Management of Hazardous Waste in the United States

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ABSTRACT

The National Hazardous Waste Survey was used to examine hazardous waste management methods. The methods used to manage industrial hazardous waste were grouped into 16 technological categories. For each category, the types of waste managed, the industry sectors generating the waste and the geographical distribution of management technologies are reported. Since many wastes are managed using a sequence of technologies, the interdependence of waste management methods was also examined. The survey reveals that waste mater treatment processes handle the vast majority of hazardous waste treatment (approximately 730 million tons in 1986). Incineration and waste reuse as fuel were used to manage on the order of 4 million tons in 1986. Geographical distribution of management facilities closely mirrors geographical distributions of waste generation since 96% of wastes examined in this survey are managed on site. However, the geographical distribution of particular management technologies is far from uniform. For example, underground injection is most commonly used in EPA Region VI while waste piles are most commonly used in Region V.

INTRODUCTION

Millions of tons of hazardous wastes are generated each year in the United States. Prior to the late 1980s, a detailed accounting of the management patterns for these waste streams was unavailable, however, with the data collection provisions enacted under the Superfund reauthorization and the Resource Conservation and Recovery Act (RCRA), the legal authority to collect such data was put in place. Now there are several databases which provide partial pictures of hazardous waste generation and management. Several of these databases are described in this special issue of Hazardous Waste and Hazardous Materials. This work will focus on the National Hazardous Waste Survey (1,2). This survey is the most detailed source of information available on hazardous waste management methods. It has two basic components, a generator survey focusing on waste characterization and a survey of treatment, storage, disposal and recycling facilities (TSDR), focusing on waste treatment and disposal. Both parts of the survey will be used in this paper to determine patterns of usage for hazardous waste management technologies. In this work we will begin by grouping management technologies into broad categories. Then, for each technology category, we will examine the types of wastes that are
managed in the units, the industry sectors that generated the wastes and where the units are located.

METHODS

National Hazardous Waste Survey

The source for the data used in this paper is the National Hazardous Waste Survey (HWS) assembled by the Research Triangle Institute (RTI) under a contract from EPA. This database consists of two data sets:

- National Survey of Hazardous Waste Generators (GENSUR)

The TSDR survey contains detailed information on some 2600 TSDR facilities that were in use in 1986. The data collected include general facility information such as onsite treatment practices, storage and recycling practices and facility schematics, information on different treatment or recovery facilities, information on land disposal, and on storage tank systems. The GENSUR database contains information on some 40,000 waste streams which fall under the provisions of the Resource Conservation and Recovery Act (RCRA). This data set provides detailed information on quantities such as waste stream flow rate, fraction managed onsite, metal loading, halogen loading, a description of the source of the waste, an ultimate analysis, and a listing of the treatment or disposal processes used for the waste. A more complete description of the database is available elsewhere (1,2).

RESULTS

The waste management technologies that will be examined in this work are listed in Table I, together with the quantity of waste managed using the technology during the calendar year 1986. The National Hazardous Waste Survey was used to determine, for each of the sixteen management technologies, specified in the survey:

a) types of waste managed
b) industry sectors generating the wastes
c) geographical distribution of the management technologies

The results are reported in Figures 1(a-c) through 16(a-c). In each case, Figure a) reports the types of waste managed, Figure b) reports the industry sectors generating the waste and Figure c) gives the geographical distribution of the management methods. Table II lists the dominant industrial sector generating the waste for each management method.

DISCUSSION

Before beginning a detailed discussion of waste management technologies, it is useful to have an overview of waste management practices. Figure 17 provides that overview. It reports the mass of waste managed in each of thirteen different types of technologies (storage and other treatment are not included here, and surface impoundment and disposal impoundment are integrated as one method). It shows the management patterns and approximate amounts of industrial waste streams, regulated under RCRA, which are processed through various treatment and disposal routes. The flow rates in Figure 17 are totals for approximately 40,000 industrial waste streams generated from all U.S. industry regulated under RCRA in 1986, the last year for
The units are

The survey (HWS) this database

Recycling

were in use treatment in different systems. The list provides onsite, metal analysis, and a description

11

eports the and Fig-

lists the

Table I, year 1986. the sixteen

reports the

and Fig-

lists the

Table I.

