomercurials. For example, several onsite and offsite facilities reported treating mercury in waste streams with multiple hazardous waste codes using fractionation/distillation (M021); thin film evaporation (M022); or other recovery (e.g., waste oil recovery, nonsolvent organics recovery)(M032). Waste streams treated in onsite facilities were easier to characterize using multiple waste codes, as shown in Tables 11, 12, and 13, because of the smaller number of waste streams. Categorizing the multiple waste code waste streams treated at offsite facilities is a more arduous task because of larger number of streams. Tables 14, 15 and 16 provide waste stream characterization for the facilities that reported the largest quantities for offsite treatment of mercury-bearing organic waste streams. In addition, looking at the multiple waste codes for the waste streams should help to identify the D009 mercury wastes that currently require IMERC and may potentially be treated using an alternative technology.

Table 11: BRS Waste Stream Characterization for On-Site Treatment of Mercury-Containing Organic Sludges

EPA ID/Facility Name	Source Code	Form Code	Mgmnt Code	Waste Description	Tons	Associated waste codes	SIC Code
FLD980729610 Laidlaw Environmental Services of Bartow	A73	B601	M021	Hazardous waste bottoms from solvent recovery and recycled on site.	9.71	D009, D029, D035, D037, D040, D041, D042, U002, U080	5093
OKD065438376 U.S. Pollution Control, Inc.	A75	B609	M111	T6 Sludge/effluent sludge	0.30	D001-D012, D018, D019, D022, D028, D029, D033, D035, D039, D040, D042, D043, F001-F011, F019, F034, F039, K001, K037, K045, K048, K051, K052, K061, K062, K086, K088, K098, P012, P015, P030, P041, P048, P075, P105, P106, U048, U056, U088, U098, U112, U120, U122, U123, U133, U134, U188, U204, U220, U226, U228, U239, U240, U359	4953
VAD003111416 Prillaman Chemical Corp.	A73	B602	M022	Flammable liquid from recycling spent solvents	2234.11	F001, F002, F003, F005, D001, D004-D010, D018, D043	7389

A73-Solvents recovery
A75-Wastewaster treatment

B601-still bottoms of halogenated solvents or other organic liquids
B602-Still bottoms of nonhalogenated solvents or other organic liquids
B609-Other organic sludges

M021-Fractionation/distillation
M022-Thin film evaporation
M111-Stabilization/chemical fixation using cementitious or pozzolanic materials

Table 12: BRS Waste Stream Characterization for On-Site Treatment of Mercury-Containing Organic Solids

EPA ID/Facility Name	Source Code	Form Code	Mgmnt Code	Waste Description	Tons	Associated waste codes	SIC Code
AL3210020027 Anniston Army Depot	A57	B405	M125	Bulk dunnage of conventional munitions sent for open burning/open detonation-demolition	744.00	D003, D005-D009, D030	9711
OKD065438376 U.S. Pollution Control, Inc.	A76	B409	M111	Concentrated multi-source leachate	12.58	D004-D011, F039	4593
TX4890110527 U.S. Doe Pantex Plant	A57 A58	B405	M125	-High explosives (e.g., scrap, residues) -Radioactive - High explosive (e.g., scrap, residues)	0.33 0.60	D003, D005, D007-D009	2892
TXD046844700 Southdown Environmental Systems	A89	B409	M021	This is for solid waste generated by TSDF operations, organi...	720.00	D001-D020, F001, F002, F003, F005	7389
VTD982762619 Central Vermont Hospital	A99	B409	M125	Mercury contaminated fecal material material from patient care, Toxic	0.26	D009	8062
WA8214053995 U.S. Army Yakima Training Center	A57	B405	M125	CTG, IGN M4 F/60MM MORTAR DODIC B621	0.04	D003, D009	-----

A57-Discarding off-spec material
A58-Discarding out-of-date material
A76-Sludge dewatering
A89-Other pollution control or waste treatment
A99-Other

B405-Reactive organic solid
B409-Other nonhalogenated organic solid

M021-Fractionation/distillation
M111-Stabilization/chemical fixation using cementitious and/or pozzolanic materials
M125-Other treatment

Table 13: BRS Waste Stream Characterization for On-Site Treatment of Mercury-Containing Organic Liquids

EPA ID/Facility Name	Source Code	Form Code	Mgmnt Code	Waste Description	Tons	Associated waste codes	SIC Code
GA1570024330 Robins Airforce Base	A21	B211	M021	Flammable paint waste thiner; thinner used as solvent	13.81	D001, D004 - D011, F001, F002, F003	9711
IND072051394 Purdue University	A94	B219	M121 M125	-Hazardous wate generatd in 1995 to be profiled for disposal in 1996. -Organic and inorganic chemical wastes from teaching and research labs.	0.01 0.08	D001- D003, D007, D009, D011, D019, D022, D038, F002, F003, F005, U006	8221
NYD096297544 CONAP, Inc.	A09	B203	M021	-Waste solvent from cleaning to NVP still -Waste solvent from tank cleaning to MEK still	39.12 16.13	-D008, D009, D035 -D008, D009, D035, D039	2821
OKD987087913 Hardage Superfund Site	A61	B219	M124	Flammable non-aqueous phase liquid from abandoned industrial waste disposal site	83.86	D001, D004, D006-D009, D035, D039, D040, D041	9999
ORD041266372 3M Medical Imaging Systems	A29	B203	M022	Methanol and MEK for recovery. Spent solvent and solvent containing silver, toluene and mercury.	928.09	D001, D009, D011, D035	-----
TN2170022600 Naval Air Station	-----	B201	M079	Mercury	0.04	D009	9711
TX7170022787 Corpus Christi Naval Air Station	A05	B203 B204	M021	Solvent non-halogenated cleaning/degreasing parts and equipment.	18.97 1.64	D001, D004-D010, D017-D019, D028, D029, D035, D040, F001-F003, F005	9711
TXD008092793 The Dow Chemical Company	A57	B219	M032 M124	Miscellaneous organic liquids	90,416.6 174.5	D001-D003, D005, D007, D009, D011, D018, D019, D021, D022, D027-D029, D032-D035, D038-D040, D043, F001-F003, F005, F024, F025, K039, K017	2869

A05-Dip rinsing	B201-Concentrated solvent-water solution	M021-Fractionation/distillation
A09-Clean out process equipment	B203-Nonhalogentated solvent	M022-Thin film evaporation
A21-Painting	B204-Halogenated/nonhalogenated solvent mixture	M032-Other recovery (e.g., waste oil recovery, nonsolvent organics)
A29-Other surface coating/preparation	B211-Raint thinner or petroleum distillates	M079-Aqueous inorganic treatment-type unknown
A57-Discarding off-spec material	B219-Other organic liquids	M121-Neutralization only
A61-Superfund remedial action		M124-Phase separation (e.g., emulsion breaking, filtration, only)
A94-Laboratory wastes		M125-Other treatment

Table 14: Organic Solids Waste Stream Characterization at Select* OFFSITE Treating Facilities

EPA ID/Facility Name	Waste Description and tons managed (1995 BRS)	Mgmt Code
ALD000622464 Chemical Waste Management	Multiple waste streams comprised of multiple waste codes. The BRS waste description field gives the primary waste constituent for why the mercury-bearing waste stream is hazaardous, including: chlorinated aliphatics; metals (As, Cr, Ba, Se, Ag, Pb, Cd); chlorobenzene; chloroform; chlorophenolic wastes; DDT; corrosive, ignitable, and reactive wastes; electroplating cyanide stripping and bath wastes; electroplating wastewater treatment wastes; chloronated aromatics; cresols; halogenated and nonhalogenated solvents; toxaphene; methoxychlor; nitrobenzene; and mercury, and other wastes. (12,449.88 tons)	M111 M125
IDD073114654 Envirosafe Services of Idaho	Contaminated material, consolidation of waste, streams by TSDRF-Paint, resin and petroleum. Waste codes D004 - D011. (36.91 tons)	M111
KYD985073196 LWD Sanitary Lanfill, Inc.	Used carbon water filter; hazardous waste solid (n.o.s.); charcoal from water filter. D006, D008, D009. (19.96 tons)	M111
LAD981057706 Marine Shale Processors, Inc.	Filters and rags. Multiple D and F codes. (72.15 tons)	M032
MID980615298 Petro-chem Proc. Group, Nortru, Inc.	Chromium; ignitable solid from in house recycling; ignitable liquids from lab wastes; ignitable solids from tanker car cleanout; TSDF operation wastes containing miscellaneous wastes; solvent; mercury operation wastes. Multiple D, K, P, F, and U waste codes. (25.61 tons)	M125
OKD065438376 U.S. Pollution Control, Inc.	Cleaning and setting wastes; consolidation of government waste; paper and trash contaminated with epoxy; miscellaneous solid waste (n.o.s.). Multiple D and F codes. (204.85 tons)	M111
WAD991281767 Burlington Environmental, Inc. - Kent	General purpose grease; Boeing ash from ticor; cadmium. D004 - D009, D011. (46.38 tons)	M111

