Chapter 5

Manufacturing Wastes

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INTRODUCTION

Subtitle D manufacturing wastes include a wide range of process residues—including sludges, oily wastes, paint wastes, ashes and slags, inorganic chemical residues, food processing residues, solvents, plastics, and off-specitfication products (119).[1] The U.S. Environmental Protection Agency (EPA) estimated that about 6.5 billion tons of such waste was managed on-site (i.e., at the point of generation) in 1985; this excludes waste from electric power and generation (see ch. 3). The new Toxicity Characteristic (TC) might result in more than 800 million tons of waste yearly being identified as hazardous, but much of this is managed in units exempt from Subtitle C.[2] This chapter also discusses kiln dust from cement manufacturing, a Bevill waste that is exempt from Subtitle C pending further study and a regulatory determination by EPA. Although EPA does not consider these dusts to be Subtitle D non-hazardous manufacturing waste, they are included in this chapter for convenience.

Almost 97 percent of the Subtitle D manufacturing wastes managed on-site in 1985 were managed in surface impoundments (119). Most of the wastes were probably wastewaters, some of which may have been treated before disposal. As of 1984, approximately 29 percent of surface impoundments had Clean Water Act permits to discharge wastewater into surface water (119). EPA was unable to estimate the amount of manufacturing wastes managed off-site.

In general, few nationwide data are available on the design and operation-including the frequency of different pollution controls and groundwater monitoring-of current management units for Subtitle D manufacturing wastes. Furthermore, potential risks to human health and the environment posed by management of such wastes are relatively unstudied by EPA, compared to risks associated with other Subtitle D wastes.

Unlike the special wastes (see chs. 2 through 4), Congress did not exempt manufacturing wastes from regulation as hazardous. As a result, many manufacturing wastestreams are indeed listed hazardous wastes, and others are subject to the TC test for hazardous characteristics. However, EPA has not developed a Subtitle D program for regulation and management of non-hazardous manufacturing solid wastes, other than the general landfill criteria that were revised in 1991 (which focus on municipal solid waste landfills). The States bear primary responsibility for developing and implementing any regulatory programs for these wastes.

WASTE GENERATION

Based on data in its 1987 telephone survey of selected industrial establishments (as reported in ref. 119), EPA estimated that the manufacturing sector produced and managed approximately 6.5 billion tons of Subtitle D wastes in 1985 (table 5-1).[3] This estimate includes only wastes managed or disposed of in on-site, land-based units (i.e., landfills, surface impoundments, land application units, and waste piles).[4] EPA did not estimate how much of the total consisted of wastewaters. However, since the vast majority of the wastes were initially managed in surface impoundments (see ''Current Management Practices" below), it is likely that most were wastewaters with small amounts of solids. EPA has not estimated the amount of wastes disposed of off-site or recycled (116), nor does it have figures on the amount that is injected underground.

Of the wastes managed in on-site, land-based units, the pulp and paper industry accounted for the largest quantity-about 35 percent of the total. The primary iron and steel and the inorganic chemicals

[1]Wastes contaminated with polychlorinated biphenyls (PCBs) and some pesticide residues are also included. The Toxic Substances Control Act (TSCA), for example, allows small capacitors containing less than 3 pounds of PCB dielectric to be disposed of in Subtitle D landfills. The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) also allows pesticide containers that have been rinsed in accordance with label instructions to be disposed of in Subtitle Dlandfiis(119).

[2]55 Federal *Register 11855,-.29,* 1990.

[3]This excludes an estimated 1 billion tom of electric power generation wastes from the coal combustion utility industry (See chs. 1 and 3).

[4]Data were derived from a telephone survey of the 17 industries believed by EPA to produce more than 99 percent of all manufacturing Subtitle D "waste. EPA asked industries to estimate the quantity of waste and the quantity of water within which it was dissolved.

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Table 5-l—Estimated Amounts of Subtitle D Manufacturing Waste Managed in Land-based Units, by Industry, 1985

Industry[a]	Amount[b] (million tons)	EPA assessment of relative levels of heavy metals or organics in wastes[c]
Pulp and paper	2,250	Moderate. Organic pollutants from wood fibers may be significant. Coal and bark ash maycontain metals. Sulfates and metals high in some pulping wastes; dioxins present from some bleaching processes.
Primary iron and steel	1,300	High. Many wastes low in pH, may release significant quantities of heavy metals.
Inorganic chemicals	920	High for organics. Some small quantity generators may dispose of hazardous wastes in on-site, land-based facilities.
Stone, clay, glass, and concrete	622	Low. Most wastes are inert, Earth-type materials. However, significant quantities of pollution control sludges are generated, and some may contain heavy metals.
Food and kindred products	374	Low. Most wastes are biodegradable, although they can cause taste and odor problems.
Textile manufacturing	254	Low. Waste descriptions indicate low organics and heavy metals, but virtually no analytical data are available for confirmation.
Plastics and resins	181	High. Many wastes contain organic solvents and unreacted monomers, which are frequently toxic.
Petroleum refining	169[d]	High. Wastes generally contain high levels of sulfides, ammonia, phenols, and oils; some also contain benzo[a]pyrene and other toxic organics. Some small quantity generators may dispose of hazardous wastes in on-site, land-based facilities.
Fertilizer and agricultural chemicals	166	High. Waste gypsum piles may cause local pH and metal contamination problems. Pesticide residues may release organics and heavy metals
Primary nonferrous metals	67	High. Several waste streams contain high levels of heavy metals.
Organic chemicals	59	High. Many waste streams contain high levels of toxic organic chemicals. Some small quantity generators also may dispose of hazardous wastes in on-site, land-based facilities.
Water treatment	59	Low. Wastes are composed mainly of alum and lime, but may contain some heavy metals.
Rubber and miscellaneous products	24	High. Sketchy data indicate possibly significant levels of elastomers, carbon black, plastic resins, plasticizers, and pigments.
Transportation equipment	13	High. Wastewater treatment sludges, oils, and other wastes expected to have potential to release heavy metals and organics. Some small quantity generators also may dispose of hazardous wastes in on-site, land-based facilities.
Leather and leather products	3	Moderate. Wastes generally contain chromium, although usually in the trivalent state.
Miscellaneous	63	
TOTAL	6,524	

[a]Excludes wastes from coal combustion by utilities (see ch. 3).
[b]Based on telephone survey. Includes only wastes from on-site, land-based facilities; indudes weight of wastewater.
[c]Based on literature search; unclear how much wastewater is included. Quality and age of sources varied widely.
[d]This EPA estimate is 10 times greater than that of the American Petroleum Institute (see text).

SOURCE: Based on EPA reports cited in U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, *Report to Congress: Solid Waste Disposal in the United States,* vols. 1-2, EPA/530-SW-88-Ol 1 (Washington, DC: October 1988).

industries accounted for an additional 20 and 14 percent, respectively.

The American Petroleum Institute (API) (10) recently published data on waste generation and management in the petroleum refining industry.[5] Based on responses from refineries representing 80 percent of domestic crude refining capacity, API estimated that 16 million wet tons of waste was generated in 1987 and 1988. About three-fourths of this was aqueous; the remainder included contaminated soils, oily sludges, chemicals, spent catalysts,

[5]API defined waste broadly to include hazardous and non-hazardous wastes, as well as secondary materials that might be considered byproducts or recyclable materials.

Photo credit: Union Carbide Chemicals and Plastics

The Union Carbide Chemical and Plastics plant in Seadrift, Texas. In the foreground are two Subtitle D wastewater impoundments; in the background are the plant production areas surrounded by cooling water impoundments.

and" other substances. Note that API's estimate is one-tenth of EPA's (see table 5-l); the discrepancy may result from differences in the degree of wetness reported, with many respondents in the API survey reporting dewatered waste.[6]

OTA is unaware of more recent information on total Subtitle D waste generation rates. The Chemical Manufacturers Association collects data on hazardous waste generation by its member companies, but it has not obtained systematic data on Subtitle D waste generation (14).

Effects of the New Toxicity Characteristic

Regardless of the exact amount of waste generated, recent regulatory developments regarding hazardous waste determinations will change the way in which some manufacturing wastes are classified. In particular, in 1990, EPA promulgated the new TC, which expands the criteria for determining whether a wastestream exhibits a hazardous characteristic (i.e., toxicity) and should therefore be regulated under Subtitle C.[7] EPA estimated that approximately 800 million tons of wastewater and between 1 to 2 million tons of sludges and solids currently managed as Subtitle D manufacturing wastes would be characterized as hazardous under the TC. By using the 1985 estimates of total manufacturing waste and the estimates regarding the effect of the TC, approximately 5.7 billion tons per year of manufacturing wastes would theoretically be subject to Subtitle D.

Some of the major chemical constituents included in the new TC are benzene, chloroform, vinyl chloride, and trichloroethylene.[8] EPA estimated that

[6]A. O'Hare, API, personal communication, Sept. 5, 1991.

