An Effective Data Collection Practice for the 1999 Air Toxics Emission Inventory of Point Sources

Chun Yi Wu, Dana A. Vanderbosch,
Christopher Nelson, Paul Kim, and David Richfield
Minnesota Pollution Control Agency, 520 Lafayette Road North, St. Paul, MN 55155-4194

ABSTRACT

An air toxics emission inventory is a necessary step in implementing the 1990 Amendments to the Clean Air Act. Estimating air toxics emissions for point sources without a mandatory reporting requirement is a challenging task in Minnesota. The basis of Minnesota's air toxics emission inventory for point sources is a criteria pollutant emission inventory that identifies sources, devices, and processes. However, among a total of 2183 point sources identified in 1999, 785 sources belonged to a category of Option D registration permits, required only to report criteria pollutant emissions at a facility-level. A lack of knowledge of process-level activities at these Option D facilities made it impossible for us to estimate air toxics emissions.

In order to account for emissions from this source category, we collected data for 240 facilities that operated under the Option D permit and emitted hazardous air pollutants (HAPs) in in particulate matter (PM) and/or HAPs in volatile organic compounds (VOC) with actual VOC emissions of more than 5 tons in 1999. These facilities are mainly companies using paints and primers, cleaning solvents, printing solutions, and paint thinners, and are required to track monthly HAP emissions. About 98% of facilities (236) responded to the data request. A manageable amount of staff time, about 124 hrs, was spent on this practice. Results showed that this effort identified 787 tons of additional HAP emissions and provided a basis for estimations of emissions from certain categories of area sources.

INTRODUCTION

The 1990 Clean Air Act Amendments changed the permitting requirements for facilities with air emissions. Prior to passage of the amendments, facilities were only required to apply for an emissions permit when they proposed new construction. The new rules required permits both for new construction and ongoing operation. Minnesota adopted rules providing several permitting options to applicants based on potential and actual emissions.

A facility's potential emissions are based on assumptions of maximum operating conditions (e.g., 8760 hours per year of operation) and maximum physical capacity. If these potential emissions exceed pollutant-specific thresholds (see Table 1), the facility is required to apply for a permit. In general, large facilities receive complicated "Individual Total Facility" permits that include detailed, process-specific data on facility operations. To ease the burden on smaller facilities, whose actual emissions are much lower than their potential emissions, Minnesota rules also include provisions for "Registration" permits that allow more flexibility.

Table 1. Facility Pollutant Thresholds.

Pollutant	Total Facility "Potential-to-Emit" Thresholds (tons per year)	
	Federal	State
Nitrogen Oxides (NOx)	100	100
Sulfur Dioxide (SO2)	100	50
Volatile Organic Compounds (VOC)	100	100
Particulate Matter (PM)	100	100
Particulate Matter less than 10 microns (PM10)	100	25

Pollutant	Total Facility "Potential-to-Emit" Thresholds (tons per year)	
	Federal	State
Carbon Monoxide (CO)	100	100
Lead (Pb)	NA	0.5
Individual Hazardous Air Pollutant	10	10
Total Hazardous Air Pollutants	25	25

One type of registration permit is an Option D permit. These permits are given to facilities whose actual emissions are less than 50% of federal thresholds due to control equipment, fuel use or other measures. The facilities receiving Option D permits are not required to provide as much detail on their facility emission as those facilities with higher emissions levels. The submittals to the criteria pollutant emission inventory contain only facility total annual emissions, not process specific emissions nor material throughput data.

The criteria pollutant emissions inventory is the basis for the point source portion of Minnesota's air toxics emissions inventory. Detailed process-specific data for large facilities in the criteria pollutant emissions inventory are used in the air toxics inventory to develop source-specific estimates of air toxics emissions or determine appropriate generic air toxics emission factors. The absence of process-specific information on throughput or emissions for Option D facilities prevents the MPCA from calculating and including air toxics emissions for these facilities in the inventory. Option D facilities accounted for 785 of the 2183 permitting facilities in the MPCA's emission inventory system in 1999, so the lack of emission estimates for these facilities may contribute to significant underestimation of air toxics emissions in Minnesota.

This paper described the approach to collecting emissions from Option D facilities and the significance of their emissions.

