

Health Consultation

CRENLO INC. PLANT #2

ROCHESTER, OLMSTED COUNTY, MINNESOTA

MARCH 31, 2003

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

You May Contact ATSDR TOLL FREE at
1-888-42ATSDR
or Visit our Home Page at: <http://www.atsdr.cdc.gov>

Health Consultation

Crenlo Inc.

Plant #2

Rochester, Olmsted County, Minnesota

Prepared by the Minnesota Department of Health
Under Cooperative Agreement with
The Agency for Toxic Substances and Disease Registry

FOREWORD

This document summarizes public health issues related to levels of chemicals emitted from Crenlo, Inc. or monitored in ambient air near Crenlo, Inc. It is based on a formal site evaluation prepared by the Minnesota Department of Health (MDH). A number of steps are necessary to do such an evaluation:

- **Evaluating exposure:** MDH scientists begin by reviewing available information about environmental conditions at the site. The first task is to find out information on the stack and fugitive emissions from a facility, and how people might be exposed to these emissions. Usually, MDH does not collect its own environmental sampling data. We rely on information provided by the Minnesota Pollution Control Agency (MPCA), U.S. Environmental Protection Agency (EPA), and other government agencies, businesses, and the general public.
- **Evaluating health effects:** If there is evidence that people are being exposed—or could be exposed—to hazardous substances, MDH scientists will take steps to determine whether that exposure could be harmful to human health. The report focuses on public health—the health impact on the community as a whole—and is based on existing scientific information.
- **Developing recommendations:** In the evaluation report, MDH outlines its conclusions regarding any potential health concern posed by facility emissions, and offers recommendations for reducing or eliminating human exposure to emitted pollutants. The role of MDH in dealing with industrial emissions is primarily advisory. For that reason, the evaluation report will typically recommend actions to be taken by other agencies—including EPA and MPCA. However, if there is an immediate health threat, MDH will issue a public health advisory warning people of the danger, and will work to resolve the problem.
- **Soliciting community input:** The evaluation process is interactive. MDH starts by soliciting and evaluating information from various government agencies, the company responsible for the emissions, and the community surrounding the facility. Any conclusions about the facility are shared with the groups and organizations that provided the information. Once an evaluation report has been prepared, MDH seeks feedback from the public.

A health consultation is a working document. It describes site conditions using data available at a specific time. If more data become available in the future, MDH can write follow-up documents to describe newly available data, information, or changing conditions.

If you have questions or comments about this report, we encourage you to contact us.

Please write to: Community Relations Coordinator
Site Assessment and Consultation Unit
Minnesota Department of Health
625 Robert St. North, P.O. Box 64975
St. Paul, MN 55164

Or call us at: 651-201-4897 or 1-800-657-3908
(toll free call—press "4" on your touch tone phone)

General information available at: <http://www.health.state.mn.us>

Introduction

Crenlo Inc. Plant #2 (Crenlo) is located in Olmsted County, in the northwestern corner of the city of Rochester, Minnesota (see map – Figure #1). It is an industrial painting company that specializes in painting tractor cabs and computer cases. Paints and pigments are mixed on-site, often to individual customer's specifications. Over 2 thousand different paint formulations may be used over the course of a year.

The Crenlo facility applied to the Minnesota Pollution Control Agency (MPCA) for a Title V: Total facility permit in May 2001. An intent of Title V permits is to limit air emissions from industrial facilities to safe levels.

The MPCA and/or community members often request consultation and recommendations from the MDH Site Assessment Unit on the potential health impacts of industrial facilities and operating permits. This health consultation is a result of a request by the MPCA for MDH assistance in reviewing potential health risks that may be associated with Crenlo emissions. The health consultation was prepared in cooperation with the U.S. Agency for Toxic Substances and Disease Registry and includes a review of emission, dispersion and ambient air data from the Crenlo facility and MDH recommendations that are protective of public health. Attachments to this document include joint MPCA/MDH information sheets addressing community concerns and the MPCA final report on ambient air monitoring near the facility.

Community complaint

In early October 2001 MDH was contacted by the MPCA about 2 reports from a member of the Olmsted County Environmental Committee (Paska, 2001a; Paska, 2001b). The individual used a public EPA dispersion model (SCREENS) and Crenlo emission data to estimate possible public exposures to emitted chemicals (see Attachment #1; Paska, 2001a). He then compared resultant, modeled concentrations of toluene and xylene with the National Institute for Occupational Safety and Health (NIOSH) recommended exposure limits (RELs) and concluded that unless individuals were 300 – 600 meters from the facility, they could be exposed to concentrations greater than the occupational limits (see Attachment #2; Paska, 2001b). In addition, he noted that there are 2 daycare facilities within about 150 meters of Crenlo; one across the street to the south, and the other across a highway and elevated above the facility to the northeast (see Figure #1).

NIOSH standards are occupational standards that assume exposed individuals are healthy and that these workers are not members of sensitive sub-populations, such as children or the elderly. In addition, NIOSH criteria are not typically based on No Observable Adverse Effect Levels (NOAELs), but may be based on levels where minimal adverse effects may occur. Therefore, the potential for adverse health effects by individuals exposed to levels of chemicals identified in the reports may have been greater than the reports implied. MDH health assessments use conservatively estimated health-based criteria, intended to be protective of the general public including sensitive individuals (e.g. MDH Health Risk Values (HRVs), EPA Integrated Risk Information System (IRIS) Reference Concentrations (RfDs) or California Office of Environmental Health Hazard Assessment (OEHHA) Reference Exposure Levels (RELs))

Table 1 contains emission estimates from Crenlo's May 2001 Title V Permit Application (Crenlo, 2001b) and dispersion modeling results (MPCA CAPHAPS Model) for locations less than 50 meters from the facility. Reported 'Actual Emissions', as well as 'Potential Emissions' (assuming fulltime operation of the facility) are included.

Table 1								
Chemicals	Emission Estimates (Title V Permit Application - 5/2001)				Possible Maximum Exposure Concentrations (MPCA CAPHAPS dispersion model)			
	Actual emissions		Potential Emissions		@ Actual emissions		@ Potential Emissions	
					Hourly Avg	Yearly Avg	Hourly Avg	Yearly Avg
	lbs/hr	tons/yr	lbs/hr	tons/yr	ug/m³	ug/m³	ug/m³	ug/m³
Cumene	0.04	0.064	6.32	27.7	130	3.1	21,000	1,300
Ethyl benzene	1.4	2.2	28.72	125.8	4,600	110	94,000	6,200
Formaldehyde	0.002	0.003	4.19	18.4	6.5	0.15	14,000	900
Glycol ethers	6.0	9.4	115.68	506.7	20,000	460	380,000	25,000
Hexamethylene-diisocyanate (HDI)	0.004	0.007	24.7	108.1	13	0.34	81,000	5,300
Hexane	-	-	0.6	2.6	-	-	2,000	130
Methanol	0.66	1.0	1.2	5.2	2,200	49	3,900	260
Methyl ethyl ketone (MEK)	9.81	15.3	23.04	100.9	32,000	750	75,000	5,000
Methyl isobutyl ketone (MIBK)	4.37	6.8	5.99	26.2	14,000	330	20,000	1,300
Methylene chloride	-	-	0.15	0.7	-	-	490	34
Phenol	0.29	0.4	9.78	42.9	950	20	32,000	2,100
Toluene	9.08	14.2	123.26	539.9	30,000	700	400,000	27,000
Toluene diisocyanate (TDI)	0.04	0.068	27.8	122	130	3.3	91,000	6,000
Trichloroethane (TCA)	-	-	0.15	0.7	-	-	490	34
Trichloroethylene (TCE)	-	-	0.15	0.7	-	-	490	34
Xylenes	10.55	16.5	233.56	1023	34,000	810	760,000	50,000

Table 2 below contains health-based exposure criteria for emitted chemicals identified in the Crenlo Title V Permit Application. Sources are MDH HRVs (MDH HRV, 2002), EPA IRIS RfCs (EPA IRIS, 2002), OEHHA RELs (CA OEHHA, 2002), and EPA Region 9 Preliminary Remediation Goals (PRGs) (EPA Region 9, 2002).

Table 2

Chemicals	Acute Exposure			Chronic Exposure			Lifetime Exposure	
	Health Endpoint	Acute Health Criteria		Health Endpoint	Chronic Health Criteria		1:100,000 Cancer Risk	
		ug/m ³	Source		ug/m ³	Source	ug/m ³	Source
Cumene				Kidney, adrenal	400	EPA		
Ethyl benzene	Reproductive; developmental	10,000	MDH	Developmental	1,000	EPA		
Formaldehyde	Irritant	94	MDH	Respiratory; eyes	3.0	OEHHA	0.8 **	MDH
Glycol ethers (as EGME)	Reproductive; developmental	90	MDH	Reproductive	60	OEHHA		
Hexamethylene-anate (HDI)				Respiratory	0.01 **	MDH		
Hexane				Nervous; upper respiratory	2,000	MDH		
Methanol	Nervous	25,000	MDH	Developmental	4,000	OEHHA		
Methyl ethyl ketone (MEK)	Irritant	10,000	MDH	Developmental	1,000	EPA		
Methyl isobutyl ketone					83	EPA Region 9		
Methylene chloride	Nervous	10,000	MDH	Cardiovascular; nervous	400	OEHHA	20	MDH
Phenol	Irritant	5,800	MDH	Alimentary; cardiovascular; kidney; nervous	200	OEHHA		
Toluene	Irritant; nervous	37,000	MDH	Nervous; upper respiratory	400	MDH		
Toluene diisocyanate (TDI)				Lower respiratory	0.08 **	MDH		
Trichloroethane (as 1,1,2-							0.6	EPA
Trichloroethylene (TCE)	Reproductive; developmental	2,000	MDH	Nervous; eyes	600	OEHHA	0.20	OEHHA
Xylenes	Irritant; nervous	43,000	MDH	Nervous; respiratory	700	OEHHA		

** May not provide protection to previously sensitized individuals.

Comparison of conservative MPCA CAPHAPs dispersion model results and health-based criteria, confirmed that the reported 'actual emissions' from the facility could result in dangerously high concentrations of some volatile organic chemicals (VOCs) near the facility. In addition, if production were to be increased at the facility and emissions were at 'potential' amounts, concentrations in ambient air would increase proportionally.

As a result of these analyses, MPCA and MDH notified the adjacent daycare centers and began developing plans to characterize emissions and potential exposures more accurately.

Site Visits

On October 15, 2001 representatives of MDH, MPCA and Olmsted County visited the Crenlo facility and conferred with their technical staff and consultants about plant operations and emissions. Crenlo is situated in an industrial park (see Figure #1) that also contains: a daycare center (Civic League Day Nursery), a school bus garage, an auto detailing company, and a trucking company garage. Across a four-lane divided road, the other daycare center (Children's Beginnings) is east-northeast of Crenlo. Farm fields are north and northwest of Crenlo.

Of special concern to MPCA and MDH were the 2 daycare centers within a couple hundred yards of the facility. Civic League Day Nursery is situated across a street, about 100 yards south of Crenlo, and adjacent to the north and east of a school bus garage. Civic League Day Nursery is also directly across the street to the west of a trucking company. While Crenlo is much larger than the other facilities in the industrial park, diesel emissions from the bus and trucking businesses could influence air quality at Civic League Day Nursery. Children's Beginnings is about 250 yards east-northeast of Crenlo. There is a 4-lane highway between the daycare center and Crenlo. Ground level at Children's Beginnings is elevated about 30 feet above Crenlo. Children Beginnings is on the northwest corner of a townhouse development.

Crenlo Plant #2 is a well-kept, flat roof, warehouse-style industrial building. The building has a footprint of about 50,000 square feet and is about 30 feet tall. Most stacks on the roof were inverted J-stacks. Inverted J-stacks will tend to minimize dispersion of emissions since they open downward. No smells were noticeable outside of the facility, and odors inside were not extreme. There are 2 main painting lines that wind from workstation to workstation through the plant. There are large pickling tanks in different areas of the plant where some parts are acid cleaned prior to painting. One enclosed production line uses phosphoric acid for cleaning and then an electrostatic process to apply paint on submerged tractor cabs. Baking the cab in an oven then sets the paint. Water used in this painting line is reportedly cleaned and reused, limiting the overall water use and concentrating waste.

About 250 to 275 gallons of paint are used in the facility per 8-hour shift (Crenlo, 2001a). At the time of the site visit, there was one shift running at Crenlo (Monday through Thursday only), but they have used a limited second shift in the past. About 45% of the paint used is water-based; 50% are thermal set acrylics; and 5% are other types of paint including urethanes. Computer cabinets are typically painted with water-based paints, and acrylics are for external use (tractor cabs).

The company also reported (Attachment #3; Crenlo, 2001c):

- Errors were found in previously reported emissions (e.g. ethylene glycol monobutyl ether usage was about 5 times less than reported (0.6 tons/yr (tpy) instead of 3.2 tpy)).
- The company was seeking replacement for glycol ethers
- The company had stopped use of hexamethylene-diisocyanate (HDI) and toluene-diisocyanate (TDI) catalysts, and was seeking replacements.
- The company had removed, and was continuing to remove, inverted J stacks. They anticipated completing the replacements by November 1, 2001.
- ‘Actual emissions’ reported in the permit application were based on 2000 production. Production volume in 2001 was down about 25%.

A community meeting was held at the Rochester Public Library on October 25 to discuss Crenlo emissions as well as MPCA plans to determine actual emissions and ambient air concentrations of industrial chemicals near the fence line of the facility. About 45 people, primarily parents of children who attended the daycare centers near Crenlo, attended the meeting. Concerns about the possible exposure of children in the daycare centers were discussed in detail. MPCA told the community about plans to set up an air monitoring station near the facility to monitor ambient levels of industrial chemicals. The tone of the meeting was very serious. The residents wanted information about the possible health effects of exposure to emissions, and MDH was able to provide general information about exposure to industrial solvents and paints. One individual was upset that MPCA and MDH approached the community without real data in hand. MDH and MPCA responded that it would have been irresponsible not to convey available information to the community, given the scale of the suggested exposure. MPCA and MDH distributed an information sheet (Attachment #4; MPCA, 2001b) to attendees that explained: how Crenlo came under scrutiny; changes that Crenlo had already made or planned to make due to the concerns raised; MPCA air-monitoring plans; potential health issues; and, MPCA’s permitting process.

MPCA and MDH held a second public meeting, at the request of the Civic League Day Nursery, on November 5. At the time of this second meeting, the monitoring station was operational. However, samples had not been analyzed; therefore, there were no additional data available for discussion. Questions were answered about potential health effects that may be associated with an exposure to high concentrations of chemicals emitted from Crenlo. In addition, MPCA answered questions about ambient air monitoring and dispersion modeling of industrial emissions. MDH and MPCA stated that site visits and discussions with Crenlo suggested that the reported emissions were overestimated and that the actual risk to children at the daycare may be minimal. However, MDH expressed concerns about locating a daycare center in an industrial park, in close proximity to a bus garage, a trucking company, an auto detailing shop and a large painting facility.

Ambient air sampling was conducted from October 29 through December 7. Upon completion of sampling, MPCA and MDH wrote an information sheet to provide a quick synopsis of the results of sampling (see Attachment #5; MPCA, 2001a). A final

summary of sampling results was completed and submitted to interested community members and local officials on January 25, 2002 (see Attachment #6; MPCA, 2002c).

Initial Chemicals of Concern

Chemicals emitted from stacks (point-sources) disperse into ambient air upon release. Inhalation of these chemicals at high enough concentrations in ambient air may result in adverse health effects. Health effects from chemicals are typically broken down into 3 categories corresponding to effects related to different exposure durations: chemicals with acute toxicity may cause effects following short-term exposures (e.g. exposures measured in minutes or hours); chemicals with chronic toxicity have effects that are associated with long-term exposures (e.g. exposures averaged over a year or more); and carcinogens, typically, are considered to have a risk associated with total exposure over a lifetime.

Of the greatest initial concern to MDH and MPCA are chemical emissions that may result in ambient air concentrations that exceed acute health-based criteria. Acutely active chemicals released from Crenlo include: glycol ethers, formaldehyde, diisocyanates, and solvents including methyl ethyl ketone, toluene, and xylene. In addition, chemicals with health impacts related to chronic exposures and carcinogens are also noted as chemicals of concern. Given the long list of chemicals that may exceed health standards in ambient air, all chemicals emitted from Crenlo were considered chemicals of concern.

Discussion

Comparison of modeling results (Table #1) with health criteria (Table #2) suggested that emissions by Crenlo could be causing a public health emergency. However, no community complaints had been registered with MDH (through the Minnesota State Duty Officer) from 1998 through 2001.

Rough calculations suggested that the emission estimates provided by Crenlo in May 2000 exceeded actual emissions by a large amount. Emissions in the above tables are for chemicals that volatilize from paint only. The company uses about 250 - 275 gallons of paint per day. Two hundred and seventy-five gallons of paint weigh about 2,200 lbs. If $\frac{3}{4}$ of the paint is volatile chemicals, and only $\frac{1}{4}$ is deposited onto products, then 1650 lbs is the maximum amount of chemicals emitted daily. Over the span of a year, this yields maximum yearly emissions of 430,000 lbs. Crenlo's report says that their actual emissions from paint are about 2,000,000 lbs yearly, or 5 times a very liberal gross estimate. Many paints used at Crenlo are water-soluble and are applied electrostatically in a water bath. Therefore, the fraction of volatile organic compounds (VOCs) in these paints is significantly lower than the above estimates. In addition, wastewater from Crenlo also contains significant amounts of paint chemicals that are assumed in a rough model to be emitted in the air.