[7]55 *Federal Register* 11798, Mar. 29, 1990; also see "Hazardous and Solid Waste Amendments" below.

[8]EPA published a complete list in 55 *Federal Register* 11804, Mar. 29, 1990.

the industries most likely to be affected by the TC were:

1. **for wastewater-petroleum refining,** organic chemicals, synthetic rubber, and synthetic fibers; and
2. for non-wastewater sludges and solids-pulp and paper, synthetic fibers, organic chemicals, pharmaceuticals, petroleum refining, and wholesale petroleum marketing.

Certain factors limit the scope of the TC.[9] For example, EPA identified three major problems in relying on the TC to characterize treatment sludges from petroleum refining. First, the sludges can contain significant levels of hazardous constituents that are not covered by the TC (e.g., benzo[a]pyrene, chrysene). Second, EPA studies have shown that both the Extraction Procedure (EP) and the TC tend to underestimate the leachability of hazardous constituents from oily wastes (also see ch. 4).[10] Third, an oily matrix interferes with analytical methods for determining what portion of chromium is present in the hexavalent form. These limitations led EPA to list several petroleum refining primary treatment sludges as hazardous wastes (i.e., F037, F038, K048, and K051).

Hazardous Wastes Currently Exempt From Subtitle C

Determiningg a waste's regulatory status is complex, not least because Resource Conservation and Recovery Act (RCRA) regulations contain many exemptions and partial exemptions (e.g., depending on whether some wastes are recycled or not). Conditionally Exempt Small Quantity Generator (CESQG) hazardous wastes (i.e., hazardous wastes generated at a rate of less than 100 kilograms per month per generator) are generally exempt from Subtitle C regulations. Although they are not considered Subtitle D manufacturing wastes, they still can be disposed of in Subtitle D facilities.[11] They account for a relatively small amount of Subtitle D wastes (120,000 tons annually), but their toxicity, corrosivity, ignitability, or reactivity might be higher than other Subtitle D wastes because they exhibit one or more hazardous characteristics; some CESQG wastes also are listed hazardous wastes. EPA (119) estimated that most (over 75 percent) CESQG waste consists of used lead-acid batteries and spent solvents and is codisposed with municipal solid waste.

The Domestic Sewage Exclusion in RCRA[12] allows industries to discharge hazardous wastes to municipal sewers that lead to publicly owned treatment works (POTWs), without meeting Subtitle C generator requirements. Because POTWs are not designed to handle hazardous wastes, the industries are generally required to have their discharges meet pretreatment standards imposed by the local POTW under the Clean Water Act (see "Clean Water Act" below) .13 EPA (1 13) studied 47 industrial categories and estimated that they discharged 3,200 million gallons of process wastewater per day into municipal sewers, accounting for about 12 percent of total POTW flow. EPA estimated that in the mid-1980s this wastewater may have contained between 12,000 and 200,000 tons of hazardous metals and organic chemicals (depending, respectively, on whether pretreatment standards were fully implemented or no pretreatment occurred). Industrial users are now required to notify POTWs, States, and EPA Regions about such discharges of hazardous waste (see "Clean Water Act" below).

In addition, kiln dusts from the cement manufacturing industry are currently exempt from regulation under Subtitle C. EPA does not consider these to be Subtitle D non-hazardous manufacturing wastes, but it does regulate cement kilns that burn hazardous waste. Box 5-A provides additional information on cement kiln dusts.

MANAGEMENT PRACTICES

EPA conducted two surveys of Subtitle D programs and waste management facilities in the mid-1980s-a census of State and territorial programs in 1985 (114) and a screening survey of

[9] 55 *Federal Register 46370, NOV. 2,* 1990.

[10] As a result, EPA developed an oily waste extraction procedure (OWEP) to evaluate delisting petitions for wastes containing more than 1 percent oil or grease; however, the OWEP is not used to initially determine whether a waste should be characterized as hazardous (50 *Federal Register 48908,* Nov. 27, 1985).

[11] CESQGs are distinguished from Small Quantity Generators (SQGs), which produce waste at a rate of 100 to 1,000 kilograms per month. SQGs were exempt from hazardous waste regulations, but the exemption ended on Sept. 22, 1987. CESQG wastes remain exempt.

[12] 40 CFR 261.4(a)(l).

[13] Some States, such as Wisconsin, require that an industry obtain specific approval from the POTW to discharge its wastes into municipal sewers.

Box 5-A-Cement Kiln Dust

The 1980 Bevill-Bentsen amendments exempted cement kiln dusts from regulation as hazardous wastes under Subtitle C, pending further study by EPA of their environmental and human health effects. EPA has not yet addressed cement kiln dust in a Report to Congress, but it did contract for a report on the cement industry (73) and it made a regulatory determination in 1991 on burning hazardous waste in boilers and industrial furnaces that also addressed cement kiln dust.[1] EPA plans to finish the required Report to Congress by April 30, 1993.[2]

Cement is produced by combining oxides of calcium, silicon, aluminum, and iron and small amounts of other ingredients at high temperatures in a rotary kiln or oven. In 1990,213 kilns operated at 112 plants,[3] Historically, cement manufacturers have used fossil fuels (coal, natural gas, petroleum products) and electricity (which is derived primarily from fossil fuels) to meet their energy needs. In the last 10 years, to lower energy costs and remain competitive, they have begun to burn certain hazardous and non-hazardous wastes (e.g., liquid organic waste solvents and waste oils) either as primary or as supplementary fuels. Currently, waste fuels (including both hazardous and non-hazardous) substitute for about 15 percent by Btu value of the cement industry's fuel requirements.[4] Some companies also selectively use a portion of an appropriate hazardous waste as a feed material for the cement itself.

Waste from cement production includes gaseous emissions and cement kiln dust. Gaseous emissions generally consist of nitrogen, carbon dioxide, and water, as well as smaller quantities of oxygen, sulfur, and nitrogen oxides; trace amounts of heavy metals with low boiling points and of organic pollutants may also be present. Cement kiln dust is generally captured by air pollution controls (e.g., electrostatic precipitators) downstream of the rotary kiln (where combustion occurs). It is composed predominantly of substances present in the feed material and products of combustion, along with trace amounts of high-boiling point heavy metals that were not exhuasted with gaseous emissions.

Cement kiln dust can be reused in cement kilns ("insufflation"), blended with sewage sludge for subsequent land application, used to produce lime products for agricultural applications, or landfilled (generally on-site). SAIC (73) estimated that approximately 160,000 tons of dust must be disposed of annually per facility, usually in on-site, land-based units.[5]

Some testing of cement kiln dust has been conducted to ascertain whether or not it exhibits hazardous characteristics.[6] The Bureau of Mines tested 113 cement kiln dust samples from 102 plants in the early 1980s (37):

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[1] 56 *Federal Register* 7134, Feb. 21, 1991.

[2] Under the terms of a proposed consent decree between EPA and the Environmental Defense Fund (see ch. 1), EPA is required to issue a Report to Congress on cement kiln dust by Apr. 30, 1993.

[3] U.S. EEA, review comments, October 1991.

[4] U.S. EPA, review comments based on Portland Cement Association plant information summary for 1990, October 1991.

[5] This estimate is based on the assumption that 98 percent of the dust is recycled back into the process as a feed material. However, this assumption may be too high by a factor of 2 to 5 (H.P. Hackett, Holnam, Inc., personal communication, May 24 and 31, 1991); if so, then larger quantities would require disposal or other management.

[6] The Portland Cement Association is finalizing a study on TC testing of dozens of cement kiln dust samples from facilities across the United States (D.L. Singletary, Cement Kiln Recycling Coalition, personal communication, May 21, 1991).

Continued on next page

industrial establishments in late 1985 and early 1986 (116). The screening survey in particular was very limited in scope, and EPA also considered the data provided by industry in response to the survey to be poor.[14] However, no national data are available on current features (e.g., design, operation, site characteristics) of these waste management units, so the two surveys provide the only national glimpse of management practices for Subtitle D manufacturing wastes. The screening survey, for example, estimated that more thi[n]- 72,006 industrial establishments generated Subtitle D wastes in 1985.

On-site, Land-based Units

EPA (116) estimated that only 17 percent of the establishments generating Subtitle D wastes in 1985 (i.e., 12,000 establishments) managed these wastes

[14] U.S. EPA, review comments, Aug. 22, 1991.

Box 5-A-Cement Kiln Dust-Continued

only 1 sample failed the EP test; the report did not indicate, however, whether any of the sampled kilns used hazardous wastes. Although EPA has no evidence that cement kiln dusts are causing widespread environmental damage, it is concerned about: 1) the industry's growing use of hazardous wastes as fuel and the potential impact of this on the character of the dust; and 2) potential problems from land disposal of cement kiln dust (partly because three cement kiln dust disposal sites are on the Superfund National Priorities List).

