



United States
Environmental Protection
Agency

EPA530-R-08-011
November 2008

National Priority Chemicals Trends Report (2004-2006)

Section 4 Trends Analyses for Specific Priority Chemicals (2004-2006): Dioxin and Dioxin-Like Compounds (Dioxin)

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Dioxin and Dioxin-Like Compounds (Dioxin)

Chemical Information

Dioxin refers to a group of chemical compounds that share similar chemical and biological properties. Several hundred of these compounds exist and are members of two closely related families: chlorinated dibenzo-*p*-dioxins (CDDs) and chlorinated dibenzofurans (CDFs). The dioxin and dioxin-like compounds category (TRI Category N150) consists of 17 specific CDD and CDF compounds reportable to TRI.

Chemical Name	Abbreviated Name
chlorinated dibenzo-<i>p</i>-dioxins (CDDs)	
2,3,7,8-tetrachlorodibenzo- <i>p</i> -dioxin	2,3,7,8-TCDD
1,2,3,7,8-pentachlorodibenzo- <i>p</i> -dioxin	1,2,3,7,8-PeCDD
1,2,3,4,7,8-hexachlorodibenzo- <i>p</i> -dioxin	1,2,3,4,7,8-HxCDD
1,2,3,6,7,8-hexachlorodibenzo- <i>p</i> -dioxin	1,2,3,6,7,8-HxCDD
1,2,3,7,8,9-hexachlorodibenzo- <i>p</i> -dioxin	1,2,3,7,8,9-HxCDD
1,2,3,4,6,7,8-heptachlorodibenzo- <i>p</i> -dioxin	1,2,3,4,6,7,8-HpCDD
1,2,3,4,6,7,8,9-octachlorodibenzo- <i>p</i> -dioxin	1,2,3,4,6,7,8,9-OCDD
chlorinated dibenzofurans (CDFs)	
2,3,7,8-tetrachlorodibenzofuran	2,3,7,8-TCDF
1,2,3,7,8-pentachlorodibenzofuran	1,2,3,7,8-PeCDF
2,3,4,7,8-pentachlorodibenzofuran	2,3,4,7,8-PeCDF
1,2,3,4,7,8-hexachlorodibenzofuran	1,2,3,4,7,8-HxCDF
1,2,3,6,7,8-hexachlorodibenzofuran	1,2,3,6,7,8-HxCDF
1,2,3,7,8,9-hexachlorodibenzofuran	1,2,3,7,8,9-HxCDF
2,3,4,6,7,8-hexachlorodibenzofuran	2,3,4,6,7,8-HxCDF
1,2,3,4,6,7,8-heptachlorodibenzofuran	1,2,3,4,6,7,8-HpCDF
1,2,3,4,7,8,9-heptachlorodibenzofuran	1,2,3,4,7,8,9-HpCDF
1,2,3,4,6,7,8,9-octachlorodibenzofuran	1,2,3,4,6,7,8,9-OCDF

General Uses: CDDs and CDFs are not commercially produced, except in small quantities for chemical analyses and toxicological research. CDDs and CDFs are formed as unwanted byproducts when chlorinated materials are involved in combustion or other high-temperature processes, such as waste incineration, energy generation, metallurgical processes, chemical manufacturing and other industrial processes. Metallurgical processes that may release CDD/CDFs include ferrous sources, such as iron ore sintering, coke production, and the production of steel in electric arc furnaces from scrap feed. Secondary aluminum, copper, and lead smelters can also be sources of CDD/CDFs. CDDs and CDFs can also be formed as unintended byproducts of manufacturing processes. For example, they are generated in pulp and paper mills during chlorine bleaching.

NOTE: Dioxins are generally produced and released by industrial processes in relatively small quantities compared with the quantities of other TRI-listed chemicals produced and released. Because of this, and the fact that certain dioxins are toxic at very low levels of exposure, a much lower TRI reporting threshold was established for dioxins (0.1 gram per year). Therefore, facilities report dioxins to TRI in grams. For the purposes of this section, we present our trends analyses using grams, rounded to the nearest whole gram. Please note that most of the dioxin quantities in the database are expressed in terms of very small quantities—even up to seven decimal places. In rounding the quantities to the nearest whole gram, certain quantities will appear to be zero. We made this conversion to facilitate our trends analyses. However, rounding these quantities to the nearest whole gram should not be interpreted as minimizing the importance of smaller quantities of dioxin—which are of considerable concern.