In addition, observations during the site-visit on October 15 also suggested that emissions were not resulting in a public health emergency. Therefore, MDH's priority was to obtain reliable data needed to develop reasonable estimates of exposure for children and

workers in the daycare centers, as well as workers in other nearby businesses and nearby residents.

Ambient air sampling

MPCA began sampling on October 29 for volatile organic compounds (VOCs), carbonyls, glycol ethers and toluene diisocyanate (TDI). Sampling continued until December 7. Chemical samples were collected over an 8-hour period (7 A.M to 3 P.M.) Monday through Friday. Throughout the sampling period, meteorological instruments monitored temperature, relative humidity, wind speed, and wind direction.

Problems were encountered with the instrument attempting to continuously monitor TDI. The instrument was designed to operate indoors, and humidity above an undetermined percent appears to register as TDI (MPCA, 2001c). MPCA monitoring experts are attempting to modify the instrument to work outdoors, but to-date monitoring for TDI has not occurred.

VOC and carbonyl data are reported in the MPCA Staff Summary Report (see Attachment #6; MPCA, 2002c). Glycol ethers: 2-butoxyethanol, 2-ethoxyethanol, and 2-methoxyethanol were not found in any samples at detection limits of 0.05, 0.04, and 0.03 $\mu\text{g}/\text{m}^3$, respectively (MDH, 2001; MDH, 2002).

Of the chemicals listed in Tables 2 and 3, toluene diisocyanate, hexamethylene-diisocyanate, methyl ethyl ketone, methyl isobutyl ketone and phenol were not analyzed.

Sampling discussion

The sampling station was set up south-southeast of the Crenlo facility in anticipation of fall and winter winds, which are predominately from the north-northwest. In addition, the sampling location was directly across the street from Civic League Day Nursery. Sampling methods are discussed in detail in the attached MPCA Staff Summary Report on Monitoring near Crenlo, Inc. (see Attachment #6; MPCA, 2002c).

Unfortunately, weather during the fall of 2001 was atypically warm and the wind was rarely from Crenlo toward the sampling station. Only 9 of the 28 days of sampling was the wind at any time (during the 7 A.M to 3 P.M. sampling period) from Crenlo toward the sampling station, and on only 3 of those days was it toward the sampling station greater than 50% of the time. November 8 wind direction during sampling (8 hours) was from the Crenlo 98% of the time, November 19 wind was from Crenlo 67% of the time, and on November 30 wind was from Crenlo 56% of the sampling time. Furthermore during the entire sampling period (28 days, 8 hours per day), the wind was from Crenlo toward the sampling station only 10.4% of the time. Figure #2 is a graphic summary of the wind data for the sampling period. Note from the map Figure #1 that Crenlo is located north-northwest of the monitoring station. Figure #2 shows the lack of regular wind from Crenlo (between about 300° and 350° (MPCA, 2002a)) during the sampling period.

The concentration of chemicals measured at a sampling station can be affected by the amount of chemical emitted, the direction from the source to the monitoring station, and the dispersion of emitted chemicals. Because only 3 days of sampling occurred when the wind was toward the monitoring station, and paint orders and production vary daily, it is unlikely that the samples taken were representative of emissions at other times. In addition, even though the wind on these 3 days was generally toward the sampling station, higher or lower concentrations in ambient air would be expected at other locations in the air plume. Furthermore, increased wind speed and turbulence facilitates dispersion, and the wind speed on these 3 days was very high (averaging 8-10 MPH; see Figure #2). Therefore, while a month of monitoring could possibly discover a serious problem, only long-term monitoring or modeling can determine if there may be smaller, but still significant hazards associated with emissions from a facility like Crenlo.

Sampling data discussion

Ratios of individual chemical concentrations when wind was from Crenlo toward the sampling station, to when wind was away from the sampling station, ranged from 70 to 0.56. Table #3 shows the concentrations of chemicals found in ambient air when the wind was from Crenlo toward the sampling station, and when it was not. Table #3 also shows the ratio of those concentrations. Ratios near or below 1 suggest that background concentrations in the vicinity of Crenlo contribute more to ambient air than Crenlo, or that there are other point or area sources nearby. Nineteen of the 44 chemicals analyzed were regularly found in ambient air. Of these 19, 7 had mean concentrations in ambient air that were less when the wind was from Crenlo than when it was from other directions. Ratios for another 2 chemicals were below 2. From sampling data it appears that Crenlo may be a significant source of 10 chemicals sampled. These chemicals are listed in Tables 3 & 4.

Non-detection of glycol ethers at analytical detection limits below $0.05 \mu\text{g}/\text{m}^3$ suggests that glycol ethers were not a health concern during the sampling period. Since analysis of diisocyanate compounds has not been successful at this location, it is not known what concentrations of diisocyanates are in ambient air near Crenlo. Some reports suggest that TDI and other diisocyanates are very reactive and will react with other chemicals, forming non-toxic products, before they travel very far from their source. However, there appears to be conflicting information about diisocyanate reactivity. Data summaries from Spectrum Laboratories (<http://www.speclab.com/compound/c584849.htm>) and the California Air Resources Board cite 3.3 hour and 1.4 day half-lives in the atmosphere for TDI. Diisocyanates may be emitted as vapors or as aerosols (particulate phase). These different physical phases can be expected to have different reactivities. In addition, analytical methods may also have different sensitivity to vapors and aerosols.

Table 3			
Chemicals*	Mean of 8-hour sample concentrations - ug/m³ (Standard Deviation)		8-hour sample ratio Wind from Crenlo: Wind NOT from Crenlo
	Wind from Crenlo (n=3)	Wind NOT from Crenlo (n=25)	
butyraldehyde	22 (20)	0.32 (0.29)	70
toluene	10 (8.6)	1.5 (1.0)	7.0
m&p-xylene	3.6 (3.5)	0.60 (0.48)	6.0
ethylbenzene	1.1 (1.1)	0.21 (0.16)	5.4
1,3,5-trimethylbenzene	0.22 (0.32)	0.051 (0.054)	4.3
o-xylene	0.86 (0.96)	0.21 (0.17)	4.0
trichloromethane	0.029 (0.026)	0.0082 (0.018)	3.6
acetone	9.9 (7.5)	3.1 (2.1)	3.2
4-ethyl toluene	0.51 (0.72)	0.16 (0.14)	3.2
1,2,4-trimethylbenzene	0.68 (0.97)	0.22 (0.17)	3.1
propionaldehyde	0.16 (0.099)	0.12 (0.100)	1.4
1,1,1-trichloroethane	0.26 (0.036)	0.19 (0.10)	1.3
trichlorofluoromethane	1.5 (0.084)	1.6 (0.086)	0.97
carbon tetrachloride	0.62 (0.036)	0.64 (0.059)	0.97
dichlorodifluoromethane	2.6 (0.26)	2.8 (0.31)	0.95
trichlorotrifluoroethane	0.43 (0.17)	0.57 (0.069)	0.76
formaldehyde	1.9 (1.5)	2.7 (1.3)	0.71
acetaldehyde	1.0 (0.72)	1.7 (0.99)	0.60
benzene	0.55 (0.16)	0.97 (0.50)	0.56

* Analysis of variance (ANOVA) of chemicals in **Bold** show significant difference between samples collected when the wind was from Crenlo, and when the wind was not from Crenlo (p<0.1).

Chemicals in ambient air that may be associated with Crenlo

Data suggest that emissions from Crenlo may be a significant source of 10 of the chemicals found in ambient air near the facility. When wind was from Crenlo toward the sampling station, 8-hour samples of these chemicals contained between 3.1 and 70 times the concentration measured when wind direction was not across the facility (see Table 3). In addition, statistical analyses of the differences in ambient air concentrations for these 10 chemicals (as well as trichlorotrifluoroethane) with Analysis Of Variance (ANOVA;

Microsoft Excel 2000 Data Analysis) demonstrate a significant difference between these 2 datasets. All sample data from the Crenlo monitoring site were 8-hour samples, collected from 7 AM to 3 PM Monday through Friday.

Table 4 shows ambient air data for the 9 chemicals (*m&p*-xylenes and *o*-xylene are combined into total xylenes for toxicity analysis) that are emitted by Crenlo, as well as 4 other chemicals of interest. The left side of the table presents data that may be used to assess long-term (chronic) exposures. These include 28-day (8-hour) mean concentration of chemical sampled at the Crenlo monitoring site, as well as data from days when the wind (8-hour sampling period) was from Crenlo toward the monitoring station over 50% of the time (n=3, 73% mean, 22% standard deviation) and on days when the wind (8-hour sampling period) was from Crenlo 0 - 50 % of the time (n=25, 1.8% mean, 6.0% standard deviation). Furthermore, health criteria based on chronic and cancer endpoints are included for comparison. Typically, chronic impacts require exposures averaged over a year or more, whereas cancer risks are calculated for lifetime (70 year) average exposures.

The right side of Table 4 summarizes the available data for short-term (acute) exposures to the identified chemicals of concern. These data include the maximum 8-hour sample concentration of a chemical on days when the wind was from Crenlo toward the sampling station (n=3) and the maximum sample concentration on days when the wind was not from Crenlo (n=25). In addition, health criteria based on acute exposures are included. These criteria are not directly comparable to sampling maximums because the criteria assume a 1-hour (or less) exposure.

For comparison, Table 4 also includes the latest published data (1998) from the MPCA statewide network of air monitoring stations (<http://www.pca.state.mn.us/air/staffpaper-airtoxics.html#search>). In 1998, 31 stations were active. Locations of most of the monitoring stations were chosen to be representative of many other areas throughout the state. Some of these monitoring stations may be impacted by industrial or landfill, point or area source emissions. All statewide monitoring data are collected every sixth day; therefore, over a year of monitoring, include data from every day of the week. Also note that the statewide network records 24-hour samples, whereas the Crenlo data are from 8-hour samples. Table 4 includes: the statewide mean concentrations for all 1998 analyses (and median concentrations) for comparison with Crenlo 28-day mean data; and, the upper 95% of all of the 24-hour sample data (and 1 day maximums) collected by the statewide monitoring network for comparison with the maximum 8-hour samples from the Crenlo monitoring station. Note that individual 8-hour and 24-hour samples are not likely to be representative of maximum 1-hour concentrations due to time dilution.

Table 4

Chemicals	*Statewide Monitoring Network: 24-hour sample - Mean ug/m ³ (Median)	Crenlo Site: 8-hour sample concentration - Mean (28-days) ug/m ³ **(wind from Crenlo, wind other)	Health-based Reference Values			Crenlo Site: 8-hour Sampling Data - Maximum		*Statewide Monitoring Network: 24-hour sample - Upper 95% ug/m ³ (Maximum)
			Chronic ug/m ³	Cancer	Acute ug/m ³	**Wind from Crenlo	Wind other	
				<1:100,000*** ug/m ³		ug/m ³		
butyraldehyde	0.26 (0.23)	2.7 (22, 0.32)	9 [#]			40	1.1	0.76 (3.4)
toluene	2.8 (2.3)	2.4 (10, 1.5)	400		37,000	15	4.2	9.1 (60)
total xylene (o,m&p)	2.0 (1.6)	1.2 (4.5, 0.82)	700		22,000	9.0	2.9	6.2 (25)
ethylbenzene	0.45 (0.37)	0.30 (1.1, 0.21)	1000		10,000	2.2	0.66	1.4 (5.4)
1,3,5-trimethylbenzene	0.012 (0.025)	0.070 (0.22, 0.051)	6.2			0.59	0.20	0.22 (0.44)
trichloromethane	0.11 (0.088)	0.010 (0.029, 0.0082)		0.4	150	0.049	0.063	0.25 (4.8)
acetone	1.7 (1.7)	3.9 (9.9, 3.1)	370		110,000	19	8.5	3.4 (8.0)
4-ethyl toluene		0.20 (0.51, 0.16)	400 ^{##}		37,000 ^{##}	1.3	0.58	
1,2,4-trimethylbenzene	0.055 (0.054)	0.27 (0.68, 0.22)	6.2			1.8	0.71	0.13 (0.46)
propionaldehyde	0.16 (0.15)	0.12 (0.16, 0.12)	9 [#]			0.28	0.40	0.43 (0.90)
benzene	1.3 (1.2)	0.92 (0.55, 0.97)		1.3 - 4.5	1000	0.73	2.5	3.2 (12)
carbon tetrachloride	0.66 (0.78)	0.64 (0.62, 0.64)		0.7		0.64	0.79	0.91 (1.1)
formaldehyde	1.7 (1.5)	2.6 (1.9, 2.7)		0.8	94	3.6	6.2	4.1 (21)
acetaldehyde	1.1 (1.0)	1.6 (1.0, 1.7)	9	5.0 [§]		1.8	4.4	2.6 (5.2)

* 1998 data from 31 sampling stations

** Wind from Crenlo - 290-360 degrees from sampling station (weighted)

*** Exposure at this concentration for a lifetime may result less than 1 additional cancer in 100,000 exposed individuals.

Acetaldehyde used as a surrogate for chemicals with similar structure

Toluene used as a surrogate for chemical with similar structure (xylene may also be used as a surrogate for 4-ethyl toluene)

§ There is no indication that butyraldehyde or propionaldehyde are carcinogens, but the toxicity surrogate (acetaldehyde) is classified by EPA as a probable human carcinogen (Class B2)

Health-based Reference Value - Sources (format-coded)

MDH HRVs - MDH Health Risk Values

IRIS RfCs / Cancer risk - US EPA Integrated Risk Information System Reference Concentrations

CalEPA OEHHA RELs - California Office of Environmental Health Hazard Assessment Reference Exposure Levels

EPA Region 9 PRGs - EPA Region 9 Preliminary Remediation Goals

ATSDR MRLs - Agency for Toxic Substances and Disease Registry Minimal Risk Levels

Butyraldehyde, propionaldehyde, acetaldehyde

Crenlo is an apparent source of relatively large amounts of butyraldehyde: the mean concentration of butyraldehyde in air on days when the wind was from Crenlo exceeded the mean concentrations on days when the wind was not from Crenlo by 70 times. In addition, Crenlo may be a minor source of propionaldehyde (ratio 1.4). The toxicity of these 2 chemicals has not been quantified by regulatory and health agencies because there are limited data available on the adverse health effects associated with them.

Aldehydes in general are strong irritants, and both of these chemicals are similar in chemical structure to acetaldehyde. However, larger aldehydes are generally less reactive than small aldehydes like acetaldehyde (unless they have a unique mechanism of toxicity). As a result, butyraldehyde and propionaldehyde are likely to be less toxic than acetaldehyde (Brabec, 1993). Therefore, the toxicity of acetaldehyde is a reasonable and conservative surrogate to use when evaluating the potential health hazards of butyraldehyde and propionaldehyde.

The sum of the 28-day (8-hour) mean concentrations of acetaldehyde, butyraldehyde and propionaldehyde was $4.43 \mu\text{g}/\text{m}^3$ (1.61, 2.69 and $0.125 \mu\text{g}/\text{m}^3$; 28-day mean concentration for each chemical, respectively). EPA (EPA IRIS, 2002) has an acetaldehyde chronic health reference concentration (RfC) of $9 \mu\text{g}/\text{m}^3$ that is based on degeneration of olfactory epithelium in rats. Exposures at this site are not 24-hour exposures. Therefore, these 8-hour potential exposures should be averaged with additional exposures in one's daily life when estimating a total long-term (chronic) exposure. In addition, this sampling period resulted in only 10.4% of all air samples coming from the direction of Crenlo.

It is expected that any changes in emission rates and different meteorological conditions may result in exposures that are both higher and lower than those measured. Therefore, because the monitored levels were about $\frac{1}{2}$ of the chronic health criterion, MDH recommends that acetaldehyde, butyraldehyde and propionaldehyde emissions from Crenlo, and potential exposures, should be characterized more completely.

The MPCA has 31 sites throughout the state that monitor air toxics, including VOCs. For comparison, the mean concentrations of acetaldehyde, butyraldehyde and propionaldehyde at these statewide sites in 1998 were $1.08 \mu\text{g}/\text{m}^3$, $0.264 \mu\text{g}/\text{m}^3$ and $0.164 \mu\text{g}/\text{m}^3$, respectively (MPCA, 2002b).

There are no acute toxicity criteria for acetaldehyde, butyraldehyde or propionaldehyde. However, tolerance of exposure to chemical concentrations above chronic criteria typically increases with decreasing time of exposure. Monitored 8-hr maximum concentrations for the 2 days that the wind was from Crenlo toward the monitoring station were 1.84, 40.34 and $0.28 \mu\text{g}/\text{m}^3$ for acetaldehyde, butyraldehyde and propionaldehyde, respectively. During the sampling time that the wind was not from Crenlo, 8-hr maximum concentrations of acetaldehyde, butyraldehyde and propionaldehyde concentrations were 4.37, 1.11 and $0.40 \mu\text{g}/\text{m}^3$, respectively. The maximum monitored 24-hour concentrations in the statewide monitoring network (see above) in 1998 for acetaldehyde, butyraldehyde and propionaldehyde were 5.24, 3.41, and $0.903 \mu\text{g}/\text{m}^3$ (MPCA sites #2005, #945 and #420, respectively) (MPCA, 2002b). Table 4 also includes the concentration that was greater than 95% of all 24-hour samples collected in 1998 by the statewide monitoring network for each chemical.