Regulatory Framework

Cement kilns are subject to RCRA regulations regarding the storage of hazardous waste. Kilns that burn hazardous waste are also subject to the hazardous waste combustion requirements recently promulgated by EPA for boilers and industrial furnaces.[7] According to a recent survey (77), there were 23 cement facilities in the United States in 1990 that together burned over 0.8 million ton of hazardous waste fuels; under the new rule, as many as 45 facilities may achieve interim status, which will add to the capacity to burn hazardous waste fuels.

Under the new regulations, a cement kiln burning hazardous waste solely "as an ingredient" will not be subject to emissions controls. There are limits, however, on the concentrations of toxic constituents in such ''ingredients,' so the process is not completely unregulated. Also, some special restrictions apply if a waste is burned even partially for energy recovery.[8] These restrictions address minimum operating temperatures, oxygen levels, hydrocarbon monitoring, and input of the hazardous waste directly into the kiln (rather than, for example, into a precalciner). Cement kiln operators, however, generally oppose these energy recovery-related restrictions.

In addition, the applicability of the Bevill exclusion to cement kilns processing primarily raw materials must also be considered.[9] First, to be eligible for the Bevill exclusion, at least 50 percent of the feedstock to a cement kiln must consist of normal raw materials. Second, to determine whether the exclusion continues to apply when a kiln burns hazardous waste, the 1991 rule promulgated a two-part test to determine, on a case-by-case basis, whether combustion of the hazardous waste would significantly affect the character of the cement kiln dust. Cement kiln dust is considered to be significantly affected if both:

1. concentrations of toxic compounds (listed in App. VIII, 40 CFR Part 261) in the dust are significantly higher than normal (i.e., compared with cement kiln dust from a facility where hazardous waste was not burned as a fuel); and
2. toxic compounds are present in the dust at levels that could pose significant risks to human health.

Even if cement kiln dust remains exempt from regulation under Subtitle C after the case-by-case determination, emissions from the facility itself are still regulated. Moreover, the facility itself becomes subject to the corrective action provisions of RCRA Sections 3008(h) and 3004(u). These require that potential problems relating to the mismanagement of any waste (including cement kiln dust) must be evaluated before completion of the permitting process. The corrective action provisions do not apply, however, if the cement kiln is not burning hazardous waste.

[7] 56 *Federal Register* 7134, Feb. 21, 1991.

[8] EPA considers a waste to be burned at least partially for energy recovery if it has a heating value of 5,000 Btu (British thermal units) or more per pound.

[9] In this context, the Bevill amendment also applies to boilers burning primarily coal or other fossil fuels and to industrial furnaces processing primarily ores or minerals.

on-site in land-based units (surface impoundments, landfills, land application units, or waste piles). Furthermore, EPA estimated that about 25,000 on-site, land-based units were active in the mid-1980s (table 5-2). Table 5-3 shows, by industry, the number of active on-site, land-based units and the percentage of waste disposed of in them in 1985 (based on the screening survey).[15]

Almost 97 percent of the wastes managed in on-site, land-based units were initially disposed of in surface impoundments (figure 5-l), indicating that most of them were probably wastewaters.[16] In 1984,

15 The 1985 census, unlike the screening survey, was not limited to on-site units; this may explain why the census found somewhat larger numbers of landfills, surface impoundments, and land application units than did the screening survey.

16 Again, the effect of the new TC on the manner in which these wastes are characterized is unknown.

Photo credit: Union Carbide Chemicals and *Plastics*

A Subtitle D wastewater impoundment at the Union Carbide Chemical and Plastics plant in Seadrift, Texas.

Table 5-2—Estimated Number of Subtitle D Manufacturing Waste Management Units, Mid-1980s

Type of Unit	EPA census[a]	EPA screening survey[b]
Landfill	3,511	2,602
Land application unit	5,605	4,266
Surface impoundment	16,232	14,033
Waste pile	N/A[c]	5,225
TOTAL	25,346	26,126

[a]Survey of 55 State and territorial solid waste management programs.
[b]Survey of 17 industry categories contributing an estimated 99 percent of manufacturing Subtitle D wastes; includes only on-site facilities. OTA subtracted facilities managing electric power generating wastes, which are covered in ch. 3.
[c]Not applicable.

SOURCES: U.S. Environmental Protection Agency, Census *of State* and *Territorial Subtitle D Nonhazardous Waste Programs*, EPA/530-SW-86-039 (Washington, DC: October 1986); U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, "Screening Survey of Industrial Subtitle D Establishments," unpublished draft final report, December 1987.

approximately 29 percent of these impoundments had discharge permits issued under the National Pollutant Discharge Elimination System (NPDES) program (119); the permits specify conditions under which effluent discharges into surface waters are allowed (see "Federal Regulations" below). The portion of all manufacturing waste that is managed in surface impoundments with discharge permits, as well as the volume of actual discharges to surface waters, is unknown. Manufacturing wastes do not appear to be injected underground in general, other than the 1 percent indicated below for alternative on-site practices; however, the extent of this practice warrants additional study.

Among industrial sectors, the pulp and paper, primary iron and steel, and inorganic chemicals industries accounted for 70 percent by weight of the wastes managed in surface impoundments. However, nearly half of the total number of impoundments were operated by the food and kindred products industry and the stone, clay, glass, and concrete industry.

About 1 percent of the total manufacturing Subtitle D wastestream was managed in landfills, 1 percent in land application units, and 1 percent in waste piles (figure 5-1).[17] In landfills, most of the wastes by weight were generated by the stone, clay, glass, and concrete; pulp and paper; fertilizer and agricultural chemicals; and primary iron and steel industries. Most of the landfills were operated by the stone, clay, glass, and concrete; pulp and paper; primary iron and steel; and food and kindred products industries. The food and kindred products industry accounted for 77 percent of the waste going to land application units and operated 73 percent of the units. The inorganic chemicals industry was responsible for more than half of the waste going to waste piles, whereas the stone, clay, glass, and concrete industry operated almost half of the piles. Based on 1985 data, the types of waste disposed of in waste piles include sludges and "off-specification" products from the organic chemicals industry, and slag from the metals manufacturing industry (119).

According to EPA's screening survey, some manufacturing establishments reported managing halogenated solvents, nonhalogenated solvents, and metals in on-site, land-based units. All of these wastes reportedly passed EP toxicity tests and thus were not characterized as hazardous. The effect of the newly promulgated TC on characterizing these wastes is unknown, but more will certainly be classified as hazardous.[18] For the petroleum refining industry, the API (10) indicated that most aqueous

[17]About 55 percent of establishments with waste piles eventually send these wastes off-site, However, some wastes are probably always being stored in the on-site piles at these establishments. This may mean that the area in which the on-site waste piles are located is a de facto permanent waste disposal site.

[18]55 Federal Register 11798, Mar. 29, 1990; also see "Federal Regulations" below.

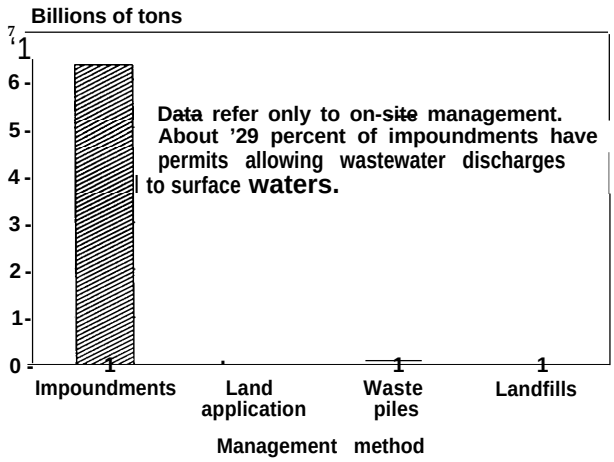
Table 5-3—Number-of On-site Subtitle D Facilities and Percentage of Waste Handled at Different Waste Management Facilities, by Industry, 1985

Industry	Type of unit				Total
	Landfill	Surface impoundment	Land application unit	Waste pile	
Organic chemicals					
Units	17	262	27	79	385
Waste (%)	0.4	96.3	3.1	0.08	
Primary iron and steel					
Units	201	383	76	464	1,124
Waste (%)	0.3	99.2	0.01	0.5	
Fertilizer and agricultural chemicals					
Units	31	274	160	50	515
Waste (%)	3.5	93.1	0.5	2.9	
Plastics and resins					
Units	32	292	17	32	373
Waste	0.05	98.2	0.02	1.7	
Inorganic chemicals					
Units	120	1,039	24	98	1,281
Waste (Ye)	0.4	95.1	0.01	4.5	
Stone, clay, glass and concrete					
Units	1,257	3,152	309	2,528	7,247
Waste(%)	1.2	97.3	0.01	1.5	
Pulp and paper					
Units	259	918	139	232	1,548
Waste (Ye)	0.3	99.3	0.4	0.07	
Primary nonferrous metals					
Units	111	448	9	312	880
Waste(%)	2.1	84.3	0.6	13	
Food and kindred products					
Units	194	4,166	3,128	540	8,029
Waste(%)	1.0	78.6	20	0.1	
Water treatment					
Units	121	659	147	48	974
Waste(%)	0.3	84.5	15	0.1	
Petroleum refining					
Units	61	915	114	158	1,248
Waste(%)	0.2	99.6	0.2	0.05	
Rubber and miscellaneous products					
Units	77	176	16	123	392
Waste(%)	2.2	97.4	0.2	0.2	
Transportation equipment					
Units	63	287	11	362	723
Waste(%)	1.4	93.1	0.01	4.6	
Selected chemicals and allied products					
Units	21	219	17	41	298
Waste(%)	0.2	99.1	0.7	0.01	
Textile manufacturing					
Units	28	741	72	103	944
Waste(%)	0.03	99.7	0.3	0.01	
bather and leather products					
Units	9	102	0	54	165
Waste(%)	0.3	99.4	0	0.3	
TOTAL[a]					
Units	2,602	14,033	4,266	5,225	26,126
Waste (%)	0.5	96.8	1.5	1.2	

[a]Table entries may not add up to their respective totals because of rounding.

