

Household Hazardous Waste Program Air Monitoring Study

FINAL REPORT

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Introduction

This report provides a general overview of the air sampling results and recommendations applicable to the Household Hazardous Waste (HHW) facilities evaluated during 2004 and 2005. The data can also be used by other HHW facilities in Minnesota that conduct similar operations under similar conditions, to evaluate their employee's exposures.

This air sampling project is a follow-up to the industrial hygiene study conducted in 1996 by the Industrial Hygiene Department at the University of Minnesota, School of Public Health¹.

The purpose of both studies was to evaluate worker exposure to solvents while bulking oil base paints, fuels, flammables and aerosols and to determine if current personal protective measures are adequate.

Fourteen HHW sites were evaluated and are identified in Table 1 in Appendix A.

Oil Base Paint	Aerosols	Fuels & Flammables
1,1,1-Trichloroethane	Acetone	Acetone
Acetone	Benzene	Benzene
Benzene	Isopropyl alcohol	Chloroform
Chloroform	Methylene chloride	Methylene chloride
Ethyl benzene	Toluene	Toluene
Hydrocarbons (total) as n-hexane	Xylene	Trichloroethylene
Isopropyl alcohol		
Methylene chloride		
Methyl ethyl ketone		
Stoddard solvent		
Toluene		
Xylene		

Standards

The Minnesota and Federal OSHA Permissible Exposure Limits (PELs)^{2,3} and the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs)⁴ were used to evaluate employee exposure to the solvent vapors measured. A list of the PELs and TLVs used for this study are in Table 3 in Appendix A.

Since multiple solvent vapor exposures exist in the jobs evaluated, the additive effect was also considered. Mixture equivalent TLVs and PELs were calculated for the samples with the highest organic vapor concentrations.

Calculations

Using the data (reported concentrations) from the laboratory, the following calculations were performed:

1. Eight-hour time-weighted average (TWA) concentrations were calculated using to the following formula:

$$\text{8-hour TWA} = \frac{(\text{concentration reported by lab}) \times (\text{sample time in hours})}{8 \text{ hours}}$$

2. % of the TLV or PEL

$$\% \text{PEL} = \frac{\text{8-hour TWA}}{\text{PEL}}$$

$$\% \text{TLV} = \frac{\text{8-hour TWA}}{\text{TLV}}$$

1. *Organic vapors:* Other than chloroform, benzene and methylene chloride, exposures to organic vapors were less than 20% of both the PEL and TLV.
2. *Benzene:* None of the benzene samples exceeded the PEL or TLV. The concentrations reported for two of the four samples were less than the analytical quantitation limit. One sample was 5% of the OSHA PEL and 10% of the TLV; the other was 36% of the PEL and 72% of the TLV. The OSHA Action Level was not exceeded in any of the samples. Refer to Table 3 in Appendix A.
3. *Chloroform:* Two samples from Kandiyohi County indicated chloroform concentrations exceeding the OSHA PEL. Additional sampling was conducted at Kandiyohi County in October 2005. Chloroform was not present at levels exceeding the analytical quantitation limit. The PEL for chloroform is significantly more stringent than the current TLV. Chloroform present in other samples did not exceed 35% of the OSHA PEL.
4. *Methylene chloride:* Methylene chloride was present in concentrations ranging up to 35% of the OSHA PEL, and in all cases was less than the OSHA Action Level. Refer to Table 3 in Appendix A.
5. *Equivalent mixture exposures:* These calculations resulted in two samples exceeding the limit of one for the mixture PEL. Both of these samples included chloroform at levels exceeding the OSHA PEL. All others were less than one for both the TLV and PEL.

Air sampling conducted independently by two other facilities and the previous HHW study overall confirm the results from this study.