*Facilities selected treat the majority of wastes reported in BRS for this category.
M032-Other recovery (e.g., waste oil recovery, nonsolvent organics recovery)
M111-Stabilization/chemical fixation using cementitious and/or pozzolanic materials
M125-Other treatment

Table 15: Organic Sludges Waste Stream Characterization at Select* OFFSITE Treating Facilities

EPA ID/Facility Name	Waste Description	Mgmt Code
CTD000604488 Clean Harbors of Connecticut, Inc.	Hazardous waste solid; Pb; Cd; Hg; oxides. D006, D008, D009. (19.49 tons)	M111
OKD065438376 U.S. Pollution Control Inc.	Caustic sludge; miscellaneous liquids; paint stripping and tank cleaning sludges; paint resins, adhesives-liquid; unused, outdated & discarded materials; various non-hazardous liquids found during plant cleanup. D002, D004 - D011. (49.34 tons)	M111
WAD991281767 Burlington Environmental, Inc.-Kent	Inorganic reactor tank bottoms; leachable sludge. D004 - D009. (13.72 tons)	M111

*Facilities selected treat the majority of wastes reported in BRS for this category.
M111-Stabilization/chemical fixation using cementitious and/or pozzolanic materials

Table 16: Organic Liquids Waste Stream Characterization at Select* OFFSITE Treating Facilities

EPA ID/Facility Name	Waste Description	Mgmt Code
CAD009452657 Romic Environmental Technologies Corp.	Acetone; flammable liquids (n.o.s.); hazardous waste liquid (n.o.s.); isopropanol; non-RCRA hazardous waste liquid; tetrachloroethylene; toxic or poisonous organic liquids (n.o.s.). D001, D004 - D011, D035, D039, F00-F003, F005, U080, U239. (77.30 tons)	M022
CAD059494310 Solvent Service Co., Inc.	No waste description, only given as D009. (24.20 tons)	M129
KYD985073196 LWD Sanitary Landfill, Inc.	Hazardous waste solid (n.o.s.). D007 - D010. (25.37 tons)	M111
LAD981057706 Marine Shale Processors, Inc.	Consolidated container residues-blanket liquid; paint sludges. Multiple D and other hazardous waste codes. (77.75 tons)	M032
MDD980555189 Clean Harbors of Baltimore	Hazardous waste liquid (1,1,1-trichloroethane, MEK); flammable/poisonous liquids (methanol, xylenes); waste butanols; miscellaneous flammable liquids (acetone, ethanol, toluene); xylenes; and gasoline. Numerous D, F and U waste codes. (3239.69 tons)	M032 M077 M085
MID980615298 Petro-Chem Proc. Group, Nortru, Inc.	Blending process waste containing halogenated and nonhalogenated solvents; ignitable liquids (n.o.s.) from CERCLA sites, fuel and cement manufacturing. Numerous D, F, K and U waste codes. (173 tons)	M125
OHD004178612 Research Oil Company	Ignitable, corrosive, reactive with metals and organics with metals; Ignitable, corrosive, reactive with various contaminants from wood preserving; ignitable waste with organic mineral spirits; organic wastes contaminated with metals and solvents. Multiple D and U waste codes. (105.89 tons)	M094
VAD003111416 Prillaman Chemical Corp.	Alcohols; hydrocarbons; spent solvents from washoff (alcohols, esters, hydrocarbons, ketones). D001, D004-D010, D014, D018, D043, F001-F003, F005. (2543.96 tons)	M022

*Facilities selected treat the majority of wastes reported.
M022-Thin film evaporation
M032-Other recovery (e.g., waste oil recovery, nonsolvent organics recovery)
M077-Chemical precipitation
M085-Other aqueous organic treatment
M111-Stabilization/chemical fixation using cementitious and/or pozzolanic materials
M094-Other organic/inorganic treatment
M125-Other treatment
M129-Other treatment - type unknown

V. Identifying Mercury Waste Streams that will Continue to Require IMERC

Waste streams that would continue to require incineration are streams that contain other hazardous wastes that must be incinerated, or are not amenable to non-combustion treatment. As discussed in Section II, waste streams containing other hazardous wastes such as dioxins, PCBs and reactives and ignitables may require incineration. A search of the 1995 BRS data showed only one hazardous waste incinerator that processed waste streams containing both D009 wastes and dioxin wastes (EPA hazardous waste codes F020-023 and F026-028). According to the 1995 BRS, the Aptus Coffeyville facility processed approximately 80 tons of wastes containing dioxins from 27 separate waste streams. Many of these wastes are from soil and debris from facility decommissioning. Three facilities processed waste streams containing both D009 wastes and PCB wastes: Aptus's facilities in Coffeyville, Kansas, and Aragonite, Utah; and Chemical Waste Management's facility in Port Arthur, Texas. These facilities processed approximately 446 tons of wastes from 22 separate waste streams. Most of the PCB wastes were organic solids and sludges. Waste streams containing reactives and ignitables covered a wide variety of waste stream codes. Many of the ignitable and reactive wastes were flammable liquids, solvents, and petroleum. In addition, it appears there are other waste streams, such as oily wastes, that require incineration. Finally, organomercury compounds (i.e., mercury fulminate and phenylmercuric acetate) may also continue to require incineration.

Because mercury is a constituent in wastes that often carry multiple hazardous waste codes, an in-depth analysis of the D009 universe is required to identify the wastes that may continue to be required to be incinerated. This analysis would require evaluating the raw data in the 1995 BRS (as opposed to the data set used in the 1995 National Biennial Report, in which waste stream data is aggregated) to evaluate whether PCBs or dioxin/furan wastes are present and then to evaluate the presence of other hazardous waste codes that have LDR specified methods of treatment that require combustion. This analysis could not be completed in time for inclusion in this report.

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APPENDIX A

WASTE CHARACTERIZATION DATA
FOR MERCURY BEARING WASTES

Table A-1. Chemical Constituents in Mercury-Bearing Waste Streams

Facility EPA ID	SIC	No.	Waste Codes	Waste Form	Waste Mgmt.	Derived-From Waste?	Avg. Conc. ppm - TOTAL	Avg. Conc. ppm - TCLP	Other Constituents	Notes
ALD000622464	N/A	3	D009	Inorg Solid	Landfill	No	5000	0		
ALD000622464	N/A	9	D001 D002 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D024 D025	Org Solid	Stabil	Yes	0.2	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver, low organics	
ALD000622464	N/A	17	D004 D005 D006 D007 D008 D009 D010 D011 F006 F007 F008 F009 F011 F012 F019 K002	Inorg Solid	Stabil	Yes	0.2	0	Arsenic, barium, chromium, lead, selenium, silver	
ALD070513767	4953	1	D001 D004 D005 D006 D007 D008 D009 D010 D011 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D035 D038 F001 F002 F003 F005	Org Liquid	Fuel Blend		0	0	Arsenic, barium, cadmium, lead, selenium, silver, organics (all conc. shown as DK)	
ALD070513767	4953	2	D001 D004 D005 D006 D007 D008 D009 D010 D011 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 F001 F002 F003 F005	Org Liquid	Fuel Blend		0	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver, organics (all conc. shown as DK)	
ALD070513767	4953	4	D001 D004 D005 D006 D007 D008 D009 D010 D011 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 F001 F002 F003 F005	Org Liquid	Fuel Blend		0	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver, organics (all conc. shown as DK)	
ALD070513767	4953	6	D001 D004 D005 D006 D007 D008 D009 D010 D011 D019 D021 D022 D023 D024 D025 D026 D027 D029 D030 D032 D033 F001 F002 F003 F005	Org Liquid	Fuel Blend		0	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver, organics (all conc. shown as DK)	
ALD070513767	N/A	16	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 F001 F002 F003 F005	Org Liquid	Fuel Blend		0	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver, organics (all conc. shown as DK)	
ALD070513767	N/A	18	D007 D009 D010 D011	Org Liquid	Fuel Blend		0	0	Chromium, selenium, silver (all conc. shown as DK)	
ALD981019045	N/A	2	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D026 D027 D028 D029 D030 D035 D038 D039 D040 D041	Org Liquid	Fuel Blend		0	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver, organics (all conc. shown as 0)	
ALD981019045	N/A	3	D001 D004 D005 D006 D007 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D032 D033 D034 D035 D036 D037	Org Liquid	Fuel Blend		0	0	Arsenic, barium, cadmium, chromium, selenium, silver, organics (all conc. shown as 0)	