SOURCES: U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, "Screening Survey of Industrial Subtitle D Establishments," unpublished draft final report, December 1987; U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, *Report to Congress: So/id Waste Disposal in the United States,* vols. 1-2, EPA/530-SW-88-011 (Washington, DC: October 1988).

Figure 5-l—Land-Based Management of Subtitle D Manufacturing Wastes, 1985



SOURCE: U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, *Report to Congress: Solid Waste Disposal in the United States,* vols. *1-2,* EPA/530-SW-88-011 (Washington, DC: October 1988).

wastes are injected underground in wells. Management methods for nonaqueous wastes varied: 23 percent recycling; 28 percent treatment (e.g., dewatering, wastewater treatment, chemical/physical treatment, incineration); 16 percent land treatment; and 33 percent disposal (landfill, impoundment, landspread).

Other On-site Units and Off-site Management

The other 60,000 manufacturing establishments identified in the survey must manage their Subtitle D wastes either off-site, or on-site via processes such as underground well injection, recycling, incineration, or treatment in tanks. EPA estimated that about 11 percent used on-site alternatives, 90 percent used off-site practices, and 13 percent employed practices that were either unknown or for which the site was unknown (the total is more than 100 percent because a given establishment can use several practices). Of the establishments that used on-site alternatives, 68 percent recycled, reclaimed, or reused some waste; 25 percent used tank treatment; 7 percent used incineration; and less than 1 percent used underground injection or boilers (1 16). EPA was unable to estimate the amounts of waste managed on-site in these other ways.

EPA was unable to depict off-site facilities in any detail or to estimate the quantities of waste disposed of in them or recycled through them. Qualitatively, however, EPA found off-site disposal to be the predominant practice in 1985 for the following industries: electrical machinery and components; food and kindred products; leather and leather tarming; machinery (except electrical); pharmaceutical preparations; and soaps, other detergents, and polishing, cleaning, or sanitation goods (1 19). Some of these off-site facilities are municipal landfills; others are for manufacturing wastes only. No national estimates exist on the amount of manufacturing solid waste disposed of at municipal solid waste landfills.

Some manufacturing wastes are sent off-site for disposal at commercial manufacturing waste landfills, which often are operated by large waste management companies. One company, for example, said that it operates special programs for these wastes to ensure compliance with relevant Federal and State regulations and keeps records of the wastes managed at its facilities.[19]

EPA is exploring information-gathering strategies, including statistical surveys, to address the gap in knowledge of off-site management practices, to update and complete its knowledge of on-site **practices,** and to obtain more detailed information that will enable it to better assess the need for development of guidelines for manufacturing wastes.[20]

Recycling

Many industries recycle some wastes on-site in the manufacturing process or sell them for off-site reuse (112). On-site recycling and reuse of spent solvents and other organic compounds (which also may be burned on-site as a fuel source) are common in the organic chemicals, plastics, and resins industries. The primary iron and steel, primary nonferrous metals, fabricated metals, and electronic component industries recover most scrap metal and often sell it to off-site scrap metal recyclers. Many organic

[19] E. Skernolis, Waste Management, Inc., review comments, Aug. 6, 1991.

[20] 56 *Federal Register 50978,* Oct. 9, 1991.

wastes from the food industry are used in byproducts such as animal feed or are otherwise recycled.[21]

The State of Ohio estimated that 32 percent by weight of the manufacturing wastestream generated in that State is recycled (55). Industries reporting the highest recycling rates included furniture and fixtures, machinery (except electrical), food and kindred products, fabricated metals, and transportation equipment.

The rate of recycling generally depends on the economic value of the wastes, the technical ease of recycling, and the fear of future liability associated with disposing of the waste (1 12). In the Ohio study, the most common reasons given by companies for not recycling were increased handling and transportation costs, liability concerns, the difficulty of recycling certain waste mixtures (i.e., mixtures of different solid waste types or wastestreams), and regulatory barriers. (See discussion of "mixture' and "derived-from" rules in chs. 1 and 2.)

The presence of regulatory barriers that inhibit off-site recycling of manufacturing wastes is an important issue in the RCRA reauthorization process. Many industries and commercial recyclers believe that regulating recycling under Subtitle C will discourage the development of collection and processing systems and lead to less recycling (1 1).[22] They are concerned, for example, about the increased costs of meeting permitting and reporting requirements and about the increased liabilities likely to be associated with recycling if it or the recyclable materials are regulated under Subtitle C. In contrast, others consider such regulation a means of promoting more responsible recycling (e.g., see ref. 70 regarding used oil). Environmental groups such as the Natural Resources Defense Council (NRDC) also believe that recycling of any hazardous wastes should be regulated as a treatment activity under Subtitle C, because of potential releases of toxic constituents to the environment, and that recyclable wastes themselves should be regulated as hazardous when, for example, they fail the TC test.[23]

An additional issue is how the regulatory status of recycling facilities might affect efforts to reduce the generation of solid wastes in the first place. In one sense, the higher costs likely to be associated with recycling if it were regulated under Subtitle C might provide an incentive for companies to look for additional means of reducing their wastes, rather than sending them off-site for recycling. According to industry representatives, however, recycling of Subtitle D processing wastes and efforts to reduce their generation already are becoming more common in some industries,[%] partly because of lessons learned from-and direct linkages with-hazardous waste prevention efforts (93). If this continues, regulating recycling under Subtitle C might lead to less recycling and to more recyclable wastes being sent to treatment and disposal facilities, depending on the costs of these various options.

The issue of recycling manufacturing wastes also affects primary smelters in the mining industry, as explained in box 5-B.

Pollution Prevention/Waste Reduction

Relatively little is known on a nationwide scale about the extent and success of efforts to reduce the generation of Subtitle D manufacturing wastes or the use of toxic substances in processes that generate these wastes. For example, only 10 percent of the industrial facilities that filed Toxics Release Inventory (TRI) forms for 1988 reported attempts to minimize TRI chemicals (reporting of such efforts was optional, though; ref. 128). However, the extent to which this applies to Subtitle D manufacturing wastes in general is unknown.

As noted above, regulating the recycling of manufacturing wastes under Subtitle C might provide some incentive for companies to explore pollution prevention opportunities, although it could also lead to more recyclable wastes being sent to treatment and disposal facilities. Alternative, nonregulatory approaches such as waste audits and technical assistance-mechanisms used with success in pollution prevention programs for hazardous waste-might provide more positive incentives.

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[21] They can also be processed and used as fuel sources; e.g., one thermochemical system devised by Battelle Pacific Northwest Laboratory reportedly can transform 1 ton of wet organic wastes (e.g., cheese whey, coffee grounds, spent brewery grains) into a fuel source with less than 20 pounds of ash residue (20).

[22] A. O'Hare, API, review comments, July 26, 1991.

[23] L. Greer, NRDC, review comments, July 1991.

[24] E. Males, Chemical Manufacturers Association review comments, Aug. 7, 1991.

Box 5-B—Recycling of Manufacturing Wastes by Smelters

One issue affecting both manufacturing and mining is the regulatory **status of the recovery or recycling, by** primary metal smelters, of metals contained in manufacturing residuals. Smelting, one of the last steps in the mining process, involves using a high temperature to separate the pure, desired metal from other compounds in concentrated ore. It can also be used to separate and recover metals from residuals such as wastewater treatment sludge and air pollution control sludge; these are generated, for example, in electroplating processes common in the electronics, automotive, aerospace, and other industries.[1]

Some primary metal smelting companies are currently recovering significant amounts of copper, zinc, and precious metals from metal-bearing wastes. Many mining industry representatives claim that this offers several advantages: 1) the metals are recovered and returned to commerce, rather than being landfilled, thereby conserving nonrenewable domestic resources; 2) the volume of incoming waste material is substantially reduced; and 3) the incoming hazardous waste material is transformed into a chemically inert slag that generally passes EPA leaching tests.[2] However, they believe that conflicts in the interpretation of RCRA, particularly whether or not recyclable materials should be defined as "solid wastes" and therefore be subject to RCRA, hinder full development of such recovery activities (including on-site closed-loop and other recovery processes; ref. 11).