Acetaldehyde is considered by EPA to be a carcinogen, but there are no reports suggesting that butyraldehyde and propionaldehyde are carcinogens. Therefore it is

inappropriate to compare the sample data for butyraldehyde and propionaldehyde to the cancer health criterion for acetaldehyde that is listed in Table 4.

Toluene and 4-ethyl toluene

Toluene emissions from Crenlo were noted in the ambient air sampling data. The ratio of ambient air concentrations when the wind was predominantly from Crenlo was 7.0 times greater than when it was not. In addition, 4-ethyl toluene also appears to be emitted from Crenlo (3.2 sampling ratio). The chemical structure of toluene (and also *p*-xylene) is similar to the structure of 4-ethyl toluene; therefore, toluene is a reasonable toxicity surrogate in lieu of any additional 4-ethyl toluene toxicity data. The mean toluene and ethyl-toluene concentrations during the 28-day (8-hour) sampling period were 2.42 $\mu\text{g}/\text{m}^3$ and 0.20 $\mu\text{g}/\text{m}^3$, respectively. A chronic HRV of 400 $\mu\text{g}/\text{m}^3$ is based on its effects on the nervous system and the upper respiratory system (MDH HRV, 2002). The mean toluene concentration at statewide monitoring sites in 1998 was 2.84 $\mu\text{g}/\text{m}^3$ (MPCA, 2002b). No statewide data are available on 4-ethyl toluene.

The maximum 8 hour concentrations of toluene and 4-ethyl toluene when the wind was from Crenlo were 15.4 $\mu\text{g}/\text{m}^3$ and 1.34 $\mu\text{g}/\text{m}^3$, respectively. When the wind was not from Crenlo, the maximum 8-hour ambient air concentrations were 4.2 $\mu\text{g}/\text{m}^3$ and 0.58 $\mu\text{g}/\text{m}^3$, respectively. An acute MDH HRV for toluene of 37,000 $\mu\text{g}/\text{m}^3$ is based on its activity as an irritant and for nervous system effects (MDH HRV, 2002). The maximum concentration of toluene at statewide monitoring sites in 1998 was 60.0 $\mu\text{g}/\text{m}^3$ (MPCA site #1240) (MPCA, 2002b).

Trimethylbenzenes

1,3,5-trimethylbenzene and 1,2,4-trimethylbenzene in samples when the wind was from Crenlo toward the sampling station were 4.3 and 3.1 times the concentration on days when the wind was from other directions. Therefore, Crenlo is a likely source of these trimethylbenzenes. A (chronic) Provisional RfC (also cited as a preliminary remediation goal) of 6 $\mu\text{g}/\text{m}^3$ for each trimethylbenzene is based on neurological effects in occupational studies of trimethylbenzene mixtures (EPA Region 9, 1996). The 28-day (8-hour) mean concentrations of 1,3,5-trimethylbenzene and 1,2,4-trimethylbenzene were 0.070, 0.27 $\mu\text{g}/\text{m}^3$, respectively. The statewide 24-hour mean at monitoring sites in 1998 was 0.012 $\mu\text{g}/\text{m}^3$ for 1,3,5-trimethylbenzene, and 0.055 $\mu\text{g}/\text{m}^3$ for 1,2,4-trimethylbenzene (MPCA, 2002b).

When the wind was from Crenlo, maximum 8-hour concentrations of 1,3,5-trimethylbenzene and 1,2,4-trimethylbenzene were 0.59 $\mu\text{g}/\text{m}^3$ and 1.8 $\mu\text{g}/\text{m}^3$, respectively. When the wind was not from Crenlo the maximum 8-hour ambient air concentrations were 0.20 $\mu\text{g}/\text{m}^3$ and 0.71 $\mu\text{g}/\text{m}^3$, respectively. The toxicity of trimethylbenzene in acute exposure scenarios has not been determined. The maximum concentration of 1,3,5-trimethylbenzene and 1,2,4-trimethylbenzene at statewide monitoring sites in 1998 were 0.44 and 0.46 $\mu\text{g}/\text{m}^3$ (MPCA monitoring sites #438 and #7549), respectively (MPCA, 2002b).

Trichloromethane

Trichloromethane (chloroform) was apparently emitted from Crenlo during the sampling period. The mean concentration in ambient air when the wind was from Crenlo was $0.029 \mu\text{g}/\text{m}^3$, and $0.0082 \mu\text{g}/\text{m}^3$ when the wind was not from Crenlo. Trichloromethane is considered a probable human carcinogen by EPA; with a maximum additional incremental risk of 1 in 100,000 for individuals exposed for their lifetime at $0.4 \mu\text{g}/\text{m}^3$ (EPA IRIS, 2002). The mean statewide monitoring network 24-hour concentration of trichloromethane for 1998 was $0.11 \mu\text{g}/\text{m}^3$ (MPCA, 2002b).

The maximum concentration of trichloromethane in an 8-hour sample was $0.049 \mu\text{g}/\text{m}^3$, when the wind was from Crenlo. MDH has an acute HRV for trichloromethane of $150 \mu\text{g}/\text{m}^3$ (MDH HRV, 2002) based on developmental and reproductive effects. The maximum statewide monitoring network 24-hour concentration of trichloromethane for 1998 was $4.8 \mu\text{g}/\text{m}^3$ (MPCA Site #1240) (MPCA, 2002b).

Xylenes

Xylene isomers *m,p&o* are apparently emitted from Crenlo: their ambient air concentrations were higher in ambient air when the wind was from Crenlo, by 6.0 (*m&p*-xylene) and 4.0 times (*o*-xylene). A chronic REL for total xylenes of $700 \mu\text{g}/\text{m}^3$ is based on effects on the nervous and upper respiratory systems (CA OEHHA, 2002). The 28-day (8-hour) mean concentration of total xylene measured at the Crenlo monitoring station was $1.2 \mu\text{g}/\text{m}^3$. The statewide 24-hour mean at monitoring sites in 1998 was 2.0 total xylene (MPCA, 2002b).

The maximum 8-hour concentration of total xylene when the wind was from Crenlo was $9.0 \mu\text{g}/\text{m}^3$. When the wind was not from Crenlo, the maximum 8-hour ambient air concentration was $2.9 \mu\text{g}/\text{m}^3$. The MDH Acute HRV for total xylene of $43,000 \mu\text{g}/\text{m}^3$ is based on its activity as an irritant and for nervous system effects (MDH HRV, 2002). The maximum concentration of total xylenes at statewide monitoring sites in 1998 was $25 \mu\text{g}/\text{m}^3$ (MPCA Site #820) (MPCA, 2002b).

Acetone

Acetone concentrations in ambient air during the monitoring period were about 3.2 times higher on days when the wind was predominantly from Crenlo towards the monitoring station. When the wind was from Crenlo the (8-hour) mean ambient air concentration was $9.9 \mu\text{g}/\text{m}^3$. When the wind was not from Crenlo the (8-hour) mean ambient air concentration was $3.1 \mu\text{g}/\text{m}^3$. The (chronic) EPA Region 9 Preliminary Remediation Goal (screening concentration) for acetone of $370 \mu\text{g}/\text{m}^3$ is calculated using a route-to-route extrapolation from an IRIS Reference Dose (RfD) (EPA Region 9, 2002). The RfD is based on a potential to incur adverse liver and kidney effects from chronic exposure to acetone (EPA IRIS, 2002). The statewide mean acetone concentration at monitoring sites in 1998 was $1.7 \mu\text{g}/\text{m}^3$ (MPCA, 2002b).

The maximum 8-hour concentration of acetone when the wind was from Crenlo was $19 \mu\text{g}/\text{m}^3$. When the wind was not from Crenlo, the maximum 8-hour ambient air concentration was $8.5 \mu\text{g}/\text{m}^3$. ATSDR has an acute MRL of $63,000 \mu\text{g}/\text{m}^3$, based on

neurological endpoints (ATSDR, 2001). The maximum concentration of acetone at statewide monitoring sites in 1998 was $8.0 \mu\text{g}/\text{m}^3$ (MPCA, 2002b).

Discussion

A number of other compounds, not associated with Crenlo, were detected in the monitoring samples at concentrations that approach levels of concern to MDH. These include benzene, formaldehyde and carbon tetrachloride. Benzene has an acute HRV of $1000 \mu\text{g}/\text{m}^3$, based on reproductive and developmental effects (MDH HRV, 2002). Formaldehyde has an acute HRV of $94 \mu\text{g}/\text{m}^3$ based on its irritant properties (MDH HRV, 2002). In addition, benzene, formaldehyde and carbon tetrachloride are all considered carcinogens, with health criteria (based on a maximum of 1 additional case in 100,000 individuals exposed for a lifetime) of 1.3 to $4.5 \mu\text{g}/\text{m}^3$ (MDH HRV, 2002), $0.7 \mu\text{g}/\text{m}^3$ (EPA IRIS, 2002), and $0.8 \mu\text{g}/\text{m}^3$ (MDH HRV, 2002), respectively. Mean (8-hour) concentrations for these chemicals during the 28 days of monitoring were 0.92 , 0.64 , and $2.6 \mu\text{g}/\text{m}^3$, respectively. In addition to these 3 chemicals, the mean ambient air concentration of acetaldehyde (a carcinogen, noted above: cancer-based HRV of $5 \mu\text{g}/\text{m}^3$ (MDH HRV, 2002)) was $1.6 \mu\text{g}/\text{m}^3$ ($4.37 \mu\text{g}/\text{m}^3$ maximum) during (8-hour) sampling.

The 1998 mean concentrations at the MPCA Rochester monitoring site (1801 9th Ave. SE, Rochester) were $1.1 \mu\text{g}/\text{m}^3$, $0.77 \mu\text{g}/\text{m}^3$, $1.5 \mu\text{g}/\text{m}^3$ and $0.83 \mu\text{g}/\text{m}^3$ for benzene, carbon tetrachloride, formaldehyde and acetaldehyde, respectively. The means of statewide monitoring data for 1998 showed concentrations of these four carcinogens to be $1.3 \mu\text{g}/\text{m}^3$, $0.66 \mu\text{g}/\text{m}^3$, $1.7 \mu\text{g}/\text{m}^3$, and $1.1 \mu\text{g}/\text{m}^3$. These data suggest that background levels of these 4 chemicals contribute to general air pollution near Crenlo as they do throughout the state.

Note that the ratio of benzene in ambient air when the wind was from Crenlo, to the benzene concentration when wind was not from Crenlo was 0.56. This dependence of air concentration on wind direction suggests that there may be a point or area source of benzene near Crenlo. The source may be: the city of Rochester (traffic or industry); businesses in the industrial park other than Crenlo, or other unidentified sources. The 1998 mean concentration of benzene at the Rochester Monitoring site was greater than the 28-day mean benzene concentration at the Crenlo site. While acetaldehyde and formaldehyde concentrations in ambient air were also greater when the wind was not from Crenlo, only the trichlorotrifluoroethane concentrations were significantly different when the wind was not from Crenlo (ANOVA; $p < 0.1$: see Table 3).

Data from the monitoring station set up from the end of October through the beginning of December 2001 suggest that emissions attributable to Crenlo did not, during the sampling time, constitute a significant public health hazard. However, the data acquired were limited by meteorological conditions during the sampling period, by the fixed location of the sampling equipment, and by the inability to measure TDI and HDI in ambient air. Therefore, additional information should be gathered during the planned Air Toxics Review.

Future Plans

MPCA anticipates finishing a Title V operating permit for Crenlo in early 2003. A draft permit is almost complete. MPCA staff plans to include stack testing and modeling of emissions followed by an analysis of any potential health impacts (i.e. air toxics review by health risk experts) in the permit. Protection of public health is one of the focuses of an MPCA Air Toxics Review. MDH reviews permits and Air Toxics Reviews at the request of affected communities, local governments, MPCA staff or the industrial facilities themselves.

Children's Health

The health consultation process includes an evaluation of hazards and risks posed to sensitive subpopulations, including children. The Crenlo site is within 250 meters of 2 daycare centers. Civic League Day Nursery, south of Crenlo, is Crenlo's closest neighbor. Therefore, it is likely that children and employees at the daycare center have the greatest potential exposure to Crenlo emissions. Health criteria used in this health consultation to evaluate the potential for adverse health effects are protective of children. Therefore subject to the analytical and monitoring limitations discussed above, there is no evidence at this time that contaminants emitted from Crenlo present a significant health risk to children at the daycare centers.

MDH does have general concerns about sighting a daycare center in an industrial park. While the emissions from each industry in an area may be safe, it is possible that the sum of exposures to emissions from all industries may be problematic. At this location, Civic League Day Nursery is situated between Crenlo, a school bus garage, a trucking company, and an auto detailing shop. All of these businesses emit volatile organic compounds (VOCs). Children at the daycare center will not be exposed to emissions from all sources simultaneously; emissions will come from each business as the wind shifts. Therefore, while the average exposure to chemicals from each facility may be small, the cumulative exposure to VOCs from all facilities may be significant.

Conclusions

- Monitoring data collected from October 29 through December 7, 2001 suggested that Crenlo is a source of butyraldehyde, toluene, xylenes, ethylbenzene, trimethylbenzenes, 4-ethyl toluene, trichloromethane and acetone. None of these chemicals were monitored at levels of health concern; however, 8-hour samples may dilute short-term maximum exposures. In addition, during the entire sampling period (28 days) wind direction was only from Crenlo toward the sampling station on only 3 days.
- Data suggested that ambient air concentrations near Crenlo approach or exceed health criteria for benzene, formaldehyde and carbon tetrachloride. The levels of these contaminants recorded at this site are in agreement with data from other monitoring stations throughout the state and appear to be representative of statewide background concentrations.

- Data suggests that Crenlo emissions do not constitute an immediate health risk to exposed individuals, but further characterization of emissions is necessary to determine if emissions restrictions are needed.
- This site is categorized as posing “no apparent public health hazard”.

MDH Recommendations

- Crenlo air emissions should be characterized.
- MPCA should conduct an Air Toxics Review of the facility so that any potential health impacts will be identified.
- Caution should be exercised when sighting daycare centers in industrial areas, or industrial parks.

Public Health Action Plan

- MDH will assist with review of further analyses, if requested.

This consultation was prepared by:

Carl Herbrandson, Ph. D.

Toxicologist

Site Assessment and Consultation Unit

Environmental Surveillance and Consultation Section

Minnesota Department of Health

References

- Agency for Toxic Substances and Disease Registry (2001). Minimal Risk Levels. Atlanta, GA: Online, December 2001, <http://www.atsdr.cdc.gov/mrls.html>.
- Brabec, M.J. (1993). Aldehydes and Acetals. Patty's Industrial Hygiene and Toxicology. G. D. Clayton and F. E. Clayton. New York, John Wiley & Sons. V. 2 Part A: 283-327.
- California Office of Environmental Health Hazard Assessment (2002). Reference Exposure Levels. Sacramento, CA: Online, December 2002, http://www.oehha.org/air/hot_spots/index.html.
- Crenlo, Inc. (2001a). On-site Meeting. Crenlo, Plant 2, Rochester, MN. MDH, MPCA, Olmsted County, October 15, 2001.
- Crenlo Inc. (2001b). Permit Application. Crenlo, Inc. Plant #2, Rochester, MN: Form EC-13A, Submitted to Minnesota Pollution Control Agency, May 2001.
- Crenlo, Inc. (2001c). Update on response actions. W. DeBruin, Crenlo, Rochester, MN. Letter to A. Jackson, Minnesota Pollution Control Agency, October 11, 2001.
- U. S. Environmental Protection Agency (2002). Integrated Risk Information System. Office of Research and Development, National Center for Environmental Assessment, Cincinnati, OH: Online, December 2002, <http://www.epa.gov/iris/>.
- U.S. Environmental Protection Agency Region 9, (1996). Risk Assessment Issue Paper for: Derivation of a Provisional RfC for 1,3,5-Trimethylbenzene (CASRN 108-67-8) and 1,2,4-Trimethylbenzene (CASRN 95-63-6), San Francisco, CA. Issue Paper, March 8, 1996.
- U. S. Environmental Protection Agency Region 9 (2002). Preliminary Remediation Goals. San Francisco, CA: Online, October 2002, <http://www.epa.gov/region09/waste/sfund/prg/index.htm>.
- Minnesota Department of Health (2001). Laboratory Report, St. Paul, MN. Glycol Ethers Analysis, November 2001.
- Minnesota Department of Health (2002). Laboratory Report, St. Paul, MN. Glycol Ethers Analysis, January 2002.
- Minnesota Department of Health (2002). Health Risk Values. Environmental Surveillance and Assessment Section, St. Paul, MN: Minnesota Rule, Online, September 11, 2002, <http://www.revisor.leg.state.mn.us/arule/4717/8000.html>.
- Minnesota Pollution Control Agency (2001a). Crenlo: Results of Air Monitoring in Northwest Rochester, St. Paul, MN. Information Sheet, December 2001.
- Minnesota Pollution Control Agency (2001b). MPCA Testing Air Quality in Rochester, St. Paul, MN. Information Sheet, October 2001.
- Minnesota Pollution Control Agency (2001c). TDI analytical equipment discussion. D. Fundine, MPCA, St. Paul, MN. Meeting with C. Herbrandson, Minnesota Department of Health, December, 2001.
- Minnesota Pollution Control Agency (2002a). Direction: Sampling station to Crenlo. D. Fundine, MPCA, St. Paul, MN. Email to C. Herbrandson, Minnesota Department of Health, January 22, 2002.
- Minnesota Pollution Control Agency (2002b). MN Air Toxics Data Spreadsheet. St. Paul, MN: Excel file, December 04, 2002, <ftp://files.pca.state.mn.us/pub/air/airtoxics.xls>.

