Health Consultation

Exposure Investigation Report

Airborne Exposures to Select Volatile Organic Compounds

PERMA-FIX OF DAYTON, INC.
(FORMERLY CLARK OIL PRODUCTIONS, INC.)
DAYTON, MONTGOMERY COUNTY, OHIO

DECEMBER 15, 2008

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

Exposure Investigation Report

Airborne Exposures to Select Volatile Organic Compounds

Perma-Fix of Dayton, Inc.
(formerly Clark Oil Production, Inc.)
Dayton, Montgomery County, OH

Cost Recovery Number A888

December 2008

Prepared by:

Diane Jackson/
ATSDR/DHAC/EISAB

Prepared by

Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation

Executive Summary

ATSDR was petitioned by a community group concerned about odors near a commercial wastewater treatment plant in a residential neighborhood of Dayton, Ohio. The community group was concerned that odors and air emissions were responsible for a range of health problems (e.g., headache, nausea, heart and memory problems, and birth defects).

Over a one-year period, ATSDR conducted outdoor air sampling for 6 days and one night (June 26-28, August 28, September 4, 2007 and June 20, 2008) testing for volatile organic compounds (VOCs) and other odor-producing compounds in the neighborhood adjacent to the Perma-Fix of Dayton (PFD) facility [now known as Clean Waters Ltd.].

None of the more than 100 compounds analyzed were detected over health-based values. The difference between the average concentrations of VOCs for downwind and upwind samples was not statistically significant.

ATSDR reviewed information on the wastes accepted and the treatment processes used by PFD. Although no obvious source for the reported odors was found in that review, one compound, ethyl acetate, which has a low odor threshold, was detected in outdoor air sampling during the third sampling event (June 2008). Ethyl acetate has the characteristic odor of fingernail polish remover. A “fingernail polish remover” odor was described by area residents, ATSDR staff, and the local air pollution control agency while in the neighborhood and when touring the PFD facility (e.g., in the filter press room, the laboratory). This compound may be the source of the reported solvent-like odors.

To reduce solvent-like odors, ATSDR is recommending that PFD determine if there is a source of ethyl acetate in their waste streams and seek to eliminate or treat it if it is present.

Objectives and Rationale

ATSDR was petitioned by a community group concerned that odors and air emissions near a commercial wastewater treatment plant in a residential neighborhood of Dayton, Ohio were responsible for a range of health problems (e.g., headache, nausea, heart and memory problems, and birth defects). ATSDR reviewed information on the wastes received, treatment processes and visited the community before deciding that outdoor air sampling adjacent to the Perma-Fix of Dayton (PFD) facility [*now known as Clean Waters Ltd.]* was warranted. This Exposure Investigation (EI) provided sampling for volatile organic compounds (VOCs) and other odor-producing compounds, evaluated exposure, and determined the public health impact.

Background

ATSDR was petitioned in September 2003 by a community group in the residential neighborhood surrounding Perma-Fix of Dayton (PFD). In March 2004, ATSDR accepted the petition request. The petitioner believes that odors and air emissions from the PFD facility are responsible for a range of health problems in the surrounding community including: headache, nausea, vomiting, nose bleeds, numbness in legs and hands, heart and memory problems, gastrointestinal and respiratory disorders, burning eyes, sore throats, unexplained rashes, premature births, and birth defects.

Operations at the facility began in 1941 as an oil recycling business that also processed tires, batteries, aluminum, asphalt, and asphalt products. Today, the PFD facility (Figure 1) operates 24-hours a day, five days a week to: 1) recycle used oil; 2) pretreat wastewater; 3) solidify non-hazardous waste; and 4) manage hazardous waste. Hazardous waste may be stored onsite prior to shipment to alternate facilities. Although PFD accepts both waste oil and non-hazardous and hazardous wastewater from industrial facilities, waste oil recycling is the primary business (ATSDR 2007).

Figure 1. Perma-Fix of Dayton [now Clean Waters Ltd.]

The majority of the waste oil (70%) is recovered from oily wastewaters. In 2006, PFD recycled 4 million gallons of oil. Waste oils are either sold for reuse or solidified for disposal (ATSDR 2007).

Wastewater treatment includes sedimentation and biological treatment before being

discharged to the county sanitary sewer. A regenerative thermal oxidizer (RTO) treats vapors from the biological treatment plant and other processes (more information on http://www.perma-fix.com/dayton/index.html).Hazardous waste organics are collected and bulked prior to shipment for energy recovery.

Residential areas lie north and west of the facility, and the wind typically blows from the southwest. The closest residential area is within 200 feet of the facility. State highway 35 lies to the east of PFD and two extensive junkyards are located south and east and northeast. Three, K-12 schools are located within 2 miles of the facility. There are approximately 3,930 people within one mile of PFD (U.S. Census Bureau 2000). Sixty-five percent are white, 31.5% are black, and 3.5% other. There are 436 (11%) children under age 6 and 508 (13%) adults older than 65. Appendix A shows an aerial photograph of the neighborhood surrounding PFD.

Previous Surveillance and Sampling

Odor Surveillance

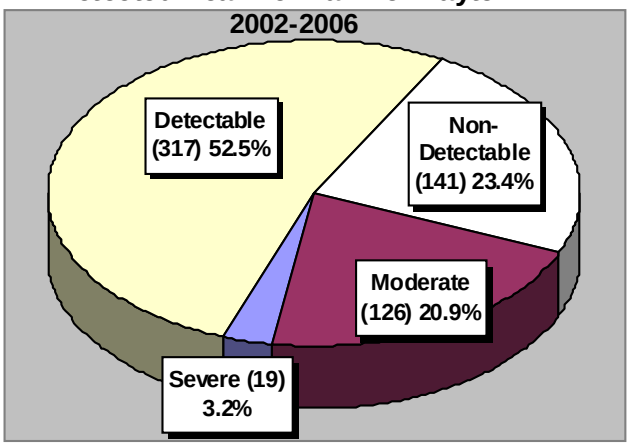
The Regional Air Pollution Control Agency (RAPCA) has conducted extensive odor surveillance and some limited air sampling in this community. RAPCA provided ATSDR with their odor logs from May 2002 to present and their air sampling data. Based on the information from RAPCA's odor surveillance logs, a large percentage (approximately 60%) of the odors are solvent-like and occur in the part of the neighborhood downwind from the facility (primarily north). Previously collected environmental samples indicate that there are VOCs in the air, but the data are not sufficient to assess the community's exposure.