<table>
<thead>
<tr>
<th>Management Method</th>
<th>Quantity Managed in 1986(^a) (Million tons)</th>
<th>Number of Facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal recovery</td>
<td>1.44</td>
<td>330</td>
</tr>
<tr>
<td>Solvent recovery</td>
<td>1.18</td>
<td>1470</td>
</tr>
<tr>
<td>Other recycling</td>
<td>0.96</td>
<td>243</td>
</tr>
<tr>
<td>Fuel blending</td>
<td>0.75</td>
<td>177</td>
</tr>
<tr>
<td>Reuse as fuel</td>
<td>1.44</td>
<td>295</td>
</tr>
<tr>
<td>Incineration</td>
<td>1.09</td>
<td>197</td>
</tr>
<tr>
<td>Solidification</td>
<td>0.77</td>
<td>122</td>
</tr>
<tr>
<td>Land treatment</td>
<td>0.38</td>
<td>58</td>
</tr>
<tr>
<td>Wastewater treatment</td>
<td>732</td>
<td>4399</td>
</tr>
<tr>
<td>Disposal impoundment(^b)</td>
<td>4.61</td>
<td>70</td>
</tr>
<tr>
<td>Surface impoundment(^c)</td>
<td>232</td>
<td>298</td>
</tr>
<tr>
<td>Landfill</td>
<td>3.17</td>
<td>118</td>
</tr>
<tr>
<td>Waste pile</td>
<td>0.68</td>
<td>71</td>
</tr>
<tr>
<td>Underground injection</td>
<td>28.7</td>
<td>63</td>
</tr>
<tr>
<td>Storage (RCRA permitted)</td>
<td>189</td>
<td>1785</td>
</tr>
<tr>
<td>Other treatment</td>
<td>1.98</td>
<td>128</td>
</tr>
</tbody>
</table>

\(^a\)Quantities reported were obtained using the TSDR section of the survey. Total waste generated in 1986 was 747 million tons; note that some wastes were managed in multiple treatment technologies and that wastes can be sent to and removed from storage.

\(^b\)Surface impoundments used for disposing of hazardous waste.

\(^c\)Includes waste entering surface impoundments for disposal, treatment and storage.
<table>
<thead>
<tr>
<th>Waste Code</th>
<th>Waste Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D001</td>
<td>Ignitable Waste</td>
</tr>
<tr>
<td>D002</td>
<td>Corrosive Waste</td>
</tr>
<tr>
<td>F001</td>
<td>Spent Halogenated Solvents Used In Degreasing</td>
</tr>
<tr>
<td>F002</td>
<td>Spent Halogenated Solvents</td>
</tr>
<tr>
<td>F003</td>
<td>Spent Nonhalogenated Solvents</td>
</tr>
<tr>
<td>X01L</td>
<td>Waste Oil</td>
</tr>
</tbody>
</table>

**Figure 1a. Total Waste Managed in Solvent Recovery By Waste Type**

<table>
<thead>
<tr>
<th>Industry Code</th>
<th>Industry Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2851</td>
<td>Paints and Allied Products</td>
</tr>
<tr>
<td>2869</td>
<td>Industrial Organic Chemicals, nec</td>
</tr>
<tr>
<td>2899</td>
<td>Chemical Preparations, nec</td>
</tr>
<tr>
<td>3471</td>
<td>Plating and Polishing</td>
</tr>
<tr>
<td>3679</td>
<td>Electronic Components, nec</td>
</tr>
<tr>
<td>3731</td>
<td>Ship Building and Repairing</td>
</tr>
<tr>
<td>7399</td>
<td>Business Services, nec</td>
</tr>
</tbody>
</table>

**Figure 1b. Total Waste Managed in Solvent Recovery By Industry Code**

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**Figure 1c. Quantity of Hazardous Waste Managed in Solvent Recovery Processes per EPA Region in 1986 (In million tons)**

