CITY OF PARK RIDGE, ILLINOIS

PRELIMINARY STUDY AND ANALYSIS OF TOXIC AIR POLLUTANT EMISSIONS FROM O'HARE INTERNATIONAL AIRPORT AND THE RESULTING HEALTH RISKS CREATED BY THESE TOXIC EMISSIONS IN SURROUNDING RESIDENTIAL COMMUNITIES

AUGUST 2000

VOLUME III

PRELIMINARY DOWNWIND SITE SAMPLING INVESTIGATION FOR AIR TOXIC EMISSIONS FROM O'HARE INTERNATIONAL AIRPORT

by

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Chicago O’Hare Report

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Chicago O'Hare Investigation for the City of Park Ridge

Introduction

The purpose of this project was to conduct a preliminary investigation of air pollution at O'Hare International Airport, particularly for those compounds that might result in additional health risks for those living in the vicinity. The air pollution targeted included particulate, volatile organics, and semi-volatile organics. The project was not meant to be an exhaustive study, but a preliminary study that would yield results that would provide a basis for the demonstration of the need for further investigation by responsible agencies. Since this study was the first of its kind to investigate these types of emissions from an airport, it was also designed as an investigation into the methodologies available for collecting and analyzing samples and to determine the appropriate sampling protocols that would result in usable data. The study was not meant to be exhaustive, nor rigorous, but to provide enough data to show that air pollution could be measured and could be attributed to operations at O'Hare International Airport. This preliminary investigation had the following goals:

- Determine if measurements of air pollutants could be made and attributed to airport activities.
- Identify compounds that were characteristic of airport activities
- Identify compounds that may pose a health risk
- Provide a snapshot of air pollutants occurring during the sampling process
- Propose additional work to be done

The main purpose of this investigation was to demonstrate the feasibility of collecting and analyzing meaningful data that could determine the extent to which O'Hare International Airport is contributing to the overall burden of air pollution in the surrounding communities. This goal has been achieved. It is hoped that the lessons learned from this study can now be used to design and implement a more comprehensive investigation that will ultimately provide a more detailed picture of the affect that air pollution from O'Hare International Airport has on the surrounding communities.

Summary of Sampling Procedure

- Three 24-hour composite background (BKD) samples for particulate, aldehydes, volatiles and semi-volatiles were taken in the vicinity of Naperville a far southwestern suburb. The location was chosen because of its remote location from O'Hare.

- Five 8-hour composite upwind (UPW) samples for particulate, aldehydes, volatiles and semi-volatiles were taken in Bensenville at a location west of York/Elmhurst Road. The location was chosen in order to be minimally impacted by airport activities when the wind was westerly.

- Five 8-hour composite downwind samples for particulate, aldehydes, volatiles and semi-volatiles were taken at or near the fence line of O'Hare and west of Manheim Road at two locations. One location (DWN) was immediately east of the auto rental facility and in line with the approach to runway 27R. The other location (DWS) was adjacent to the O'Hare fence line immediately east of the taxiway leading to 27L and 22L. These locations were selected in order to be minimally impacted by vehicular traffic other than traffic resulting from activities on O'Hare property.

- Two sets of two grab samples for volatiles were taken at the DWS location. Grab samples were taken to supplement the 8-hour composite data in an attempt to capture aircraft exhaust that was not diluted by ambient air.

- Samples were only collected when the wind was generally from out of the west.

- A sample of auto exhaust was collected and analyzed exactly as were the ambient air samples for volatiles. This was done so that the compounds related to auto exhaust could be compared to those found in the ambient samples.

- Wipe samples were taken from several locations for the purpose of determining if they could be related to airport activities.

Summary of Principal Findings

- Results of particulate analysis suggest that operations at O'Hare International Airport are contributing to the overall burden of respirable dust in the environment downwind from the airport particularly in the 2.5 micron and below.

- Aldehydes, which is a family of chemical compounds that includes formaldehyde which is a suspected carcinogen were found at increased levels downwind from O'Hare International Airport. Eight aldehyde compounds were identified and all were found to be at increased levels downwind of the airport with formaldehyde having the most dramatic increase over background levels.