Facility EPA ID	SIC	No.	Waste Codes	Waste Form	Waste Mgmt.	Derived-From Waste?	Avg. Conc. ppm - TOTAL	Avg. Conc. ppm - TCLP	Other Constituents	Notes
ALD981019045	N/A	5	D001 D003 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D026 D033 D034 D035 D036 D037 D038 D039 D040 D041 F001	Org Liquid	Fuel Blend		0	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver, organics (all conc. shown as 0)	
ALD981019045	N/A	7	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 D033 D034 D035	Org Liquid	Fuel Blend		0	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver (all conc. shown as 0); tetrahydrofurans; organics	
ALD981019045	N/A	9	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 D033 D034 D035	Org Liquid	Fuel Blend		0	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver (all conc. shown as 0); tetrahydrofurans; organics	
ALD981019045	N/A	10	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D021 D022 D026 D028 D029 D030 D035 D038 D039 D040 F001 F002 F003 F004 F005	Org Liquid	Fuel Blend		0	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver (all conc. shown as 0); tetrahydrofurans; organics	
ALD981019045	N/A	13	D001 D005 D006 D007 D008 D009 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 D033 D034 D035 D037 D038 D039	Org Liquid	Fuel Blend		0	0	Barium, cadmium, chromium, lead, (all conc. shown as 0); tetrahydrofurans; organics	
ARD981057870	N/A	3	D001 D005 D006 D007 D008 D009 D019 D026 D035 D040 F001 F002 F003 F004 F005 K093 K094 U009 U012 U019 U021 U028 U031 U044 U045	Org Solid	Fuel Blend		0	0	Barium, cadmium, chromium, lead, organics (all conc. shown as 0)	4
ARD981057870	N/A	6	D001 D004 D005 D006 D007 D008 D009 D010 D011 D028 D029 D035 D039 D040 F001 F002 F003 F004 F005	Org Liquid	Fuel Blend		0	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver, organics (all conc. shown as 0)	
ARD981057870	N/A	19	D006 D007 D008 D009 D018 F037 K048 K049 K050	Org Solid	Fuel Blend		0	0	Cadmium, chromium, lead, nickel, cyanides, organics (all conc. shown as 0)	
CAD982444887	N/A	1	D004 D005 D006 D007 D008 D009 F001 F002 F003 F004 F005 K048 K086 U002 U003 U019 U031 U037 U057 U069 U080 U112 U121 U140 U154	Org Liquid	Engy Rec	Yes	0	0	Arsenic, barium, cadmium, chromium, lead, nickel, cyanides (all conc. shown as DK); organics	7, 8, 11
CO7890010526	3489	1	D001 D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D022 D028 D035 D039 D040 D043 F001 F002 F003 F005 F007 F009	Inorg Liquid	Other Treat		0	0	Arsenic, barium, chromium, lead, nickel, selenium, silver, cyanides, organics (all conc. shown as 0)	

Facility EPA ID	SIC	No.	Waste Codes	Waste Form	Waste Mgmt.	Derived-From Waste?	Avg. Conc. ppm - TOTAL	Avg. Conc. ppm - TCLP	Other Constituents	Notes
CO7890010526	3489	2	D005 D007 D009 F001	Inorg Liquid	Carbn Absorp		0	0	Barium, chromium, organics (all conc. shown as 0)	
COD991300484	9511	1	D001 D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D012 D013 D014 D015 D016 D017 D018 D019 D020 D021 D022 D023 D024 D025	Inorg Solid	Stabil	Yes	NT	0.1	Arsenic, barium, cadmium, chromium, lead, selenium, silver, pesticides, cyanides, organics	
COD991300484	9511	2	D001 D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D012 D013 D014 D015 D016 D017 D018 D019 D020 D021 D022 D023 D024 D025	Inorg Solid	Landfill	Yes	NT	0.1	Arsenic, barium, cadmium, chromium, lead, selenium, silver, pesticides, cyanides, organics	
COD991300484	N/A	3	D004 D005 D006 D007 D008 D009 D010 D011 D012 D013 D014 D015 D016 D017 D018 D019 D020 D021 D022 D023 D024 D025 D026 D027 D028	Inorg Solid	Landfill	Yes	NT	0.1	Arsenic, barium, cadmium, chromium, lead, selenium, silver, pesticides, organics	
COD991300484	N/A	4	D001 D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D012 D013 D014 D015 D016 D017 D018 D019 D020 D021 D022 D023 D024 D025	Inorg Solid	Landfill	Yes	NT	0.1	Arsenic, barium, cadmium, chromium, lead, selenium, silver, pesticides, cyanides, organics	
COD991300484	N/A	10	D002 D006 D008 D009 D011	Inorg Solid	Landfill	Yes	NT	0.1	Cadmium, lead, silver	
COD991300484	N/A	12	D001 D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D012 D013 D014 D015 D016 D017 D018 D019 D020 D021 D022 D023 D024 D025	Inorg Solid	Landfill	Yes	NT	0.2	Arsenic, barium, cadmium, chromium, lead, selenium, silver, pesticides, cyanides, organics	
COD991300484	N/A	13	D001 D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D012 D013 D014 D015 D016 D017 D018 D019 D020 D021 D022 D023 D024 D025	Inorg Solid	Landfill	100	0	0.2	Arsenic, barium, cadmium, chromium, lead, selenium, silver, pesticides, cyanides, organics	
IDD073114654	N/A	14	D004 D005 D006 D007 D008 D009	Inorg Solid	Stabil		0	0	Arsenic, barium, cadmium, chromium, lead (all conc. shown as 0)	
ILD010284248	N/A	10	D006 D008 D009	Inorg Solid	Stabil	Yes	36.2	0.001	Arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, zinc	
IND006419212	3241	3	D004 D005 D006 D007 D008 D009 D010 D011 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 F001 F002 F003 F004 F005	Org Liquid	Fuel Blend	Yes	0.55	0	Arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, cyanides, organics	

Facility EPA ID	SIC	No.	Waste Codes	Waste Form	Waste Mgmt.	Derived-From Waste?	Avg. Conc. ppm - TOTAL	Avg. Conc. ppm - TCLP	Other Constituents	Notes
IND006419212	N/A	5	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D033 D034 D035 D036	Org Liquid	Fuel Blend	Yes	0.55	0	Arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, cyanides, organics	
IND006419212	N/A	8	D001 D009 F001 F002 F003 F004 F005	Org Liquid	Fuel Blend	Yes	0.55	0	Arsenic, barium, chromium, lead, selenium, silver, cyanides, organics	
IND006419212	N/A	15	D001 D004 D005 D006 D007 D008 D009 D018 D019 D025 D026 D035 F001 F002 F003 F004 F005 F019 K022 K024 K048 K049 K050 K051 K052	Org Liquid	Fuel Blend	Yes	0.55	0	Arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, cyanides, organics	
KSD031203318	N/A	1	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 D033 D034 D035	Org Solid	Engy Recov		0	0	Barium, cadmium, chromium, lead, selenium, silver, organics (all conc. shown as 0)	
KSD031203318	N/A	2	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D028 D029 D030 D033 D034 D035 D036 D038	Org Solid	Engy Recov		0	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver, organics (all conc. shown as 0)	
KSD031203318	N/A	4	D001 D005 D006 D007 D008 D009 D019 D026 D035 D040 F001 F002 F003 F004 F005 K001 K027 K048 K049 K050 K051 K060 K083 K086 K093	Org Solid	Engy Recov		0	0	Arsenic, barium, cadmium, chromium, lead, nickel, cyanides, organics (all conc. shown as 0)	3
KSD031203318	N/A	5	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D022 D035 D039 D040 F001 F002 F003 F005	Org Liquid	Engy Rec		0	0	Arsenic, barium, cadmium, lead, selenium, silver, organics (all conc. shown as 0)	
KSD980633259	N/A	3	D001 D005 D006 D007 D008 D009 D018 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 D033 D034 D035 D036 D038 D039 D040 F001 F002 F003 F004 F005 K048 K049 K050 K051 K052 K086 K087 U002 U003 U019 U031 U037 U055 U056 U057 U080 U112 U121 U140 U154	Org Liquid	Fuel Blend	No	0	0	Barium, cadmium, chromium, lead, nickel, cyanides (all conc. shown as 0); organics	4, 7, 8, 11