- **Region I:** 0.03 (7.1%)
- **Region II:** 0.05 (4.3%)
- **Region III:** 0.08 (7.1%)
- **Region IV:** 0.15 (12.6%)
- **Region V:** 0.15 (12.6%)
- **Region VI:** 0.37 (31.6%)
- **Region VII:** 0.00 (0.1%)

**Note:** Region II includes Puerto Rico and the Virgin Islands
Region I includes Hawaii and Guam
Region X includes Alaska

Percentages in parentheses indicate the percentage of all hazardous waste managed in solvent recovery processes that was managed in the region indicated.
Figure 2a. Total Waste Managed in Metal Recovery By Waste Type

<table>
<thead>
<tr>
<th>Waste Code</th>
<th>Waste Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D002</td>
<td>Corrosive Waste</td>
</tr>
<tr>
<td>D008</td>
<td>Lead</td>
</tr>
<tr>
<td>D011</td>
<td>Silver</td>
</tr>
<tr>
<td>FN7</td>
<td>Spent Cyanide Plating Bath Solutions From Electroplating Operations</td>
</tr>
<tr>
<td>K061</td>
<td>Emission Control Dust/Sludge from Primary Production of Steel in Electric Furnaces</td>
</tr>
<tr>
<td>K062</td>
<td>Spent Pickle Liquor from Steel Finishing Operations that Produce Iron or Steel</td>
</tr>
<tr>
<td>P115</td>
<td>Thallium (I) Sulfate</td>
</tr>
</tbody>
</table>

Figure 2b. Total Waste Managed in Metal Recovery By Industry Code

<table>
<thead>
<tr>
<th>Industry Code</th>
<th>Industry Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3312</td>
<td>Blast Furnaces and Steel Mills</td>
</tr>
<tr>
<td>3341</td>
<td>Secondary Nonferrous Metals</td>
</tr>
<tr>
<td>3471</td>
<td>Plating and Polishing</td>
</tr>
<tr>
<td>3479</td>
<td>Metal Coating and Allied Services</td>
</tr>
<tr>
<td>9711</td>
<td>National Security</td>
</tr>
</tbody>
</table>

Figure 2c. Quantity of Hazardous Waste Managed in Metal Recovery Processes per EPA Region in 1986 (in million tons)
**Waste Code** | **Waste Description**
---|---
D001 | Ignitable Waste
D002 | Corrosive Waste
F003 | Spent Nonhalogenated Solvents
XOIL | Waste Oil

**Figure 3a.** Total Waste Managed in Reusing As Fuel By Waste Type

**Industry Code** | **Industry Description**
---|---
2800 | General Chemical Manufacturing
2819 | Industrial Inorganic Chemicals, nec
2821 | Plastic Materials and Resins
2865 | Cyclic Crudes and Intermediates
2869 | Industrial Organic Chemicals, nec
2911 | Petroleum Refining

**Figure 3b.** Total Waste Managed in Reusing As Fuel By Industry Code

**Figure 3c.** Quantity of Hazardous Waste Managed in Reuse-as-Fuel Processes per EPA Region In 1986 (in million tons)
Waste Code | Waste Description
--- | ---
D001 | Ignitable Waste
F003 | Spent Nonhalogenated Solvents

Figure 4a. Total Waste Managed in Fuel Blending By Waste Type

<table>
<thead>
<tr>
<th>Industry Code</th>
<th>Industry Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2851</td>
<td>Paints and Allied Products</td>
</tr>
<tr>
<td>2869</td>
<td>Industrial Organic Chemicals, nec</td>
</tr>
<tr>
<td>3471</td>
<td>Plating and Polishing</td>
</tr>
<tr>
<td>3711</td>
<td>Motor Vehicles and Car Bodies</td>
</tr>
<tr>
<td>4953</td>
<td>Refuse Systems</td>
</tr>
<tr>
<td>7399</td>
<td>Business Services, nec</td>
</tr>
</tbody>
</table>

Figure 4b. Total Waste Managed in Fuel Blending By Industry Code

Figure 4c. Quantity of Hazardous Waste Managed in Fuel Blending Processes per EPA Region in 1986 (in million tons)

Note: Region II includes Puerto Rico and the Virgin Islands
Region IX includes Hawaii and Guam
Region X includes Alaska