To determine when to sample and for what compounds, ATSDR reviewed the odor surveillance logs to determine if the frequency or intensity of the odors has changed, when the worst odors are detected, and what types of odors are the most prevalent. This information is presented in the following section.

Odor Frequency and Intensity

RAPCA continues to qualitatively monitor the air near PFD for odors. From May 2002 to December 2006, mostly during weekday business hours, RAPCA inspectors randomly visited the neighborhoods near the Perma-Fix facility to monitor odors. During that period, they detected odors on 462 of 603 (76.6%) visits, including 126 detections considered "moderate" and 19 detections considered "severe" (Figure 2).

Figure 2. Severity & Frequency of Odors Detected near Permafix of Dayton * 2002-2006



*The odor intensity categories severe, moderate, and detected were defined by RAPCA for use by their staff. According to RAPCA, detected odors were noticeable, severe odors are strong enough that they were overpowering and moderate odors were in between.)

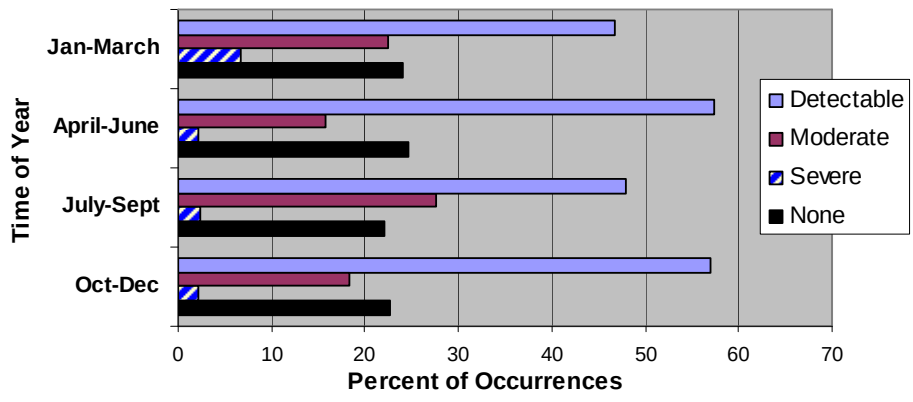
Location of Moderate and Severe Odors

The area directly north and west of PFD is primarily residential. According to RAPCA's odor surveillance conducted between 2002 and 2006, all of the "severe" odors and 89% of the "moderate" odors detected were north to northwest of the facility on Bronson Street, Cherokee Avenue, S Northampton Avenue, and Calumet Lane (approximately 0.1- 0.4 miles from PFD) (Appendix A has an aerial photograph of those streets). Occasionally, moderate to strong odors were also detected in the areas near W 3rd St, US 35, and Infirmary Road (approximately ½ mile northeast of PFD).

Odor Variability by Time of Year

Between 2002 and 2006, odor detections, intensities, and characteristics did not vary much by time of year. Figure 3 shows the odor intensity occurrences by time of year.

Figure 3. Odor Intensity by Quarter near Permafix of Dayton - 2002-2006

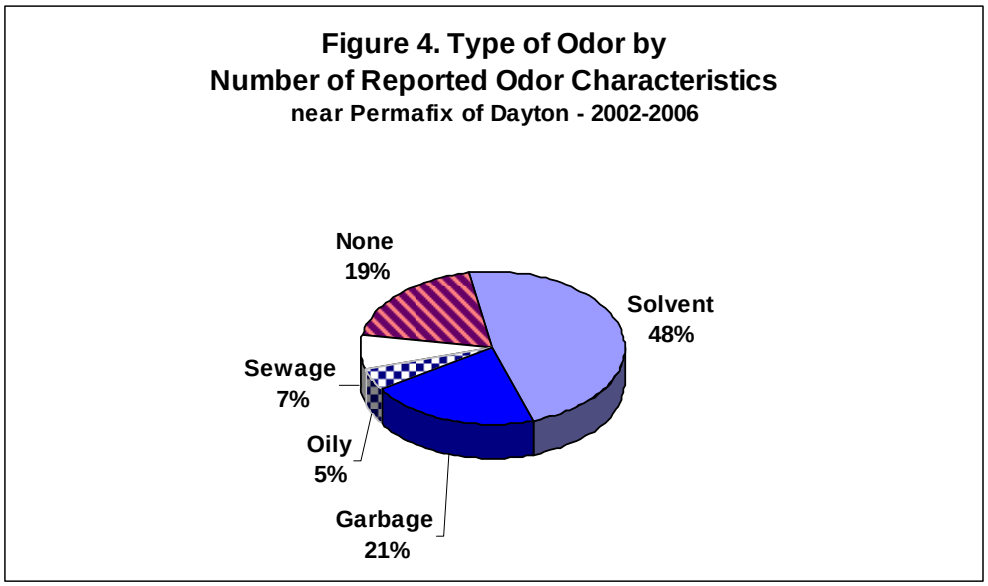


(Note: These statistics were compiled from the "worst case" odor location from each visit. RAPCA reports that the number of moderate and

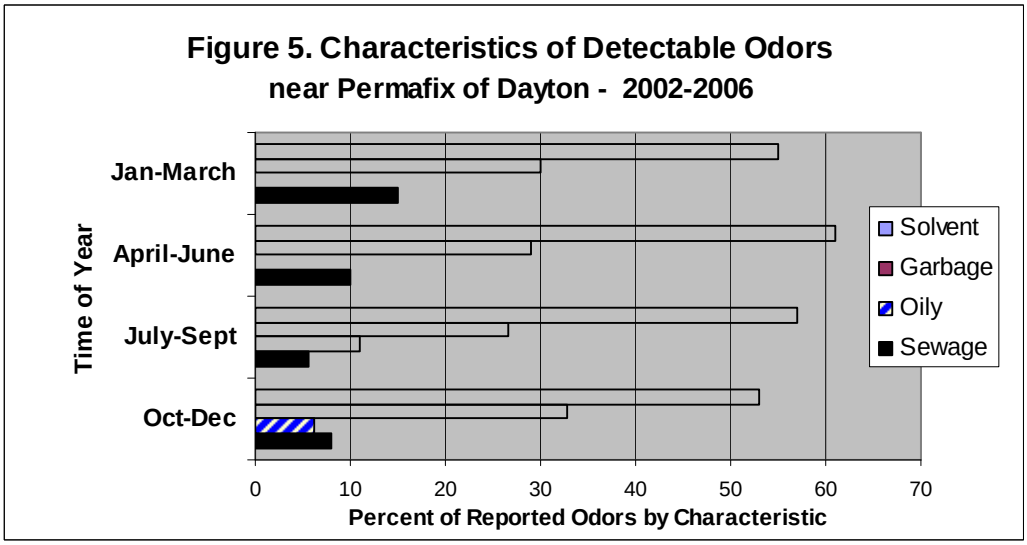
severe detections per location per visit, has dropped significantly since 2005 (ATSDR 2006)).