Facility EPA ID	SIC	No.	Waste Codes	Waste Form	Waste Mgmt.	Derived-From Waste?	Avg. Conc. ppm - TOTAL	Avg. Conc. ppm - TCLP	Other Constituents	Notes
KSD980633259	N/A	4	D001 D002 D005 D006 D007 D008 D009 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 D033 D034 D035 D036 D038 D039 D040 F001 F002 F003 F004 F005 K048 K049 K050 K051 K052 K086 K087 U002 U003 U019 U031 U037 U055 U056 U057 U080 U112 U121	Org Liquid	Fuel Blend	No	0	0	Barium, cadmium, chromium, lead, nickel, cyanides (all conc. shown as 0); organics	4, 7, 8
KSD980633259	N/A	6	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D032 D033 D035 D036 D038 D039 D040 D041 F001 F002 F003 F004 F005 K048 K049 K050 K051 K052 U001 U002 U031 U051 U069 U080 U112 U121 U154 U159 U210 U211	Org Liquid	Fuel Blend	No	0	0	Arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, cyanides (all conc. shown as 0); organics	4, 11
KSD980633259	N/A	8	D001 D005 D006 D007 D008 D009 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D032 D033 D034 D035 D036 D037 D038 D039 D040 D041 D042 F001 F002 F003 F004 F005 K022 K048 K049 K050 K051 K086 U002 U019 U031 U051 U057 U080 U112 U117 U121 U140 U154	Org Liquid	Fuel Blend	No	0	0	Barium, cadmium, chromium, lead, nickel, cyanides (all conc. shown as 0); organics	8, 11
KSD980633259	N/A	9	D001 D005 D006 D007 D008 D009 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 D033 D034 D035 D036 D038 D039 D040 D041 F001 F002 F003 F004 F005 U002 U003 U019 U031 U051 U052 U056 U069 U112 U121 U140 U154 U159 U161 U162 U165 U188 U213	Org Liquid	Fuel Blend	No	0	0	Barium, cadmium, chromium, lead (all conc. shown as 0); tetrahydrofuran, organics	4, 7, 11
KSD980633259	N/A	13	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D034 D035 D036 D037 D038 D039 D040 D041 F001 F002 F003 F004 F005 F037 F038 F039 K048 K049 K050 K051 K086 U031 U154 U159 U210 U220 U226 U239	Org Liquid	Fuel Blend	No	0	0	Arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, cyanides (all conc. shown as 0); tetrohydrofurans, organics	11

Facility EPA ID	SIC	No.	Waste Codes	Waste Form	Waste Mgmt.	Derived-From Waste?	Avg. Conc. ppm - TOTAL	Avg. Conc. ppm - TCLP	Other Constituents	Notes
KSD980633259	N/A	17	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 D033 D034 D035 D036 D037 D038 D039 D040 D041 D042 F001 F002 F003 F004 F005 K048 K049 K050 K051 K052 K086 U001 U002 U003 U019 U031 U037	Org Liquid	Fuel Blend	No	0	0	Arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, cyanides (all conc. shown as 0); tetrohydrofurans, organics	4, 7
KSD980633259	N/A	18	D001 D005 D006 D007 D008 D009 D010 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 D033 D034 D035 D036 D037 D038 D039 D040 D041 D042 F001 F002 F003 F004 F005 F039 U002 U019 U031 U051 U056 U057 U112 U117 U154 U159 U161 U213 U220 U226	Org Liquid	Fuel Blend	No	0	0	Barium, cadmium, chromium, lead, selenium (all conc. shown as 0); tetrohydrofurans, organics	4, 8, 11
KSD980633259	N/A	19	D001 D007 D008 D009 D018 D026 D035 D038 D039 D040 F001 F002 F003 F004 F005	Org Liquid	Fuel Blend	No	0	0	Chromium, lead (all conc. shown as 0); tetrohydrofurans, organics	
KSD980739999	N/A	3	D001 D002 D004 D005 D006 D007 D008 D009 D010 D018 D021 D023 D024 D025 D026 D027 D028 D029 D030 D035 D036 D038 D039 D040 D042	Org Liquid	Engy Rec	No	0	0	Arsenic, barium, cadmium, chromium, lead, selenium, organics (all conc. shown as 0)	
KSD980739999	N/A	4	D001 D002 D004 D005 D006 D007 D008 D009 D010 D018 D021 D023 D024 D025 D026 D027 D028 D029 D030 D035 D036 D038 D039 D040 D042	Org Liquid	Engy Rec	No	0	0	Arsenic, barium, cadmium, chromium, lead, selenium, organics (all conc. shown as 0)	
KSD980739999	N/A	5	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D021 D023 D024 D035 D039 D040 F001 F002 F003 F004 F005 F039 K048 K049 K050	Org Liquid	Engy Rec	No	0	0	Arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, cyanides, organics (all conc. shown as 0)	
KSD980739999	N/A	8	D001 D002 D004 D005 D006 D007 D008 D009 D010 D011 D012 D013 D015 D016 D018 D019 D020 D021 D022 D023 D024 D025 D026 D027 D028	Org Liquid	Engy Rec	No	0	0	Arsenic, barium, cadmium, lead, selenium, silver, pesticides, organics (all conc. shown as 0)	
KSD980739999	N/A	9	D001 D004 D005 D006 D007 D008 D009 D010 D018 D021 D035 F001 F002 F003 F005 K001 K027 K048 K049 K050 K051 K060 K083 K086 K093	Org Liquid	Engy Rec	No	0	0	Arsenic, barium, cadmium, chromium, lead, nickel, selenium, cyanides, organics (all conc. shown as 0)	3

Facility EPA ID	SIC	No.	Waste Codes	Waste Form	Waste Mgmt.	Derived-From Waste?	Avg. Conc. ppm - TOTAL	Avg. Conc. ppm - TCLP	Other Constituents	Notes
KSD981506025	N/A	2	D001 D004 D005 D006 D007 D008 D009 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D033 D034 D035 D036 D038 D039 D040 F001 F002 F003 F004 F005 K022 K024 K048 K049 K050 K051 K052 K085 K086 K094 K095 U001 U002 U012 U019 U031 U051 U052 U055 U056	Org Liquid	Incin	Yes	1.34	0	PCBs, furans, cyanides (all conc. shown as DK); arsenic, barium, cadmium, chromium, lead, nickel, organics	4
KSD981506025	N/A	3	D006 D007 D008 D009	B301	Incin	No	17.6	0	Cadmium, chromium, lead	
LAD000777201	N/A	6	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D035 D038 D039 D040 D043 F001 F002 F003 F004 F005 F024 F034 F037 K048 K049 K050 K051 K086 U002 U052 U080 U152 U154 U159 U161 U185 U188 U210 U220 U227	Inorg Solid	Landfill	60-100%	0	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver, organics (all conc. shown as ND)	1, 11
LAD000777201	N/A	8	D002 D005 D006 D007 D008 D009	Inorg Sludge	Landfill	No	0.2	0	Barium, cadmium, chromium, lead	
LAD008161234	N/A	10	D001 D008 D009 D018	Org Liquid	Engy Rec	No	0	0	Lead, benzene	
MID048090633	N/A	11	D009		Landfill	No	0.5	0		
MND006172969	N/A	6	D001 D002 D003 D007 D009 D011 D018 D035 U008		Incin	No	0	0	Chromium, silver, cyanides, organics (all conc. shown as 0)	4
MOD050232560	N/A	3	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D031 D033 D034 D035	Org Liquid	Engy Rec		0	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver, organics (all conc. shown as 0)	
MOD050232560	N/A	4	D001 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 D033 D034 D035 D036	Org Liquid	Engy Rec		0	0	Barium, cadmium, chromium, lead, selenium, silver, organics (all conc. shown as 0)	
MOD050232560	N/A	10	D001 D004 D005 D006 D007 D008 D009 D010 D011 D012 D013 D015 D016 D018 D019 D020 D021 D022 D023 D024 D025 D026 D027 D028 D029	Org Liquid	Engy Rec		0	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver, pesticides, organics (all conc. shown as 0)	