- Minnesota Pollution Control Agency (2002c). MPCA Staff Summary Report on Monitoring near Crenlo, Inc. from October 2001 - December 2001, St. Paul, MN. January 25, 2002, 18 pg.
- Paska, T.M. (2001a). Olmsted County/Rochester Ambient Air Quality Concerns, Rochester, MN. Report, June 5, 2001, 11 pg.
- Paska, T.M. (2001b). Summary of Crenlo Plant #2, Rochester, MN. Report, October 10, 2001, 3 pg.

CERTIFICATION

This Crenlo Inc. Plant #2 Site Health Consultation was prepared by the Minnesota Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun.

Signed copy available on request

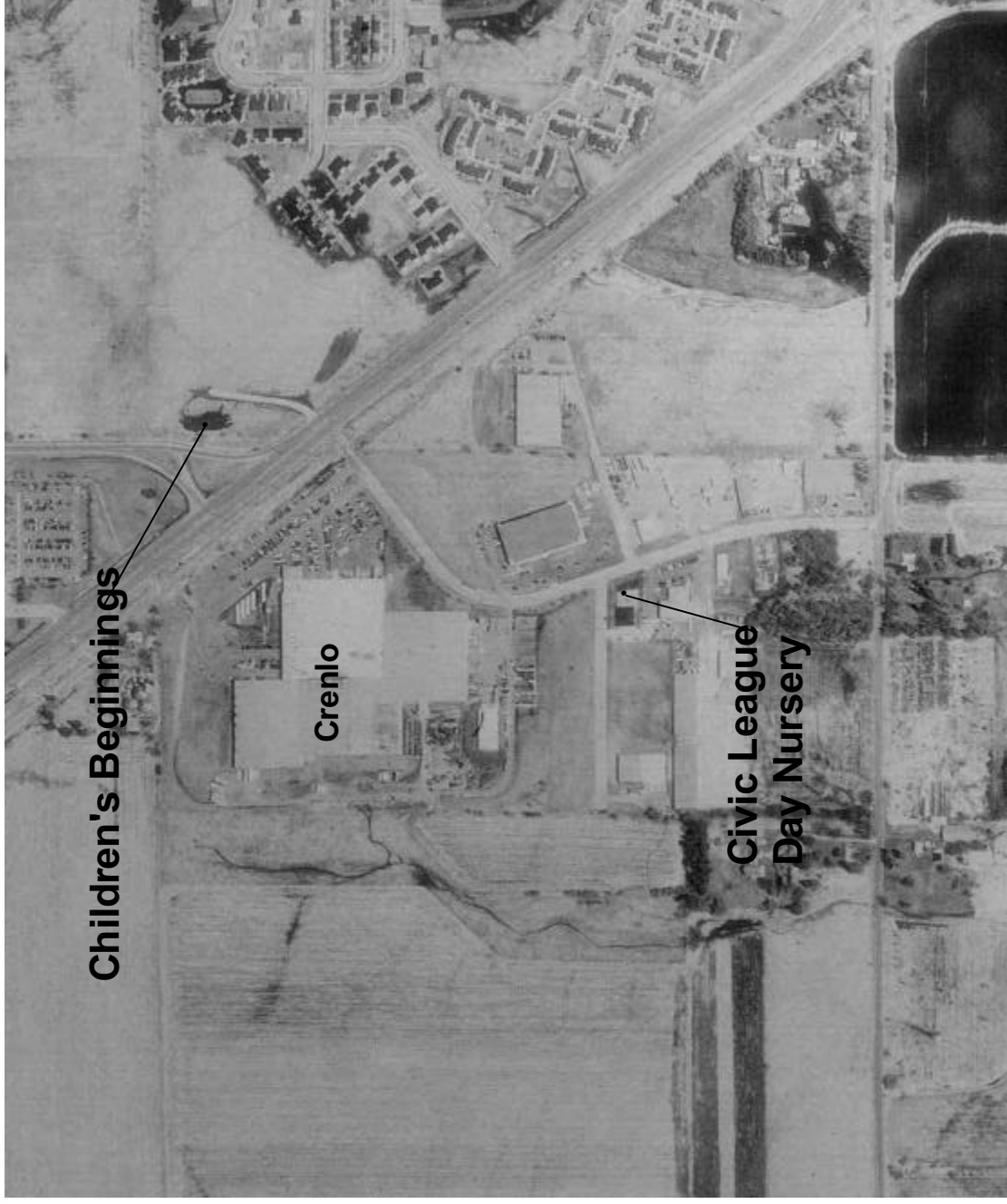
Alan W. Yarbrough
Technical Project Officer, SPS, SSAB, DHAC
ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health consultation and concurs with the findings.

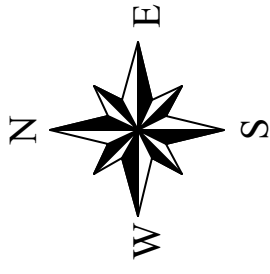
Signed copy available on request

Roberta Erlwein
Chief, State Program Section, SSAB, DHAC, ATSDR

Figure #1: Crenlo Plant #2 and Nearby Childcare Facilities

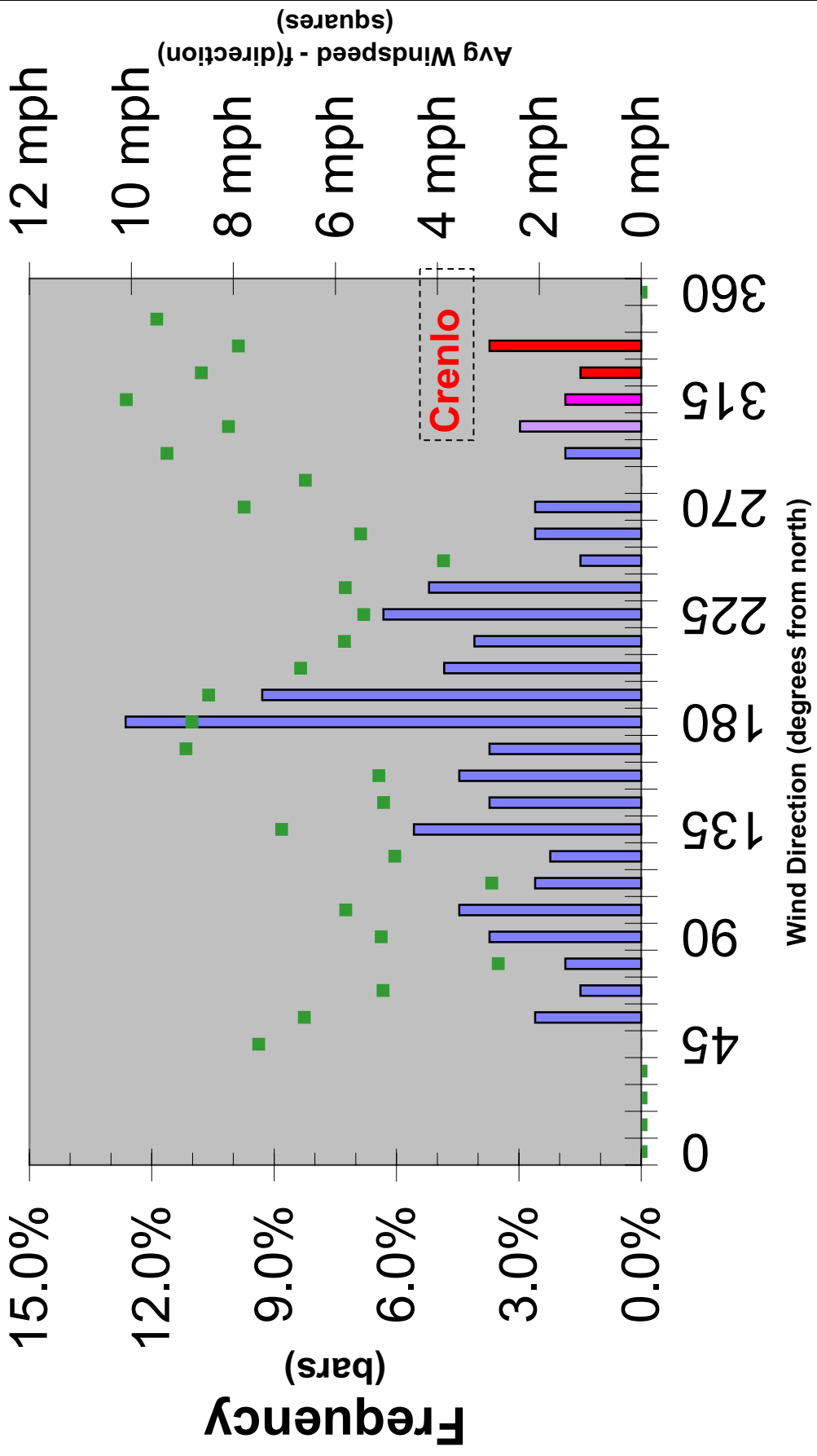


0.2 0 0.2 0.4 Miles



Wind 10/26-12/7/01

7AM-3PM Weekdays Only



Olmsted County/Rochester Ambient Air Quality Concerns

Thomas M. Paska, PE
Olmsted County Environmental Commission member

June 5, 2001

The Intent of this report:

The intent of this report is to focus on initial findings regarding the quality of the Olmsted County (*specifically Rochester's*) ambient air (*or conversely, its toxicity*). The results are a first approximation, but the magnitudes of the results are significant and merit further investigation and/or immediate action. This report is in regards to NW region of the city, but may well involve a larger region and population.

Table [1.0] depicts the pollutants and toxins currently being released into the air. There are twenty-one toxic sources identified and the amounts of their release are tabulated. This investigation focuses on VOCs (Volatile Organic Compounds) being released by these sources. Two sources Crenlo's Plant #2 and Rochester Medical Corp. – Site #1.

Summary:

The average person breathes 3,400 gallons of air each day. It is vitally important that the quality of that air (*both indoors and outdoors*) be free of contaminants and toxins. There are sensitive segments of the populations, such as asthmatics, children and the elderly who are more sensitive to airborne contaminants and toxics. Children are at greater risk because they are more active outdoors and their lungs are still developing. The elderly are also more sensitive to air pollution because they often have heart and/or lung diseases. For the most part the effects of these air pollutants can occur gradually over time, which confounds immediate association to the cause and effect.

I have pull together data from a numerous public databases and reports, and with the aid of a "Gaussian Point Source Plume Model", I have reduced the mass emissions data of Industrial Toxin releases to more meaningful (*and human*) values. judgments can be made as to public safety and environmental health risk for Olmsted County and Rochester. The toxic source (in this case) is the Crenlo's Plant #2, located at 2510 Valley High Drive NW.

The results (*at a distance 1 km*) from the modeling is very disconcerting, since they indicate that worst case toxic levels far exceed safe limits. The results for Crenlo are:

- Toluene is **32x** its recommended limit
- Xylene is **14x** its recommended limit

Olmsted County/Rochester Ambient Air Quality Concerns:

Toluene and Xylene, both have a Toxicity Value of **4** (out of a maximum of 5).

This paper will focus on a group of air toxins called Volatile Organic Compounds (VOCs), specifically Toluene and Xylene.

Toluene and Xylene are irritating to the skin and respiratory tract and can cause live damage. The target organs affected and damaged by Toluene and Xylene are:

- 1. Brain**
- 2. Central Nervous System**
- 3. Eyes**
- 4. Liver**
- 5. Lungs**
- 6. Kidneys**
- 7. Skin**

Toluene and Xylene are narcotic in high concentrations. Intentional inhaling of these substances can cause headaches, giddiness, and transient euphoria followed by depression. Hallucinations may occur, especially following chronic exposure. Neurological damage occurs from concentrated inhalation of these compounds. Symptoms include fatigue, weakness, confusion, headache, tearing, nervousness, muscular fatigue, insomnia, dermatitis and intolerance to light.¹

With the presence of these compounds in the ambient air, individuals of Olmsted County and Rochester, have no choice to avoid these risks.

There may be Environmental Justice issues in this particular case (*see maps, page 12*) since the Hylands (*government assisted-housing*) is the will within 1 km from the source.

Also in close proximity to the source is high density residential housing (see map) and

- Sunset Elementary School
- Children's Beginnings Day Care
- Maple Manor Nursing Home
- Rochester Healthcare Center

Even though these compounds have an offensive and annoying odor, the exist "Odor Ordinance, [63.630] could apply but appears to be ineffective (*refer to page 9*).

What are the VOCs

The term VOC (*Volatile organic compounds*) is defined in the federal rules as a chemical that participates in forming ozone. Elevated concentrations of ozone at ground level are a major health and environmental concern. Unlike other criteria pollutants, ground-level ozone is not released directly into the air. It is formed through a complex series of photochemical reactions in the presence of sunlight and involves VOCs and

¹ Reference sources: <http://www.atsdr.cdc.gov/tfacts71.html>

Olmsted County/Rochester Ambient Air Quality Concerns:

NO_x. In addition there contribution to the formation of ozone, VOCs contribute directly to serious health threats and risks.

Background information for Olmsted County:

This information was obtained from the Minnesota EPA website:

Criteria Air Pollutant Emissions in MN 1998 Data	Air Toxin being emitted in tons/year						
	CO	NO ₂	PB	PT	PM ₁₀	SO ₂	VOC
Facility name emitting							
Olmsted Waste-To-Energy Facility (10900005)	10.01	110.40	0.02	9.24	21.56	84.59	3.15
IBM - Rochester (10900006)	20.71	38.28		8.92	7.07	46.79	8.22
St Mary's Hospital (10900008)	64.54	54.34		12.92	12.92	0.84	2.76
Associated Milk Producers Inc (Roch) (10900010)	8.94	11.92		1.12	1.07	1.77	0.68
Rochester Public Utilities - Silver Lake (10900011)	32.69	937.82	γ 0.13	210.80	57.37	2,980.27	5.45
Williams Pipe Line Co - Rochester (10900013)	7.16	2.87					22.17
Franklin Heating Station (10900019)	54.55	198.71		6.37	5.42	42.44	4.25
Rochester Public Utility - Cascade Creek (10900020)	0.75	10.85		0.95	0.95	7.77	0.36
Crenlo Inc - Plant 2 ◇ (10900022)	4.70	6.81		0.43	0.43	0.01	α 122.97
Mayo Foundation Medical Waste Incin (10900030)	7.54	9.52		4.69	5.10	0.06	0.49
Halcon Corp (10900051)							57.38
Rochester Medical Corp - Site 1 ◇ (10900093)							β 213.37
Rochester Medical Corp - Site 2 (10900094)							12.65
Seneca Foods Corp - Rochester (10900036)	5.87	7.01		0.53	0.53	0.04	0.38
Rochester Sand & Gravel - Plant 3 (10900055)	10.88	0.80		12.09	8.30	0.16	0.54
Schmidt Printing (10900056)	0.14	0.70		0.02	0.02		29.21
Post-Bulletin Co Inc (10900067)	0.01	0.01		5.61			3.07
Pace Dairy Foods Co (10900068)	0.26	1.23		0.15	0.15	0.01	0.07
Briese Iron Works Inc (10900069)				2.20			10.22
Rochester Ford Toyota (10900079)				0.25			3.23
Government Center (10900092)	0.19	0.87		0.06	0.06	0.06	0.06
Toxin Quantity	228.94	1,392.14	0.15	276.35	120.95	3,164.81	500.68
Units	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr

Table 1.0 Olmsted County Air Pollution Emissions

Significants of table

Table 1.0 depicts the 21 major toxic sources in Olmsted County along with their contribution in tons/year. The breakdown for the Crenlo VOC contribution is derived from a 1999 MEPA report condensed below:

Crenlo, exhaust 100% of their paint spray & solvents directly into the ambient air, with minimal or no treatment. The exhaust stacks are (*curved downward, inverted J, to avoid rain*) and disperse the exhausted gases directly downward toward ground level.

Olmsted County/Rochester Ambient Air Quality Concerns:

The following table is derived from a Dec 10, 2000 Chemical release report:

Compound Name	2000 Tons/yr	% of total	1998 Tons/yr
Methyl Ethyl Ketone	1.23	3.3 %	4.05
N Buytl Alcohol	15.32	41.4 %	50.5
Toluene	10.21	27.6 %	33.62
Xylene	10.21	27.6 %	33.62
<i>Total for year</i>	<i>37.3</i>	<i>100.0%</i>	<i>122.3</i>

Consequences of pollutions

At sufficient concentrations and length of exposure; human health effects from toxic air pollutants may include cancer, poisoning and acute illness. Other, less measurable effects include immunological, neurological, reproductive, developmental and respiratory problems. Inhalation, absorption to forage plants and bioaccumulation are all possible pathways to exposure.

Toluene (C₆H₆CH₃) details:

Also known as toluol or methylbenzene)

Odor threshold range (<i>Benzene-like</i>)	0.17 – 40 ppm
Toxicity rating	4 out of a max of 5
Short term exposure NIOSH	375 µg/m ³ or 100 ppm
MPCA guidelines	ACL = 400 µg/m ³ (103ppm)

Toluene is a man-made aromatic hydrocarbon produced mostly from petroleum. It is used as a cleaning solvent in the coating, printing and leather industry and in the manufacturing of paints and coatings, inks, adhesives, resins and pharmaceuticals. It is also used as an intermediate in the production of benzene and toluene diisocyanate, and for gasoline blending.