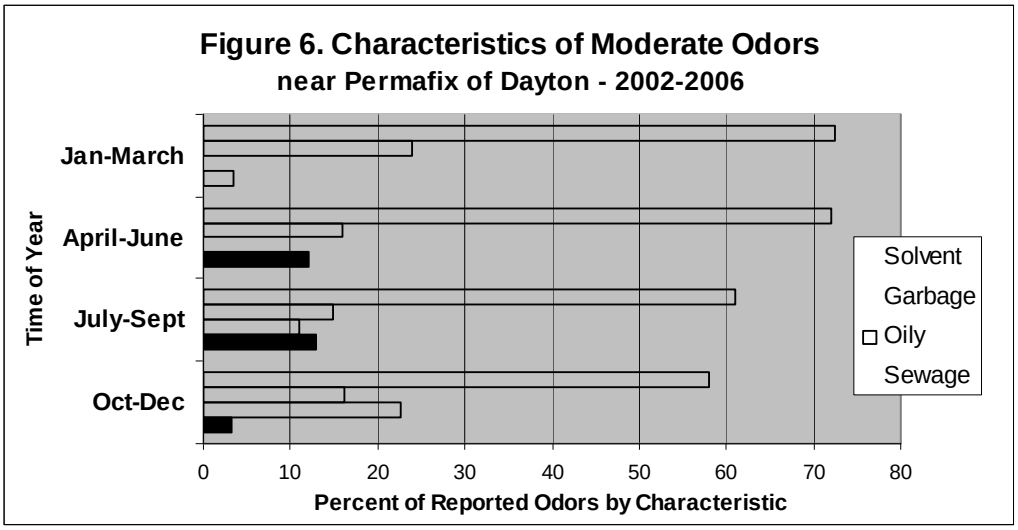
Odor Characteristics

For the four years evaluated, odors were described as solvent-like in 48% of the number of reported odors, garbage-like in 21%, oily in 5%, septic/sewage-like in 7%, and no odor in 19%.



Evaluation of the odor surveillance log showed that odor characteristics also did not vary much by quarter or season. Figures 5 and 6 show the percent of reported odors by characteristic by time of year (Note: Figures 5 &6 do not include days with no odor).





Previous Air Sampling

RAPCA has conducted two separate environmental sampling events near PFD. In July 2001, RAPCA collected a single one-hour canister sample. The sample was then analyzed by the Ohio Environmental Protection Agency (EPA). Acrylonitrile (1.1 µg/m^3; 0.46 ppb), benzene (20.4 µg/m^3; 5.9 ppb), and 1,3-butadiene (0.24 µg/m^3; 0.010 ppb) were detected below the U.S. EPA's Reference Concentration for Chronic Inhalation Exposure (RfC) [1]

RAPCA completed a 12-month air sampling and modeling project in November 2004 in the greater Dayton area with a grant from the EPA National Air Toxics Assessment (NATA) program. SUMMA™ canisters were used to collect air samples at four locations in the Dayton area, including a county health clinic ¼ mile north-northwest from the PFD facility. Thirty-one, 24-hour canisters from the health clinic were analyzed for 18 VOCs. In addition, passive sorbent tubes were located at the health clinic (16 tubes) and a resident's yard directly across Cherokee Avenue from PFD (25 tubes). Samples were collected over 28 days and were analyzed for benzene, methylene chloride, trichloroethylene (TCE) and perchloroethylene (PCE). The sampling results were all below ATSDR's MRLs[2] (RAPCA 2004).

[1] Reference Concentration (RfC) is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily inhalation exposure of the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. The RfC considers toxic effects for both the respiratory system (portal-of-entry) and for effects peripheral to the respiratory system (extrarespiratory effects). http://www.epa.gov/iris/subst/0361.htm

[2] MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancer health effects.

Methods

Exposure Investigation Design

Choosing the Sampling Parameters

ATSDR conducted ambient air sampling for the following chemicals:

- **Volatile organic compounds (VOCs) and semi-volatile compounds (SVOCs) (i.e., Phenol) –** VOCs and SVOCs were selected for monitoring during this EI because these compounds: 1) were present in previous sampling; 2) are listed as emitted in the company's Toxic Release Inventory (TRI) report; 3) are a major contaminant listed in the material shipped to the facility for treatment; and, 4) some have a "sweet" odor like the most commonly reported odor in the four-year odor log. More than 100 VOCs were analyzed. See Appendix B for the complete list.
- **Ethylene Glycol –** Ethylene glycol is used in anti-freeze and is frequently mixed in with the waste oil that PFD collects from oil-changing stations. Ethylene glycol was also listed on the TRI list of chemicals shipped to PFD.
- **Formaldehyde –** Formaldehyde was listed on the TRI list of chemicals shipped to PFD. Formaldehyde is formed in the environment during the burning of fuels or household waste. It has a low odor threshold (i.e., you can smell it a low levels) and a pungent odor.
- **Petroleum distillates –** Petroleum distillates are used in the oil/waste oil industry as a degreaser. Since PFD recycles used oil, it is likely degreasers are in the waste oils brought to the facility.
- **Amines –** According to PFD personnel, PFD collects waste oils and wastewater from many metals-working industries. Amines are used in "cutting fluids" for lubrication and cooling in the metal working industry. They can have a mild, sweet fragrance.
- **Phthalates –** Phthalates are also used in lubricating oils.
- **Acetaldehyde –** Acetaldehyde is an impurity in the production of ethylene glycol and is also a decomposition product of ethylene glycol. It has a low odor threshold and a fruity odor.