Facility EPA ID	SIC	No.	Waste Codes	Waste Form	Waste Mgmt.	Derived-From Waste?	Avg. Conc. ppm - TOTAL	Avg. Conc. ppm - TCLP	Other Constituents	Notes
MOD050232560	N/A	15	D001 D005 D006 D007 D008 D009 D019 D026 D032 D035 D040 F001 F002 F003 F004 F005 F011 K001 K027 K046 K048 K049 K050 K051 K060	Org Liquid	Engy Rec		0	0	Arsenic, barium, cadmium, chromium, lead, nickel, silver, cyanides, organics (all conc. shown as 0)	3
MOD050232560	N/A	16	D001 D006 D007 D008 D009 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 D033 D034 D035 D036 D038 D040 F001	Org Liquid	Engy Rec		0	0	Cadmium, chromium, lead, organics (all conc. shown as 0)	
MOD981127319	N/A	3	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D022 D027 D028 D035 D038 D039 D040 F001 F002 F003 F004 F005 F037 F038	Org Liquid	Engy Rec	Yes	0.01	0	Arsenic, barium, cadmium, chromium, lead, silver; organics (NT)	
MOD981127319	N/A	4	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D022 D026 D035 D039 D040 F001 F002 F003 F004 F005 U002 U028 U154 U159	Org Liquid	Engy Rec	Yes	0.01	0	Arsenic, barium, cadmium, chromium, lead, silver; organics (NT)	11
MOD981127319	N/A	5	D001 D005 D006 D007 D008 D009 D019 D026 D035 D040 F001 F002 F003 F004 F005 K001 K027 K048 K049 K050 K051 K060 K083 K086 U002	Org Liquid	Engy Rec		0.01	0	Arsenic, barium, cadmium, chromium, lead; organics (NT)	3
MOD981127319	N/A	6	D001 D004 D005 D006 D007 D008 D009 D010 D011 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 D033 D034 D035 D036	Org Liquid	Engy Rec	Yes	0.01	0	Arsenic, barium, cadmium, chromium, lead, silver; organics (NT)	
MOD981127319	N/A	8	D001 D004 D005 D006 D007 D008 D009 D010 D011 F001 F002 F003 F004 F005	Org Liquid	Engy Rec	Yes	0.01	0	Arsenic, barium, cadmium, chromium, lead, silver, organics	
MOD981127319	N/A	11	D001 D004 D005 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 D033 D034 D035 D036	Org Liquid	Engy Rec	Yes	0.01	0	Arsenic, barium, chromium, lead, silver; organics (NT)	
MOD981127319	N/A	14	D001 D002 D005 D006 D007 D008 D009 D010 D011 D018 D019 D022 D028 D035 D037 D038 D039 D040 F001 F002 F003 F005 K086 U007 U041	Org Liquid	Engy Rec	Yes	0.01	0	Barium, cadmium, chromium, lead, silver; organics (NT)	4
MOD981127319	N/A	15	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 D033 D034 D035	Org Liquid	Engy Rec	Yes	0.01	0	Arsenic, barium, cadmium, chromium, lead, silver; organics (NT)	

Facility EPA ID	SIC	No.	Waste Codes	Waste Form	Waste Mgmt.	Derived-From Waste?	Avg. Conc. ppm - TOTAL	Avg. Conc. ppm - TCLP	Other Constituents	Notes
MOD981127319	N/A	18	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D035 D037 D039 D040 F001 F002 F003 F004 F005 K001	Org Liquid	Engy Rec	Yes	0.01	0	Arsenic, barium, cadmium, chromium, lead, silver; organics (NT)	
NJD002385730	9511	1	F034 F035 F037 F038 K031 K044 K045 K047 K071 K084 K088 K106 U134	Org Sludge	Landfill	Yes	0	0	Arsenic, chromium, lead, organics	12, 13
NJD002385730	2869	19	D009	Inorg Liquid	Precip/ biotrt	No	0	0.262		
NJD002385730	2869	20	D009 D018 D028 D039 D043 F039	Inorg Liquid	Precip/b iotrt	No	0	1.49	Organics	
NVT330010000	N/A	5	D008 D009 D010 D011	Inorg Solid	Landfill		0	0	Lead, selenium, silver	
NVT330010000	N/A	15	D009	Inorg Solid	Stabil		0	0		
NYD049836679	N/A	13	D004 D005 D006 D007 D008 D009 D010 D011 F007 F008 F009 F011 F012 F019 K015 K039 K040 K041 K042 K044 K045 K047 K048 K049 K050 K051 K052 K061 K062 *K064 K065 K066* (remanded wastes) K071 K073 K083 P045 P046 P047 P048 P049 P050 P051 P054 P056 P057 P058 P059 P060 P062 P063	Inorg Solid	Stabil	Yes	0	0	Barium, cadmium, chromium, nickel, silver, thallium, organics; arsenic, antimony, cyanides, pesticides (all reported at ND); beryllium, lead, selenium, zinc (all reported as PR)	3, 4, 12, 14,
NYD980592497	3861	1	D001 D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D014 D018 D019 D020 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D031 D032 D033 D034 D035 D036 D038 D039 D040 D043 F001 F002 F003 F004 F005 F008 F011 F039 P001 P003 P005 P014 P024 P028 P048	Org Liquid	Incin	No	0	0	Arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, cyanides, pesticides, organics (all conc. shown at 0)	4
NYD980592497	3861	2	D001 D002 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D020 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D031 D032 D033 D034 D035 D036 D038 D039 D040 D043 F001 F002 F003 F004 F005 F039 P048 U002 U003 U007 U008 U009 U012 U019 U031 U037 U044	Org Liquid	Incin	No	0	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver, pesticides, organics (all conc. shown at 0)	4,7
OHD005048947	N/A	18	D001 D005 D006 D007 D008 D009 D018 D026 D029 D030 D032 D034 D035 D036 D039 D040 F001 F002 F003 F005 U154		Fuel Blend	No	0	0	Barium, cadmium, chromium, lead (all conc. shown as 0); tetrahydrofuran, organics	11

Facility EPA ID	SIC	No.	Waste Codes	Waste Form	Waste Mgmt.	Derived-From Waste?	Avg. Conc. ppm - TOTAL	Avg. Conc. ppm - TCLP	Other Constituents	Notes
OHD045243706	N/A	9	D009		Landfill	No	1042	0.65		
OHD048415665	N/A	7	D001 D002 D005 D006 D007 D008 D009 D010 D011 D018 D022 D026 D028 D029 D034 D035 D038 D039 D040 F001 F002 F003 F004 F005 U001 U002 U003 U012 U019 U031 U052 U056 U057 U112 U140 U154 U161 U165 U220 U239		Incin	No	0	0	Barium, cadmium, chromium, lead, selenium, silver, organics (all conc. shown at 0)	4, 7, 8, 11
OHD987048733	N/A	1	D001 D005 D006 D007 D008 D009 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D031 D032 D033 D034 D035 D036 D037 D038 D039 D040 D041 D042 F001 F002 F003 F004 F005 K022 K048 K049 K052 K086 U001 U002 U003 U019 U031 U051 U052 U055 U056 U057		Engy Rec	Yes	ND	0	Barium, cadmium, chromium, lead, nickel, cyanides, pesticides, furans (all conc. shown at ND); organics	4, 7, 8
OKD065438376	N/A	1	D001 D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D012 D013 D014 D015 D016 D018 D019 D020 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D031 D032 D033 D034 D035 D036 D037 D038 D039 D040 D041 D042 D043 F001 F002 F003 F004 F005 F006 F007 F008	Inorg Solid	Stabil	Yes	0	0.014925	Arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, cyanides, pesticides,	
OKD065438376	N/A	2	D001 D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D012 D013 D014 D015 D016 D018 D019 D020 D021 D022 D023 D024 D025 D026 D027 D028 D029 D031 D032 D033 D034 D035 D036 D037 D038 D039 D040 D041 D042 D043 F001 F002 F003 F004 F005 F006 F007 F008 F009	Inorg Sludge	Stabil	Yes	0	0.0002	Arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, cyanides, pesticides, organics	
OKD065438376	N/A	3	D001 D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D012 D013 D014 D015 D016 D017 D018 D019 D020 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D031 D032 D033 D034 D035 D036 D037 D038 D039 D040 D041 D042 D043 F001 F002 F003 F004 F005 F006 F007	Inorg Solid	Stabil	Yes	0	0.015385	Arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, cyanides, pesticides, organics	