Exposure to toluene vapors via inhalation irritates the respiratory tract, impairs the central nervous system and damages the liver and kidneys. Symptoms include fatigue, weakness, confusion, dizziness, headaches and skin irritation. According to the Air Toxics Guideline, toluene has an ACL of 400.0 µg/m³ (103 ppb) for potential for non-carcinogenic effects. An interim acute (one hour) exposure of 3,000 µg/m³ is reported for toluene.

The Occupational Safety and Health Administration (OSHA) set a maximum level of 200 ppm toluene in workplace air for an 8-hour workday, 40-hour workweek. The National Institute for Occupational Safety and Health (NIOSH) recommends an exposure limit of

Olmsted County/Rochester Ambient Air Quality Concerns:

100 ppm of toluene in workplace air and the American Conference of Governmental Industrial Hygienists (ACGIH) recommends an exposure limit of 50 ppm in workplace air.

After absorption, benzene and presumably toluene and xylene are concentrated in body fat (Schrenk et al. 1941)

The euphoric and central nervous depressant effects of toluene are sought out habitually by some individuals (antisocial teenagers and children), and may be responsible for the widespread practice of inhaling glues, paints thinners, finger nail polish removers,

How can toluene affect my health?

Toluene affects the **brain**: Low-to-moderate levels from long-term exposure can cause tiredness, confusion, weakness, drunken-type actions, memory loss, nausea and loss of appetite, and hearing loss.

Inhaling a high level of toluene in a short time can make you feel light-headed, dizzy, or sleepy. It can cause unconsciousness, and even death. Repeated exposure to high levels can cause permanent brain and speech damage, vision and hearing problems, loss of muscle control, and poor balance. It can also cause memory loss and decreased mental ability.

Toluene also affects the **kidneys**: Several studies have shown that unborn animals were harmed when high levels of toluene were breathed by their mothers. Babies can have neurological problems and retarded growth and development if their mothers breathe a high level of toluene during pregnancy. We do not know if toluene harms the unborn child if the mother is exposed to low levels of toluene during pregnancy.

Xylene (C₈H₁₀) details:

Also known as o-Xylene, m-Xylene and p-Xylene also known as Xylol or DimethylBenzene.

Odor threshold range	0.08 – 3.7 ppm
Toxicity rating	4 out of a max of 5
Short term exposure	375 µg/m ³ or 100ppm
MPCA guidelines	ACL is 862 µg/m ³ or 230 ppm

The amount of xylene retained ranges from 50% to 75% of the amount of xylene that you inhale. Xylene passes into the blood soon after entering the body. It is typically stored in fat or muscle tissue.

Health Effects: short term exposure of people to high levels of xylene can cause irritation of the skin, eyes, nose and throat;

1. Difficulty in breathing; impaired functions of the lungs
2. Delayed response to a visual stimulus

Olmsted County/Rochester Ambient Air Quality Concerns:

3. Impaired memory
4. Stomach discomfort
5. Possible changes in the liver and kidney
6. Effects on the nervous system (headaches, lack of muscle coordination, dizziness, confusion and changes in one's sense of balance.
7. People who have been exposed to Very high levels of xylene for a short period of time have died.

Results of studies of animals indicate that large amounts of xylene can cause changes in the liver and harmful effects on the kidneys, lungs, heart, and nervous system. Short-term exposure to very high concentrations of xylene causes death in animals, as well as muscular spasms, in-coordination, hearing loss, changes in behavior, changes in organ weights, and changes in enzyme activity. Long-term exposure of animals to low concentrations of xylene has not been well studied. Exposure of pregnant women to high levels of xylene may cause harmful effects to the fetus.

Reproductive effects: Mixed Xylenes have been shown to produce developmental effects, such as an increased incidence of skeletal variations in fetuses, delayed ossification, fetal resorptions, hemorrhages in fetal organs, and decreased fetal body weight in animals via inhalation exposure.

CHRONIC TOXICITY

Chronic (*long-term*) exposure of humans to mixed Xylenes, as seen in occupational settings, has resulted primarily in neurological effects such as headache, dizziness, fatigue, tremors, and in coordination. Labored breathing, impaired pulmonary function, increased heart palpitation, severe chest pain, an abnormal EKG, and possible effects on the blood and kidney have also been reported. Mixed Xylenes have not been extensively tested for chronic effects, although animal studies show effects on the liver from inhalation exposure and effects on the blood, kidney, and CNS from oral exposure to mixed Xylenes (US EPA).

NOTE: The five air toxics with highest Minnesota emissions are toluene, xylene (*mixed isomers*), methyl-ethyle ketone, methanol and ammonia. These chemicals account for about 57% (approximately 6,000 tons/year) of total TRI air emissions in Minnesota.

The Point-Source Gaussian Plume Model:

The model addresses the question of "How do pollutants behave once they have been emitted, and how may we predict their concentrations in the atmosphere?"

Attempt to relate emissions to air quality is the assumption that the time-average pollutant concentrations down-wind from a source can be modeled using a normal, or Gaussian, distribution curve.

The Gaussian plume model assumes that the pollutant concentration follows a normal distribution about the centerline in both the vertical and horizontal planes.

Olmsted County/Rochester Ambient Air Quality Concerns:

$$(Q / (\pi \times \mu h \times \sigma_y \times \sigma_z)) \exp(-H^2/2\sigma_z^2) \exp(-y^2/2\sigma_y^2)$$

$C_{(x,y)}$ = Concentration at ground level at the point (x,y) in ug/m^3 microgram/cubic meter

x = distance directly down wind, in m

y = horizontal distance from the plum centerline in m

Q = emission rate of pollutant, in ug/sec

H = effective stack height in m

μh = average windspeed at the effective height of the stack in m

σ_y = horizontal dispersion coefficient (std dev) in m

σ_z = vertical dispersion coefficient (std dev) in m

$\exp = 2.718$

NOTE: Downwind concentration appears to be inversely proportional to wind speed

High wind speeds reduce the effective height of the stack H

Although the Gaussian plume equation is based on both theory and actual measured data, it is still at best, a crude model. Predictions based on the model should be assumed to be accurate to within +/- 50%. It is a good first approximation. More accurate results should be obtained by actual sampling, or more elaborate modeling.

This model assumes:

1. A fall afternoon, or a cloudy summer day, or clear summer day with the sun at 15 – 35 degrees above the horizon.
2. The rate of emission from the source is constant
3. Wind speed is constant
4. The terrain is relatively flat, open country

Modeling Results:

Pollution Modeling Calculations

TMPaska

June 5, 2001

Crenlo PtSourceModel#2z

Point Source Plume Model for pollution concentrations from a stack:

Crenlo Plant #2 on Valley High Drive NW at a distance 1km from source

$$C_{(x,0)} = (Q / (\pi \times UH \times \sigma_y \times \sigma_z)) \exp(-H^2/2\sigma_z^2) \exp(-y^2/2\sigma_y^2)$$

$C_{(x,y)}$ = Concentration at ground level at the point (x,y) in ug/m^3

x = distance directly down wind, in m

y = horizontal distance from the plum centerline in m

Q = emission rate of pollutant, in ug/s

H = effective stack height in m

UH = average wind speed at the effective height of the stack in m

σ_y = horizontal dispersion coefficient (std dev) in m

σ_z = vertical dispersion coefficient (std dev) in m

$\exp = 2.718$

Olmsted County/Rochester Ambient Air Quality Concerns:

air toxics targeted in this paper. More work needs to be done to determine the significance of non-cancer endpoints, such as cardiopulmonary, neurologic, immunologic and reproductive/developmental systems effects.

Note: <http://www.epa.gov/ttn/uatw/nata/index.html>
<http://www.pca.state.mn.us/air/airtoxics.html>
<http://www.kccotv.com/news/stories/news-19991116-161844.html>

Reference to Rochester City Ordinance on odor

63.630	<p style="text-align: center;">Local Industrial Performance Standards</p> <p>The City of Rochester shall enforce the following standards for industrial nuisance where the regulations are not superseded by more stringent State, Federal or other local standards.</p>
63.631	<p>Odors: In those instances where Federal and State regulations are not applicable, no use in an M-1 or M-2 District shall emit any continuous, frequent, or repetitive odor or odor causing substances which is detectable at or beyond the point of measurement (<i>property line</i>). An odor which is emitted no more than fifteen (15) minutes in any one day nor more than two (2) days out of the calendar month shall not be deemed to be continuous, frequent, or repetitive under this subsection. The existence of an odor shall be presumed when the concentration of the odor causing substance in the air at or beyond the point of measurement exceeds the lowest concentration listed as the odor threshold for such a substance in Table III, ODOR THRESHOLD, appearing in Chapter 5 “Physiological Effects”, “The Air Pollution Abatement Manual”, Manufacturing Chemists’ Associations (1952) or any subsequent amendments or revisions thereto. Substances which are not listed in that table shall not be deemed to be odorous unless analysis by a competent chemist demonstrates that a discernible odor is being emitted. In any district other than the M-1 or M-2, no emission of an odor or odor causing substances shall be permitted.</p>

GLOSSARY:

Some, but not all, of unfamiliar terms referred to in this report:

Term	Definition
Acute Exposure	One dose or multiple doses occurring within a short period of time (typically 24 hours or less). For purposes of inhalation ATRs, acute exposure is defined as a one-hour average ambient air concentration.
ACL	Air Concentration Limit, usually expressed in $\mu\text{g}/\text{m}^3$ or ppb.
Air Pollution	[1] One or more chemicals in high enough concentration in the air to harm humans, other animals, vegetation or materials. Excess heat or noise can also be considered forms of air pollution. [2] Presence of substances in the air in concentrations sufficient to interfere with health, comfort, and safety, or with the full use and enjoyment of an area. <i>More than 150 million tons were released into the air in 1999.</i>
Air Quality	A comparison of the composition of the air we breathe to an uncontaminated air resource.
Air Toxics	Pollutants known to cause or suspected of causing cancer (carcinogens)

Olmsted County/Rochester Ambient Air Quality Concerns:

	or other health effects, or causing ecosystem damage. The Clean Air Act lists 188 hazardous air pollutants / toxics.
Ambient Air	The outdoor air through which chemical or pollutants can move and reach a receptor (e.g., humans, wildlife) or another environmental medium, such as water or soil. Ambient air is defined by Minn. R. 7009.0020 to begin at the property boundary of a facility emitting the chemical or pollutant, provided that the general public does not have access to the property. This generally means that ambient air begins at the “fence line”, that is, at the point where access by the general public has been restricted.
ATR	Air Toxic Review
Bioaccumulation	The process by which persistent pollutants in the environment accumulate in living organisms.
Bioconcentration	The process by which persistent pollutants in the environment accumulate in living organisms through the intake from water or air.
Chronic Exposure	Multiple exposures occurring over an extended period of time or a significant fraction of an individual’s lifetime.
Criteria Pollutants	The pollutants for which U.S. EPA has established national ambient air quality standards: <ol style="list-style-type: none"> 1. Particulate matter less than 10 microns (PM₁₀) 2. Sulfur Dioxide (SO₂) 3. Oxides of Nitrogen (NO_x) 4. Carbon Monoxide (CO) 5. Volatile Organic Compounds (VOCs) 6. Lead (Pb)
Emphysema	A respiratory disease due to prolonged exposure to air pollutants. Causes damage to air sacs, loss of lung elasticity and acute shortness of breathe.
HAP	Hazardous Air Pollutants have the distinct potential to cause health problems and environmental contamination at very low concentrations.
PM	Particular Matter, usually express as to the diameter of the particle (<i>in micrometers</i>).
TRI (Toxic Release Inventory)	Toxic Release Inventory, is the primary source of comprehensive information on emissions of air toxics.
Teratogen	Toxic chemical that causes birth defects
Mutagen	Mutagen = Chemicals that causes inheritable changes in the DNA molecules making up genes that can yield changes in anatomy, physiology, and/or behavior in offspring.
VOCs	Volatile Organic compounds is defined in the federal rules as a chemical that participates in forming ozone. This does not include other organic chemical with negligible photochemical reactivity.
µg/m ³	Micrograms (of contaminant) per cubic meter of air.
Internet References	http://www.chem-tox.com/ http://www.chem-tox.com/immunesystem/immune-sys-index.htm http://www.atsdr.cdc.gov/ http://www.100toppollutionsites.com/Pollution/polution/100/96k US EPA. http://www.epa.gov/ttn/uatw/hlthef/xylenes.html http://risk.lsd.ornl.gov/tox/profiles/toluene_c_V1.shtml

Olmsted County/Rochester Ambient Air Quality Concerns:

SEE ATTACHED FILE

Figure 1: Population Density in immediate vicinity of Crenlo

Above Density map of vicinity (1 mile radius) around Crenlo Plant #2, depicting population density. Note the new construction with high-density structures.

SEE ATTACHED FILE

Figure 2: Population Density for Children under 6 yrs old

Above depicting density of children less than 6 years old in vicinity of Crenlo

Summary of Crenlo Plant #2

October 10, 2001

Pollutant Concentrations:

Toluene
Xylene

The results of the EPA Screens Modeling program for the Crenlo Plant #2 are presented here, and are cause for concern.

The VOC emissions concentrations from the Crenlo Plant #2 were obtained from their May 26, 1998 Permit Application, and it is duplicated here.

This is the input data for the various runs of the SCREEN Model:

The following information from Crenlo Air Quality Permit
Application Form GI-04 AQ Facility ID
= 10900022

*Based on
6hour period
Source
Output*

Limited Controlled HAP Emissions	<i>based on lbs/hr</i>			<i>g/sec</i>
	Tons/yr	lbs/hr	g/sec	g/sec
Methyl ethyl Ketone	100.9	23.4	2.96	16.,84
Toluene	539.9	123.26	15.57	90.89
Xylene	1023	233.56	29.50	172.,22
Ethylbenzene	125.8	28.72	3.63	21.21
Methanol	5.2	1.2	0.15	.87
MIBK	26.2	5.99	0.76	4.41
Methylene Chloride	0.7	0.15	0.02	
Trichloroethane	0.7	0.15	0.02	
Trichloroethylene	0.7	0.15	0.02	

Actual Controlled HAP Emissions	Tons/yr	lbs/hr	g/sec	g/sec
Methyl ethyl Ketone	15.3	9.81	1.24	2.58
Toluene	14.2	9.08	1.15	2.39
Xylene	16.5	10.55	1.33	2.78
Ethylbenzene	2.2	1.4	0.18	
Methanol	1	0.66	0.08	
MIBK	6.8	4.37	0.55	
Methylene Chloride	0	0	0.00	
Trichloroethane	0	0	0.00	
Trichloroethylene	0	0	0	

The results in the last column is to consider the actual concentrations which might develop where the emission period is 6 hours per day and 250 days per year. This would represent a more realistic worst-case situation. The results are indicated with a “06” tag.

The basic inputs for each run are:

SIMPLE TERRAIN INPUTS:

Parameters: Value units
 SOURCE TYPE P Point
 EMISSION RATE **##** g/sec
 STACK HEIGHT 0.0 m
 STK INSIDE DIAM 1.5 m
 STK EXIT VELOCITY 1.0 m/sec
 STK GAS EXIT TEMP (K) 293.0 kelvin
 AMBIENT AIR TEMP (K) 293.0 kelvin
 RECEPTOR HEIGHT (m) 0.0 m
 URBAN/RURAL OPTION U/R U Urban
 BUILDING HEIGHT (m) 10.0 m
 MIN HORIZ BLDG DIM (m) 215.0 m
 MAX HORIZ BLDG DIM 325.0 m
 Bldg Cavation ss Schulman-Scire Downwash

Note ## input taken from first table

The modeling results for full meteorology application are :

Emission rate g/sec > Distance Crenlo Units = m	Toluene				Xylene			
	Toluene	Toluene	Toluene	Toluene	Xylene	Xylene	Xylene	Xylene
	L24 Conc	L06 Conc	A24 Conc	A06 Conc	L24 Conc	L06 Conc	A24 Conc	A06 Conc
	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3
100	15.57	90.89	1.15	2.39	29.5	172	1.33	2.78
200	12,940	819,300	1,037	2,154	83,520	487,000	1,199	2,506
300	6,728	415,500	526	1,092	26,590	155,000	608	1,271
400	6,728	257,500	326	677	13,480	78,620	377	788
500	2,957	178,500	226	469	8,358	48,730	261	546
600	2,214	132,900	168	350	5,794	33,780	195	406
700	1,739	103,900	132	273	4,313	25,150	152	318
800	1,414	8,424	107	222	3,373	19,670	123	258
900	1,181	7,016	89	185	2,734	15,940	103	215
1000	1,007	5,970	76	157	2,277	13,280	87	183
					1,938	11,300		

Four conditions were modeled [1] Limit 24 hour period [2] Limit 6 hour period [3] Actual 24 hour period and [4] Actual 6 hour period. The results are only for Toluene and Xylene.

The National Institute for Occupational Safety and Health (NIOSH) recommends the safe toxicity levels for these pollutants are:

Toluene	400 ug/m ³
Zylene	863 ug/m ³

The modeling results would indicate that for **Toluene**:
distance to a safe concentration level is 400 to 600 meters.

The modeling results would indicate that for **Xylene**:
distance to a safe concentration level is 300 to 400 meters.

This represents a first approximation of the modeling effort, but the results are significant (since the daycare facilities are approximately 150 meters from this facility) and prudence would indicate action. With this in mind, please disregard any typos or grammatical errors in this report.

Thomas M.Paska



Attachment #3

Crenlo, Inc.