Environmental Sampling

Sampling Dates and Number of Samples

Samples were collected during three different time periods over one year. Samples were collected on weekdays because PFD operates 24 hours per day/ 5 days per week. For each sampling round, ATSDR set up a portable meteorological station and collected meteorological data. For the first sampling event in June 2007, ATSDR spent five days in the Drexel area assessing the conditions and sampling for 3 days and one night because some area residents reported that a majority of the more severe odors occur at night.

The second sampling event took place on August 28 and September 4, 2007.The third round of sampling took place on June 20, 2008. The Regional Air Pollution Control Agency (RAPCA) conducted the sampling for the second and third rounds.

Sampling for specific compounds was not repeated in the next round if they were not detected or were detected in similar concentrations in the upwind and downwind samples. Instead, we substituted other odor-producing compounds in subsequent sampling rounds. Table 1 lists the compounds sampled by date.

Table 1. Summary of Compounds Sampled by Date near PFD

Compound	Sample Method	Number of Samples	Sampling Event[1]
VOCs (Carbotraps)	TO-17	16 11 downwind, 5 upwind	1,2,3
Phenol	OSHA-32	10 7 downwind 3 upwind	1
Ethylene Glycol	NIOSH 5523	10 7 downwind 3 upwind	1
Formaldehyde	NIOSH 2541	10 7 downwind 3 upwind	1
Petroleum distillates	OSHA 48, NIOSH 1550	3 2 downwind 1 upwind	2
Amines	NIOSH 2010	3 2 downwind 1 upwind	2
Phthalates	NIOSH 5020	3 2 downwind 1 upwind	2
Acetaldehyde	NIOSH 2538	3 2 downwind 1 upwind	3

[1]Round 1: (10 samples – 7 downwind, 3 upwind) (6- 26-28, 2007)

Round 2: (3 samples – 2 downwind (Aug & Sept), 1 upwind) (8/28, 9/4, 2007)

Round 3: (3 samples – 2 downwind, 1 upwind) (6/20/2008)

Sampling Locations, Wind Speeds, and Directions

Most of the downwind samples were taken near the intersection of Bronson Street and S Northampton Avenue in Dayton, Ohio. This is the same location that most of the more severe odors were reported. The overnight downwind sample was taken east of PFD near Highway 35. We only collected one overnight sample because the odor intensity observed by the samplers was not noticeably different from the daytime samples and the wind directions were predicted to vary more overnight. The upwind samples were collected at Arthur Fisher Park which is off of Dayton Liberty Road. Appendix C shows the approximate sample locations.

Table 2 lists the approximate sampling times, wind speeds, and wind direction for each sampling date.

Table 2. Wind Speed and Direction for Sample Dates

Date	Approximate Sample Location	Sample Time*	Wind Direction	Wind Speed (mph) Mean / (range)
6/26/2007	113 S Northampton Arthur Fisher Park (pond)	10:40a-6:45p	SW-S	7.8 (4-9)
6/26/07- 6/27/20007	Hwy 35	9:15p-8a	W-NW	1 (0-3)
6/27/2007	113 S Northhampton S Northhampton & Bronson Arthur Fisher Park (trail)	11:30a-3:30p 11:30a-5:40p 4p-7p	SW-W	6.6 (3-9)
6/28/2007	S Northhampton & Bronson Arthur Fisher Park (trail)	7a-11:40a	SW-W	3.8 (3-4)
8/28/2007	S Northhampton & Bronson	12p-2p	SW	4 (3-7)
9/4/2007	S Northhampton & Bronson Arthur Fisher Park (pond)	10a-12:30p	SW	4 (1-7)
6/20/2008	Dead end & Bronson S Northhampton & Bronson Arthur Fisher Park (pond)	11a-2p	SE	7.9 (3-13)

* Sample times vary for each compound. This is the range for all samples.

Sampling Procedures

All samples were collected by drawing a known volume of ambient air (at heights between 2 to 6 feet) by a battery-operated pump.

VOCs - *Carbotrap*™ – VOCs were collected with Carbotrap™ tubes and analyzed consistent with the USEPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Determination of VOCs and SVOCs in Ambient Air Using Active Sampling onto Sorbent Tubes with Subsequent Analysis by Gas Chromatography (TO-17) (EPA 1997). A sample of ambient air was drawn by a battery-operated pump into a Carbotrap™ tube. The samples were collected over a 2 to 4-hr period. The sample chamber is a metal tube filled with carbon granules and washed in XAD-2 resin. The cap is closed with screw caps by a gloved scientist to prevent introduction of other VOCs. Samples were shipped following chain of custody and storage procedures. The sampling volumes of VOCs on hydrophobic adsorbents

such as Tenax®, other porous polymers, Carbotrap™ and Carbopack™ are relatively unaffected by atmospheric humidity (EPA 1997).

Phenol – *OSHA Method-32* **–** The sample was collected onto a XAD-7 sampling tube. Most of the samples were collected over a 4-hr period although a few were collected over a 5-7-hr period primarily during the overnight sampling. These samples were desorbed with methanol and analyzed by high performance liquid chromatography (HPLC) with ultraviolet (UV) detection.

Ethylene Glycol – *NIOSH 5523* **–** The sample was collected onto a XAD-7 sampling tube. Most of the samples were collected over a 1.5 to 4-hr period although a few were collected over a 6 to 11.5-hr period primarily during the overnight sampling. These samples were desorbed with methanol and analyzed by a gas chromatograph.

Formaldehyde –*NIOSH 2541* **–** The sample was collected onto a XAD-2 sampling tube (**(**10% (2-hydroxymethyl) piperdine on XAD-2, 120 mg/60 mg). Most of the samples were collected over a 3 to 4-hr period although a few were collected over a 6 to 11.5-hr period primarily during the overnight sampling. These samples were desorbed and analyzed by a gas chromatograph.

Petroleum Distillates – The sample was collected onto a charcoal tube. Most of the samples were collected over a 1 to 1.5-hr period. Samples were desorbed with carbon disulfide and analyzed by gas chromatography using a flame ionization detector.

(Aliphatic) Amines – The sample was collected onto a solid sorbent tube (silica gel). Most of the samples were collected over a ½ -hr period. Samples were analyzed by gas chromatography using a flame ionization detector.