Facility EPA ID	SIC	No.	Waste Codes	Waste Form	Waste Mgmt.	Derived-From Waste?	Avg. Conc. ppm - TOTAL	Avg. Conc. ppm - TCLP	Other Constituents	Notes
OKD065438376	N/A	7	D002 D003 D006 D009 D011 F001 F002 F003 F004 F005 F006 F007 F008 F009 F019 F022 F024 F032 F034 F035 K019 K022 K029 K030 K042 K048 K049 K050 K051 K052 K085 K086 K095 K096 K108 K110 K132 P001 P002 P003 P004 P005 P007 P008 P010 P014 P018 P020 P022 P028	Inorg Solid	Stabil	Yes	0	0	Arsenic, cadmium, chromium, lead, nickel, silver, cyanides, pesticides, organics	1, 15, 16, 17
OKD065438376	N/A	11	D004 D005 D006 D007 D008 D009 D010 D011 D012 D013 D014 D015 D016 D017 F001 F002 F003 F004 F005 F006 F007 F008 F009 F011 F019 F032 F035 F037 F038 F039 K016 K019 K020 K022 K035 K048 K049 K050 K051 K052 K083 K085 K149 P001 P003 P004 P005 P012 P014 P020	Inorg Solid	Stabil	Yes	0	0	Arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, cyanides, pesticides, organics	4, 15
OKD065438376	N/A	17	D001 D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D012 D013 D014 D015 D016 D018 D019 D020 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D031 D032 D033 D034 D035 D036 D037 D038 D039 D040 D041 D042 D043 F001 F002 F003 F004 F005 F006 F007 F008	Inorg Solid	Stabil	Yes	0	0.0002	Arsenic, barium, cadmium, chromium, lead, nickel, selenium, silver, cyanides, pesticides, organics	
PAD083965897	N/A	1	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D032 D033 D034 D035	Org Liquid	Engy Rec	Yes	0.28	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver	
PAD083965897	N/A	2	D001 D002 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D020 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D031 D032	Org Liquid	Engy Rec	Yes	1.05	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver	
PAD083965897	N/A	5	D001 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D026 D027 D028 D029 D033 D034 D035 D036 D039 D040 F001 F002	Org Liquid	Engy Rec	Yes	0.64	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver, organics	
PAD083965897	N/A	6	D001 D002 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D025 D026 D028 D029 D032 D033 D034 D035 D036 D039 D040	Org Liquid	Engy Rec	Yes	1.7	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver	

Facility EPA ID	SIC	No.	Waste Codes	Waste Form	Waste Mgmt.	Derived-From Waste?	Avg. Conc. ppm - TOTAL	Avg. Conc. ppm - TCLP	Other Constituents	Notes
SC1890008989		1	D002 D007 D009		Evap	No	296	0	Arsenic, barium, chromium, lead, silver	
SC1890008989		2	D002 D007 D009		Evap	No	7083	0	Arsenic, barium, chromium, lead	
SCD070375985	N/A	8	D009		Landfill	No	130	0		
TND003337292		1	D009		Dispos	No	225.025	0		
TXD000742304	9999	1	D001 D004 D005 D006 D007 D008 D009 D010 D011 F001 F002 F003 F004 F005	Org Sludge	Fuel Blend	No	0	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver, organics (all conc. shown as 0)	
TXD000838896	4953	1	D001 D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D012	Inorg Solid	Stabil	No	0.003	0	Arsenic, barium, cadmium, chromium, lead, silver, pesticides, cyanides	
TXD000838896	4953	2	D001 D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D012	Inorg Solid	Landfill	Yes	0.003	0	Barium, cadmium, chromium, lead, selenium, cyanides, pesticides; arsenic & silver (conc. shown as ND)	
TXD000838896	4953	3	D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D012 D013 D014 D015 D016	Inorg Solid	Stabil	Yes	0.003	0	Barium, chromium, lead, selenium, pesticides, cyanides; arsenic & silver (conc. shown as ND)	
TXD000838896	4953	4	D001 D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D012	Inorg Solid	Landfill	Yes	0.003	0	Barium, cadmium, chromium, lead, selenium, pesticides, cyanides; arsenic & silver (conc. shown as ND)	
TXD000838896	4953	5	D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D012 D013 D014 D015 D016	Inorg Liq	Deep-well inject	Yes	5	0	Arsenic, barium, chromium, lead, selenium, silver, pesticides, cyanides	
TXD000838896	4953	6	D001 D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D012 D013 D016 D017	Inorg Liquid	Incin	Yes (20%)	0	0	Arsenic, barium; cadmium, chromium, lead, silver, selenium, pesticides, cyanides (conc. shown as ND)	
TXD000838896	4953	7	D001 D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D012	Inorg Solid	Incin	No	0.003	0	Barium, cadmium, chromium, lead, selenium; pesticides, cyanides, arsenic, silver (conc. shown as ND)	
TXD000838896		14	D004 D005 D006 D009		Incin	No	0.25	0	Arsenic, barium, cadmium, lead, organics	
TXD000838896		18	D007 D008 D009 F001		Incin	No	0.03	0	Chromium, lead, organics	

Facility EPA ID	SIC	No.	Waste Codes	Waste Form	Waste Mgmt.	Derived-From Waste?	Avg. Conc. ppm - TOTAL	Avg. Conc. ppm - TCLP	Other Constituents	Notes
TXD007330202	2869	1	D001 D018 D019 D020 D021 D022 D023 D024 D025 D026 D027 D028 D029 D030 D031 D032 D033 D034 D035 D036 D037 D038 D039 D040 F001 F002 F003 F005 U001 U002 U003 U019 U028 U031 U037 U044 U056 U070 U107 U108 U112 U113 U115 U117 U122 U140 U147 U151 U154 U159	Org Liquid	Incin	No	0	0	Organics	4, 7, 9, 10, 11
TXD007330202	2869	2	D018 D019 D020 D021 D022 D023 D024 D025 D026 D027 D028 F001 F002 F003 F005 K009 K010 U001 U002 U003 U019 U028 U031 U037 U044 U056 U070 U107 U108 U112 U113 U115 U117 U122 U140 U147 U151 U154 U159 U161 U169 U190 U196 U211 U213 U226 U239 U359	Org Liquid	Incin	Yes	0.0515464	0	Organics, pesticides	4, 6, 7, 9, 10, 11
TXD007330202	2869	6	D001 D018 D019 D020 D021 D022 D023 D024 D025 D026 F001 F002 F003 F005 K009 K010 U001 U002 U003 U019 U028 U031 U037 U044 U056 U070 U107 U108 U112 U113 U115 U117 U122 U140 U147 U151 U154 U159 U161 U169 U190 U196 U211 U213 U226 U239 U359	Inorg Sludge	Incin	Yes	0.095	0	Antimony, barium, beryllium, cadmium, chromium, cobalt, copper, lead, nickel, selenium, thallium, tin, vanadium, zinc, organics	4, 6, 7, 9, 10, 11
TXD007330202	2869	7	F001 F002 F003 F005 K009 K010 U001 U002 U003 U004 U006 U019 U028 U029 U031 U037 U044 U056 U057 U069 U070 U088 U102 U107 U108 U112 U113 U115 U117 U122 U124 U133 U138 U140 U147 U151 U154 U159 U161 U162 U169 U190 U196 U211 U213 U226 U239 U359	Inorg Solid	Landfill	Yes	0	0.0004	Antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, lead, nickel, selenium, silver, thallium, tin, vanadium, zinc, organics	4, 5, 6, 7, 8, 9, 10, 11
TXD008079642	2821	1	D001 D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D012 D013 D014 D015 D016 D017 D018 D019 D020 D021 D022 D023 D024	Inorg Liquid	Incin		0	0	Arsenic, cadmium, chromium, lead, selenium, silver, pesticides, cyanides, organics (all conc. shown as 0)	
TXD008079642	2821	4	D001 D002 D003 D004 D005 D006 D007 D008 D009 D010 D011 D012 D013 D014 D015 D016 D017 D018 D019 D020 D021 D022 D023 D024	Inorg Solid	Incin		0	0	Arsenic, barium, cadmium, chromium, lead, selenium, silver, pesticides, cyanides, organics (all conc. shown as 0)	
TXD078432457	2869	2	D001 D002 D004 D005 D006 D007 D008 D009 D011 F001 F002 F003 F004 F005 U002 U008 U113 U115 U138 U154 U159 U197 U226	Inorg Liquid	Deep-well inject	No	0	0	Barium, chromium, silver, organics; arsenic, cadmium, lead (all conc. shown as ND)	4, 10, 11