In addition, elsewhere in this document, where analyses of trends for aggregated quantities of PCs are presented, we converted the quantities (grams) of dioxin to pounds (using 454.5 grams/pound) and rounded these quantities to the nearest whole pound. We made this conversion to provide uniformity and consistency in the quantities used to perform analyses of trends at the more aggregated levels. Again, this conversion and rounding should not be interpreted as minimizing the potential health effects associated with smaller quantities of dioxin.

How Much Dioxins Were Generated?

For 2006, 362 facilities reported approximately 229,000 grams of dioxins were generated. Six facilities reported approximately 82 percent of the national total quantity generated of this PC; 17 facilities reported approximately 96 percent of the dioxins generated. Compared to the total quantities of dioxins reported for 2004 and 2005, the quantity increased by approximately 6,900 grams and 10,000 grams, respectively (Exhibit 4.19).

Exhibit 4.19. National Generation of Dioxins (2004–2006)

TRI Reporting Year	2004	2005	2006
Total Quantity of Dioxins (grams)*	221,633	218,530	228,516
Number of TRI Facilities Reporting Dioxins	376	373	366

* Facilities report dioxin and dioxin-like compounds to TRI in grams, with a reporting threshold of 0.1 grams. For the purposes of this table, we rounded the quantity reported to the nearest whole gram.

Where Were Dioxins Generated?

For 2006, facilities in 46 states reported generating dioxins (Exhibit 4.20). From 2004 to 2006, facilities in EPA Region 6 reported most of the dioxin quantity generated, with Louisiana and Texas facilities accounting for approximately 49 percent and 29 percent, respectively. Exhibit 4.21 shows the counties in which facilities reported approximately 98 percent of the total quantity of dioxin generated for 2006. A petroleum refinery located in Iberville County, Louisiana reported an increase of approximately 42,400 grams and noted that it experienced hurricane-related operational problems during the 2005 reporting year.

In Harris County, Texas, two organic chemical manufacturing facilities (same company) accounted for most of the approximately 25,000 gram increase in 2006. One of these facilities attributed the increased quantity of dioxin to operational issues—it had to transfer material off-site due to a by-product reactor being down, while the other facility noted an increase in the quantity of heavy ends received from sister facilities for incineration.

Exhibit 4.20. Location of Facilities that Generated Dioxins (2006)