Phthalates – The sample was collected onto a filter (cellulose ester membrane) over a 1 to 3-hr period. Samples were analyzed by gas chromatography using a flame ionization detector.

Acetaldehyde – The sample was collected onto a XAD-2 sampling tube over a 1½ to 2-hr period. Samples were analyzed by gas chromatography using a flame ionization detector.

Results

Overall Summary

None of the more than 100 compounds sampled were detected over health-based values. We used ATSDR's Minimum Risk Levels as a health-based comparison values, where available. An MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancer health effects. One compound, ethyl acetate, was detected near its odor detection threshold in one sample in the third sampling round in 2008.

VOC summary

Presented in Table 3 are compounds that were 1) not detected in upwind samples, 2) were detected in higher concentrations in downwind samples than upwind; and/or 3) were frequently

detected. Although overall the concentrations were higher in downwind samples than upwind samples, the difference between the average concentrations of VOCs for downwind and upwind samples was not statistically significant. This lack of difference may be due to the small sample size. The downwind and upwind range, mean and standard deviations are shown in Table 3.

In the third sampling event, ethyl acetate was detected in the one upwind (240 µg/m^3) and two downwind samples (4,600 and 1,200 µg/m^3). The maximum downwind concentration was almost 20 times higher than the upwind concentration and within the reference range for odor threshold detection. Review of the windrose data indicates that the detection of ethyl acetate in the upwind sample could have been due to a wind shift. Ethyl acetate has the characteristic odor of fingernail polish remover. Ethyl acetate was not detected in previous sampling rounds (4 upwind and 9 downwind samples).

A summary of all of the VOCs detected by compound can be found in Appendix D.

Other Compounds Summary

- Round 1 (June 26-28, 2007 (3 upwind, 7 downwind) also included formaldehyde, ethylene glycol, and phenol. Formaldehyde was high in upwind and downwind samples (over normal values found in cities). No ethylene glycol or phenols were detected.
- Round 2 (August 28 & September 4, 2007) (1 upwind, 2 downwind) also included petroleum distillates, amines, and phthalates. No petroleum distillates, amines, and phthalates were detected.
- Round 3 (June 20, 2008) (1 upwind, 2 downwind) also included acetaldehyde. The downwind levels of acetaldehyde were similar to the upwind.

Discussion

ATSDR's objective was to identify and detect odor-producing compounds in the neighborhood surrounding the Perma-Fix of Dayton (PFD) facility and determine the public health impact.

- *VOCs*: Over a one-year period, ATSDR sampled 6 days and one night when PFD was operating. We analyzed the samples for more than 100 VOCs. Odors were evident to the samplers each time we sampled. We chose days with steady, light winds (from 1-9 mph, primarily from the SW and SE (See Table 2)) to ensure our samples were downwind throughout the sampling event.

- *Odors*: Although we found one possible cause for the solvent odors, the compound – ethyl acetate – was only detected during one sampling event. Ethyl acetate has a low odor threshold and the characteristic odor of fingernail polish remover. People, including ATSDR and RAPCA staff, reported a fingernail polish remover odor in the neighborhood. That same odor was also observed when ATSDR staff toured the PFD facility. It was most noticeable in the filter press room and the testing laboratory.

  The American Industrial Hygiene Association (AIHA) lists the geometric mean for the odor (detection) threshold as 18,000 ppb – we detected 1300 ppb (4,600 µg/m^3). The AIHA range of acceptable values for odor detection was 6,000 to 50,000 ppb with the

range of referenced values 170 to 190,000 ppb (AIHA 1997).[3] It is possible that people can detect ethyl acetate at 1,300 ppb.

Odors and odor complaints continue to be a problem near the PFD facility and RAPCA continues to conduct odor surveillance. From January 2007 to August 28, 2008, inspectors detected odors on 75% of their 68 visits; more than ¼ of those were moderate or severe. Most of the odors are still detected north to northwest of the facility.

Ethyl Acetate Uses and Hazards

Some of the consumer products containing ethyl acetate are automotive and machinery paints, inks, lubricating oils, moisturizing creams, nail polish, enamels and removers, paint thinners, premoistened towelettes, resin and rubber adhesives, and artificial flavorings (Commonwealth of Australia 2008). Ethyl acetate is a highly effective solvent for organic chemicals and surface coatings (NLM 2008). It is also an ingredient in chigger and mosquito insecticide (U.S. Department of Health and Human Services 2008) Ethyl acetate is made by reacting acetic acid and ethanol (Wittcoff 2004).

The OSHA Permissible Exposure Limit (PEL)[4] is 400 ppm (400,000 ppb) (OSHA 2008a) which is much higher than the detected level (1,300 ppb) near the PFD facility. At high concentrations (>400 ppm), eye, nose, throat irritation; cough, sore throat; headache, nausea; dizziness, drowsiness, weakness; narcosis; dermatitis are possible (OSHA 2008b).

[3] The AIHA Odor Thresholds for Chemicals with Established Occupational Health Standards (1989 reprinted 1997). AIHA reviewed hundreds of studies and established a criterion for acceptability. The mean is for all the studies they found acceptable.

[4] OSHA sets enforceable permissible exposure limits (PELs) to protect workers against the health effects of exposure to hazardous substances. PELs are regulatory limits on the amount or concentration of a substance in the air. They may also contain a skin designation. OSHA PELs are based on an 8-hour time weighted average (TWA) exposure.