- 219 volatile compounds were found in this investigation. Volatile compounds are a class of compounds that remain in the gaseous state at ambient temperature. Of the compounds found, 92 were identified, and 78 were found to be at increased levels downwind of O'Hare International Airport. The implication is that these compounds are contributing to the overall air pollution burden for those communities that are located downwind from the airport.

- 24 volatile organic compounds that were found to be present at increased concentrations downwind from O'Hare International Airport were compared to average concentrations of the same compound found at the Jardine monitoring station. For all but two compounds, the concentrations at the fence line of the airport were higher than at the Jardine sampling location.

- The following volatile organic compounds were found at increased levels at the fence line of O'Hare International Airport and were attributed to airport activities.

Propane + Propene	Chloromethane	Isobutane + Acetaldehyde
Butene + IsoButene	Butane	Acetonitrile
Acrolein	Isopentane	Acetone
Isopropanol	Pentane	Methylene Chloride
C_5H_{10} Alkane	Carbon Disulfide	2-Methylpropane
Trichlorotrifluoroethane	Methacrolein	2,3-Dimethylbutane
2-Methylpentane	Butanal	2-Butanone
3-Methylpentane	2-Methyl Furan	2-Methyl-1-Propanol
Methylcyclopentane	2,4-Dimethylpentane	n-Butanol
Benzene	Carbon Tetrachloride	2-Methylhexane
2,3-Dimethylpentane	Pentanal	3-Methylhexane
Trichloroethene	Iso-Octane	n-Heptane
4-Methyl-2-Pentanone	Methylcyclohexane	C_8H_{18} Compounds
Toluene	2-Hexanone	Hexanal
2,4-Dimethyl-3-Pentanone	n-Octane	Unidentified Compounds
Ethylbenzene	m & p-Xylene	Cyclohexanone
Heptanal	Styrene	o-Xylene
Butoxyethanol	n-Nonane	alpha-Pinene
Benzaldehyde+2-Ethylhexane	3-Ethyltoluene	4-Ethyltoluene
1,3,5-Trimethylbenzene	Octanal	1,2,4-Trimethylbenzene
n-Decane	$C_8H_{14}O$ Aldehyde	Acetophenone
$C_{10}H_{14}$ Aromatic	$C_{11}H_{24}$ Alkane	Octamethylcyclotetrasiloxane
Nonanal	n-Undecane	$C_9H_{16}O$ Aldehyde
Naphthalene	n-Dodecane	n-Tridecane
n-Tetradecane		

- The investigation of semi-volatile compounds which are a class of compounds that are not expected to be in the gaseous state at ambient temperature did not produce any usable data.

- The wipe samples did not result in the identification of any polynuclear aromatic hydrocarbons. A comparison with a standard of NIST Urban Dust demonstrated that the material contained many more compounds than are related to the NIST Urban Dust. This aspect of the project requires further investigation in order to determine what these deposits are related to.

Selection of Sampling Locations

Downwind Sampling Locations

Since it was anticipated that it would not be possible to obtain the cooperation of the City of Chicago in this endeavor, two sites were selected that were located immediately adjacent to the fence line on the right-of-way of Manheim Road. The sampling modules for these two locations were also located near the ends of runways 27R and 27L. The location at the end of runway 27R identified as DWN (DownWind North) for the first two sampling events was located west of a grove of trees west of Manheim road and east of the southbound entrance ramp to O'Hare (DWNa). The location is shown in the photographs in Figure 1.

Figure 1. Location DWNa for the first two sampling events at the end of runway 27R.

This location was moved after the first two sampling events west of the southbound entrance ramp for subsequent sampling events (DWNb). This location was in line with the approach to 27R and immediately east of the auto rental lots located along Bessie Coleman Drive. A creek or drainage ditch was between the fence line and the sampling module. The reason from moving this location was to get as close to the airport as

possible and to minimize the affect of traffic entering O'Hare on the southbound Manheim access ramp. The location is shown in the photographs in Figure 2.

Figure 2. Location DWNb for the subsequent sampling events at the end of runway 27R.

From the photo on the right, the auto rental facilities at O'Hare airport can be seen in the background. The creek is just beyond the sampling module where the bushes are. Also, evident is the fact that this module is lined up with the end of runway 27R by both the airplane landing and the light standard in the background.