Rochester

October 11, 2001

Anne Jackson
 Minnesota Pollution Control Agency
 520 Lafayette Rd
 St. Paul, MN 55155-4194

ethylene glycol monobutyl ether

Dear Ms. Jackson:

As reported to you by telephone earlier this afternoon, Crenlo has accomplished a lot in the last 24 hours since your telephone call on Wednesday, October 10, 2001 including the following:

- Errors have been found in our submitted data. Example – Butoxy Ethanol. Crenlo reported a usage of 835 gallons or 6,234 pounds in 2000. Crenlo actually used three drums or 1,245 pounds. Crenlo will continue to review this data.
- Substitution – Aggressively seeking a substitute for our largest source of Glycol Ethers, part # 93318. Good progress has already been made.
- Have immediately stopped using HDI and TDI Catalyst. Aggressively seeking substitutes.
- Moving ahead quickly to remove elbows located on twelve stacks. Project should be completed within one week. The twelve stacks will be extended by ten feet with an anticipated completion date of November 16, 2001.
- Reported to you that our production volume in 2001 is down approximately 25% from 2000.
- Suggest a follow-up telephone conference call no later than the middle of next week. Possibly should schedule a meeting with all interested parties to more clearly understand the issues. Your assistance in coordinating this follow-up will be appreciated.
- It would be appreciated if you would send us a copy of your updated modeling as soon as possible.

Please notify me if you have any questions or need any further information at this time. It will be appreciated if you stay in touch on any subsequent developments.

Sincerely,

Wayne

Wayne DeBruin
 Director Human Resources

bjr



Crenlo: Results of Air Monitoring in Northwest Rochester

Geographic/Olmsted County/#55.01/December 2001

Introduction

The Minnesota Pollution Control Agency (MPCA) and the Minnesota Department of Health (MDH) became concerned about air emissions from the Crenlo Inc. manufacturing facility in northwest Rochester after reviewing information Crenlo submitted to the MPCA as part of its air emissions permit application. Of most interest and concern was the close proximity of daycare facilities to Crenlo.

Ambient air monitoring recently undertaken near Crenlo shows that, in chemicals for which there are reliable results, none are at levels of immediate concern to either MPCA or MDH staff.

However, it must be noted that, during the monitoring period, Crenlo was operating at a reduced production level, which means that the monitoring does not reflect the facility's emissions when at full production. The MPCA will therefore require Crenlo to conduct computer modeling to determine ambient air impacts when the plant is at higher production. The MPCA will base further permit and/or control requirements on the results of this modeling.

Weather Affects Air Monitoring

MPCA ambient air monitoring began October 22 and concluded December 7, 2001. Monitoring was planned and

conducted to measure ambient (in the open air, as opposed to measured directly from a smokestack or other outlet) air concentrations at the daycare to the south of Crenlo, because this facility was expected to be in the direction of prevailing winds for this time of year.

A meteorological station installed along with ambient air monitors indicated that weather patterns during the monitoring period were not normal. Typically, in the fall, winds are from the northwest and blow toward the south. This fall, winds were from the southeast and southwest instead. No winds were from the west. It is likely, therefore, that the highest outdoor concentrations of pollutants released from Crenlo would have been north to northwest of the Crenlo facility instead of the predicted south.

Other Matters Affect Air Monitoring Results

Crenlo Inc. undertook some immediate changes to its operations that likely affect the amount of chemicals in the air. Crenlo informed the MPCA that it would cease using isocyanate paint formulations, and seek long-term substitutions. Crenlo also committed to changing paint formulations to reduce the amount of glycol ethers released by the facility.





Most importantly, as requested by the MPCA, stacks on the north side of the Crenlo facility were modified to remove the “J-stack” shape. The stacks were changed so that they discharge straight into the air and disperse, rather than pointing directly down to the ground. The changes were completed by November 15, 2001.

The stack change is very important, because a stack that points up allows for more outside air to mix with pollutants released. This mixing results in diluting the concentration of pollutants, lowering the overall concentrations in the ambient air.

Preliminary Results of the Air Monitoring

The results discussed in this fact sheet are preliminary. The MPCA and MDH are still awaiting laboratory analysis of glycol ether samples collected from November 29 to December 7, 2001. Further, after completing a final review of the data and doing comparisons to monitoring conducted elsewhere in Minnesota, the MPCA and MDH would like to provide Rochester citizens with a more detailed interpretation of the data.

Overall, MPCA staff are satisfied that monitoring results reflect ambient air concentrations from Crenlo, and that the results are not unduly affected by emissions from traffic or from the general activity of an urban area. Small “bumps” in monitored emissions are likely from fugitive emissions—releases of chemicals that are not from a stack but from open doors and windows, offgassing of finished products when being loaded, transported or stored, and so on.

Attached to this fact sheet is a spreadsheet containing all the air monitoring data available at this point. Although this data is believed to be reliable, final quality assurance/quality control checks are being completed now.

• Glycol Ethers

Ambient air sampling was conducted for glycol ethers 2-butoxyethanol, 2-ethoxy ethanol, and 2-methoxyethanol. None of these were detected in the air at the detection level of 0.010 ppm. This detection limit is about 1.5 times above level chronic exposure criteria for 2-methoxyethanol, but well below the level of concern for other glycol ethers.

It is likely that the average daily concentration of 2-methoxyethanol, and possibly even the maximum eight-hour concentration during the monitoring period did not exceed this chronic, or long-term criteria. We are expecting to have discussions with the analytical laboratory about a final analytical report and about the possibility of lowering detection limits in the future. The detection limit for the remaining glycol ethers is below their health benchmarks. In summary, monitoring shows that levels of glycol ethers were not of concern at this location during this monitoring period.

• Isocyanates

Crenlo reported using polyurethane paint formulations that contained isocyanates, a family of chemicals of particular concern because some people are extremely sensitive to them at very low levels in the air. Crenlo officials informed the MPCA that, upon learning of the concern about these chemicals, they ceased use of isocyanate paint formulations and are seeking a permanent substitute.

Polyurethane paints containing isocyanates are widely used in automobile and truck body repairs and detailing. Because there are a number of small businesses nearby that likely engage in body repair work with the potential of using isocyanates, the MPCA attempted to use a special monitor to measure isocyanates in the outdoor air.

The special monitor used was originally designed to measure isocyanates in an *indoor environment* to determine compliance with Occupation Safety and Health Administration (OSHA) thresholds. The MPCA found, and will report to the manufacturer, that the monitor is very sensitive to relative humidity, in addition to isocyanates. That is, moisture in the air is measured as if it is an isocyanate chemical. Therefore, this special monitor produced no reliable data. The MPCA is investigating other means of monitoring isocyanates.

• Volatile Organic Chemicals (VOCs) and Carbonyls

The air monitoring near Crenlo measured the same VOCs that the MPCA measures in its statewide air toxics monitoring program. The purpose of this monitoring was to learn whether general air toxic levels in this location were different from residential locations monitored elsewhere in the state.



The results of the air sampling were compared to health benchmarks. Three chemicals found in air samples approached levels of concern (benzene, formaldehyde, and carbon tetrachloride). However, the concentrations measured are similar to levels found throughout the Rochester area and other urban areas in the state, and none of these chemicals are associated with releases from the Crenlo facility. Butyraldehyde was measured at significantly higher levels when the wind direction was coming from the Crenlo facility. There are no health criteria for butyraldehyde but it is probably less toxic than acetaldehyde. Using acetaldehyde chronic health criteria, MDH does not expect butyraldehyde exposures to result in health impacts. These common chemicals are emitted in every locality by industrial sources, mobile sources, and even private households. Everyone has to work together to reduce these emissions.

Next Steps

The MPCA and MDH do not believe further monitoring is necessary at the current location. Both agencies are satisfied that current operations at Crenlo do not present reason for immediate concern to either daycare facility to the east and south of Crenlo.

The MPCA must issue all air emissions permits, including Crenlo's, by December 2003 in order to maintain program commitments to the U.S. Environmental Protection Agency (EPA). Therefore, the MPCA must continue processing Crenlo's air emissions permit.

Through this air permit process, the MPCA and MDH will discuss with Crenlo how Crenlo will conduct dispersion modeling to best reflect production operations at historical "normal levels", and potentially future higher levels of production. The dispersion modeling will be a requirement of the air emissions permit.

The MPCA will also continue to investigate what control efficiencies are expected from particulate matter pollution-control equipment currently in place at Crenlo. To best determine release rates of chemicals, the MPCA may require Crenlo to measure concentrations of chemicals at the stack. Stack testing is a common requirement of air emission permits.

Further Information

Remaining glycol ether samples will be analyzed the second week of January 2002 and a final report issued by January 25, 2002. This report will contain a more refined analysis of the monitoring data, as well as a comparison of Crenlo monitoring results with air toxics monitoring conducted elsewhere in Rochester and in Minnesota.

Questions can be addressed to:

- Marshall Cole of the MPCA's Rochester office at (507) 280-2992 (*air quality permits*)
- Anne Jackson of the MPCA's St. Paul office at (651) 296-7949 (*air monitoring*)
- Dr. Carl Herbrandson of the MDH at (651) 215-0925 (*health effects or related issues*)

MPCA Web site: <http://www.pca.state.mn.us>



Minnesota
Pollution
Control
Agency

Policy &
Planning

Air Quality
Program

Air Quality Monitoring In Northwest Rochester

G-55-01, October 2001

This fact sheet is intended to inform the public about air monitoring activities undertaken by the Minnesota Pollution Control Agency (MPCA) around the Crenlo Inc., manufacturing plant located in northwest Rochester.

What is Crenlo and where is it located?

Crenlo is an existing metal fabricating facility that has been located on Valleyhigh Drive since 1968. Crenlo produces computer cabinets and cabs for off-road vehicles. During the manufacturing process metal is cut, welded, cleaned, dried, painted, and cured. These processes produce air emissions that are vented to the outdoors.

Why is the MPCA checking the air?

Based on a review of the data contained in the May 2001 air permit application from Crenlo, and the land use surrounding Crenlo, the MPCA staff became concerned about the projected levels of air emissions for several substances, including isocyanates and glycol ethers. The MPCA conducted a review called a screening assessment. This screening assessment uses computer models to conservatively predict concentrations of pollutants in the outdoor air. Screening is used to determine whether a source emitting air pollution deserves a closer review. The assessment does not involve any testing of actual air samples from the stacks at

the Crenlo plant, or in the air of the surrounding community. The MPCA shared the screening results with the Minnesota Department of Health (MDH). Together, the agencies have decided the first step in assessing this area is to conduct ambient air monitoring.

What is the MPCA doing?

The agency is installing air-sampling equipment at two locations near the plant to collect actual air samples from outside the plant. This is known as ambient air monitoring. Ambient air is defined as "the outside or open air that surrounds us and that we breathe." A decision for the future is to determine what, if any, sampling the MPCA will require of Crenlo. The MPCA may require Crenlo to do stack testing, which is, sampling the air as it leaves the stacks. Crenlo will need to hire an independent contractor because the MPCA does not do this type of work.

When will testing be completed?

The MPCA expects to begin ambient air sampling by sometime this week. Samples will be collected three days a week (Monday, Wednesday and Friday) for at least two to four weeks. Analysis of the samples will be done at the MPCA and MDH laboratories. The MPCA and MDH will evaluate the findings to determine the health risk, and if additional air pollution control requirements are needed at Crenlo.

MPCA Air Quality Contacts:

Marshall Cole, Rochester
Permitting
(507) 280-2992

Anne Jackson, St. Paul
Engineer
(651) 296-7949

Melanie Miland, Rochester
Information Officer
(507) 285-7151



What is Crenlo doing to minimize potential risks?

The company has taken several steps including:

- Reconfiguring and extending the 12 stacks in the computer cabinet production line. Currently, the company is using stacks fitted with an inverted J bend that discharges emissions downward towards the roof. These will be changed to eliminate the “J” bend, and will be extended by 10 feet. This work is to be completed by November 16.
- Seeking substitute materials to modify the paint formulations.
- Re-evaluating its emissions data to correct errors and account for reduced production.

What is the permitting status of Crenlo?

The MPCA issued an air emissions permit to the Company in 1986 for operation of the facility. The 1986 permit limited particulate matter emissions from painting and natural gas combustion equipment. In 1998 a permit was issued to authorize installation of the E-coat process, a less-polluting method of priming metal. It, too, limited particulate matter emissions from the coating process.

The MPCA is preparing a new permit that meets the requirements of the 1990 Clean Air Act Amendments. This permit is the first permit to address hazardous air pollutants from this facility. Once the permit is drafted, it will be placed on public notice.

What information is available on possible health effects?

Most of the chemicals of concern are volatile organic compounds (VOCs). Exposures to VOCs such as those emitted from Crenlo could result in headaches, or irritation of the eyes, respiratory system or skin. Typically, these effects are short-lived.

Sometimes these chemicals may affect other organs or organ systems, especially if exposures occur over long periods of time or during vulnerable periods. The developing fetus or growing children are often

more sensitive to chemical exposures. In addition, individuals with preexisting conditions such as asthma may be affected to a greater extent. Criteria used by MDH to evaluate chemical exposures take into account the greater vulnerability of sensitive groups.

If you have specific concerns about health impacts on your children, MDH recommends that you contact your physician. For further information, you or your physician may contact MDH toxicologists, Dr. Rita Messing (651/215-0924) or Dr. Carl Herbrandson (651/215-0925).

Where can I get more information on the progress of the MPCA air testing?

For additional information, contact the MPCA staff Marshall Cole, permitting at (507) 280-2992; Anne Jackson, engineer at (651) 296-7949; or Melanie Miland, information officer at (507) 285-7151.

For more information about air quality, log onto the MPCA website at:

<http://www.pca.state.mn.us/air/index.html>.

MPCA Staff Summary Report on Monitoring near Crenlo, Inc. from October 2001 – December 2001.

Introduction

The Minnesota Pollution Control Agency (MPCA) and the Minnesota Department of Health (MDH) became concerned about air emissions from the Crenlo Inc. manufacturing facility in northwest Rochester after reviewing information Crenlo submitted to the MPCA as part of its air emissions permit application. Of most interest and concern was the close proximity of daycare facilities to Crenlo. The MPCA undertook ambient air monitoring near one of the daycare facilities to determine if any chemicals were at levels of immediate concern.

The MPCA attempted to monitor for isocyanates because Crenlo reported using polyurethane paint formulations that contained isocyanates, a family of chemicals of particular concern because some people are extremely sensitive to them at very low levels in the air. Crenlo officials informed the MPCA that, upon learning of the concern about these chemicals, they ceased use of isocyanate paint formulations and are seeking a permanent substitute.

However, polyurethane paints containing isocyanates are widely used in automobile and truck body repairs and detailing. Because there are a number of small businesses nearby that likely engage in body repair work with the potential of using isocyanates, the MPCA attempted to use a special monitor to measure isocyanates in the outdoor air.

Glycol ethers were sampled by the MPCA and analyzed by the Minnesota Department of Health because initial modeling indicated that emissions of these chemicals from Crenlo might pose a health concern.

The MPCA also measured volatile organic compounds (VOCs) and carbonyls. The purpose of this monitoring was to learn whether general air toxic levels in this location were different from residential locations monitored elsewhere in the state.

This summary report is prepared to document sampling methods, analysis and data treatment and also to capture the results of the monitoring and resulting MPCA staff recommendations.

Sampling and Analysis

VOCs, Carbonyls, Glycol Ethers, and Isocyanates

The MPCA established one ambient air monitoring site at the daycare to the south of Crenlo. Due to the time of year, it was expected that the prevailing winds would be primarily from the north, thus the monitor was expected to be principally impacted by winds from the direction of Crenlo. MPCA ambient air monitoring began October 29 and concluded December 7, 2001. Samples were collected Monday through Friday for 8 hours (corresponding to the time that Crenlo was in operation).

Four types of samples were collected at the site: volatile organic compounds (VOCs), carbonyls, glycol ethers, and isocyanates.

The VOC samples were collected following the U.S. federal reference method TO-14Aⁱ in evacuated, summa-polished, stainless steel canisters, two-valve model. The canisters were deployed using a Xon Tech model 910A canister sampler. The samples were analyzed using a Varian Saturn model 2000 gas chromatograph/mass spectrometer. The carbonyl samples were collected and analyzed following U.S. federal reference method TO-11Aⁱⁱ.

Glycol ethers were sampled by the MPCA and analyzed by the Minnesota Department of Health (MDH)—Environmental Laboratory. The three glycol ethers analyzed were 2-butoxyethanol, 2-ethoxyethanol and 2-methoxyethanol.

Isocyanates such as toluene di-isocyanate (TDI) are not among the chemicals included in the MPCA lab's normal chemical list. However, the Crenlo study provided an opportunity to field test a continuous running monitor that could detect the presence of chemicals containing isocyanates. The type of isocyanate monitor used was originally designed to measure isocyanates in an *indoor environment* to determine compliance with Occupation Safety and Health Administration (OSHA) thresholds. The monitor was not specifically sited to measure emissions from the Crenlo facility, but was deployed to examine the general industrial atmosphere at the monitoring site. Therefore, it was operated for 24 hours a day producing a continuous record to a data logger on site. This type of monitor was not previously used to gather ambient data anywhere in the state and was operated as an experiment by the Agency.

Meteorological Data

A complete set of meteorological instruments was also placed at the monitoring location. This equipment continuously measured and recorded the wind speed, wind direction, relative humidity, and temperature at the site. Even though the samples other than the isocyanates were collected only for the eight-hour period during the operation of the facility, the weather data was acquired 24 hours a day from October 29 through December 6.