Table 3. Select Volatile Organic Compounds[1] [all in µg/m^3]

Compound	Downwind			Upwind			Comparison Value (CV) µg/m^3	CV Source[3]
	Sample size n	Range µg/m^3	Mean ± Standard Deviation[2] µg/m^3	Sample size n	Range µg/m^3	Mean ± Standard Deviation[2] µg/m^3		
VOCs								
Acetone	11	0*-90	12.35 ± 27.08	5	0-37	7.96 ±16.25	30,000	EMEG/ MRL
Acetone – (minus) high	10	0-28	4.59 ± 8.81					
Benzene	11	0-3.8	1.36 ± 1.59	5	0	0	10	EMEG/ MRL
Ethyl Acetate	11	0-4,600[4]		5	0-240[4]	[4]	1,400,000	TWA/REL
Heptane	11	0-3.4	1.46 ± 1.32	5	0	0	350,000	TWA/REL
Hexane	11	0-58	11.31 ± 17.79	5	0-110	24.6 ± 48.07	2,000	EMEG/ MRL
Methylene Chloride	11	0-150	18.83 ± 45.16	5	0-29	11.42 ± 14.72	1,000	EMEG/ MRL
Methylene Chloride – high	10	0-40	5.72 ± 12.79					
Toluene	11	2.1-27	10.25 ± 8.41	5	1.4-20	10.62 ± 8.73	300	EMEG/ MRL

[1]These compounds are either not in upwind samples, were in much higher concentrations in downwind samples than upwind, and/or were frequently detected.
[2] The difference between the average concentrations of VOCs for downwind samples and the average concentrations of VOCs for upwind samples was not statistically significant.
[3]CV**:** Comparison Value - Screening tools used to evaluate environmental data. EMEG - Environmental Media Evaluation Guide, MRL – Minimum Risk Level an MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancer health effects. TWA – time weighted average. a recommended exposure limit (REL)) as a TWA for up to a 10-hour workday and a 40-hour workweek

[4]All of the ethyl acetate detections were from one sampling event. There was only one upwind detection so we cannot calculate a mean.
* We substituted a zero for non detect (ND) to calculate arithmetic means (see below).

Statistical Analysis Methods
For select VOCs, all VOC data below the detection limit were substituted with a zero to calculate arithmetic means. Because moderate amounts (15%-50%) of data were below the detection limits, Aitchison's method was used to make the adjustment to means and standard errors (Reference: EPA QA/G-9S: page 130-132). However, the adjustment produced the same results. We used two-sample t-test to test if the average concentrations for downwind samples differed from the average concentrations for upwind samples for the same VOCs at significance level (alpha) 0.05 (Reference: EPA QA/G-9S: page 67). None of the comparisons were statistically significant.

Limitations

The data collected were for ambient concentrations that were measured near the residential area during the time of the investigation. The sample averaging time ranged from 2 -12 hours, which will not allow detections of short peak events that may produce acute odor events. This type of sampling also does not allow for the analysis of compound concentration trends in ambient air. Although there are no known major sources of most of the compounds sampled, mobile sources such as motor vehicles produce VOCs.

Child Health Considerations

The many physical differences between children and adults demand special emphasis when children are exposed to hazardous substances. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. For that reason, ATSDR uses health comparison values that are protective of children. ATSDR did not detect any chemicals in the outdoor air over health-based values.

Conclusions

1. Although the data only represent ambient air concentrations during the time of sampling, none of the more than 100 compounds analyzed were detected over health-based values.

2. The differences between the average concentrations of volatile organic compounds (VOCs) for downwind and upwind samples were not statistically significant. This lack of difference may be due to the small sample size.

3. ATSDR's review of information on the wastes accepted and the treatment processes used by PFD did not reveal an obvious source for the observed odors in the neighborhood.

4. ATSDR's outdoor air sampling revealed one compound, ethyl acetate – which has a low odor threshold and the characteristic odor of fingernail polish remover – may be the source of the reported solvent-like odors. That same odor was observed by ATSDR staff while touring the PFD facility and was most noticeable in the filter press room and testing laboratory.

Recommendations

1. To reduce solvent-like odors, PFD should determine if there is a source of ethyl acetate in their waste streams and seek to eliminate or treat it if it is present.

Authors, Technical Advisors

Author:
Diane Jackson P.E.
Exposure Investigation Section
Exposure Investigation and Site Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

Reviews and Technical Advisors:

Andrew J. Roth
Monitoring & Analysis Unit Supervisor
Regional Air Pollution Control Agency
Dayton, OH

Greg Zarus, MS
Team Lead
Site and Radiological Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

Hatice Zahran MD, MPH
Exposure Investigation Team
Exposure Investigation and Site Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

References

AIHA (American Industrial Hygiene Association). 1997. Odor Thresholds for Chemicals with Established Occupational Health Standards 1997, Fairfax, VA (1989 reprinted 1997).

ATSDR 2006. Agency for Toxic Substances and Disease Registry. Telephone conversation between Diane Jackson and Andy Roth, RAPCA, Nov 13, 2006. Atlanta: US Department of Health and Human Services

ATSDR 2007. Agency for Toxic Substances and Disease Registry. Personal communication between Diane Jackson and John Staton, Perma-Fix of Dayton, March 14, 2007. Atlanta: US Department of Health and Human Services

Commonwealth of Australia, 2008. Department of the Environment, Water, Heritage and the Arts Ethyl acetate fact sheet. National Pollutant Inventory (NPI). Accessed online at http://www.npi.gov.au/database/substance-info/profiles/38.html#common

EPA, 1997. Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air
http://www.epa.gov/ttn/amtic/files/ambient/airtox/to-17.pdf

EPA, 1998. US Environmental Protection Agency. Office of Research and Development Research Triangle Park, NC EPA/600/N-98/002 Spring/Summer 1998. Access via website at http://www.epa.gov/appcdwww/iemb/insideiaq/ss98.pdf#search=%22inside%20iaq%20epa%201998%22

NLM (National Library of Medicine) 2008. Haz-Map database. Occupational Exposure to Hazardous Agents. Available online at http://hazmap.nlm.nih.gov/cgi-bin/hazmap_generic?tbl=TblAgents&id=721

OSHA (Occupational Safety and Health Administration) 2008a. Chemical Sampling Information: Ethyl Acetate. Available online at
http://www.osha.gov/dts/chemicalsampling/data/CH_239500.html

OSHA 2008b. Occupational Safety and Health Guideline for Ethyl Acetate. Available online at http://www.osha.gov/SLTC/healthguidelines/ethylacetate/recognition.html

RAPCA 2004. Regional Air Pollution Control Agency, 2004a. Assessment of Air Quality Near Perma-Fix of Dayton. Regional Air Pollution Control Agency's 2003-2004 Study of Air Quality in the Greater Dayton Area