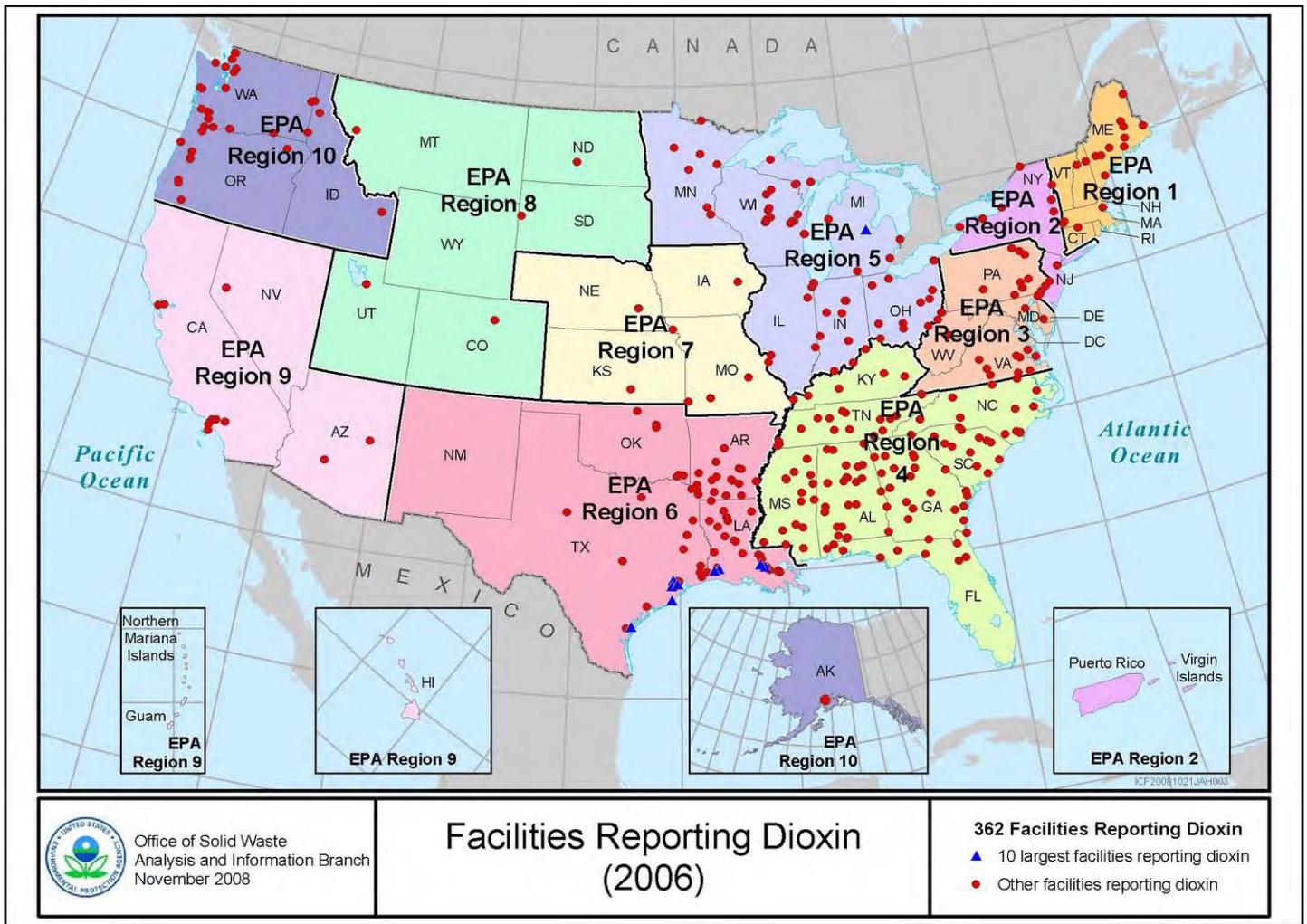


Exhibit 4.21. Quantity of Dioxins, for Facilities Reporting 98 Percent of Total Quantity, by County (2006)

EPA Region	State	County	Quantity (grams) of Dioxins			Percent of Total Quantity (2006)
			2004	2005	2006	
6	LA	Iberville	60,224	102,656	83,724	36.6%
6	TX	Harris	23,403	16,852	42,049	18.4%
5	MI	Midland	26,455	14,658	34,617	15.1%
6	LA	Calcasieu	27,257	22,195	23,882	10.5%
6	TX	Brazoria	13,020	17,357	16,431	7.2%
6	TX	San Patricio	7,072	6,532	6,302	2.8%
6	LA	Ascension	3,073	3,422	3,526	1.5%
4	TN	Blount	2,309	2,210	2,510	1.1%
4	MS	Grenada	28,036	18,157	2,003	0.9%
4	SC	Florence	15,028	1,092	1,650	0.7%
4	KY	Marshall	2,262	2,068	1,363	0.6%
4	NC	Brunswick	281	1,262	1,186	0.5%
5	IN	Wabash	1,187	898	1,048	0.5%
4	KY	Hancock	14	590	860	0.4%
6	LA	Rapides	1,100	941	722	0.3%
6	TX	Williamson	0	0	510	0.2%

**Exhibit 4.21. Quantity of Dioxins, for Facilities Reporting 98 Percent of Total Quantity, by County (2006)
(Continued)**

EPA Region	State	County	Quantity (grams) of Dioxins			Percent of Total Quantity (2006)
			2004	2005	2006	
4	AL	Escambia	41	301	503	0.2%
4	MS	Kemper	171	670	446	0.2%
3	WV	Marshall	430	428	432	0.2%
Total			211,363	212,287	223,766	97.9%

Which Industries Generated Dioxins?

For 2006, facilities in 47 NAICS codes reported dioxins. Exhibit 4.22 shows the nine industries in which facilities accounted for approximately 99 percent of the dioxins generated. Facilities in four of these industries reported 88 percent of the dioxins generated. One facility in NAICS code 324110 (Petroleum refineries) reported most of the dioxins in this industry from 2004 to 2006, including 99.9 percent of the industry's total quantity in 2006.

Exhibit 4.22. Industry Sectors Quantities of Dioxins, for Facilities Reporting 99 Percent of Total Quantity (2006)

Primary NAICS code	NAICS Code Description	Facilities Reporting (2006)	Quantity (grams) of Dioxins			Percent of Total Quantity (2006)
			2004	2005	2006	
324110	Petroleum Refineries	21	57,925	100,274	81,247	35.6%
325199	All Other Basic Organic Chemical Manufacturing	7	28,328	18,209	42,540	18.6%
325320	Pesticide and Other Agricultural Chemical Manufacturing	6	30,855	21,872	41,766	18.3%
325181	Alkalies and Chlorine Manufacturing	13	35,492	36,645	36,405	15.9%
321114	Wood Preservation	21	50,686	24,512	7,834	3.4%
325211	Plastics Material and Resin Manufacturing	13	5,383	5,417	5,760	2.5%
325110	Petrochemical Manufacturing	8	6,191	4,751	5,479	2.4%
331314	Secondary Smelting and Alloying of Aluminum	33	2,394	2,766	3,009	1.3%
331312	Primary Aluminum Production	2	2,309	2,210	2,510	1.1%
Total		124	219,561	216,655	226,551	99.1%

How Did Facilities Manage Dioxins?