Percentages in parentheses indicate the percentage of all hazardous waste managed in fuel blending processes that was managed in the region indicated.
Waste Code  Waste Description
D002  Corrosive Waste
D008  Lead
F001  Spent Halogenated Solvents Used In Degreasing
K062  Spent Pickle Liquor From Steel Finishing Operations That Produce Iron or Steel
XWWL  Hazardous Wastewater Treatment Liquid

Figure 5a. Total Waste Managed In Other Recycling By Waste Type

Industry Code  Industry Description
3312  Blast Furnaces and Steel Mills
3321  Gray Iron Foundries
3585  Refrigeration and Heating Equipment
3711  Motor Vehicles and Car Bodies

Figure 5b. Total Waste Managed In Other Recycling By Industry Code

Total quantity managed = 0.96 million tons

Figure 5c. Quantity of Hazardous Waste Managed In Other Recycling Processes per EPA Region In 1988 (In million tons)
Figure 6a. Total Waste Managed in Incineration By Waste Type

<table>
<thead>
<tr>
<th>Waste Code</th>
<th>Waste Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D001</td>
<td>Ignitable Waste</td>
</tr>
<tr>
<td>D002</td>
<td>Corrosive Waste</td>
</tr>
<tr>
<td>D004</td>
<td>Arsenic</td>
</tr>
</tbody>
</table>

Figure 6b. Total Waste Managed in Incineration By Industry Code

<table>
<thead>
<tr>
<th>Industry Code</th>
<th>Industry Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2800</td>
<td>General Chemical Manufacturing</td>
</tr>
<tr>
<td>2821</td>
<td>Plastics Materials and Resins</td>
</tr>
<tr>
<td>2824</td>
<td>Organic fibers, noncellulosic</td>
</tr>
<tr>
<td>2833</td>
<td>Medicinals and botanicals</td>
</tr>
<tr>
<td>2869</td>
<td>Industrial Organic Chemicals, nec</td>
</tr>
<tr>
<td>4800</td>
<td>Electrical, Gas, and Sanitary Services</td>
</tr>
</tbody>
</table>

Figure 6c. Quantity of Hazardous Waste Managed in Incinerators per EPA Region in 1986 (in million tons)

Note: Region II includes Puerto Rico and the Virgin Islands; Region IX includes Hawaii and Guam; Region X includes Alaska. Percentages indicate the percentage of all hazardous waste managed in incinerators that was managed in the region indicated.
Figure 7a. Total Waste Managed in Solidification By Waste Type

<table>
<thead>
<tr>
<th>Waste Code</th>
<th>Waste Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D001</td>
<td>Ignitable Waste</td>
</tr>
<tr>
<td>D002</td>
<td>Corrosive Waste</td>
</tr>
<tr>
<td>D008</td>
<td>Lead</td>
</tr>
<tr>
<td>F006</td>
<td>Wastewater Treatment Sludges from Certain Electroplating Operations</td>
</tr>
<tr>
<td>K022</td>
<td>Distillation Bottom Tars from the Production of Phenol/Acetone from Cumene</td>
</tr>
<tr>
<td>K061</td>
<td>Emission Control Dust/Sludge from Primary Production of Steel in Electric Furnaces</td>
</tr>
<tr>
<td>K062</td>
<td>Spent Pickle Liquor from Steel Finishing Operations that Produce Iron or Steel</td>
</tr>
</tbody>
</table>

Figure 7b. Total Waste Managed in Solidification By Industry Code

<table>
<thead>
<tr>
<th>Industry Code</th>
<th>Industry Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2865</td>
<td>Cyclic Crudes and Intermediates</td>
</tr>
<tr>
<td>2911</td>
<td>Petroleum Refining</td>
</tr>
<tr>
<td>3312</td>
<td>Blast Furnaces and Steel Mills</td>
</tr>
<tr>
<td>3317</td>
<td>Steel Pipe and Tubes</td>
</tr>
<tr>
<td>3714</td>
<td>Motor Vehicle Parts and Accessories</td>
</tr>
<tr>
<td>4953</td>
<td>Refuse Systems</td>
</tr>
</tbody>
</table>