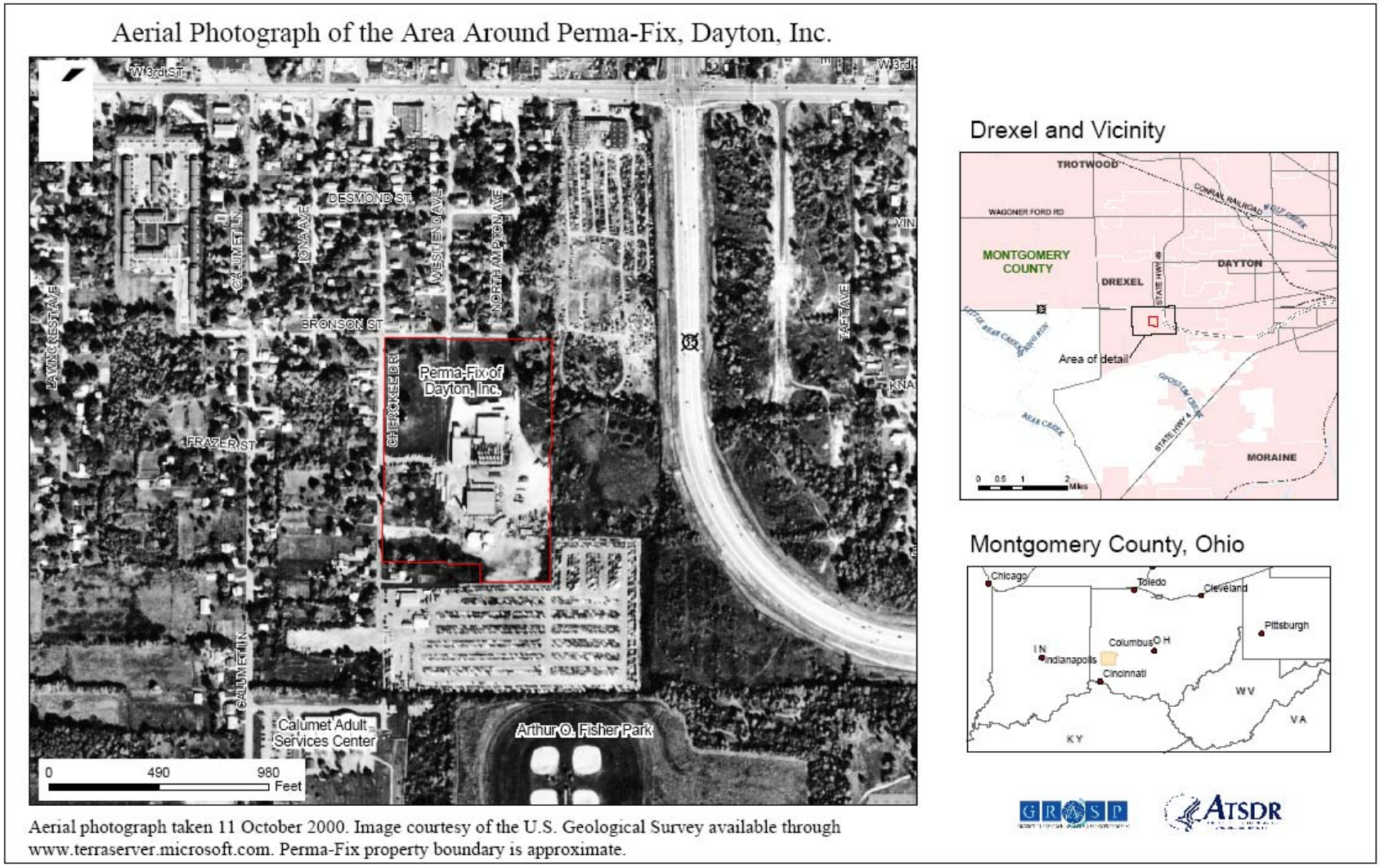
U.S. Census Bureau, 2000. Online at http://www.census.gov/main/www/cen2000.html

U.S. Department of Health and Human Services 2008. Household Products Database. Online at http://hpd.nlm.nih.gov/cgi-bin/household/brands?tbl=chem&id=196&query=ethyl+acetate&searchas=TblChemicals

Wittcoff, Harold A., Rueben, Bryan, G 2004. Industrial Organic Chemicals. 2nd Edition. Plotkin, John Wiley & Sons Published by Wiley-IEEE, NJ 2004

APPENDICES

Appendix A. Aerial photograph of neighborhood surrounding PFD



Aerial photograph taken 11 October 2000. Image courtesy of the U.S. Geological Survey available through www.terraserver.microsoft.com. Perma-Fix property boundary is approximate.

Appendix B. List of VOCs Analyzed

Table B1. VOC analyzed in Method TO-17

Acetone
Benzene
Benzyl Chloride
Bromodichloromethane
Bromoform
Bromomethane
1,3 Butadiene
2-Butanone
Carbon Disulfide
Carbon Tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloromethane
Cyclohexane
Dibromochloromethane
1,2-Dibromoethane
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
cis-1,2 Dichloroethene
trans-1,2-Dichlorethene
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
Dichlorodifluoromethane
1,2-Dichloropropane
cis-1,3-Dichloropropene
trans-1,3-Dichloropropene
Ethanol
Ethyl Acetate
Ethylbenzene
4-Ethyl toluene
Freon-11
Freon-14
Freon-113
Heptane
Hexane
Hexachlorobutadiene
2-Hexanone
Isopropyl alcohol
Methylene Chloride
Methyl t-Butyl Ether
4-Methyl 2-Pentanone
Propene
Styrene
Toluene
Vinyl Acetate
Vinyl Chloride
1,1,2,2-Tetrachloroethane
Tetrachloroethene
Tetrahydrofuran
1,1,1 Trichloroethane
1,1,2-Trichloroethane
1,2,4-Trichlorobenzene
Trichloroethene
1,3,5 Trimethylbenzene
1,2,4 Trimethylbenzene
m,p Xylene
O-Xylene

Tentatively Identified Compounds (TICs)
Acetic acid
Butane, 2 methyl
Butane
Butane, 2,2,3,3 tetramethyl
Butane, 2,3 dimethyl
Pentane
2,3 Pentadiene
Pentane, 2 methyl
Pentane, 2,3 dimethyl
Pentane, 2,2,4 trimethyl
Pentane, 3 methyl
Cyclopentane, methyl
Hexane, 2,4 dimethyl
Hexane, 2 methyl
Hexane, 3 methyl
Hexane, 2,3,4 trimethyl
Hexane, 2,2 dimethyl
C12 hydrocarbon
1,3 Butadiene, 2 methyl
Benzene, 1,2 dimethyl
Heptane, 2,4 dimethyl
Nonanoic acid
2,4 Dimethyl 1-heptene
Octane, 4 methyl
Octane
C11 Hydrocarbon
Nonanal
Cyclohexane
Cyclohexane, methyl
Cyclopentane, 1,3 dimethyl
C8 Hydrocarbon
Decane, 3,7 dimethyl
Decane, 2,3,6 trimethyl
Decane
Decane, 2,4 dimethyl
Sulfur Dioxide
Pentanal
4,7 Methano-1H-indene, octahyd
2 Propanol, 2 methyl
1 Pentene, 2 methyl
C 9 Hydrocarbon
Dodecane
C 13 Hydrocarbon
Decanal
Note: Compounds in *italics* were detected in air sampling.