APPROACH

To gather information on air toxic emissions from Option D permittees, the MPCA developed a survey requesting information on the HAP emissions emitted from these Option D facilities in 1999. The HAP survey was a simple one-page inventory that asked facilities to provide the name of the HAP, the amount emitted in 1999 and the method of calculation. A second portion asked the permittee to describe any fuel combustion emission sources, the type and amount of fuel burned and the type of any control device associated with the source.

Although Minnesota's air toxics emission inventory collects information on additional air toxics beyond the specific 188 HAPs regulated under the Clean Air Act, the survey requested data only on emissions of the 188 HAPs.

Of the 785 Option D permittees, only 240 received the HAP survey. These facilities emitted HAPs in PM and/or HAPs in VOC with actual VOC emissions greater than 5 tons in 1999. According to State rules, a facility in which the only HAP emissions are VOC emissions and that has actual VOC emissions less than 5 tons per year are not required to calculate emissions of HAPs. Therefore, the survey was not sent to the remaining Option D facilities. The 240 permittees were given six weeks to complete the survey. The Small Business Assistance Program (SBAP) within the MPCA assisted with data collection. This program has three staff whose primary responsibility is to help small businesses comply with environmental rules and regulations associated with their permits. This unit reviewed the draft cover letter to be mailed to the permittees to ensure that the language used was easy to understand and straight-forward. They also assisted in answering questions about the survey from the Option D permittees.

About 85% of the surveys were received by the initial deadline. Although MPCA's emission inventory staff received very few calls from permittees, SBAP did receive a fair number of calls from permittees who were trying to complete the survey.

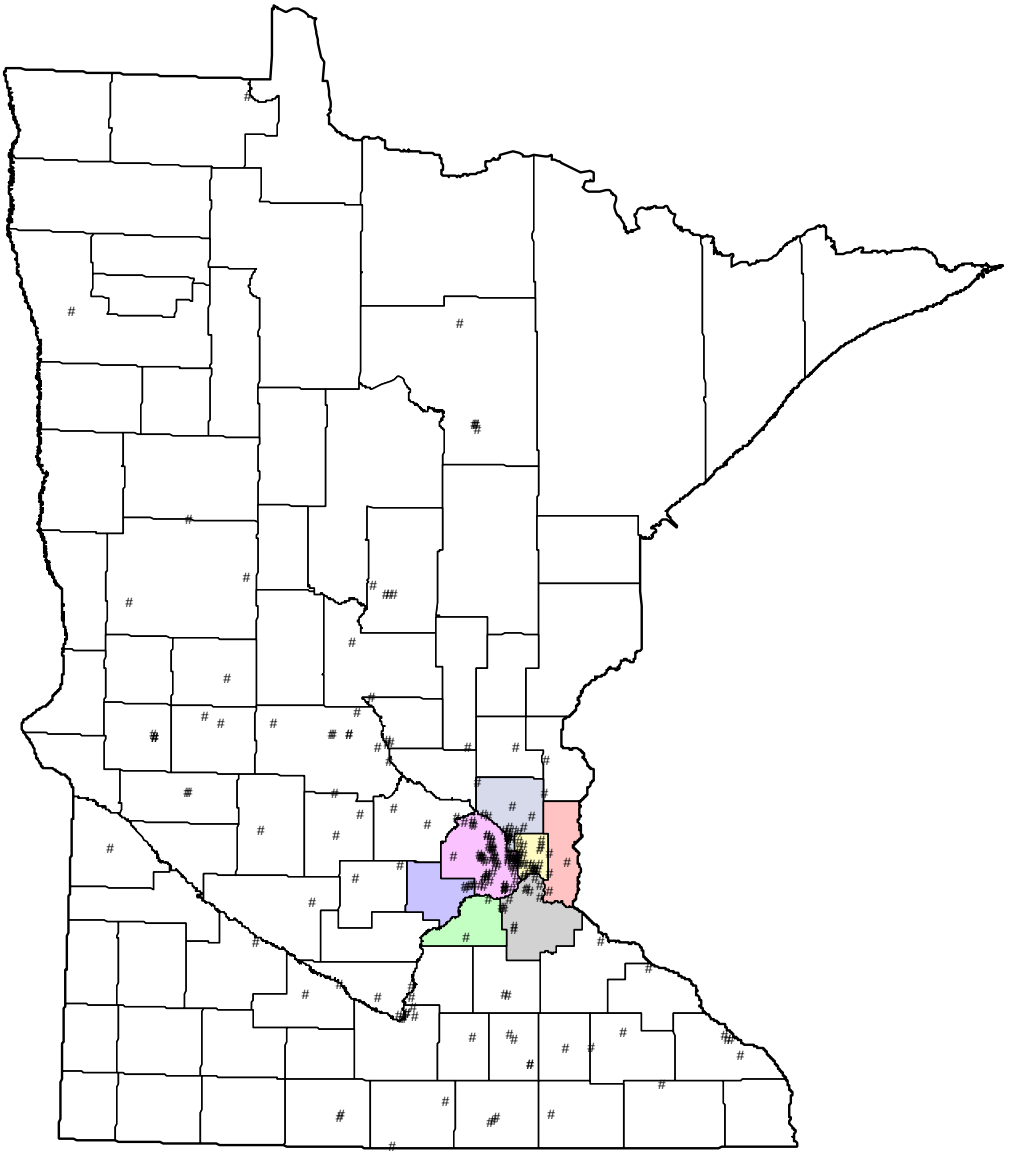
After the initial deadline, a second survey was sent to facilities that not submitted facility HAP data by the first deadline. These permittees were given two more weeks to complete and return the survey. An additional 13% of the surveys were received after this second mailing.