EPA does not generally have authority under RCRA to regulate primary manufacturing **production** processes (see ch. 2). However, it does have authority to include **reclamation** (i.e., recovery) and residuals from such reclamation in the scope of solid waste management under RCRA and to regulate some aspects of production under the Toxic Substances Control Act (TSCA); it may also have authority under RCRA when hazardous wastes are introduced into primary processes. A reclamation process is subject to Subtitle C regulation if the residuals being treated are listed hazardous wastes (unless the process is a closed loop). Moreover, any subsequent residuals from the reclamation process may be regulated as hazardous under the "mixture" and "derived-from" rules (see ch. 1), whether or not the residuals exhibit hazardous waste characteristics.

The American Mining Congress (AMC) challenged inclusion of these manufacturing residuals in the definition of solid waste. In 1987, the court agreed with the AMC and ruled that the definition of solid waste was limited to materials that are discarded by virtue of being disposed of, abandoned, or thrown away.[3] The court also ruled that EPA had specifically exceeded its authority insofar as it classified certain in-process streams in the petroleum refining and primary smelting industries as RCRA solid wastes. Some representatives of the mining industry contend that EPA has ignored the ruling and that metal recycling by smelters is still unnecessarily constrained (e.g., 30).

EPA expressed its own view on the ruling in 1988.[4] The Agency stated it would amend its rules so that they do not extend to ongoing manufacturing operations characterized by continuous extraction of material values from an original raw material. It specifically proposed changing the rules to state that recycled oil-bearing secondary

[1] Recycling of similar wastes generated from the mining and mineral processing industry itself also occurs. For example, metal-bearing dusts and sludges generated during the smelting of ores maybe reintroduced into smelters. Material from one mining sector may be used by other sectors (e.g., dust or sludges from zinc smelters may have high lead values recoverable in a lead smelter) (Crozier, Phelps Dodge Corp., personal communication, Mar. 6, 1991).

[2] Multinational Business Services, Inc., review comments, July 30, 1991.

[3] *American* Mining *Congress v. EPA, 824* F.2d 1177 (D.C. Cir. 1987).

[4] 53 *Federal Register* 520, Jan. 8, 1988.

Continued on next page

Some States have developed programs-which vary in scope and funding-to promote pollution prevention efforts for manufacturing wastes, particularly those considered hazardous or toxic. As of 1991, for example, over one dozen States had some legislation dealing with pollution prevention; these laws generally target hazardous waste and toxic releases as defined by or listed under RCRA, the Superfund Amendments and Reauthorization Act, and various State statutes and regulations (45a). Furthermore, as many as 46 States, regardless of legislative mandate, have developed or initiated some form of pollution prevention program (or support for such a program). These typically consist of activities relating to promotion (e.g., technical assistance), regulatory integration (e.g., multimedia permitting), or facility planning; a few provide incentives (e.g., tax breaks, Governors' awards) to companies to work toward pollution prevention (45a). While no State is known to have a program

Box 5-B—Recycling of Manufacturing Wastes by Smelters-Continued

materials from petroleum refining are not solid wastes, provided there is no other element of discard or disposal.[5] For recycling by the primary smelting industry, however, EPA noted that whereas some operations are ongoing manufacturing processes, others involve sludges and byproducts that are not part of ongoing processes and contain elements of discard. The Agency proposed to revise its rule to state that the ultimate jurisdictional testis whether the materials are being used in an ongoing continuous manufacturing process.

Two other major treatment options exist for these metal-bearing industrial residuals. They can be incinerated at **a** hazardous waste treatment facility, with subsequent landfilling of ash residues (which may or may not test as hazardous, depending on the specific residues), or they can be stabilized with cement and then landfilled Each option has several drawbacks: neither recovers the metals; stabilization substantially increases the volume of the waste; and both require final land disposal.

In February 1991, EPA issued a Rule on Burning of Hazardous Wastes in Boilers and Industrial Furnaces.[6] A portion of the rule defers regulation of those primary metal smelters that accept hazardous metallic sludges solely for metal recovery. EPA intends to study whether regulation of these smelters under the Clean Air Act would be more appropriate.

In the rule, EPA also stated its intent to discourage "sham" recycling operations, in which operators seek to remove conventional treatment operations from regulation as hazardous waste management facilities by claiming that they actually are processing materials for recycling. EPA defined conditions to be met before such operations would be considered eligible for deferred regulatory status: 1) hazardous waste must be burned solely to recover metals (as opposed to burning for treatment or for energy recovery); 2) wastes must contain economically viable amounts of recoverable metals; and 3) operators must be in the business of producing metals for public sale.

Primary metal smelters contend that their metal recovery operations represent a legitimate and environmentally sound activity. Thus, they would like to see Congress encourage such recovery (while discouraging "sham" metal recycling) by requiring that: 1) facilities engaged in legitimate metal recovery not be treated as waste management facilities under RCRA; 2) secondary materials that are processed for metal recovery purposes not be defined as solid wastes; and 3) residuals from legitimate metal recovery operations be regulated based on their actual characteristics, not on the derived-from and mixture rules.[7] Amoco (11), for example, suggested that EPA either develop a special "recycling category" or support a new RCRA subtitle on recycling, with different regulatory treatment for consumer recyclable materials (e.g., used oil), commercial recycling facilities, and industrial recycling activities.[8]

As noted in this chapter, many of these suggestions run counter to the position taken by certain environmental groups and the Hazardous Waste Treatment Council regarding recycling of manufacturing wastes in general.

[5]EPA also viewed the court's opinion as not affecting any of its rules (with the exception of in-house recycling activities in petroleum refining) on burning of hazardous secondary materials for energy recovery or using such materials to produce fuels.

[6]56 *Federal Register* 7134, Feb. 21, 1991.

[7]How the international Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, adopted in 1989 but not yet in force, might affect such recycling is unclear. Annex IV of the convention includes recycling of hazardous waste as a form of disposal.

[8]In a more general context, mining companies believe that any secondary materials generated in the industry and reused in normal primary production processes should not be regulated under Subtitle C (S. Crozier, Phelps Dodge Corp., personal communication, Mar, 6, 1991). They suggest, however, that EPA should ensure these materials are properly conveyed or transported to the recycling site and properly handled while there.

specifically aimed at Subtitle D manufacturing **wastes,** some State programs do include activities devoted to Subtitle D wastes. Several States also are conducting "roundtables" on pollution prevention; these focus primarily on hazardous wastes but some include efforts to address Subtitle D wastes (141a). In addition, EPA is examining several State programs to get a better perspective on their scope and is considering holding workshops in which States would exchange infomation and ideas about regulating Subtitle D manufacturing wastes.[25]

Some municipalities, in attempts to ease local landfill capacity shortfalls, have actively promoted the reduction of Subtitle D manufacturing wastes by passing laws and implementing cooperative efforts

[25]K. Sandler, U.S. EPA, personal communication Nov. 6, 1991.

with industrial generators. These efforts, though, are generally aimed only at the portion of Subtitle D manufacturing wastes that is managed at municipal landfills.

RISKS FROM MANUFACTURING WASTES

Land-based waste management units in general can release some contaminants, which may or may not approach levels of concern for human health and the environment. Constituents can leach from landfills, surface impoundments, or waste piles into nearby soil and groundwater; runoff can contaminate surface water; and volatile organic chemicals can be released to the air. Several factors suggest that land-based management of Subtitle D manufacturing wastes may pose some risks to human health and the environrnent-large quantities of wastes are generated (see above); a variety of toxic constituents are present in them; their management relies heavily on numerous land-based units (most of which probably lacked pollution controls in the mid- 1980s; see above); and some exempted hazardous wastes are disposed of in Subtitle D waste management units. Sites on the National Priorities List (NPL) are linked with poor management practices in the past for Subtitle D non-hazardous manufacturing wastes.

Even so, although problems do exist, it is difficult to be more precise about the overall hazards posed by these wastes. Few risk assessments have been performed, and few data are available on specific environmental and human health impacts resulting from the management of Subtitle D manufacturing wastes. It is also difficult to determine how many Superfund sites resulted primarily from contamination by non-hazardous manufacturing wastes.[26] Municipal landfills comprise about 20 percent of the NPL, and most of them received manufacturing waste at some time, but even in these cases it is difficult to pinpoint exact sources of contamination (see ref. 95).

Toxicity

A crude, qualitative idea of the level of toxicity of Subtitle D manufacturing wastes, and how these levels might vary among industries, is conveyed in table 5-1. These data were compiled in 1985, from diverse studies which varied in age and quality, for 22 industries expected to generate more than 99 percent of the Subtitle D manufacturing wastes managed on-site. They compare estimated waste generation with **qualitative estimates** of the levels of heavy metals or organic chemicals in the wastes. EPA estimated that wastes contained relatively high levels of heavy metals and organic chemicals in 12 industries, relatively moderate levels in 4 industries, and low levels in 6 industries.