1. *Olmsted County:* Air Sampling was conducted during oil base paint bulking at the Olmsted County HHW facility on August 26 and September 2, 2004. Results indicated that exposures to solvent vapors were less than 10% of the PELs and TLVs, as well as the mixture TLV⁶.
2. *Scott County:* Air sampling conducted by Scott County HHW on August 4, 2003 also shows airborne exposure to solvents to be well below the PEL and TLV⁷.
3. *MPCA.* The industrial hygiene survey conducted by the University of Minnesota during July – September 1996 demonstrated that no chemical exposures exceeded 10% of the allowable limits¹.

Contact Hazards: Skin contact is another potential exposure route. Staff is required to wear chemical-resistant gloves while performing bulking operations. In all cases reported in this study, chemical-resistant gloves were worn. Facilities also reported the use of additional personal protective equipment including tyvek or polycoated tyvek coveralls and/or an apron.

Respirator use must be in accordance to the OSHA standard 29 CFR 1910.134:

1. Any facility requiring the use of respirators must comply with the entire respirator standard, whether or not the employee is overexposed.
2. If respirators are worn by employees on a voluntary basis, certain provisions of the OSHA respirator standard must still be met.
3. Refer to the *HHW SOP 2.5 – Respiratory Protection* for detailed information and compliance guidance.

Due to the chloroform sampling results from the Kandiyohi County HHW facility, the following is recommended.

1. Containers of waste that include chloroform as the main ingredient should be lab packed instead of bulked.
2. If chloroform is bulked, then the employee shall wear the appropriate respiratory protection and follow *HHW SOP 2.5 – Respiratory Protection*.

Conclusion

The data generated by this study supports the past sampling conducted by the State and other counties. Inhalation of organic vapors does not pose a risk to HHW employees when proper procedures for chemical handling and bulking are followed. This includes the use of adequate ventilation when these operations are conducted indoors.

OSHA standards do not specifically require each facility to conduct air sampling. Instead, OSHA requires the employer to evaluate exposures to determine whether staff is exposed above the limits. Assessment of the facility operations combined with the data from air monitoring studies that have been conducted by the State or individual facilities can be used to make an exposure determination.

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Table 1:	Facility/Sampling Locations	12
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Table 2
Sample Identification & Location Summary

Badge Number	Facility	Person Sampled	Operation
DC6104	Tri-County	Chuck Holmblad	Bulk oil base paint
DC6112	WLSSD	Ryan Cunningham	Bulk oil base paint
DC6117	WLSSD	Randy Johnson	Bulk oil base paint
DC6120	NW	Randy Bodensteiner	Bulk oil base paint
DC6122	NW	Randy Bodensteiner	Bulk oil base paint
DC6130	Clay	Julie Kennedy	Bulk oil base paint
DC6142	Otter Tail	Larris Grewe	Bulk oil base paint
DC6149	Becker	Sandy Gunderson	Bulk oil base paint
DC6154	NW	Randy Bodensteiner	Fuels & flams
DC6161	NW	BLANK	
DC6164	Clay	Kent Severson	Aerosol
DC6166	Blue Earth	Ted Lustvig	Aerosol
DC6168	Lyon	Darron Grahn	Mobile, bulk oil base
DC6171	McLeod	Jeff Strazzinski	Bulk fuel & flams
DC6178	Otter Tail	David Stadum	Aerosol
DC6179	Lyon	Mark Koster	Bulk oil base paint
DC6180	Tri-County	Chuck Homblad	Bulk fuel & flams
DC6181	McLeod	Jeff Strazzinski	Bulk oil base paint
DC6182	Olmsted	David Vail	Bulk oil base paint
DC6183	Olmsted	Mike Shulman	Bulk oil base paint
DC6185	Nobles	Mark Koster	Aerosol
DC6190	Becker	Bob Eilertson	Bulk oil base paint

Table 3
EXPOSURE LIMITS
8-hour TWA (ppm)