RESULTS AND DISCUSSION

The survey results are available for emissions of HAPs, which comprise the majority of the pollutants included in Minnesota's air toxics emission inventory. Besides the 188 HAPs specifically listed in the Clean Air Act, the inventory also covers 17 pollutants that are identified as significant contributors to the contamination of the Great Lakes and/or are monitored by the MPCA. The following analyses are based on HAP emissions only.

Responses were received from 236 facilities out of 240 facilities that were requested to submit HAP emission information. Among the 236 facilities, 230 facilities emitted HAPs in 1999. Sixty percent of the 230 facilities are located in a metropolitan area. Figure 1 shows the location of facilities. Shading area represents the seven-county metropolitan area in the Minneapolis and St. Paul Twin Cities. The 230 facilities cover many industries with printing and manufacturing the most representative of the group. The facilities that reported were heavy ink users and many, many had paint booths that sprayed paints, thinners, lacquers, primers and used cleaning solvents.

Figure 1. Map of Option D facilities.



A total of 787 tons of additional HAP emissions from these 230 facilities were estimated for 122 HAPs. Although the total amount of emissions for all HAPs is equivalent to 3.3% of point source total emissions, these additional emissions account for more than 10% emissions for 53 HAPs and more than 50% emissions for 32 HAPS. Table 2 summarizes the additional emissions obtained from the Option D facilities.

Table 2. Summary of additional emissions from Option D facilities.

HAP Name	Cas No.	Option D Additional Emissions (lb)	Total Emissions from Point Sources (lb)	Option D/Total (%)
Arsenic trioxide	1327-53-3	0.1	0.1	100.0
Butyl carbitol acetate	124-17-4	75.8	75.8	100.0