Facility EPA ID	SIC	No.	Waste Codes	Waste Form	Waste Mgmt.	Derived-From Waste?	Avg. Conc. ppm - TOTAL	Avg. Conc. ppm - TCLP	Other Constituents	Notes
UTD981552177	N/A	3	D001 D002 D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D023 D024 D025 D026 D027 D028 D029 D032 D035 D036 D039 D040 F001 F002 F003 F004 F005 F037 K001 K009 K010 K015 K016 K017 K018 K019 K020 K022 K023 K024 K025 K026 K030 K036 K042 K048	Org Liquid	Incin	Yes	0.0555556	0	Barium, cadmium, chromium, lead, selenium, silver, organics; cyanides (conc. shown as 0)	1, 2
UTD991301748	N/A	3	D002 D004 D007 D008 D009 D010 F001 F002 F003 F004 F005 F006 F007 F008 F009 F010 F011 F019 F037 F038 F039 K001 K019 K020 K022 K048 K049 K050 K051 K052 P001 P002 P003 P004 P005 P006 P008 P010 P011 P012 P013 P014 P015 P017 P018 P020 P021 P022 P023 P024	Inorg Solid	Stabil	Yes	0.174	0	Selenium, organics; cyanides (conc. shown as ND)	4, 17, 18, 19
UTD991301748	N/A	9	D002 D004 D006 D007 D008 D009 D010 D011 F001 F002 F003 F004 F005 F006 F007 F008 F009 F010 F011 F019 F037 F038 F039 K001 K019 K020 K022 K048 K049 K050 K051 K052 P001 P002 P003 P004 P005 P006 P008 P009 P010 P011 P012 P013 P014 P015 P017 P018 P020 P021	Inorg Solid	Stabil	Yes	0.004381	0	Cadmium and lead; arsenic, beryllium, chromium, selenium, silver, cyanide (conc. shown as ND); barium (NT), arsenic acid (NT)	4, 5, 18, 19

Source: National Hazardous Waste Constitutent Survey, 1997 and Biennial Report, 1993

Abbreviations:
DK - Don't Know
NA - Not Available and not expected to be present
ND - Not Detected
NT - Not tested, but could be present

Notes for Table A-1:

1) F024, K026: CMBST for WW and NWW
2) K025: LLEST fv SSTRP fb CARBN; or CMBST for WW. CMBST for NWW
3) K027, K039, P062: CARBN; or CMBST for WW. CMBST for NWW.
4) U001, U006, U007, U008, U021, U041, U055, U056, U113, U122, U124, U147, U197, U213, P001, P002, P005, P007, P008, P014, P017, P018, P023, P028, P045, P046, P047(salts only), P049, P054, P057, AND P058: (WETOX or CHOXD) fb CARBN; or CMBST for WW. CMBST for NWW
5) U133: CHOXD; CHRED; CARBN; BIODG; or CMBST for WW. CHOXD; CHRED; or CMBST for NWW.
6) U359 AND P009: CMBST; or CHOXD fb (BIODG or CARBN); or BIODG fb CARBN for WW. CMBST for NWW.

7) U003: 5.6 mg/L acetonitrile for WW. CMBST or alternative standard of 38 mg/kg acetonitrile for NWW.
8) U057: 0.36 mg/L cyclohexanone for WW. CMBST or alternative standard of 0.75 mg/L cyclohexanone for NWW.
9) U108: (WETOX or CHOXD) fb CARBN; or CMBST for WW. CMBST or alternative standard of 170 mg/kg 1,4-Dioxane for NWW.
10) U115: (WETOX or CHOXD) fb CARBN; or CMBST or alternative standard of 0.12 mg/L ethylene oxide for WW. CHOXD; or CMBST for NWW.
11) U154: (WETOX or CHOXD) fb CARBN; or CMBST or alternative standard of 5.6 mg/L methanol for WW. CMBST or alternative standard of 0.75 mg/L TCLP methonol for NWW.
12) K044, K045, K047: DEACT for WW and NWW.
13) U134: 35 mg/L hydrogen fluoride for WW. ADGAS fb NEUTR for NWW
14) P056: 35 mg/L fluorine for WW. ADGAS fb NEUTR for NWW.
15) F032: Alternative standard allows CMBST for dioxins and furans in WW and NWW.
16) K110: CMBST; or CHOXD fb CARBN; or BIODG fb CARBN for WW. CMBST for NWW.
17) P022: CMBST or alternative standard of 4.8 mg/L TCLP carbon disulfide for NWW.
18) P006: CHOXD; CHRED; or CMBST for WW and NWW.
19) P015: RMETL; or RTHRM for WW and NWW.

Table A- 2. Physical Data for Mercury-Bearing Wastes

Facility EPA ID	No.	% Solid	% TSS	% Ash	% Water	% TOC	% Oil	pH	Flash Pt.	BTU	Halogen
ALD000622464	3	100			0			NA	NA		
ALD000622464	9	95-100			0-5			NA	NA		
ALD000622464	17	90-100			0-10			4-11	NA		
ALD070513767	1	5-20 est.		1-10 est.	0-25 est.			5-9 est.	<100F est.	8000-18000/LB est.	
ALD070513767	2	5-20 est.		1-10 est.	0-25 est.			5-9 est.	<100F est.	8000-18000/LB est.	
ALD070513767	4	5-20 est.		1-10 est.	0-25 est.			5-9 est.	<100F est.	8000-18000/LB est.	
ALD070513767	6	5-20 est.		1-10 est.	0-25 est.			5-9 est.	<100F est.	8000-18000/LB est.	
ALD070513767	16	10-20 est.	15-25 est.					3-12 est.	<75F est.	90000-120000/ Gal est.	
ALD070513767	18	0-20 est.		0 est.	0 est.			6 est.	<100F est.	126000/Gal est.	
ALD981019045	2	33.86		8.52	9.83					12193/LB	2.23
ALD981019045	3	22.53		7.26	16.03					12160/LB	2.05
ALD981019045	5	8.35		4.03	8.63					13204/LB	2.54
ALD981019045	7	30.99		10.21	12.78					11217/LB	2.33
ALD981019045	9	18.77		5.95	16.34					13074/LB	1.59
ALD981019045	10	9.32		4.65	13.52					12889/LB	1.57
ALD981019045	13	17.56		7.56	17.35					11235/LB	2.32
ARD981057870	3										
ARD981057870	6										
ARD981057870	19										
CAD982444887	1	17 est. (c)	NT	3.3 est. (c)	0 est. (c)	NT	NT	7.8 est.1996	NT	11600/LB est.1993	NT
CO7890010526	1										
CO7890010526	2										
COD991300484	1	97 (a)	ND (a)	NAA (a)	3 (a)	<0.025 (a)	0 (a)	7 (a)	>60C (a)	NA (a)	<0.5 (a)
COD991300484	2	50 (a)	ND (a)	NAA (a)	50 (a)	<0.025 (a)	0 (a)	7 (a)	>60C (a)	NA (a)	<0.0005 (a)
COD991300484	3	100 (a)	0 (a)	100 (a)	0 (a)	<0.05 (a)	NA, (a)	9.92 (a)	>60C (a)	NA (a)	<0.005 (a)
COD991300484	4	100 (a)	0 (a)	100 (a)	0 (a)	<0.05 (a)	NA, (a)	10.23 (a)	>60C (a)	NA (a)	<0.05 (a)
COD991300484	10	100 (a)	0 (a)	100 (a)	0 (a)	<0.05 (a)	NA, (a)	6 (a)	>60C (a)	NA (a)	<0.0005 (a)
COD991300484	12	100 (a)	0 (a)	NAA (a)	0 (a)	<0.05 (a)	NA, (a)	9.92 (a)	>60C (a)	NA (a)	<0.0005 (a)
COD991300484	13	100 (a)	0 (a)	NAA (a)	0 (a)	<0.05 (a)	NA, (a)	6 (a)	>60C (a)	NA (a)	<0.0005 (a)
IDD073114654	14										
ILD010284248	10	100.8 est.	NT	86.1 est.	0 est.	13.7 est.	<0.05 est.	9.47STD est.	>212F est.	est.	<0.02 est.