Figure 7c. Quantity of Hazardous Waste Managed in Solidification Processes per EPA Region in 1986 (in million tons)

Total quantity managed = 0.77 million tons

Note: Region II includes Puerto Rico and the Virgin Islands
Region IX includes Hawaii and Guam
Region X includes Alaska

Percentages indicate the percentage of all hazardous waste managed in solidification processes that was managed in the region indicated.
### Figure 8a. Total Waste Managed in Wastewater Treatment By Waste Type

<table>
<thead>
<tr>
<th>Waste Code</th>
<th>Waste Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D001</td>
<td>Ignitable Waste</td>
</tr>
<tr>
<td>D002</td>
<td>Corrosive Waste</td>
</tr>
<tr>
<td>D007</td>
<td>Chromium</td>
</tr>
<tr>
<td>D009</td>
<td>Mercury</td>
</tr>
<tr>
<td>XWWL</td>
<td>Hazardous Wastewater Treatment Liquid</td>
</tr>
</tbody>
</table>

### Figure 8b. Total Waste Managed in Wastewater Treatment By Industry Code

<table>
<thead>
<tr>
<th>Industry Code</th>
<th>Industry Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2800</td>
<td>General Chemical Manufacturing</td>
</tr>
<tr>
<td>2812</td>
<td>Alkalies and Chlorine</td>
</tr>
<tr>
<td>2869</td>
<td>Industrial Organic Chemicals, nec</td>
</tr>
<tr>
<td>2892</td>
<td>Explosives</td>
</tr>
<tr>
<td>2911</td>
<td>Petroleum Refining</td>
</tr>
</tbody>
</table>

### Figure 8c. Quantity of Hazardous Waste Managed in Wastewater Treatment Processes per EPA Region in 1986 (in million tons)

Total quantity managed = 731.98 million tons

Note: Region II includes Puerto Rico and the Virgin Islands
Region IX includes Hawaii and Guam
Region X includes Alaska

Percentages indicate the percentage of all hazardous waste managed in wastewater treatment processes that was managed in the region indicated.
Which components of hazardous waste make up amounts of other recyclables? One fraction of the total mass of hazardous waste may be components that would be in hazardous waste streams if there were no direct incineration or treatment of the hazardous waste. Moderate treatment involves multiple steps.

Figure 17 (example) shows that pollution control technologies are legally mandated for wastewater flow and wastewater treatment plants are required to generate hazardous waste. Given that incineration is not an option for individuals or small communities, returning hazardous waste to safe recycling technologies (DO01), etc.
which complete data are available. This figure provides useful information about the relative amounts of the wastes managed by different techniques. For example, it indicates that a small fraction of wastes flows through recycling loops. The total mass involved in solvent, metal and other recycling is about 5 million tons per year (mt/yr). The largest single stream in terms of total mass flow, approximately 730 mt/yr (more than 90% of the total waste mass flow), is hazardous wastewater. Most of this stream is water, hence the mass of the chemically hazardous component of this stream is on the order of the components being recycled. A third set of waste streams, about 4 mt/yr, is sent to various thermal treatment technologies which include direct incineration, fuel blending and reuse as fuel. Although incineration destroys less than 1% of the hazardous waste mass currently generated, these incinerated wastes generally contain moderate to high concentrations of regulated substances.

Figure 17 also reveals the interdependencies of many waste management technologies. For example, roughly 1.0 million tons of waste were incinerated in 1986. Scrubbers in the air pollution control equipment of these incinerators generated 40 million tons of wastewaters that are legally defined as hazardous and which must be treated as hazardous wastewaters. So, the waste flow diagram shows 1 million tons of waste entering the incineration step and 40 million tons leaving the incineration step. Other interdependent management technologies include wastewater treatment and land treatment (biological sludges from hazardous wastewater treatment plants are sent to solidification and hazardous waste landfills); material from waste piles and surface impoundments are sometimes sent to landfills and solvent and metal recovery operations generate hazardous wastewaters. From Figure 17 it is clear that waste management frequently involves multiple technologies.