HAP Name	Cas No.	Option D Additional Emissions (lb)	Total Emissions from Point Sources (lb)	Option D/Total (%)
Chromium (6) compounds		47.0	47.0	100.0
Diethylene glycol monoethyl ether	111-90-0	8.0	8.0	100.0
Diethylene glycol monomethyl ether	111-77-3	28.5	28.5	100.0
Diethylene glycol	111-46-6	188.4	188.4	100.0
Hydrogen cyanide	74-90-8	464.0	464.0	100.0
Lindane, (all isomers)	58-89-9	3.0	3.0	100.0
Manganese dioxide	1313-13-9	13.1	13.1	100.0
Nickel oxide	1313-99-1	34.0	34.0	100.0
p-Phenylenediamine	106-50-3	99.0	99.0	100.0
Phosphine	7803-51-2	20.0	20.0	100.0
Zinc chromate	13530-65-9	13.9	13.9	100.0
p-Xylene	106-42-3	132.7	132.7	100.0
Diethylhexyl phthalate	117-81-7	1,156.3	1,157.3	99.9
m-Xylene	108-38-3	305.5	306.0	99.8
Dimethylbenz(a)anthracene	57-97-6	197.0	198.1	99.5
Cobalt compounds		2,512.5	2,528.9	99.4
o-Cresol	95-48-7	21.0	21.3	98.8
Catechol	120-80-9	627.0	636.0	98.6
Propylene glycol methyl ether acetate	108-65-6	140.2	143.7	97.6
Diethanolamine	111-42-2	144.9	150.9	96.0
Hydroquinone	123-31-9	2,149.3	2,340.7	91.8
4,4-Methylene dianiline	101-77-9	133.0	151.0	88.1
Chromium compounds		7,454.0	8,781.5	84.9
Propylene glycol monomethyl ether	107-98-2	7,140.0	9,805.3	72.8
Dibutyl phthalate	84-74-2	1,730.4	2,376.6	72.8
Lead compounds		3,207.9	4,868.9	65.9
Naphthalene	91-20-3	72,332.6	110,364.8	65.5
1,1,1-Trichloroethane	71-55-6	3,555.1	5,636.6	63.1
Propyl cellosolve	2807-30-9	879.3	1,494.3	58.8
Manganese compounds		2,832.4	5,206.0	54.4
Ethylene oxide	75-21-8	5,234.3	11,080.3	47.2
Antimony compounds		340.3	765.6	44.4

HAP Name	Cas No.	Option D Additional Emissions (lb)	Total Emissions from Point Sources (lb)	Option D/Total (%)
Diethylene glycol butyl ether		5,008.1	12,096.9	41.4
Ethylene glycol	107-21-1	19,793.4	54,849.0	36.1
Cobalt	7440-48-4	815.0	2,288.7	35.6
Vinyl acetate	108-05-4	10,041.4	28,861.8	34.8
Toluene-2,4-diisocyanate	584-84-9	1,606.6	4,887.6	32.9
Triethylamine	121-44-8	167.2	590.2	28.3
Methylene chloride	75-09-2	47,079.3	182,892.2	25.7
Vinyl chloride	75-01-4	174.7	822.6	21.2
Methyl isobutyl ketone	108-10-1	72,475.4	353,939.4	20.5
Propylene oxide	75-56-9	118.8	644.8	18.4
Xylenes (mixed isomers)	1330-20-7	362,831.3	2,062,138.4	17.6
Ethylbenzene	100-41-4	44,967.9	257,605.5	17.5
Methyl ethyl ketone	78-93-3	186,895.3	1,189,607.2	15.7
Glycol ethers		102,761.1	722,631.8	14.2
Butyl cellosolve	111-76-2	25,079.1	183,729.3	13.7
Toluene	108-88-3	297,489.3	2,279,149.9	13.1
Nickel compounds		781.5	6,394.8	12.2
Hexamethylene-1,6-diisocyanate	822-06-0	1,452.5	12,058.5	12.0
Acetonitrile	75-05-8	1,317.0	12,220.9	10.8
Grand Total Emissions for All HAPs		1,573,749	47,710,462	3.3
Number of HAPs		122	222	

Notable emissions were estimated for chromium compounds, 7,454 lbs. Chromium is a pollutant of concern. Its median exposure concentrations for Minnesota were greater than 1 in a million cancer risk (upper bound cancer risk assuming a lifetime exposure) according to USEPA's National-Scale Air Toxics Assessment based on the 1996 emission data, 14,420 lbs.[1, 2] Chromium emissions from Option D facilities added more than 50% of the 1996 statewide emissions to the 1999 emission inventory. This makes human exposure to chromium even more of a concern in Minnesota.

In addition to more emissions estimated, the information from Option D facilities provides a basis for calculation of emissions from area sources in certain categories. HAP emissions from the 230 facilities came from 97 distinct Standard Industrial Classification (SIC) Codes. Emissions for certain SICs or SIC groups were collected from a considerable number of facilities. For example, emissions of 30 facilities were estimated for SIC 2752, Commercial Printing, Lithographic. Option D facilities are smaller than facilities with regular permits regarding to their air emissions. Operating conditions of Option D facilities are closer to area sources than those facilities with regular permits. Therefore, speciation profiles developed from Option D facilities are more representative than profiles developed from facilities with regular permits.