This information **was** compiled by EPA prior to promulgation of the new TC (see "Effects of the New Toxicity Characteristic" above). Some manufacturing wastes now handled at Subtitle D landfills and surface impoundments would probably be classified as hazardous by using the new TC.[27] The extent to which this would change relative amounts and toxicity levels is unkown.

EPA's screening survey (116) found that 16 percent of CESQGs managed their hazardous wastes in on-site surface impoundments, waste piles, landfills, and land application units.

Some reviewers suggested that the TRI might provide information on where some of the potentially greatest risks from manufacturing solid wastes might be found.[28] EPA conducted a preliminary analysis of the TRI database, in the belief that the data might give some hint of where some of the potentially greatest risks from manufacturing solid

[26] At many sites, very little is known about the origin or character of wastes present, partly because such sites frequently contain wastes generated before RCRA was passed. Furthermore, whether a waste found at a Superfund site currently exhibits a hazardous characteristic may not be sufficient information to determine ifit exhibited that characteristic when generated. Hence, although information on specific cases of conlamination caused by known Subtitle D non-hazardous manufacturing waste generators is attainable, EPA suggests that the aggregate number of sites on the Superfund NPL resulting primarily from non-hazardous manufacturing waste conlamination is probably indeterminable (U.S. EPA, review comments, Aug. 22, 1991).

[27] The TC rule will not apply to the special wastes that are currently exempt from Subtitle Cregulation (i.e., mining and some mineral processing wastes, oil and gas exploration and production wastes, and cement kiln dust), unless EPA determines on a case-by-case basis that some of these wastes warrant such regulation (55 *Federal Register* 11835, Mar. 29, 1990). If such a determination is made, EPA would then make a separate determination concerning the applicability of the TC to the wastes.

[28] Title III (the Emergency Planning and Community Right-to-Know Act) of the 1986 Superfund Amendments and Reauthorization Act requires certain companies manufacturing or processing certain amounts of 302 individual toxic chemicals and 20 categories of chemical compounds to file an annual TRI report with EPA and the appropriate State agency. Companies with Standard **Industrial Classification (SIC) codes 20 to 39, having 10 or more employees, are required to report. The threshold for reporting in 1988 was 25 tons; the threshold in subsequent years is 12.5 tons. Companies using** 10 **tons or more of a chemical annually (as of** 1988; 5 **tons or more subsequently) also are required to report.**

Table 5-4-Number (and percentage) of On-site Subtitle D Manufacturing Waste Management Facilities With Different Design and Operating Controls, 1985

Design and operating controls	Type of waste management facility		
	Landfill	Surface impoundment	Land application unit
Synthetic liners	45(1 %)	756 (5%)	N/A
Natural liners, including slurry walls	392 (ll%)	2,818 (17%)	N/A
Leachate collection systems	112 (3%)	Unknown	N/A
Leak detection systems	Unknown	896 (65%)	N/A
Runon/runoff controls	1,150 (33%)	Unknown	3,837 (69%)
Overtopping controls	N/A	3,672 (23%)	N/A
Methane controls	98 (3%)	N/A	N/A
Ban on certain Subtitle D waste types (e.g., bulk liquid)	1,200 (34%)	2,685 (17%)	3,633 (65%)
Discharge permits	Unknown	4,738 (29%)	Unknown
Waste application rate limits	N/A	N/A	4,085 (73%)
Restrictions on growing food chain crops	N/A	N/A	2,395 (43%

NOTE: N/A = not applicable.

SOURCE: U.S. Environmental Protection Agency, Census *of State and Territorial Subtitle D* Nonhazardous *Waste* Programs, EPA/530-SW-86-039 (Washington, DC: October 1986).

wastes might be found.[29] EPA believes that TRI provides a sense for the intrinsic hazard of wastes, but because the data are reported in pounds of chemicals released, not as concentrations of chemicals in wastestreams, they are not directly comparable to data on the quantities of wastes produced by manufacturing facilities. EPA views this information as a starting point for future studies, not as a definitive indicator of risk; it therefore does not intend to release this information to the public.[30]

Frequency of Pollution Controls

According to data in EPA (119), the presence of pollution controls and monitoring at management facilities for manufacturing waste was minimal in the mid-1980s, in part because they often were not required prior to that time. Some States have adopted liner and leachate requirements for Subtitle D units since then, but OTA is unaware of aggregate data on the presence of controls at facilities for manufacturing waste that have been constructed or retrofitted since that time.[31]

Design and operating controls such as liners and emissions controls were rare in the mid-1980s, especially at landfills and surface impoundments (table 5-4). Because 97 percent of Subtitle D manufacturing wastes which were disposed on-site were disposed of in surface impoundments, and **because wastes generally are in** mobile form, the deficiency of controls at impoundments seems particularly significant, especially if the same situation exists today. In the mid- 1980s, only 4.7 percent had synthetic liners, 17.4 percent had natural liners such as existing clay, 5.5 percent had leak detection systems, 23 percent had overtopping controls, and 17 percent had any restrictions on receipt of liquids. No information was available on the fkequency of leachate collection systems or runon/runoff controls at the impoundments. Designs for waste piles occasionally included runon/runoff controls, but liner systems were generally not used (119).

Available information on the frequency of monitoring and violations at these facilities showed that very few Subtitle D landfills, surface impoundments, and land application units were monitoring potential or actual releases to the environment as of 1984 (table 5-5). Of the facilities that were conducting monitoring, many were violating State standards. Because more than one violation may have been detected at a single facility, the actual percentage of facilities with monitoring that also experienced a violation may be lower than indicated in table 5-5.

[29]U.S. EPA, review comments, Aug. 22, 1991.

[30]U.S. EPA, review comments, Nov. 8, 1991.

[31]Ch. 1 discusses a recent survey (33) of State requirements for liners at non-hazardous industrial waste landfills; the survey data, however, do not distinguish between landfills that accept only manufacturing wastes and those that accept a broader range of non-hazardous solid wastes.

Table 5-&Violations of State Standards Detected at Subtitle D Manufacturing Waste Management Facilities in 1984

Medium of concern	Landfills				Surface impoundments				Land application units			
	Facilities with monitoring	Percentage of total facilities	Violations detected	Percentage of facilities with monitoring also with violation[a]	Facilities with monitoring	Percentage of total facilities	Violations detected	Percentage of facilities with monitoring also with violations[a]	Facilities with monitoring	Percentage of total facilities	Volations detected	Percentage of facilities with monitoring also with violation@
Groundwater	626	18	111	18	1,396	9	416	30	592	11	45	8
Surface water	230	7	50	22	3,151	19	279	9	137	2	60	44
Air	80	2	18	23	73	Lees than 1	145	100	31	bee than 1	10	32
Methane (subsurface gas)	63	2	8	13								
Soil	204	4	N/A	N/A								
Total active facilities	3,511				16,232				5,605			

NOTE: N/A = not applicable.

[a]Because more than one violation may have occurred at the same facility, this is the maximum percentage of facilities with monitoring that may have had a violation.

SOURCE: U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, *Report to Congress: Solid Waste Disposal in the United States*, vols. 1-2, EPA/530-SW-88-011 (Washington, DC: October 1988).

In 1990, the General Accounting Office (83) interviewed State regulatory officials about non-hazardous waste facilities in six States (Alabama, Ohio, Pennsylvania, Tennessee, Texas, and Washington). Officials in all six States were concerned about groundwater contamination at these facilities for several reasons. First, the same facilities had been responsible for groundwater contamination in the past. Second, some unpermitted facilities did not have proper controls. Finally, the States lacked resources to complete all required inspections. Based on data supplied by California and New Jersey, GAO reported that groundwater contamination had been detected at 68 (61 percent) of 112 manufacturing waste management facilities that monitored groundwater in these two States. At 32 facilities (29 percent of the total), the known or suspected source of contamination was a Subtitle D non-hazardous industrial landfill, surface impoundment, or construction/demolition debris landfill.[32] State officials believed that 18 of these 32 facilities posed a "moderate" to "great" threat to groundwater.

Some Subtitle D non-hazardous manufacturing waste is managed at on-site facilities that are also Subtitle C treatment, storage, or disposal facilities (TSDFs). All Subtitle D management units located at Subtitle C TSDFs are subject to RCRA Subpart S corrective action requirements, even if the units receive only Subtitle D wastes. These wastes may pose lower risks than wastes that are otherwise regulated. ICF (40) estimated that 780 million tons of wastes included in EPA's manufacturing waste telephone survey were managed at facilities with TSDF status.