Given that waste management is frequently a multistep process, examination of usage patterns for individual technologies must be done with care and the data must not be over interpreted. Returning to Figures 1a-16a, which focus the wastes managed in individual treatment technologies we see that many of the wastes have been described by characteristic, i.e. ignitable (D001), corrosive (D002) or reactive (D003). These results must be used with caution. The
Figure 11a. Total Waste Managed in Landfill by Waste Type

Figure 11b. Total Waste Managed in Landfill by Industry Code

Figure 11c. Quantity of Hazardous Waste Managed in Landfills per EPA Region in 1986 (In million tons)
Figure 12a. Total Waste Managed in Land Treatment By Waste Type -

<table>
<thead>
<tr>
<th>Waste Code</th>
<th>Waste Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D001</td>
<td>Ignitable Waste</td>
</tr>
<tr>
<td>K048</td>
<td>Dissolved Air Floatation (DAF) Float From the Petroleum Refining Industry</td>
</tr>
<tr>
<td>K049</td>
<td>Slop Oil Emulsion Solids From the Petroleum Refining Industry</td>
</tr>
<tr>
<td>K051</td>
<td>API Separator Sludge From the Petroleum Refining Industry</td>
</tr>
<tr>
<td>XOIL</td>
<td>Waste Oil</td>
</tr>
</tbody>
</table>

Figure 12b. Total Waste Managed in Land Treatment By Industry Code -

<table>
<thead>
<tr>
<th>Industry Code</th>
<th>Industry Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2911</td>
<td>Petroleum Refining</td>
</tr>
</tbody>
</table>

Figure 12c. Quantity of Hazardous Waste Managed in Land Treatment Areas per EPA Region in 1986 (In million tons)

Total quantity managed = 0.38 million tons
Other 21%

DO02 83%

2869 7%

2819 72%

Waste Code Waste Description
DO02 Corrosive Waste

Figure 13a. Total Waste Managed in Disposal Impoundment By Waste Type

Industry Code Industry Description
2819 Industrial Inorganic Chemicals, nec
2869 Industrial Organic Chemicals, nec

Figure 13b. Total Waste Managed in Disposal Impoundment By Industry Code

Total quantity managed = 4.61 million tons

Figure 13c. Quantity of Hazardous Waste Managed in Disposal Impoundments per EPA Region in 1985 (in million tons)
<table>
<thead>
<tr>
<th>Waste Code</th>
<th>Waste Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D001</td>
<td>Ignitable Waste</td>
</tr>
<tr>
<td>D002</td>
<td>Corrosive Waste</td>
</tr>
<tr>
<td>D003</td>
<td>Reactive Waste</td>
</tr>
<tr>
<td>D007</td>
<td>Chromium</td>
</tr>
<tr>
<td>K011</td>
<td>Bottom Stream From the Wastewater stripper in production of acrylonitrile</td>
</tr>
<tr>
<td>K013</td>
<td>Bottom Stream From the Wastewater column in production of acrylonitrile</td>
</tr>
</tbody>
</table>

**Figure 14a. Total Waste Managed in Injection Wells By Waste Type**

<table>
<thead>
<tr>
<th>Industry Code</th>
<th>Industry Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2800</td>
<td>General Chemical Manufacturing</td>
</tr>
<tr>
<td>2812</td>
<td>Alkalies and Chlorines</td>
</tr>
<tr>
<td>2824</td>
<td>Organic Fibers, noncellulosic</td>
</tr>
<tr>
<td>2869</td>
<td>Industrial Organic Chemicals, nec</td>
</tr>
<tr>
<td>2911</td>
<td>Petroleum Refining</td>
</tr>
</tbody>
</table>

**Figure 14b. Total Waste Managed in Injection Wells By Industry Code**

- **Figure 14c. Quantity of Hazardous Waste Managed in Injection Wells per EPA Region in 1986 (in million tons)**
**Waste Code** | **Waste Description**
--- | ---
D003 | Reactive Waste
D006 | Cadmium
D007 | Chromium
D008 | Lead
K061 | Emission Control Dust/Sludge from Primary Production of Steel in Electric Furnaces
XA81 | Waste Which Has Concentration of Polychlorinated Biphenyls Less Than 50 Parts Per Million
XPB1 | Other