Exhibit 4.23 shows how facilities, by industry, managed dioxins in 2006.

Land Disposal: Facilities disposed of approximately 19 percent of the dioxins generated.

Energy Recovery: Facilities reported using energy recovery for 0.2 percent of the dioxins generated.

Treatment: Facilities treated, primarily onsite, approximately 81 percent of the dioxins generated.

Recycling: Recycling is not applicable to this PC.

Exhibit 4.23. Management Methods for Dioxins in Industry Sectors (2006)

Primary NAICS Code	NAICS Code Description	Total PC Quantity* Reported	Quantity (grams) of Dioxins					
			Disposal		Energy Recovery		Treatment	
			Onsite	Offsite	Onsite	Offsite	Onsite	Offsite
324110	Petroleum Refineries	81,247	90	32	0	0	81,121	5
325199	All Other Basic Organic Chemical Manufacturing	42,540	0	8,769	0	0	19,649	14,123
325320	Pesticide and Other Agricultural Chemical Manufacturing	41,766	14,776	7,147	0	1	17,730	2,110
325181	Alkalies and Chlorine Manufacturing	36,405	8,975	253	0	0	23,870	3,307
321114	Wood Preservation	7,834	0	290	0	401	1,189	5,954
325211	Plastics Material and Resin Manufacturing	5,760	3	721	0	1	4,956	78
325110	Petrochemical Manufacturing	5,479	0	220	0	0	548	4,712
331314	Secondary Smelting and Alloying of Aluminum	3,009	219	951	0	0	1,829	10
331312	Primary Aluminum Production	2,510	0	10	0	0	2,500	0
Total		226,551	24,064	18,392	0	404	153,392	30,299

Data Derived From Hazardous Waste Biennial Reports for Dioxins

In this section, we present data on which facilities submitted information to the BR system. As discussed in Section 1, we caution readers against making casual one-to-one comparisons between the TRI and BR data. The differences between these two reporting systems can cause significant variation in the number of reporting facilities and quantities of chemicals reported.

Exhibit 4.24 shows the estimated quantity of dioxins contained in hazardous wastes generated in 2005—derived from data reported by facilities on the BR. We estimate that hazardous wastes reported by facilities in these industries contained 84,992 grams of dioxins. Waste streams classified as non-wastewaters contained approximately 99 percent of the dioxins. Facilities in three industries: NAICS code 321114 (Wood Preservation), NAICS code 325410 (Pharmaceutical and Medicine Manufacturing), and NAICS code 325181 (Alkalies and Chlorine Manufacturing) accounted for approximately 94 percent of the total estimated quantity of dioxins in the hazardous waste streams.

Exhibit 4.24. Estimated Quantity of Dioxins in Primary Generation Hazardous Waste for Facilities Reporting 97 Percent of the Total Priority Chemical Quantity, by NAICS Code (2005)

Primary NAICS Code	NAICS Code Description	Number of Facilities	Quantity (grams) of Dioxins*			Percent of Total Quantity
			Non-wastewaters	Wastewaters	Total Quantity	
321114	Wood Preservation	27	61,812	1,818	63,630	74.9%
325410	Pharmaceutical and Medicine Manufacturing	1	8,636	0	8,636	10.2%
325181	Alkalies and Chlorine Manufacturing	1	7,272	0	7,272	8.6%
332722	Bolt, Nut, Screw, Rivet, and Washer Manufacturing	1	1,818	0	1,818	2.1%
54171	Research and Development in the Physical, Engineering, and Life Sciences	6	1,818	0	1,818	2.1%
325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing	4	909	0	909	1.1%
541380	Testing Laboratories	6	909	0	909	1.1%
Total		46	83,174	1,818	84,992	100.0%

*We converted the BR quantities (pounds) of dioxin to grams (using 454.5 grams/pound) and rounded these quantities to the nearest whole gram. We made this conversion to provide uniformity for comparing TRI and BR quantities of dioxins in this section of the Report.