CURRENT REGULATORY PATHWAYS

Subtitle D manufacturing wastes are primarily controlled at the State level, under programs developed by each State. EPA believes that much more information on waste types and characteristics, management facility design, exposure routes, and State regulation must be obtained before a Federal Subtitle D program for manufacturing wastes can be developed.[33]

State Programs

In many States, relatively few regulatory requirements exist beyond those contained in the Federal Subtitle D landfill criteria, which are applied in most instances to municipal landfills (see ch. 1). Several States, however, have promulgated more comprehensive regulations.[34] As of 1991, for example, Pennsylvania was finalizing extensive amendments to its regulations for "residual" wastes (i.e., non-hazardous solid waste from industrial, mining, and agricultural operations) .35 The amended regulations set forth requirements for permits, permit review procedures, bonding and insurance, civil penalties and enforcement, and beneficial use; they also require generators to prepare a source reduction strategy. In addition, they establish standards for the design, construction, and operation of impoundments that store or dispose of residual waste.

In GAO's study (83), all six States varied in their requirements for permits, liners, and groundwater monitoring for manufacturing waste facilities. Five of the States also exempt some categories of facilities from permit requirements. For example, Alabama exempts all industrial surface impoundments established before 1979 (when the State instituted a permit requirement) unless they are associated with wastewater treatment plants that discharge to surface water. Texas exempts all on-site landfills and on-site surface impoundments that are not apart of a wastewater treatment plant. According to EPA (as cited in the GAO study), facilities exempted from permits could threaten groundwater because they may handle harmful substances but not be required to have environmental controls.

Furthermore, permitted facilities in the States varied greatly in the percentage of facilities having liners and groundwater monitoring controls (see

[32] At the other facilities with detectable groundwater contamination, either different sources (e.g., a hazardous waste management unit, underground storage tank, or adjacent facility) were known or suspected, or the source of contamination was unknown.

[33] 53 Federal Register 33327, Aug. 30, 1988.

[34] ICF (41) prepared a study for API and CMA on the status of State Subtitle D regulatory programs for manufacturing wastes; the study attempts to evaluate the quality of current programs and their level of implementation and enforcement. OTA did not receive this document in time to summarize its findings or to discuss it with representatives from environmental groups, EPA, and other interested parties.

[35] These regulations were proposed under the State's Solid Wrote Management Act. Mining wastes from non-coal surface mining activities and oil and gas residual wastes are regulated under different State statutes.

table 5-6). All six States require liners and groundwater monitoring at some permitted facilities. However, the requirements for particular units are determined on a site-specific basis.[36] In addition, the States varied in the type of material required for liners. Not all permitted facilities had required controls in place, because States either have not fully implemented requirements or have exempted older facilities.

No systematic summmary is available on the overall efficacy and enforcement of current State regulations. As of 1985, according to EPA's State census, more than half of all industrial surface impoundments, 84 percent of land application units, and almost 20 percent of industrial landfills were being inspected by State agencies once every 2 years or less frequently in the mid-1980s (119).

Federal Regulations

In theory, waste management facilities for nonhazardous manufacturing wastes are regulated under Subtitle D of RCRA. However, the only extant major Federal regulations are the criteria for solid waste disposal facilities, which have been applied primarily to municipal solid waste (MSW) landfills and which were revised in 1991 (see below and ch. 1). The 1984 Hazardous and Solid Waste Amendments (HSWA) attempted to rectify this situation (see below), and other Federal statutes such as the Clean Water Act and Clean Air Act also regulate some aspects of manufacturing wastes.

Hazardous and Solid Waste Amendments

HSWA included several provisions that greatly affect the design and operation of Subtitle D waste management units, as well as those manufacturing wastes that are to be regulated under Subtitle C rather than Subtitle D.

First, HSWA required EPA to revise the Subtitle D criteria for facilities that may receive hazardous waste from households and small quantity generators, by March 31, 1988. EPA focused initially on MSW landfills and issued new criteria for them in October 1991.[37] While MSW landfills represent only a small portion of Subtitle D waste management facilities, they probably receive the bulk of household hazardous waste and CESQG waste. EPA plans to explore information-gathering strategies to learn more about facilities that handle Subtitle D manufacturing wastes to determine if revised criteria are necessary for these facilities.[38]

Although some States (e.g., California, New York, Pennsylvania) have revised their Subtitle D programs, including aspects applicable to manufacturing waste, other States probably will not amend their regulations unless EPA issues new criteria for Subtitle D waste management facilities. Because only one-third to one-half of the landfills and one-half of the surface impoundments used for Subtitle D manufacturing waste in the mid-1980s had permits (based on data in ref. 119), it seems important that EPA evaluate the extent of risks associated with such facilities and whether new criteria are needed for them.

Second, HSWA directed EPA to promulgate additional characteristics to replace the EP toxicity characteristic. EPA issued regulations on a new Toxicity Characteristic in 1990, under court order.[39] The TC covers 39 substances, including 25 organic chemicals. On a case-by-case basis, this characteristic effectively removes some wastes from Subtitle D regulation and includes them in the Subtitle C universe. This could affect about 800 million tons of wastewater and 1 to 2 million tons of sludges and solids, except that many of these are managed in units exempt from Subtitle C (see "Waste Generation" above). However, environmental groups believe that the TC inadequately predicts the toxicity of the 39 substances, does not cover enough substances, and does not address exposure pathways such as ingestion and inhalation (e.g., see ref. 76). In contrast, industry groups believe that in some instances the model upon which the TC testis based (i.e., continuous waste input to a municipal landfill) overestimates the risks posed by disposing of many wastestreams.[40] Whether the TC satisfies the HSWA

[36] Application on a site-specific basis may be considered appropriate by some, depending, for example, on exposure of humans and other species to releases from given sites.

[37] 56 *Federal Register 50978,* Oct. 9, 1991.

[38] 56 *Federal Register 50978,* Oct. 9, 1991.

[39] 55 *Federal Register* 11798, Mar. 29, 1990.

[40] A. O'Hare, API, review comments, July 26, 1991.

Table 5-6-Estimated Number and Percentage of Permitted Surface Impoundments and Landfills With Liners or Groundwater Monitoring for Six States

	Surface impoundment						Landfills					
	Liners			Monitoring			Liners			Monitoring		
State	Requirement	Number	Percentage	Requirement	Number	Percentage	Requirement	Number	Percentage	Requirement	Number	Percentage
Alabama	All[a]	500	83	Site specific	30		Site specific	7	9	Site specific	13	16
Ohio	All'	674	50	Certain Categories	674	50	All	[b]	[b]	All	10	5od
Pennsylvania	Site specific	109	38[c]	Site specific	144	50	Site specific	11	10	All	98	90
Tennessee	Site specific	10	11	Site specific		12	Site specific		5	Site specific	33	58
Texas	Site specific	350	50	Site specific	11	20	Certain categories	:	57	Certain categories	2	29
Washington	All	[b]	[b]	Alll[d]	[d]	[d]	All	[b]	[b]	All	[d]	[d]

NOTE: Based on data submitted by six States in telephone interviews with the U.S. General Accounting Office.

[a]The liner requirement applies to all units built after the requirement was established. As a result, less than 100 percent of all permitted units have liners.

[b]The State was implementing this control at all units at the time of the phone interviews. As a result, the number of permitted units with liners is not available.

[c]Estimate based on 1980 data.

[d]The State was implementing this control at all units at the time of the phone interviews. As a result, the percentage of units with groundwater monitoring was less than 100, or data were not available.

[e]The groundwater monitoring requirement applied to all units that were built after the equipment was established. As a result, less than 100 percent of all Permitted units have groundwater monitoring.

SOURCE: U.S. Congress, General Accounting Office, *Nonhazardous Waste: Environmental Safeguards for Industrial Facilities Need To Be Developed,* GAO/RCED-90-92 (Washington, DC: April 1990).

mandate is the subject of continuing litigation by the Environmental Defense Fund.[41]

Because the TC will identify additional wastes as hazardous, Subtitle D surface impoundments that continue to accept wastes newly classified as hazardous either must be retrofitted (in most instances by March 29, 1994) to meet certain minimum technological standards under Subtitle C or must cease operation.[42] In effect, EPA expected this to cause many surface impoundments to be closed and many aqueous hazardous wastes to be treated or stored in tanks rather than impoundments.

Third, HSWA (Sec. 3004 of RCRA) restricted the land disposal of hazardous wastes according to prescribed deadlines and required EPA to set levels or methods of treatment for hazardous wastes by each of the deadlines.[43] The treatment standards were to be based on performance of the best demonstrated available treatment (BDAT) to treat the waste.[44] A listed hazardous waste, even if treated to BDAT levels, cannot be disposed of in a Subtitle D facility unless it has been delisted (see derived-from rule in 40 CFR 261.3). Only characteristic hazardous wastes from which the characteristic has been removed may be disposed of at Subtitle D facilities (40 CFR 268.9). However, EPA has not yet issued treatment standards for wastes exhibiting the TC, even though RCRA (Sec. 3004(g)(4)) required the Agency to make a determination on land disposal restrictions and treatment standards for all TC wastes within 6 months of the March 29, 1990 rulemaking.