The second sampling module identified as DWS (DownWind South) was located just north of the end of runway 27L and in line with the approach to 22L. This location placed the sample module immediately west of the tarmac leading to these two runways and when these two runways were active, planes would queue up on this tarmac waiting to take off. It was also only a few hundred feet from the jets that would be sitting there idling. A service road was located between the fence and the active runways. This service road is used primarily by airport vehicles and is on airport property. Any emissions from vehicles using this road would be considered a result of airport activities. This location would allow sampling of pollutants that were crossing from O'Hare property into the surrounding communities while minimizing or eliminating the collection of pollutants from automobile traffic and light industry immediately east of the airport. The location is shown in the photographs in Figure 3.

Figure 3. Location DWS for the sampling events at the end of runway 27L.

The lower photograph in Figure 3 demonstrates just how close this location was to the active runway.

The only other ingredient would need to be westerly winds that would ensure that air that was being sampled was contaminated only with pollutants from airport activities. Eight hour composite samples were planned. It was also planned that the eight-hour samples would include either the morning or evening "rush hour" at O'Hare. Air traffic is heaviest in the morning around 7:00 a.m. and in the evening about 7:00 p.m. Because of the large size of O'Hare, it was anticipated that any pollution emitted by light industry on the west side of O'Hare would be very dilute by the time it reached the sampling modules on the east side of the airport.

The ambient air or "background" in the Chicago metropolitan area contains pollutants from automobile and truck exhaust, airplane exhaust, emissions from various types of heavy and light industry and natural processes such as decaying vegetation. In order to further differentiate between pollutants that were present in the "background" from those that were exclusively attributable to the airport activities, it was necessary to provide for background sampling and upwind sampling.

Upwind Sampling Location

A location for the upwind sampling module, identified as UPW (UPWind) was selected that was close to the airport on the west side, but was affected as little as possible by vehicular traffic. The location is shown in Figure 4 and Figure 5.

Figure 4. Location UPW for the sampling events at upwind location.

The location that was selected was in Bensenville and was about 1000 feet west of Elmhurst/York road in an area that was surrounded by an undeveloped field and mostly warehousing type activities.

Figure 5. Location UPW for the sampling events at upwind location.

Interstate 90 was to the south of this location which would be toward the left in the left photograph in Figure 5. This location was also immediately west of the end of runway 27R. This location placed the upwind sample module on roughly the same latitude as DWN a & b that was at the other end of this runway. It was believed that this location would provide data that was representative of the urban background pollution that was typical of the area in which O'Hare is located.

Background Sampling Location

A location in a far western Naperville residential area was selected for the background sampling. This location would provide data on the air quality about 40 miles west of the airport in an area of farms and residential homes. The location was southwest of downtown Naperville. The air quality in this area was expected to be impacted by less industrial and vehicular traffic emissions and would be representative of "clean air". Three separate 24-hour composite samples were taken in this area on consecutive days. This location is shown if the photographs in Figure 6 on the next page.

Figure 6. Background location for the sampling events of the background.

The photograph in the upper left of Figure 6 is looking north, the photograph in the upper right of Figure 6 is looking east, and the lower photograph in Figure 6 is looking west.

Selection of Target Analytes

The ambient air, the air we breathe, consists of a myriad of constituents at widely varying concentrations. For example, the major constituents, Nitrogen and Oxygen exist at roughly 78% and 21% respectively. These percent level constituents are quickly followed by constituents in the part per million range, e.g. Carbon Dioxide at approximately 330 ppm and Argon at approximately 9,340 ppm. This does not include the water vapor, which is commonly referred to as humidity that is also present in the percent level. If this were all that the ambient air contained, this study would not have been necessary.

Ambient air also contains many other constituents that are the result of living in an industrialized environment. Some of these compounds have natural sources such as decaying vegetation, forest fires, volcanoes, airborne dust, etc., but many are also the result of modern life. These are called air pollutants, since they are thought not to occur naturally. The sources of these compounds include stationary and mobile combustion of fossil fuels including coal, oil, gas, gasoline and jet fuel. It includes chemicals emitted from all manufacturing. It includes compounds that are emitted as fugitive emissions from such activities as waste disposal and sludge processing. Almost any activity that occurs in modern society adds chemicals to the ambient air.