The monitored location was between the Crenlo facility and the day care facility to the southeast. This location would be impacted by the Crenlo roof stacks when there was a wind from the northwest or during calm conditions.

Limits of Detection

The analytical equipment can only reliably detect chemical concentrations down to a certain level. This level is known as the detection limit. The detection limit varies depending on the lab, the specific technique used for analysis and the chemical being analyzed.

The lower detection limit (LDL) is reported for the VOCs and carbonyls. In order to determine the LDLs, a standard was prepared to 5 times the estimated LDL. Seven replicate measurements of the standard was made, and the LDL was taken as the standard deviation of the replicate analyses divided by the square root of n , and this quantity was multiplied by the Student's t -value appropriate for a 99% confidence level with $n-1$ degrees of freedom.

The best method for treating data below the detection limit is a matter of debate in the scientific literature. MPCA air monitoring staff have chosen to retain all of the raw values in the data for summary and statistical calculations, including values below detection and zeroes. If more than half of the data for a given compound was below detection, the data was deemed insufficiently

complete to undergo summary and statistical calculations. Therefore, summary information for these compounds is not included in this report.

The MDH—Environmental Laboratory reported the glycol ether limit of detection (LOD) as 0.010 ppm. Since MPCA has reported the other compound concentrations in $\mu\text{g}/\text{m}^3$, the LOD was converted to $\mu\text{g}/\text{m}^3$ for each of the glycol ethers.

Health Benchmarks

The concentration data from this monitoring study at Crenlo was compared to three types of health benchmarks: acute (short-term) non-cancer, chronic (long-term) non-cancer and chronic cancer. Non-cancer acute benchmarks are defined as concentrations of a pollutant in the ambient air below which there is likely to be no public health concern over a short (1-hr, 1 day, etc.) exposure period. Non-cancer chronic benchmarks are defined as concentrations of a pollutant in the ambient air below which there is likely to be no public health concern over a lifetime of exposure. The cancer benchmarks are pollutant concentrations posing a 1×10^{-5} upper-bound excess lifetime inhalation cancer risk for an adult.

These health benchmarks were derived from several sources. The primary source of benchmarks was the Minnesota Department of Health (MDH) draft inhalation health risk values (IHRVs).ⁱⁱⁱ The second source of benchmarks was the U.S. EPA reference concentrations and inhalation unit risks from the Integrated Risk Information System (IRIS)^{iv} and the Health Effects Assessment Summary Tables (HEAST).^v If values from these sources were not available, we used inhalation unit risks and inhalation reference exposure values from the California Office of Environmental Health Hazard Assessment.^{vi} See *Table 1* for a list of the health benchmarks used for this evaluation.

Results and Discussion

Meteorological Data

The MPCA sited the monitoring location between the Crenlo facility and the day care facility to the southeast. This location would be impacted by the Crenlo roof stacks when there was a wind from the northwest or during calm conditions. Since the northwest wind direction is historically one of the most common directions during the fall period of the year in Rochester, the MPCA expected to be getting a significant amount of monitoring data impacted by Crenlo emissions. However, this year the wind was mostly from the southwest with unusually warm conditions and few calm periods. As a result, there were only three sampling episodes when the winds were calm or from the northwest; these were November 8, November 19, and November 30. See *Table 2* for summary wind direction data.

Although it would have been desirable to collect more samples from the northwest wind direction, there were at least a few dates where the facility impact could be observed. It is not possible to move the type of sampling equipment used for the study to the downwind location on a daily basis because of logistical problems including the need for AC power; it is also not possible to clearly predict what the wind will do ahead of time. Winds from other directions are also useful and reveal the contributions from other sources in the neighborhood and the general Rochester background concentrations for the pollutants measured.

The data collected represents the conditions to which a person residing at or near the sampling location would be exposed at the time of the sampling. These conditions could be different during other seasons of the year or if the facility operation was changed.

Isocyanates

Unfortunately the data gathered by the isocyanate monitor was not of sufficient quality to produce conclusive results. The normal application for this monitor is to assess indoor air quality such as would be needed for gathering OSHA (worker safety) data. The indoor environment is much more stable than the outdoor (ambient) environment.

It was discovered that the experimental monitor was being influenced by the presence of high humidity in the air and temperature variations in the sampling shelter that housed the monitor. These effects produced a false positive response under certain conditions. The effect was verified after the study by conducting moisture experiments in the MPCA Air Laboratory. When examining the data from the monitor it became difficult to separate the possibility of an authentic response from the false data generated by the humidity effects.

This monitor is the only known way of measuring isocyanate compounds on a real time and high sensitivity basis. As such, the Agency is interested in working to overcome the sampling problems encountered during the Rochester sampling experiment. If these problems can be overcome it would be possible to resample the neighborhood of the original study in the future.

Glycol Ethers

Ambient air sampling was conducted for the glycol ethers 2-butoxyethanol, 2-ethoxy ethanol, and 2-methoxyethanol. None of these chemicals were detected in the air at the detection level of 0.010 ppm. This detection limit is about 1.5 times above level chronic exposure criteria for 2-methoxyethanol, but well below the level of concern for the other glycol ethers. According to the MDH, since a larger sample volume was used than anticipated in the normal method, the detection level is actually 10 times lower (1ppb)^{vii} and would be well under all the health benchmarks.

Therefore, the average daily concentration of any of the glycol ethers did not exceed the chronic, or long-term health benchmark at the monitoring location. In summary, monitoring shows that levels of glycol ethers were not of concern at this location during this monitoring period.

VOCs and Carbonyls

Forty-four VOCs and carbonyls were analyzed. Of these, 20 of the compounds were below the detection limit for all samples. Eight of the compounds were primarily below detection, but had a few measurable samples. For the remaining 16 compounds, almost all of the samples were measured above the detection limit. See *Table 2* for complete results.

The results of the air sampling were compared to health benchmarks. In almost all cases, either the detection limit was below health benchmarks or no health benchmark was available. For the compounds that were undetected, only two, ethylene dibromide and 1,3-butadiene, had cancer health benchmarks that were lower than the detection limit. For the compounds with only a few detects, all of the detected concentrations were below applicable health benchmarks. When

health benchmarks were not available, the compounds were not evaluated for potential human health effects.

Of the chemicals that were detected, only three chemicals found in air samples approached levels of concern (benzene, formaldehyde, and carbon tetrachloride). However, the concentrations measured are similar to levels found throughout the Rochester area and other urban areas in the state, and none of these chemicals are associated with releases from the Crenlo facility.

Benzene and formaldehyde emissions are associated primarily with mobile sources (cars, trucks, buses, etc.) and tend to be elevated in urban areas throughout the state. Carbon tetrachloride is a long-lived chemical that is no longer used except for limited production and usage of preexisting stocks. It is found at similar concentrations in both rural and urban areas throughout the state. Indeed, the concentrations seen are believed to represent a global background that is found throughout the world.

No chemicals associated with Crenlo were found at levels above health benchmarks. However, health benchmarks are not available for all of the compounds monitored. In addition, the wind was blowing from Crenlo's direction for only three days when MPCA was monitoring and even on those dates the wind direction and speed varied during the sampling period. On these dates there were noticeable increases in the concentration of certain compounds measured by the canister and carbonyl samplers. Higher values were particularly seen on November 8 and November 30.

For example, toluene was 7 times higher on those three days than during the rest of the monitoring period. Butyraldehyde concentrations were 70 times greater. Even on those days, toluene was well below health benchmarks. Butyraldehyde did not have an available health benchmark, however, it is in the same family as acetaldehyde which has a chronic health benchmark of $9 \mu\text{g}/\text{m}^3$ and a cancer health benchmark of $5 \mu\text{g}/\text{m}^3$. Acetaldehyde would be expected to be more toxic than butyraldehyde. The average concentration of butyraldehyde was $3 \mu\text{g}/\text{m}^3$, which is below acetaldehyde's health benchmark. However, when the wind was blowing from Crenlo's direction, the concentration of butyraldehyde was as high as $40 \mu\text{g}/\text{m}^3$.

Chronic and cancer health benchmarks are most appropriately compared to at least a year of average monitoring data. No acute values (which would be appropriate for an 8-hr monitoring sample) are available for butyraldehyde. Using acetaldehyde chronic health criteria, MPCA does not expect butyraldehyde exposures to result in health impacts at the levels found at our monitoring location. However, the butyraldehyde levels might pose a concern at higher levels of production at Crenlo and/or when more Crenlo emissions reach the monitoring location.

The MDH is in the process of preparing a Health Consultation for Crenol. This report will go into more detail on potential health impacts from the facility. The Health Consultation should be available in the next few months.

Comparison With Other Monitoring Locations in Southern Minnesota

The MPCA has VOC and carbonyl monitoring data from several locations in southern Minnesota. This data was collected as part of the statewide monitoring study. The sites were all located at rooftop level away from immediate pollution sources. Monitoring data was collected

in Zumbrota from October 1996-September 1997, Rochester from October 1997-September 1998, and Winona from October 1998-September 1999.

MPCA did a rough comparison between the means for the Southern Minnesota data and the Crenlo monitoring data for the sixteen chemicals that had sufficient data over the detection limit. In almost all cases, the Crenlo data was similar to the data found at the other non-industrial locations. However, the means of four chemicals (acetaldehyde, acetone, butyraldehyde, and formaldehyde) found at Crenlo were slightly higher (although not statistically higher) than at the other locations. Acetaldehyde and formaldehyde concentrations at Crenlo and Winona were similar. However, acetone concentrations were at least double that of the other sites and butyraldehyde was ten times higher than the other sites.

Table 3: Pollutant concentrations at Crenlo compared to sites in southern Minnesota

	Crenlo	Zumbrota	Rochester	Winona
Acetaldehyde				
Average	1.6	0.63	0.91	1.5
Standard Error	0.98	0.041	0.050	0.081
Maximum	4.4	1.7	1.8	4.3
Acetone				
Average	3.9	0.97	1.2	1.76
Standard Error	3.55	0.069	0.057	0.15
Maximum	19	2.7	2.6	4.6
Butyraldehyde				
Average	2.7	0.20	0.23	0.29
Standard Error	8.89	0.014	0.018	0.020
Maximum	40	0.61	0.79	1.0
Formaldehyde				
Average	2.6	1.2	1.4	2.1
Standard Error	1.35	0.11	0.087	0.16
Maximum	6.2	3.2	2.9	6.1

The acetone and butyraldehyde maximum concentrations were correlated with wind directions from the northwest. The acetaldehyde and formaldehyde maximum concentrations were not correlated with wind directions from Crenlo.

Acetaldehyde and formaldehyde are common combustion products. The elevated concentrations may be a result of traffic in the location of the monitoring sites. Acetone is a common solvent and may be correlated with Crenlo emissions. It is unknown what the source of the butyraldehyde is. Butyraldehyde is also a combustion product, but would not be expected at such elevated levels due only to increased traffic.

Conclusions

MPCA staff does not believe further monitoring is necessary at the current location. We are satisfied that current operations at Crenlo do not present reason for immediate concern to the

daycare facilities to the east and south of Crenlo. However, since Crenlo was not operating at full capacity and the wind directions at the MPCA monitoring location were from Crenlo's direction on only three days, questions regarding the air quality near the daycare facilities still exist.

MPCA staff believes that the best way to resolve these concerns is through refined emission estimates and air dispersion modeling for Crenlo.

The MPCA must issue all air emissions permits, including Crenlo's, by December 2003 in order to maintain program commitments to the U.S. Environmental Protection Agency (EPA). Therefore, the MPCA must continue processing Crenlo's air emissions permit.

Through this air permit process, the MPCA and MDH will discuss with Crenlo how Crenlo will conduct dispersion modeling to best reflect production operations at historical "normal levels", and potentially future higher levels of production. The dispersion modeling will be a requirement of the air emissions permit.

The MPCA will also continue to investigate what control efficiencies are expected from particulate matter pollution-control equipment currently in place at Crenlo. To best determine release rates of chemicals, the MPCA may require Crenlo to measure concentrations of chemicals at the stack. Stack testing is a common requirement of air emission permits.

ⁱ U.S. EPA. Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, 2nd ed. Compendium Method TO-14A. EPA/625/R-96/010b. Cincinnati, OH:U.S. Environmental Protection Agency Office of Research and Development, 1999.

ⁱⁱ U.S.EPA. Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, 2nd ed. Compendium method TO-11A. EPA/625/R-96?010b. Cincinnati, OH:U.S. Environmental Protection Agency Office of Research and Development, 1999.

ⁱⁱⁱ Minnesota Department of Health. Minnesota Health Risk Values (HRV). St. Paul, MN:Minnesota Department of Health, 2001

^{iv} U.S.EPA. Integrated Risk Information System (IRIS). Available: <http://www.epa.gov/iris/> [cited November 2002].

^v U.S. EPA Health Effects Assessment Summary Tables (HEAST). EPA/540/R-97/036. Washington DC:U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, 1997.

^{vi} California Environmental Protection Agency Office of Environmental Health Hazard Assessment. Air. Available: <http://www.oehha.org/air.htm> [cited November 2001]

^{vii} E-mail from Carl Herbrandson of the Minnesota Department of Health, January 18, 2002.

Table 1: Health Benchmarks used for Crenlo Assessment

Chemical Name	Acute Non-Cancer			Cancer			Chronic Non-Cancer		
	Health Benchmark Source	Acute Health Benchmark (ug/m3)	Toxic Endpoint	Health Benchmark Source	Unit Risk (ug/m3)-1	10-5 Cancer Health Benchmark (ug/m3)	Health Benchmark Source	Chronic Health Benchmark (ug/m3)	Toxic Endpoint
1,2-dichloroethylene									
Acetaldehyde				HRV	2.20E-06	5	IRIS	9	oifactory epithelium degeneration
Acetone									
Benzaldehyde									
Benzene (cyclohexatriene)	HRV	1000	developmental	HRV	7.80E-06	1.3	CAL EPA	60	Hematopoietic system; development; nervous system
Butadiene, 1,3-									
Butyraldehyde				HRV	2.80E-04	0.04	CAL EPA	20	Reproductive system
Carbon tetrachloride	CAL EPA	1900	developmental	IRIS	1.50E-05	0.7	CAL EPA	40	Alimentary system; development; nervous system
Chlorobenzene (benzyl chloride)							CAL EPA	1000	Alimentary system; kidney; reproductive system
Chloroform (trichloromethane)	HRV	100	developmental	IRIS	2.30E-05	0.4	CAL EPA	300	Alimentary system; kidney; development
Crotonaldehyde									
Dichlorobenzene(m), 1,3-									
Dichlorobenzene(o), 1,2-							HEAST	200	decreased body weight gain
Dichlorobenzene(p), 1,4-				CAL EPA	1.10E-05	0.9	IRIS	800	increased liver weight
Dichlorodifluoromethane (CFC-12)							CAL EPA	1000	Alimentary system
Dichloropropene,				IRIS	4.00E-06	2.5	HRV	20	upper respiratory

Trichloro-1,2,2-trifluoroethane, 1,1,2- (Freon 113)									CAL EPA	90000	Nervous system
Trichloroethane, 1,1,2- (vinyl trichloride)				IRIS	1.60E-05	0.6			CAL EPA	400	Alimentary system; kidney; nervous system; cardiovascular
Trichloroethylene (trichloroethene)	HRV	2000	developmental	CAL EPA	2.00E-06	5			CAL EPA	600	Nervous system; eyes
Trichlorofluoromethane (CFC-11)									CAL EPA	20000	Nervous system
Trimethylbenzene, 1,2,4-											
Trimethylbenzene, 1,3,5-											
Vinyl chloride (chloroethene)	CAL EPA	180000	irritant - eye and respiratory system; CNS	HRV	8.80E-06	1			IRIS	100	Liver cell polymorphism
Vinylidene chloride (1,1-Dichloroethylene)				IRIS	5.00E-05	0.2					
Xylenes (isomers and mixture)	HRV	22000	irritant - eye and respiratory system; CNS						CAL EPA	700	Nervous system; respiratory system

HRV: Minnesota Department of Health, Draft Inhalation Health Risk Values

CAL EPA: California Office of Environmental Health Hazard Assessment.