**Industry Code** | **Industry Description**
--- | ---
2911 | Petroleum Refining
3312 | Blast Furnaces and Steel Mills
3321 | Gray Iron Foundries
3714 | Motor Vehicle Parts and Accessories
4953 | Refuse Systems

**Figure 15a.** Total Waste Managed in Waste Pile By Waste Type

**Figure 15b.** Total Waste Managed in Waste Pile By Industry Code

**Figure 15c.** Quantity of Hazardous Waste Managed in Waste Piles per EPA Region in 1986 (In million tons)
### Waste Code and Waste Description

<table>
<thead>
<tr>
<th>Waste Code</th>
<th>Waste Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D002</td>
<td>Corrosive Waste</td>
</tr>
<tr>
<td>K062</td>
<td>Spent Pickle Liquor From Steel Finishing Operations of Plants That Produce Iron or Steel</td>
</tr>
<tr>
<td>XSCR</td>
<td>Hazardous incinerator, boiler, or furnace scrubber water</td>
</tr>
<tr>
<td>XWML</td>
<td>Hazardous wastewater treatment liquid</td>
</tr>
</tbody>
</table>

**Figure 16a. Total Waste Managed In Surface Impoundment By Waste Type**

- D002: Corrosive Waste
- K062: Spent Pickle Liquor From Steel Finishing Operations of Plants That Produce Iron or Steel
- XSCR: Hazardous incinerator, boiler, or furnace scrubber water
- XWML: Hazardous wastewater treatment liquid

### Industry Code and Industry Description

<table>
<thead>
<tr>
<th>Industry Code</th>
<th>Industry Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2800</td>
<td>General Chemical Manufacturing</td>
</tr>
<tr>
<td>2812</td>
<td>Alkalies and Chlorine</td>
</tr>
<tr>
<td>2869</td>
<td>Industrial Organic Chemicals, nec</td>
</tr>
</tbody>
</table>

**Figure 16b. Total Waste Managed In Surface Impoundment By Industry Code**

Total quantity managed = 231.70 million tons

**Figure 16c. Quantity of Hazardous Waste Managed In Surface Impoundments per EPA Region in 1986 (In million tons)**

- Region I: 0.01 (1.0%)
- Region II: 59.41 (25.6%)
- Region III: 35.96 (15.5%)
- Region IV: 41.84 (18.1%)
- Region V: 46.88 (19.9%)
- Region VI: 44.83 (19.3%)
- Region VII: 0.03 (<0.1%)
- Region VIII: 0.14 (0.1%)
- Region IX: 2.70 (1.2%)
- Region X: 0.73 (0.3%)

Note: Region II includes Puerto Rico and the Virgin Islands.
Region IX includes Hawaii and Guam.
Region X includes Alaska.

Percentages in parentheses indicate the percentage of all hazardous waste managed in surface impoundments that was generated in the region indicated.
Figure 17. U.S. Industrial Hazardous Waste Flows
### Table II

Hazardous Waste Management Technology Usage by Industrial Sector (2 digit SIC code)

<table>
<thead>
<tr>
<th>Management Method</th>
<th>Major Contributor</th>
<th>% Contribution by major contributor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal recovery</td>
<td>Primary metal</td>
<td>34</td>
</tr>
<tr>
<td>Solvent recovery</td>
<td>Chemical manufacturing</td>
<td>21</td>
</tr>
<tr>
<td>Other recovery</td>
<td>Nonelectrical machinery</td>
<td>38</td>
</tr>
<tr>
<td>Fuel blending</td>
<td>Chemical manufacturing</td>
<td>46</td>
</tr>
<tr>
<td>Reuse as fuel</td>
<td>Chemical manufacturing</td>
<td>53</td>
</tr>
<tr>
<td>Incineration</td>
<td>Chemical manufacturing</td>
<td>83</td>
</tr>
<tr>
<td>Solidification</td>
<td>Chemical manufacturing</td>
<td>29</td>
</tr>
<tr>
<td>Land treatment</td>
<td>Petroleum industry</td>
<td>83</td>
</tr>
<tr>
<td>Wastewater treatment</td>
<td>Chemical manufacturing</td>
<td>46</td>
</tr>
<tr>
<td>Disposal Impoundment</td>
<td>Chemical manufacturing</td>
<td>79</td>
</tr>
<tr>
<td>Surface impoundment</td>
<td>Chemical manufacturing</td>
<td>86</td>
</tr>
<tr>
<td>Landfill</td>
<td>Metal fabrication</td>
<td>20</td>
</tr>
<tr>
<td>Waste pile</td>
<td>Transportation equipment</td>
<td>30</td>
</tr>
<tr>
<td>Underground injection</td>
<td>Chemical manufacturing</td>
<td>60</td>
</tr>
</tbody>
</table>