Facility EPA ID	No.	% Solid	% TSS	% Ash	% Water	% TOC	% Oil	pH	Flash Pt.	BTU	Halogen
IND006419212	3	15		6	16	80	5	7	<100F est.	11000/LB	1.5
IND006419212	5	15		6	16	80	5	7	<100F est.	11000/LB	1.5
IND006419212	8	15		6	16	80	5	7	<100F est.	11000/LB	1.5
IND006419212	15	15		6	16	80	5	7	<100F est.	11000/LB	1.5
KSD031203318	1										
KSD031203318	2										
KSD031203318	4										
KSD031203318	5										
KSD980633259	3	10.49		4.42	15.95					12277/LB	2.12
KSD980633259	4	23.18		5.04	16.19					11845/LB	1.33
KSD980633259	6	20.08		2.33	14.29					12372/LB	1.43
KSD980633259	8	24.47		4.11	11.11					12521/LB	0.97
KSD980633259	9	4.8		2.04	14.59					13461/LB	2.78
KSD980633259	13	30.02		5.48	12.89					13679/LB	1.6
KSD980633259	17	11.55		4.09	23.21					12228/LB	1.33
KSD980633259	18	3.17		4.54	15.26					12936/LB	1.07
KSD980633259	19	14.12		4.92	16.95					12160/LB	1.26
KSD980739999	3										
KSD980739999	4										
KSD980739999	5										
KSD980739999	8										
KSD980739999	9										
KSD981506025	2	20 est.	20 est.	2.04 est.	1 est.	NT est.	NT	5.7 est.	<72F est.	13620/LB est.	1.8 est.
KSD981506025	3	100 est.	NT	64.61 est.	NA	NA	NT	5.9 est.	>140F est.	<1000/LB est.	0.3 est.
LAD000777201	6	NT	NA	NT	NT	NT	NT	NT	NA	NT	NT
LAD000777201	8	NT	NA	NT	NT	NT	NT	0.5-13.5 est. (a)	NA	NT	NT
LAD008161234	10										
MID048090633	11	100 est.	NA	NA	NA	NA	NA	7.5 S.U.	>140F	NA	NA
MND006172969	6										
MOD050232560	3										
MOD050232560	4										
MOD050232560	10										
MOD050232560	15										

Facility EPA ID	No.	% Solid	% TSS	% Ash	% Water	% TOC	% Oil	pH	Flash Pt.	BTU	Halogen
MOD050232560	16										
MOD981127319	3			7.49	15.95			6.07		13068/LB	1.03
MOD981127319	4			3.8	18.41			7. (b)		12656/LB	1.03
MOD981127319	5			8.07	16.54			7.57		11601/LB	3.16
MOD981127319	6			4.64	14.78			6.77		13542/LB	1.3
MOD981127319	8			4.66	16.4			7.78		12062/LB	2.14
MOD981127319	11			11.64	13.5			8.06		1 (c)/LB	2.15
MOD981127319	14			3.19	18.17			7.41		12531/LB	3.16
MOD981127319	15			5.23	8.55			7.37		11703/LB	2.46
MOD981127319	18			17.7	21.14			7.73		11380/LB	2.19
NJD002385730	1	40-60	NT	0-5	40-60	NT	NT	10-12	>60C		0-10
NJD002385730	19	<1 est.	<1 est.	<0.1 est.	100	NT	NA	5.9	78C	<2000/LB est.	NT
NJD002385730	20	<1 est.	0.007	<0.1 est.	100	0.004	NA	5.7	75C	<2000/LB est.	NT
NVT330010000	5										
NVT330010000	15										
NYD049836679	13										
NYD980592497	1										
NYD980592497	2										
OHD005048947	18	17.62		5.07	15.39					11363/LB	5.81
OHD045243706	9	90 est. (a)	NA	NT	10 est. (a)	NT	NT	7.2 S.U est. (a)	>212F est. (a)	NT	NT
OHD048415665	7										
OHD987048733	1	NA	14.14 (a)	4.65 (a)	10.46 (a)	NA	NA	7.5 (a)	NA	12491/LB (a)	1.69 (a)
OKD065438376	1	NT est. (a)	NT est. (a)	NT est. (a)	NT est. (a)	NT est. (a)	NT est. (a)	10.3 est. (a)	NA est. (a)	NT est. (a)	ND est. (a)
OKD065438376	2	NT	NT	NT	NT	NT	NT	10	NA	NT	ND
OKD065438376	3	NT est. (a)	NT est. (a)	NT est. (a)	NT est. (a)	NT est. (a)	NT est. (a)	11.4 est. (a)	NA est. (a)	NT est. (a)	NT est. (a)
OKD065438376	7	NT est. (a)	NT est. (a)	NT est. (a)	NT est. (a)	NT est. (a)	NT est. (a)	5 est. (a)	NA est. (a)	NT est. (a)	NT est. (a)
OKD065438376	11	NT est. (b)	NT est. (b)	NT est. (b)	NT est. (b)	NT est. (b)	NT est. (b)	10.2 est. (b)	NA est. (b)	NT est. (b)	NT est. (b)
OKD065438376	17	NT est. (a)	NT est. (a)	NT est. (a)	NT est. (a)	NT est. (a)	NT est. (a)	10 est. (a)	NA est. (a)	NT est. (a)	ND est. (a)
PAD083965897	1			2.2	5.65			7 est.	12F est.	17616/LB	1.64
PAD083965897	2			5.07	13.07			6 est.	70F est.	14189/LB	1.14
PAD083965897	5			6.22	11.66			7 est.	85F est.	13629/LB	0.96
PAD083965897	6			9.39	15.46			8 est.	70F est.	11704/LB	1.39
SC1890008989	1	45 est.	35 est.	NA	55 est.	<0.4 est.	NA	13.6 est.	NA	NT	NA

Facility EPA ID	No.	% Solid	% TSS	% Ash	% Water	% TOC	% Oil	pH	Flash Pt.	BTU	Halogen
SC1890008989	2	45 est.	35 est.	NA	55 est.	<0.4 est.	NA	13.8 est.	NA	NT	NA
SCD070375985	8	95-100	NA	NA	0-5	NA	NA	6-8	NA	NA	NA
TND003337292	1	<1 est.	<1 est.	<0.1 est.	>99 est.	<0.1 est.	<0.1 est.	6-10 UNITS	NA est.	NA est.	<0.1 est.
TXD000742304	1										
TXD000838896	1	100	NT	99	<1	<1	NT	7	>60C	<500/LB	<0.1
TXD000838896	2	100	NT	99	<1	<1	NT	7	>60C	<500BTU	<1
TXD000838896	3	100	NT	99	<1	<1	NT	7	>60C	<500BTU	<1
TXD000838896	4	100	NT	99	<1	<1	NT	7	>60C	<500BTU	<1
TXD000838896	5	<0.25	NT	<4	95	<1	<0.5	8	>60C	<400/LB	<0.3
TXD000838896	6	<0.25	NT	<0.2	93.6	6.2	NT	7	>60C	<400/LB	<0.3
TXD000838896	7	100	NT	99	<1	<1	NT	7	>60C	<500/LB	<1
TXD000838896	14	NT	NT	26.1	0.142	>4	NT	5	38C	>540/LB	1.52
TXD000838896	18	NT	NT	0.817	17.1	82	NT	6	38C est.	13300/LB	<0.3
TXD007330202	1			0.08 est.	<1 est.				100F est.	19000/LB est.	
TXD007330202	2			0.2 est.	10 est.	90 est.		6.4 SU est.	>140F est.	11620/LB est.	<0.1 est.
TXD007330202	6	15 est.		4.5 est.	85 est.				<140F est.	1100/LB est.	0.012 est.
TXD007330202	7	20 est.		20 est.	80 est.	<0.001 est.	0.0165 (b)	10 SU est.	>180F est.	0/LB est.	
TXD008079642	1										
TXD008079642	4										
TXD078432457	2	NT	0.1	NA	>99	0.3	NT	4.5	NT	NA	NT
UTD981552177	3	5	NA	10	<20	NA	NA		73-99F	10000-18000/LB	1.5
UTD991301748	3	95 est.	NT est.	100 est.	5 est.	NT est.	NT est.	8.23 est.	NT est.	NT est.	NT est.
UTD991301748	9	NT est.	NT est.	100 est.	NT est.	NT est.	NT est.	8.67 est.	NT est.	NT est.	NT est.

(a) Based on 1993 data
(b) Based on 1994 data
(c) Based on 1995 data
NA - No reason to believe the constituent/parameter is present in the waste.
NT - Constituent/parameter might be present in the waste but was not measured.