<u>Substance</u>	<u>PEL*</u> <u>OSHA</u>	<u>TLV (2005)</u> <u>ACGIH</u>	<u>Target</u> <u>(CNS)^{3,4}</u>
Acetone	750	500	CNS
Benzene	1 (0.5 action level)	0.5 (skin)	CNS
Chloroform	2	10	CNS
Ethyl benzene	100	100	CNS
n-Hexane	50	50 (skin)	CNS
Isopropyl alcohol (isopropanol)	400	200	CNS
Methyl ethyl ketone (MEK) (2-butanone)	200	200	CNS
Methylene chloride (MeCl) (dichloromethane)	25 (12.5 action level)	50	CNS
Stoddard solvent	100	100	CNS
Toluene	100	50 (skin)	CNS
1,1,1-trichloroethane (methyl chloroform)	350	350	CNS
Trichloroethylene	50	50	CNS
Xylene	100	100	CNS

*Minnesota PELs are used where there is a number different than that used by Federal OSHA.

Skin: Skin designation. The chemical can be absorbed through the skin and add to the exposure from inhalation.

Action Level: A limit established by OSHA that indicates that certain actions need to occur when the exposure exceeds this amount. Refer to federal OSHA standard for each specific chemical.

County	Air Contaminant	Badge Number	Sampling Time (hrs)	Conc. TWA (ppm)	8-hr TWA Calc. (ppm)	MN OSHA PEL 8-hr TWA (ppm)	% PEL	ACGIH TLV 2005 8-hr TWA (ppm)	% TLV	In-door	Out-door	Fuel	Aerosol	Oil Base	Sample Date
Clay	Acetone	DC6130	5	65.6	41	750	5.5	500	8.2	X				X	11/2/04
Clay	MeCl	DC6130	5	8.3	5.2	25	20.8	50	10.4	X				X	11/2/04
Clay	Toluene	DC6130	5	9.12	5.7	100	5.7	50	11.4	X				X	11/2/04
Clay	Acetone	DC6164	5.25	95.3	62.54	750	8.34	500	12.5	X			X		11/1/04
Clay	MeCl	DC6164	5.25	13.5	8.86	25	35.4	50	17.72	X			X		11/1/04
Clay	Toluene	DC6164	5.25	16.4	10.76	100	10.7	50	21.52	X			X		11/1/04
Clay	Acetone	DC6220	5	50.8	31.7	750	4.23	500	6.34	X				X	11/2/04
Clay	MeCl	DC6220	5	8.03	5.02	25	20.0	50	10.04	X				X	11/2/04
Clay	Toluene	DC6220	5	9.07	5.67	100	5.67	50	11.34	X				X	11/2/04
Kandiyohi	Acetone	DC6200	4	43.3	21.65	750	2.89	500	4.33	X				X	10/5/04
Kandiyohi	Chloroform	DC6200	4	9.23	4.61	2	230	10	46	X				X	10/5/04
Kandiyohi	Toluene	DC6200	4	20.4	10.2	100	10.2	50	20.4	X				X	10/5/04
Kandiyohi	Chloroform	DC6278	5	4.68	2.92	2	146	10	29	X				X	8/27/04
Kandiyohi	Toluene	DC6278	5	8.93	5.58	100	5.58	50	11.16	X				X	8/27/04
Kandiyohi	Xylene	DC6278	5	5.07	3.17	100	3.17	100	3.17	X				X	8/27/04
Kandiyohi	Benzene	DC6222	6.5	0.447	0.36	1	36	0.5	72	X				X	11/14/05
Kandiyohi	Chloroform	DC6222	6.5	<0.0479	---	2	---	10	---	X				X	11/14/05
Kandiyohi	Toluene	DC6222	6.5	6.62	5.4	100	5.4	50	10.8	X				X	11/14/05
Lyon	Isopropyl alcohol	DC6168	3.5	1.29	0.56	400	0.14	200	0.28	X				X	9/10/04
Lyon	Toluene	DC6168	3.5	0.483	0.19	100	0.19	50	0.38	X				X	9/10/04
Lyon	Xylene	DC6168	3.5	1.15	0.5	100	0.5	100	0.5	X				X	9/10/04