Fourth, HSWA mandated that EPA determine, in most cases by February 8, 1986, whether or not to list 24 additional wastes as hazardous. The Agency has not made determinations yet for 17 of the wastestreams and, as a result, was sued by the Environmental Defense Fund to comply with the HSWA mandate.[45] The two litigants recently proposed a consent decree that establishes a schedule for making these determinations. (See ch. 1 for more information on the consent decree.) When made, the determinations will likely expand the universe of wastes managed under Subtitle C.

Finally, HSWA directed EPA to review the domestic sewage exemption (see following section).

Clean Water Act

Although surface impoundments themselves are regulated under RCRA, discharges of wastewater from impoundments (or directly from manufacturing processes, for that matter) into surface waters are regulated under the Clean Water Act. This act established the National Pollutant Discharge Elimination System (NPDES), which is implemented primarily by the States. Dischargers must receive a NPDES permit that specifies conditions under which discharges are allowed. (See ch. 2 for additional details.) In general, permit writers base conditions on various Federal and State guidelines, including EPA's effluent limitations guidelines, which themselves are usually based on best available technology economically achievable (BAT). OTA is unaware of aggregate nationwide information on the range of conditions contained in permits for discharges from surface impoundments.

RCRA's Domestic Sewage Exclusion also allows industries to discharge hazardous wastes into sewers

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[41] *Environmental Defense Fund* v. *U.S. EPA et al.,* U.S. District Court for D.C., Civ. No. 89-0598. A consent decree proposed in June 1991 addresses many of EDF's claims (see ch. 1), but not the claim that EPA has not adequately met HSWA's mandate to promulgate regulations identifying additional characteristics of hazardous waste; the court has been has been fully briefed on this latter claim and a decision is pending (K Florini, EDF, personal communication, Oct. 1, 1991).

[42] 55 *Federal* Register 11835, Mar. 29, 1990. HSWA allows hazardous wastes to be stored or treated in surface impoundments that meet certain minimum technological requirements under Subtitle C. For already permitted landfills snd impoundments, owners/operators of new units or extensions of existing units must install two or more liners and a leachate collection system. For interim status facilities, owners/operators must install liners and a leachate collection system or equivalent protection.

[43] 55 *Federal Register* 22520, June 1, 1990. The land disposal restrictions are required unless EPA determines "to a reasonable degree of certainty, tbat there will be no migration of hazardous constituents from the disposal unit. . . for as long as the wastes remain hazardous." The schedule, based on a ranking of listed wastes that considers intrinsic hazard and volume, was designed to ensure that prohibitions and treatment standards are promulgated first for high-volume hazardous wastes with high intrinsic hazards. It required EPA to make these determinations for at least one-third of all listed hazardous wastes by Aug. 8, 1988; at least two-thirds by June 8, 1989; and all remaining listed hazardous wastes and all characteristic hazardous wastes by May 8, 1990.

[44] They could be in t& form of performance standards (e.g., maximum concentration of a constituent allowed in the waste) or specified technologies. In its final rule on land disposal restrictions (51 *Federal Register* 40572, Nov. 7, 1986), EPA promulgated an approach to establishing treatment standards based entirely on technology-based standards expressed as BDAT.

[45] This suit also included the claim mentioned above regarding the adequacy of the TC (*Environmental Defense Fund* v. *U.S. Environmental Protection Agency et al.*, U.S. District Court for D.C., Civ. No. 89-0598).

that lead to publicly owned treatment works (POTWs). The Clean Water Act regulates discharges from POTWs and also established a ''pretreatment' program for industrial discharges into sewers. As a result, some industrial wastewaters are 'pretreated' prior to their discharge into sewers, in accordance with Federal pretreatment regulations and limits developed by local POTWs. However, POTWs generally are not designed to handle metals and certain organic chemicals. Pretreatment programs also had not been widely implemented as of 1987 (81, 92), although EPA has attempted to rectify this situation. In 1990, for example, EPA issued a rule that substantially strengthened legal control over all non-domestic sources.[46] It also required industrial users (with certain exemptions for generators of less than 15 kilograms of hazardous waste per month) to notify the POTW, State, and EPA Region of any discharge into the POTW of a substance which, if otherwise disposed of, would be a hazardous solid waste.[47] In 1989, however, the Natural Resources Defense Council filed suit contesting EPA's failure to promulgate pretreatment and effluent standards in a timely fashion, and the results of this suit are still pending.[48]

Neither NPDES nor the pretreatment program directly addresses groundwater. Most Subtitle D surface impoundments and landfills were unlined as of the mid- 1980s, and contamination of groundwater has been documented (see "Frequency-of Pollution Controls" above).

Clean Air Act

The Clean Air Act Amendments of 1990 **require** EPA to propose standards for emissions from incineration units handling commercial or manufacturing waste, within 3 years of enactment. Primary or secondary smelters that combust waste materials for the purpose of recovering metals are not included among these units.

ISSUES/QUESTIONS

Development of a Federal Subtitle D regulatory program for manufacturing wastes is generally further behind than similar programs for exempted special wastes. EPA believes it is necessary to understand Subtitle D manufacturing wastes in greater detail and to assess their relative risks before developing new regulatory efforts. However, many groups have expressed interest in an interim program for Subtitle D manufacturing wastes, to help bridge the gap until (and if) a final Subtitle D program is developed.[49] Under the auspices of The Keystone Center, representatives of these diverse interests have been meeting to develop consensus agreements on requirements for an interim program that would be as self-implementing as possible.[50] The group is attempting to reach agreements on notification of manufacturing solid waste activity; waste characterization, minimization, and tracking; site characterization and environmental assessments; release notification and corrective action; closure; State implementation of legal authority for interim measures; and funding for State enforcement of such measures. EPA is participating in the discussions, but the Agency is concerned that it might not have sufficient information or resources to define or implement some of these interim requirements.[51] Thus the Agency questions whether such a program should be mandated at this time.

Some issues and questions related to manufacturing waste management that Congress might address include, but are not necessarily limited to, the following:

- **Relationships Among Federal and State Agencies-what degree** of primacy does Congress wish States to have in managing Subtitle D manufacturing wastes? Should EPA develop a State-implemented regulatory program with Federal oversight and enforcement or should it

[46] 55 Federal Register 30105, July 24, 1990.

[47] This is a one-time notification requirement, as long as the discharge does not change substantially.

[48] The NRDC sued EPA in 1989 for failure ''to promulgate a comprehensive set of effluent standards and systematically to revise and strengthen its existing standards' under the Clean Water Act and for failure "to promulgate the pretreatment standards called for by the Domestic Sewage Study" under RCRA (*Natural Resources Defense Council, Inc., et al., v. U.S. Environmental Protection Agency*, U.S. District Court for the District of Columbia, Civ. No. 89-2980 (RCL)).

[49] This would b. similar in a sense t. the interim program developed for hazardous wastes after RCRA was passed in 1976.

[50] T. Mealey, The Keystone Center, review comments, Aug. 8, 1991. Represented interests include a variety of industry sectors (e.g., chemical, petroleum, pulp and paper, commercial waste management), State and Federal regulatory agency representatives, national environmental groups, and congressional staff.

[51] U.S. EPA, review comments, Aug. 22, 1991.

restrict its role to developing voluntary guidelines and providing technical and financial support for individual State programs? Does EPA need additional oversight and enforcement authority under RCRA to support effective State programs? In addition, should relationships between RCRA and the Clean Water Act—which, for example, regulate different aspects of surface impoundments-be better clarified and coordinated?

- Interim Regulatory Program-Should EPA be directed to establish interim requirements for Subtitle D manufacturing wastes or to gather additional information before developing any program?
- Pollution Prevention/Waste Reduction—Should EPA's pollution prevention program, which focuses primarily on reducing the generation of hazardous wastes, include more efforts to address the generation of non-hazardous manufacturing wastes and to reduce the use of toxics in general? Should non-hazardous manufacturing wastes destined for land-based disposal be subject to treatment regulations (e.g., similar to BDAT for hazardous wastes) to encourage pollution prevention? Should additional chemicals or even wastestreams be included in the TRI? Should the Domestic Sewage Exemption be continued?
- Recycling-Should facilities that recycle hazardous residuals from manufacturing processes, and the residuals themselves, be regulated under Subtitle C or Subtitle D, exempted, or otherwise regulated? How should recycling of non-hazardous wastes be regulated?
- Adequacy of Existing Toxicity Tests-Is the TC an appropriate means of determining the potential for long-term migration of the full spectrum of contaminants of concern from waste management facilities? Should additional characteristics be promulgated to ensure that Subtitle D wastes are of less concern than Subtitle C wastes? If so, what characteristics?
- Resources for Administration and Enforcement of Programs-Are resources sufficient to administer and enforce Federal and State manufacturing waste regulatory programs? If not, what mechanisms are available to provide such resources? What emphasis should be given to enforcement of these programs relative to other Subtitle D programs and, in turn, relative to other environmental protection programs? Should independent audits be conducted to assess how effectively various Federal and State regulations are being enforced?