### Table III. Distribution of Incinerator Types in Use in 1986

<table>
<thead>
<tr>
<th>Incinerator Type</th>
<th>No. of Incinerators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid Injection</td>
<td>129</td>
</tr>
<tr>
<td>Rotary Kiln</td>
<td>27</td>
</tr>
<tr>
<td>Kiln+Liquid Injection</td>
<td>23</td>
</tr>
<tr>
<td>Two Stage</td>
<td>20</td>
</tr>
<tr>
<td>Fixed Hearth</td>
<td>17</td>
</tr>
<tr>
<td>Multiple Hearth</td>
<td>7</td>
</tr>
<tr>
<td>Fluidized Bed</td>
<td>7</td>
</tr>
<tr>
<td>Infrared</td>
<td>0</td>
</tr>
<tr>
<td>Fume/Vapor</td>
<td>4</td>
</tr>
<tr>
<td>Pyrolytic</td>
<td>9</td>
</tr>
<tr>
<td>Other</td>
<td>17</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>260</strong></td>
</tr>
</tbody>
</table>

*This is the number of incinerator units which is different from the number of management facilities with incinerators (see Table I).*
Total Quantity Managed = 747.4 million tons

Offsite/Captive
11.6 million tons (1.6%)

Onsite/Commercial
16.8 million tons (2.2%)

Onsite
719.0 million tons (96.2%)

Figure 18. Quantity of Hazardous Waste that was Managed Onsite, Commercially, and Captively in 1986.

Moving on to Figures 1b-16b (results summarized in Table II), we see that chemical manufacturing is the dominant user of most technologies. Some of the exceptions to this pattern are logical. For example, the primary metals industry is a disproportionately large user of metal recovery operations. Other exceptions require explanation. For example, in 1986 the petroleum refining industry used a practice called landfarming in which petroleum wastes are mixed with surface soil and biodegraded (3). Finally, the geographical distribution of management units shown in Figures 1c-16c show that most incineration, reuse as fuel, land treatment and underground injection occur in EPA Region VI. Regions VII and VIII are notable for their lack of hazardous waste management activity. These geographical distributions of management practices closely mirror the geographical distribution of waste generation (1).

CONCLUSION

This paper has presented data from the National Hazardous Waste Survey on usage patterns for waste management technologies. Due to space limitations, we are unable to present the true depth of the survey data. For example, we have combined all data on waste incineration, however, as shown by the incineration data in Table III (4), the survey can be used to examine more details in any of the management technologies.

The data presented in Figures 1-16 are the best estimates available for the distribution of waste managed by different techniques by waste type and by industry category. The data must be used with caution, however, due to the following uncertainties,

- Any national survey of this scope will contain some inaccuracies in data reporting.
In the Generator Survey (the basis for Figures 1a-16a and 1b-16b) a single waste flow rate, equal to the rate of waste generation, is reported for the entire treatment train. Thus, if a waste stream was managed by a sequence of operations such as solvent recovery, metal recovery and incineration, the waste flow rate to each process would not be known. Only the total waste generation rate is certain. This introduces some uncertainties in Figures 1-16. However, comparison of the TSDR and Generator Survey data indicates that this uncertainty is not significant.

The type of waste generated at a site, could be reported using up to five different waste codes. These codes were arranged in the database in alphabetic order. This ordering introduces limitations in the interpretation of the results of the major waste types.

REFERENCES