IRIS: U.S. EPA Integrated Risk Information System

HEAST: U.S. EPA Health Effects Assessment Summary Tables

Table 2: Summary of Crenlo Monitoring Data (October 29, 2001–December 7, 2001)

Date of Collection	Wind speed (miles per hour) ¹	Wind direction (degrees) ¹	Wind direction ¹	1,1,1-trichloroethane (methyl chloroform) (ug/m3)	1,1,2,2-tetrachloroethane (ug/m3)	1,1,2,3,4,4-hexachloro-1,3-butadiene (ug/m3)	1,1,1,2-trichloroethane (vinyl trichloride) (ug/m3)	1,1-dichloroethane (dichloroethene) (ug/m3)	1,1-dichloroethene (vinylidene chloride) (ug/m3)	1,1-dibromoethane (ethylene dibromide) (ug/m3)	1,2-dichloroethane (ethylene dichloride) (ug/m3)	1,2-dichloropropane (propylene dichloride) (ug/m3)	1,3,5-trimethylbenzene (ug/m3)	1,3-Butadiene (ug/m3)
10/29/2001	7	50	ne	0.22	<	<	<	<	<	<	<	<	<	<
10/30/2001	8	122	se	0.22	<	<	<	<	<	<	<	<	<	<
10/31/2001	11	176	se	0.23	<	<	<	<	<	<	<	<	<	<
11/1/2001	6	250	sw	0.17	<	<	<	<	<	<	<	<	<	<
11/2/2001	7	260	sw	0.21	<	<	<	<	<	<	<	<	<	<
11/5/2001	8	180	s	0.32	<	<	<	<	<	<	<	<	<	<
11/6/2001	7	215	sw	<	<	<	<	<	<	<	<	<	<	<
11/7/2001	5	130	se	<	<	<	<	<	<	<	<	<	0.11	<
11/8/2001	12	330	nw	0.29	<	<	<	<	<	<	<	<	0.59	<
11/9/2001	6	212	sw	0.25	<	<	<	<	<	<	<	<	<	<
11/12/2001	7	175	se	0.22	<	<	<	<	<	<	<	<	<	<
11/13/2001	7	190	sw	<	<	<	<	<	<	<	<	<	<	<
11/14/2001	6	190	sw	<	<	<	<	<	<	<	<	<	<	<
11/15/2001	4	230	sw	0.23	<	<	<	<	<	<	<	<	<	<
11/16/2001	3	130	se	0.27	<	<	<	<	<	<	<	<	0.19	<
11/19/2001	9	300	nw	0.26	<	<	<	<	<	<	<	<	<	<
11/20/2001	10	180	s	0.24	<	<	<	<	<	<	<	<	0.07	<
11/21/2001	6	210	sw	0.23	<	<	<	<	<	<	<	<	<	<
11/26/2001	8	90	e	0.27	<	<	<	<	<	<	<	<	<	<
11/27/2001	4	100	se	0.31	<	<	<	<	<	<	<	<	<	<
11/28/2001	4	85	ne	0.27	<	<	<	<	<	<	<	<	<	<
11/29/2001	2	variable		0.25	<	<	<	<	<	<	<	<	0.08	<
11/30/2001	3	300	nw	0.22	<	<	<	<	<	<	<	<	0.08	<
12/3/2001	6	140	se	0.24	<	<	<	<	<	<	<	<	0.20	<
12/4/2001	6	195	sw	0.21	<	<	<	<	<	<	<	<	<	<
12/5/2001	12	180	s	<	<	<	<	<	<	<	<	<	0.14	<
12/6/2001	7	180	s	0.21	<	<	<	<	<	<	<	<	<	<
12/7/2001				0.21	<	<	<	<	<	<	<	<	<	<
Average ²				0.20	<	<	<	<	<	<	<	<	<	<
Minimum				<	<	<	<	<	<	<	<	<	0.59	<
Maximum				0.32	<	<	<	<	<	<	<	<	0.11	<
Standard Error				0.10										
Acute Health Benchmark (ug/m3) ³				68000										
Cancer Health Benchmark (ug/m3) ³					0.2	0.5	0.6	0.2	6	0.05	0.4			0.04
Chronic Health Benchmark (ug/m3) ^{3,4}						90	400	500	500	0.8	400	4		20
Hazard quotient (acute) ⁵				0%										
Hazard quotient (cancer) ⁵				0%										
HQ(chronic) ⁵														
LOD (ug/m3) ⁶				0.11	0.19	0.18	0.18	0.19	0.19	0.16	0.09	0.31	0.06	0.39

Table 2: Summary of Crenlo M

Date of Collection	4-Ethyl Toluene (ug/m3)	Acetaldehyde (ug/m3)	Acetone (ug/m3)	Benzaldehyde (ug/m3)	benzene(cyclohexatriene) (ug/m3)	bromomethane (methyl bromide) (ug/m3)	Butyraldehyde (ug/m3)	carbon tetrachloride (tetrachloromethane) (ug/m3)	chlorobenzene (benzyl chloride) (ug/m3)	chloroethene(vinyl chloride) (ug/m3)	cis-1,2-dichloroethylen dichloroethene (ug/m3)	dis-1,3-dichloropropene (ug/m3)	Crotonaldehyde (ug/m3)	dichlorodifluoromethane(freon 12) (ug/m3)
10/29/2001	<	1.78	1.98	<	0.60	<	0.14	0.67	<	<	<	<	<	3.80
10/30/2001	<	1.47	1.04	<	0.67	<	0.05	0.70	<	<	<	<	<	2.66
10/31/2001	0.23	1.88	3.64	<	0.77	<	0.08	0.62	<	<	<	<	<	2.80
11/1/2001	<	2.74	3.19	<	0.58	<	0.56	0.64	<	<	<	<	<	2.67
11/2/2001	<	1.45	1.02	<	0.37	<	0.04	0.52	<	<	<	<	<	2.67
11/5/2001	<	2.84	1.94	<	0.75	<	0.18	0.70	<	<	<	<	<	2.43
11/6/2001	<	3.13	5.15	<	0.66	<	0.58	0.62	<	<	<	<	<	2.53
11/7/2001	0.27	4.37	6.11	<	1.34	<	0.92	0.62	<	<	<	<	<	2.52
11/8/2001	1.34	1.84	18.60	<	0.44	<	26.56	0.58	<	<	<	<	<	2.38
11/9/2001	<	1.72	1.78	<	0.53	<	0.08	0.66	<	<	<	<	<	2.49
11/12/2001	<	2.44	3.07	<	0.81	<	0.39	0.67	<	<	<	<	<	2.42
11/13/2001	<	2.20	5.21	<	1.04	<	0.43	0.70	<	<	<	<	<	2.97
11/14/2001	<	2.12	5.23	<	1.30	<	0.45	0.67	<	<	<	<	<	2.75
11/15/2001	<	1.67	4.27	<	0.80	<	0.54	0.79	<	<	<	<	<	3.00
11/16/2001	0.46	2.70	5.29	<	2.31	<	0.75	0.67	<	<	<	<	<	3.06
11/19/2001	<	0.52	5.35	<	0.47	<	0.26	0.64	<	<	<	<	<	2.61
11/20/2001	<	1.00	5.62	<	1.04	<	0.21	0.64	<	<	<	<	<	2.66
11/21/2001	<	0.92	2.28	<	1.10	<	0.28	0.58	<	<	<	<	<	2.86
11/26/2001	<	0.38	0.75	<	0.65	<	0.12	0.64	<	<	<	<	<	2.88
11/27/2001	<	0.27	0.73	<	0.96	0.06	0.07	0.63	<	<	<	<	<	3.39
11/28/2001	<	0.36	4.19	<	0.61	<	<	0.64	<	<	<	<	<	2.62
11/29/2001	0.26	0.76	8.47	<	0.90	<	1.10	0.59	<	<	<	<	<	2.74
11/30/2001	<	0.70	5.85	<	0.73	<	40.34	0.64	<	<	<	<	<	2.90
12/3/2001	0.58	2.05	2.07	<	2.46	<	0.33	0.65	<	<	<	<	<	2.83
12/4/2001	<	1.16	1.96	<	0.91	<	0.33	0.53	<	<	<	<	<	2.54
12/5/2001	0.37	0.89	1.31	<	0.83	<	0.10	0.53	<	<	<	<	<	2.63
12/6/2001	<	0.73	0.86	<	0.80	<	0.07	0.64	<	<	<	<	<	2.56
12/7/2001	<	1.09	1.41	<	1.37	<	0.19	0.63	<	<	<	<	<	2.81
Average ²	<	1.61	3.87	<	0.92	<	2.69	0.64	<	<	<	<	<	2.76
Minimum	<	0.27	0.73	<	0.37	<	<	0.52	<	<	<	<	<	2.38
Maximum	1.34	4.37	18.60	<	2.46	0.06	40.34	0.79	<	<	<	<	<	3.80
Standard Error		0.98	3.55		0.49		8.89	0.06						0.30
Acute Health Benchmark (ug/m3) ³					1000	2000		1900						
Cancer Health Benchmark (ug/m3) ³		5			1.3		0.7					2.5		
Chronic Health Benchmark (ug/m3) ^{3,4}		9			60	5	40		1000	100		20		1000
Hazard quotient (acute) ⁵					0%	0%		0%						
Hazard quotient (cancer) ⁵		32%			71%			95%						
HQ(chronic) ⁵		18%			2%	0%		2%						0%
LOD (ug/m3) ⁶	0.22	0.02	0.03	0.04	0.12	0.12	0.12	0.22	0.13	0.18	0.14	0.27	0.04	0.16

Table 2: Summary of Crenlo M

Date of Collection	dichloromethane (methylene chloride) (ug/m3)	dichlorodifluoroethane (in 114) (ug/m3)	dichlorotetrafluoroethane (in 114) (ug/m3)	Formaldehyde (ug/m3)	m&p-xylene (1,3/1,4-dimethylbenzene) (ug/m3)	m/1,3-dichlorobenzene (ug/m3)	o/1,2-dichlorobenzene (ug/m3)	o-xylene (1,2-dimethylbenzene) (ug/m3)	p/1,4-dichlorobenzene (ug/m3)	Propionaldehyde (ug/m3)	styrene(vinyl benzene) (ug/m3)	tetrachloroethylene(perchloroethylene) (ug/m3)	toluene(methyl benzene) (ug/m3)	trans-1,3-dichloropropene (ug/m3)
10/29/2001	<	0.06	0.09	1.87	0.30	<	<	0.10	<	0.22	<	<	0.76	<
10/30/2001	<	0.06	0.10	1.27	0.35	<	<	0.11	<	0.08	<	<	0.77	<
10/31/2001	<	<	0.16	2.12	0.42	<	<	0.17	<	0.13	<	0.30	0.96	<
11/1/2001	<	<	0.08	2.72	0.25	<	<	0.09	<	0.10	<	<	0.66	<
11/2/2001	<	<	<	1.42	<	<	<	0.02	<	0.05	<	<	0.24	<
11/5/2001	<	<	0.11	2.72	0.34	<	<	0.13	<	0.12	<	<	0.87	<
11/6/2001	<	<	0.12	2.94	0.29	<	<	0.09	<	0.21	<	<	1.14	<
11/7/2001	<	<	0.36	3.46	0.92	<	<	0.37	<	0.40	<	<	2.58	<
11/8/2001	<	<	2.19	3.55	7.14	<	<	1.91	<	0.28	<	<	15.11	<
11/9/2001	<	<	0.07	2.18	<	<	<	0.07	<	0.05	<	<	0.58	<
11/12/2001	<	<	0.10	3.43	0.26	<	<	0.09	<	0.17	<	<	0.84	<
11/13/2001	0.16	<	0.20	2.14	0.51	<	<	0.17	<	0.18	<	0.48	1.53	<
11/14/2001	<	<	0.20	2.33	0.53	<	<	0.18	<	0.09	<	1.07	1.46	<
11/15/2001	<	<	0.13	5.57	0.38	<	<	0.13	<	0.10	<	<	0.98	<
11/16/2001	0.28	<	0.53	6.22	1.60	<	<	0.58	<	0.37	0.14	1.02	4.19	<
11/19/2001	<	<	<	1.32	<	<	<	<	<	0.10	<	<	0.42	<
11/20/2001	<	<	0.21	1.67	0.64	<	<	0.20	<	0.13	<	<	1.52	<
11/21/2001	<	<	0.28	1.47	0.73	<	<	0.26	<	0.09	<	0.20	1.69	<
11/26/2001	<	<	<	1.85	<	<	<	<	<	<	<	<	0.63	<
11/27/2001	<	<	0.22	2.97	0.59	<	<	0.25	0.40	<	<	<	2.06	<
11/28/2001	<	<	0.09	0.77	0.27	<	<	0.10	<	0.07	<	<	0.69	<
11/29/2001	<	<	0.41	0.80	1.19	<	<	0.35	<	0.14	<	<	2.50	<
11/30/2001	<	<	1.14	0.80	3.70	<	<	0.65	<	0.12	<	<	15.45	<
12/3/2001	0.18	<	0.66	4.89	2.13	<	<	0.76	<	0.08	0.12	1.20	4.20	<
12/4/2001	<	<	0.11	3.12	0.43	<	<	0.14	<	0.06	<	<	1.00	<
12/5/2001	<	<	0.36	2.58	1.09	<	<	0.43	<	0.07	<	<	1.84	<
12/6/2001	<	<	0.20	2.75	0.60	<	<	0.20	<	<	<	0.27	1.21	<
12/7/2001	<	0.09	0.29	3.48	0.81	<	<	0.31	<	0.07	<	0.13	1.93	<
Average ²	<	<	0.30	2.59	0.93	<	<	0.28	<	0.12	<	<	2.42	<
Minimum	<	<	<	0.77	<	<	<	<	<	<	<	<	0.24	<
Maximum	0.28	0.09	2.19	6.22	7.14	0.02	0.07	1.91	0.40	0.40	0.14	1.20	15.45	<
Standard Error			0.44	1.35	1.43			0.37		0.10			3.76	
Acute Health Benchmark (ug/m3) ³	10000		10000	94	22000			22000			21000	20000	37000	
Cancer Health Benchmark (ug/m3) ³	20			0.8					0.9			1.7		2.5
Chronic Health Benchmark (ug/m3) ^{3,4}	400		1000	3	700	200	200	700	800		1000	35	400	20
Hazard quotient (acute) ⁵	0%		0%	7%	0%			0%			0%	0%	0%	0%
Hazard quotient (cancer) ⁵	0%			323%										
HQ(chronic) ⁵	0%		0%	86%	0%		0%	0%					1%	
LOD (ug/m3) ⁶	0.15	0.15	0.07	0.02	0.23	0.10	0.14	0.08	0.26	0.03	0.06	0.10	0.08	0.17

Table 2: Summary of Crenlo M

Date of Collection	trichloroethylene (trichloroethene) (ug/m3)	trichlorofluoromethane (trichloroethane) (ug/m3)	trichloroethane (chloroform) (ug/m3)	trichlorotrifluoroethane (freon 113) (ug/m3)	2-butoxyethanol (Ethylene Glycol Mono-n-butyl Ether)	2-ethoxyethanol (Ethylene glycol monoethyl ether)	2-methoxyethanol (Ethylene Glycol Mono Methyl Ether)
10/29/2001	<	1.45	<	0.48	<	<	<
10/30/2001	<	1.56	<	0.61	<	<	<
10/31/2001	<	1.64	<	0.54	<	<	<
11/1/2001	<	1.52	<	0.60	<	<	<
11/2/2001	<	1.54	<	0.58	<	<	<
11/5/2001	<	1.68	<	0.57	<	<	<
11/6/2001	<	1.49	<	0.64	<	<	<
11/7/2001	<	1.55	<	0.48	<	<	<
11/8/2001	<	1.50	<	0.55	<	<	<
11/9/2001	<	1.69	<	0.58	<	<	<
11/12/2001	<	1.53	<	0.62	<	<	<
11/13/2001	<	1.78	<	0.57	<	<	<
11/14/2001	<	1.66	<	0.57	<	<	<
11/15/2001	<	1.67	<	0.58	<	<	<
11/16/2001	<	1.62	<	0.54	<	<	<
11/19/2001	<	1.62	<	0.51	<	<	<
11/20/2001	<	1.43	<	0.67	<	<	<
11/21/2001	<	1.57	<	0.61	<	<	<
11/26/2001	<	1.51	<	0.71	<	<	<
11/27/2001	<	1.58	<	0.57	<	<	<
11/28/2001	<	1.53	<	0.48	<	<	<
11/29/2001	<	1.60	<	0.59	<	<	<
11/30/2001	<	1.46	<	0.25	<	<	<
12/3/2001	<	1.57	<	0.64	<	<	<
12/4/2001	<	1.45	<	0.46	<	<	<
12/5/2001	<	1.47	<	0.43	<	<	<
12/6/2001	<	1.49	<	0.54	<	<	<
12/7/2001	<	1.57	<	0.64	<	<	<
Average ²		1.56		0.56			
Minimum		1.43		0.25			
Maximum		1.78		0.71			
Standard Error		0.08		0.09			
Acute Health Benchmark (ug/m3) ³	2000		100		14000	400	90
Cancer Health Benchmark (ug/m3) ³	5		0.4				
Chronic Health Benchmark (ug/m3) ^{3,4}	600	20000	300	90000	13000	200	20
Hazard quotient (acute) ⁵			0%				
Hazard quotient (cancer) ⁵							
HQ(chronic) ⁵		0%		0%			
LOD (ug/m3) ⁶	0.25	0.24	0.09	0.20	48	37	31

¹ Meteorological data not available for December 7, 2001

² Averages were calculated including the reported concentration number (even if it was below the detection limit). Therefore, the averages seen may be slightly different than the averages that would be calculated from the concentrations given. Averages were not calculated for chemicals with greater than 50% of data below the detection limit.

³ The health benchmarks are from the following sources: the Minnesota Department of Health, Draft Health Risk Values, Fall 2001; the U.S. EPA Integrated Risk Information System (IRIS), Fall 2001; the U.S. EPA Health Effects Assessment Summary Tables (HEAST), 1997; California Office of Environmental Health Hazard Assessment (OEHHA), 2000-2001.

⁴ The cancer health benchmarks are based on the Minnesota Department of Health Tolerable Risk Level of 1x10⁻⁵.

⁵ The acute hazard quotient is calculated by dividing the maximum concentration by the acute health benchmark. The cancer hazard quotient is calculated by dividing the average concentration by the cancer hazard benchmark. The chronic hazard benchmark is calculated by dividing the average concentration by the chronic hazard benchmark.

⁶ The VOC limits of detection (LODs) are reported by MPCA for 2000. The Carbonyl LODs are an average LOD from 1995-1999. Glycol ether detection limits were reported by the Department of Health, Fall 2001. The (<) sign indicates that the concentration of the chemical was below the LOD for the analysis equipment.