County	Air Contaminant	Badge Number	Sampling Time hrs	Conc. TWA (ppm)	8-hr TWA Calc. (ppm)	MN OSHA PEL 8-hr TWA (ppm)	% PEL	ACGIH TLV 2005 8-hr TWA (ppm)	% TLV	In-door	Out-door	Fuel	Aerosol	Oil Base	Sample Date
NW	Toluene	DC6122	3	3.17	1.19	100	1.19	50	2.38	X				X	9/16/04
NW	Acetone	DC6154	3	3.36	1.26	750	0.17	500	0.25	X		X		X	9/24/04
NW	MeCl	DC6154	3	1.56	0.58	25	2.3	50	1.16	X		X		X	9/24/04
NW	Toluene	DC6154	3	2.48	0.93	100	0.93	50	1.86	X		X		X	9/24/04
NW	Acetone	DC6243	3	3.58	1.34	750	0.18	500	0.27		X		X		9/15/04
NW	MeCl	DC6243	3	0.68	0.25	25	1	50	0.5		X		X		9/15/04
NW	Toluene	DC6243	3	1.47	0.55	100	0.55	50	1.1		X		X		9/15/04
Olmsted	Acetone	DC6021	2	5.98	1.49	750	0.2	500	0.3	X				X	8/26/04
Olmsted	Benzene	DC6021	2	0.193	0.05	1	5	0.5	10	X				X	8/26/04
Olmsted	MEK	DC6021	2	6.79	1.7	200	0.85	200	0.85	X				X	8/26/04
Olmsted	Toluene	DC6021	2	3.33	0.83	100	0.83	50	1.66	X				X	8/26/04
Olmsted	Acetone	DC6182	2	6.27	1.57	750	0.21	500	0.31	X				X	8/26/04
Olmsted	MEK	DC6182	2	6.76	1.69	200	0.84	200	0.84	X				X	8/26/04
Olmsted	Toluene	DC6182	2	3.23	0.81	100	0.81	50	1.62	X				X	8/26/04
Olmsted	Ethyl benzene	DC6183	1.7	1.43	0.3	100	0.3	100	0.3	X				X	9/2/04
Olmsted	Toluene	DC6183	1.7	1.69	0.36	100	0.36	50	0.72	X				X	9/2/04
Olmsted	Xylene	DC6183	1.7	5.62	1.19	100	1.19	100	1.19	X				X	9/2/04
Olmsted	Acetone	DC6230	.75	2.46	0.23	750	0.03	500	0.05	X			X		9/2/04
Olmsted	IPA	DC6230	.75	1.37	0.13	400	0.03	200	0.06	X			X		9/2/04
Olmsted	Toluene	DC6230	.75	1.67	0.16	100	0.16	50	0.32	X			X		9/2/04
Ottertail	Acetone	DC6142	4.5	3.92	2.2	750	0.3	500	0.4	X				X	11/19/04
Ottertail	Toluene	DC6142	4.5	2.18	1.22	100	1.22	50	2.4	X				X	11/19/04
Ottertail	Xylene	DC6142	4.5	1.53	0.86	100	0.86	100	0.86	X				X	11/19/04
Ottertail	Acetone	DC6178	5.25	4.9	3.21	750	0.43	500	0.64	X			X		11/19/04
Ottertail	Toluene	DC6178	5.25	2.54	1.7	100	1.7	50	3.4	X			X		11/19/04
Ottertail	Xylene	DC6178	5.25	1.45	0.95	100	0.95	100	0.95	X			X		11/19/04
Rice	Acetone	DC6236	4	19.6	9.8	750	1.3	500	2	X			X	X	9/9/04
Rice	Stoddard solvent	DC6236	4	12.9	6.45	100	6.45	100	6.45	X			X	X	9/9/04