For one area source category, graphic arts, generic speciation profiles from USEPA's SPECIATE 3.1 database were developed in the eighties.[3] The U.S.EPA used a profile based on generic speciation profiles in the 1999 National Emission Inventory (NEI).[4] An Option D profile was developed by dividing a sum of emissions for a HAP to a sum of VOC emissions from all facilities with the same SIC code, 2752. A comparison of speciation profiles used in the 1999 NEI and developed based on emissions of Option D facilities indicates a significant difference between them (Table 3). The total weight of HAPs vs. VOC is about 85% in the NEI profile but 11% based on the Option D profile. Methyl ethyl ketone is a primary constituent of HAP emitted from the graphic arts category, accounting for 54% of VOC emissions, according to the NEI profile. In contrast, the weight fraction of methyl ethyl ketone in VOC is only about 0.4% based on the Option D profile. The NEI document suggested 0.00065 tons VOC per capita from this category. With the 1999 Minnesota population, 4,775,508, the NEI profile estimates 2,271.91 tons more HAP emissions than the Option D profile. These overestimated HAP emissions from the graphic arts category alone are about 10% of HAP emission from all point sources, 23,855 tons.

Table 3. Comparison of speciation profiles for graphic arts category.

		Speciation (%)	
HAP Name	**Cas No.**	**Option D**	**1999 NEI**
Butyl cellosolve	111-76-2	1.200E+00	
Butyl carbitol acetate	124-17-4	7.029E-03	
Cumene	98-82-8	1.852E-01	
Dibutyl phthalate	84-74-2	9.177E-06	1.000E+01
Diethylene glycol monomethyl ether	111-77-3	2.638E-03	
Diethylene glycol butyl ether		3.878E-01	
Diethanolamine	111-42-2	1.445E-03	
Diethylene glycol	111-46-6	1.746E-02	
Ethylbenzene	100-41-4	7.845E-03	
Ethylene glycol	107-21-1	8.720E-01	
Glycol ethers		3.181E+00	
Hydroquinone	123-31-9	1.136E-01	
Methyl carbitol	78-93-3		4.000E-02
Methyl ethyl ketone	108-10-1	3.659E-01	5.427E+01
Methyl isobutyl ketone	67-56-1	8.191E-04	1.400E+01
Methanol	75-09-2	8.649E-01	
Methylene chloride	91-20-3	6.022E-01	
Naphthalene	107-98-2	7.934E-02	
Propylene glycol monomethyl ether	2807-30-9	6.618E-01	
Propyl cellosolve	100-42-5	7.379E-02	
Styrene	71-55-6	6.731E-04	
1,1,1-Trichloroethane	108-88-3	2.224E-02	

HAP Name	Cas No.	Speciation (%)	
		Option D	1999 NEI
Toluene	95-63-6	3.134E-01	6.480E+00
Toluene diisoyanade	25551-13-		3.000E-02
1,2,4-Trimethylbenzene	108-05-4	7.153E-01	
Trimethylbenzene	1330-20-7	9.905E-01	
Vinyl acetate		8.778E-04	
Xylenes (mixed isomers)		9.608E-01	
Total		1.163E+01	8.482E+01

The MPCA spent approximate 124 hours developing the survey, answering questions related to the survey, and then compiling the results. The total includes 44 hours of SBAP staff time on assisting permittees. The amount of assisting time is expected to decrease when we compile the next emission inventory. Overall, this is a manageable effort.

CONCLUSIONS

Collecting HAP emission data from Option D facilities that emit HAPs in PM and/or HAPs in VOC with actual VOC emissions greater than 5 tons is a feasible approach. This approach took a manageable amount of time, 124 hours, and identified 787 tons of additional HAP emissions in 1999, including significant emissions for some pollutants in concern, such as chromium. The emission information from Option D facilities also provided a basis for estimating emissions from certain categories of area sources. Therefore, this effort should be continued in future emission inventory development.

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