Appendix C
Figure C1. Approximate Sample Locations- Full View

Figure C2. Approximate Upwind Sample Locations – Arthur Fisher Park

Figure C3. Approximate Downwind Sample Locations

Appendix D. Summary of VOC Data

Note: The difference between the average concentrations of VOCs for downwind and upwind samples was not statistically significant.

Acetone- Four of 6 samples had higher values than upwind. Acetone was detected in six of eleven (6/11) of the downwind samples and 3/6 upwind. Highest downwind 90 µg/m^3, upwind 37 µg/m^3.

Benzene – Was not in any upwind samples. Levels detected were not higher than normal urban levels (5 ppb). Detected in 6/11 downwind samples. Highest downwind concentration 3.8 µg/m^3.

2-Butanone – Detected in 3/11 downwind samples (highest 1.1 µg/m^3) and 1/5 upwind (9.2 µg/m^3). All detections were in low concentrations.

Carbon Disulfide – Detected in 1/11 downwind samples (3.3 µg/m^3) and no upwind.

Cyclohexane – Detected in no downwind and 1/5 upwind samples (5.3 µg/m^3).

Ethanol – Detected in 3/11 downwind samples (highest 4.9 µg/m^3) and 1/5 upwind (0.8 µg/m^3).

Ethyl Acetate – Detected in 2/11 downwind samples (1200 and 4600 µg/m^3) and 1/5 upwind (240 µg/m^3). All detections were in 2008 Round 3. Downwind concentrations were 20 times higher than upwind.

Ethylbenzene – Detected in 1/11 downwind samples (1.8 µg/m^3) and no upwind.

4-Ethyl toluene – Detected in 1/11 downwind samples (0.66 µg/m^3) and no upwind.

Freon 11 – Detected in 2/5 upwind samples (highest 120 µg/m^3) and 2/11 downwind (highest 31 µg/m^3). Most of the detections were in the 2008 sampling round.

Freon 113 – Detected in 2/11 downwind in 2008 only (highest 6.5 µg/m^3).

Heptanes – Detected in 7/11 downwind samples (2007 only) and no upwind. The highest downwind sample was 3.8 µg/m^3.

Hexane – Detected in high concentrations in both upwind (2/5) and downwind (8/11) samples – all 2007. Typical outdoor concentrations are 4 µg/m^3 (EPA 1997). We detected levels as high as 58 µg/m^3 in downwind and 110 µg/m^3 in upwind. The lower sample volume samples had the highest levels. Other hexane compounds were detected in tentatively identified compounds (TICs) and not in upwind samples.

Isopropyl alcohol – Detected in 2/11 downwind samples (highest 6.1 µg/m^3). Not in upwind samples.

Methylene Chloride – Detected as high as 150 µg/m^{3}in a downwind sample and 29 µg/m^3 in an upwind sample. Typical outdoor concentrations are 1 µg/m^3 (EPA 1997). Detected in 6/11 downwind samples and 2/5 upwind samples. The 2008 samples were 5 times higher in downwind than upwind.

4-Methyl 2-Pentanone – Detected in 1/11 downwind samples (0.54 µg/m^3). Not in upwind samples.

Propene – Detected in 3/11 downwind samples (highest 5.6 µg/m^3) and in one upwind (4.2 µg/m^3).

Toluene – Detected in all samples. Highest downwind 27 µg/m^3 ; highest upwind 20 µg/m^3.

1,3,5 Trimethylbenzene – Detected in one downwind sample (0.9 µg/m^3) and no upwind.

1,2,4 Trimethylbenzene – Detected in 2/11 downind samples (highest 3.1µg/m^3) and no upwind.

Xylenes – Detected in 4/11 downwind samples (highest 6.0 µg/m^3). Not in upwind samples.

Frequently Detected Tentatively Identified Compounds (TICs)

Acetic acid – 8/11 downwind, 3/5 upwind
Pentane – 5/11 downwind, 1/5 upwind
Pentane, 2 methyl – 7/11 downwind, 1/5 upwind
Hexane, 2 methyl – 5/11 downwind, no upwind
Hexane, 3 methyl – 6/11 downwind, no upwind
Heptane, 2,4 dimethyl – 11/11 downwind, 4/5 upwind

Compounds not in upwind samples:

Benzene (6/11)
Carbon Disulfide (1/11)
Freon 113 (2/11)
Heptane (7/11)
Isopropyl alcohol (2/11)
4-Methyl 2-Pentanone (1/11)
1,3,5 Trimethylbenzene (1/11)
1,2,4 Trimethylbenzene (2/11)
m,p Xylene (4/11)
O-Xylene

Tentatively Identified Compounds (TICs) <u>not</u> in upwind samples

Butane (1/11)
Butane, 2,2,3,3 tetramethyl(1/11)

Butane, 2,3 dimethyl (2/11)
Pentane, 2,3 dimethyl (1/11)
Pentane, 3 methyl (2/11)
Hexane, 2,4 dimethyl (1/11)
Hexane, 2 methyl (5/11)
Hexane, 3 methyl (6/11)
Hexane, 2,2 dimethyl (1/!11)
Benzene, 1,2 dimethy (1/11)l
Nonanoic acid (2/11)
Octane (1/11)
Nonanal (1/11)
Cyclohexane, methyl (4/11)
Cyclopentane, 1,3 dimethyl (1/11)
C8 Hydrocarbon (1/11)
Decane (1/11)
Decane, 2,4 dimethy (1/11)
2 Propanol, 2 methyl (1/11)
1 Pentene, 2 methyl (1/11)
Decanal (1/11)