Since 1981, the USEPA has worked with these activities to curtail the emission of excessive amounts of air pollutants. Devices have been developed that when applied correctly provide a control for the emission of pollutants from a particular source. These devices have included scrubbers, electrostatic precipitators and the more familiar catalytic converter on automobiles. The USEPA has also worked to identify better fuels. For example switching to low sulfur sources for coal to prevent the formation of sulfur dioxide or the use of alternative fuels that produce fewer pollutants such as natural gas.

In this investigation, it was determined that a wide variety of air pollutants needed to be investigated. The following broad classes of pollutants were selected, particulate matter, volatile organic compounds, aldehyde compounds and polynuclear aromatic hydrocarbons. These were selected based on the data presented in Table 1. Particulate matter was added since it is thought to be the source of some respiratory illnesses.

These are the classes of compounds that were determined to be target compounds for this investigation and for which a suitable sampling module would need to be designed. Each class of compounds requires different sampling media for effective collection and each would require a different sampling rate of the ambient air to ensure that a useable sample would be collected. Also, as part of this investigation, it was determined that anecdotal evidence from various residents of Park Ridge required that wipe samples be taken in order to determine if residues that appeared to be accumulating on surfaces were related to aircraft activity.

Sampling Module Design

Each sampling module was constructed from a 30” x 16” x 12” top opening steel tool chest. The tool chest was mounted on the 12” x 16” end on five-foot long legs made of Unistrut. A ¾” plywood shelf was mounted near the bottom of the legs to provide a support for the Minkota batteries that would supply power to the unit. Each module contained a Davis Instruments Weather Wizard III weather station that recorded wind speed, wind direction, outside temperature and inside temperature of the module. The weather station also provided an on-board clock. Three Gast, Inc. DC operated oil-less

Figure 7. Inside view of the sampling module.

diaphragm pumps were mounted inside the module with one pump capable of 36 L/min pumping speed and the other two capable of 6.5 L/min pumping speed. Each pump was connected to a Dwyer flowmeter with 2% full scale accuracy. One flowmeter was 0-20 L/min, one was 0-10 L/min and one was 0-5 L/min to accommodate the various flow rates that would be required for the different media. Tygon tubing served as the sample line to a hole in the bottom of the sampling module for each type of media. The sampling media hung from the sample tubing under the bottom of the sampling module which served to protect the media from rain or debris that might fall from the sky. Space was provided for a SUMMA canister and an 1/8" stainless steel tube was also routed to the underside of the sampling module to allow volatile organics to be sampled. A picture of the inside of the sampling module is shown in Figure 7.

Sampling

It was determined that a phased approach would be better than to simply go out and take samples and then try to determine if the correct procedures had been used. It was planned that two sampling events at O'Hare and three background samples would be taken in order to determine if the correct methodologies, sampling procedures and sampling times had been selected. The samples would be sent to the laboratory and after the data had been received and evaluated, adjustments to the sampling protocol could be made to insure that representative samples were being obtained. These activities were designated as the "Preliminary Sampling Event" and "Background Sampling Event".

Preliminary Sampling Events

Field Test #1

Sampling modules were placed in the field on September 14, 1999 at the UPW, DWNa and DWS locations. Since the weather stations indicated the wind was out of the west, it was decided that each sampling module would be activated with the installation of the collection devices and conduct the first test, designated as Test #1. Collection devices were placed in the sampling modules at UPW (11:27 a.m.), DWNa (11:54 a.m.) and DWS (12:10 p.m.). Initial flow rates were adjusted on the pumps, and the devices were checked during the sampling period to ensure that everything was operating properly. The sampling event was completed at UPW (7:27 p.m.), DWNa (7:54 p.m.) and DWS (8:10 p.m.) or after exactly eight hours.

One of the requirements for collecting accurate wind direction data was that the arm on which the anemometer was mounted needed to be placed so that it was aligned due north. During this event the weather arm of each station was aligned with some man-made feature such as a street or the light towers leading to a runway. For example the UPW location was aligned with the access street, which was a north-south street. The DWNa location was aligned perpendicular to the light standards leading to runway 27R. The DWS location was aligned parallel with Manheim Road. This did not seem very scientific, so a compass was purchased between the first test and the second test to ensure that the weather station could be aligned with magnetic north. It was determined that at the DWS location, Manheim road does not go north and south, but is aligned slightly west of north. The wind direction has been adjusted accordingly on the map for Test #1 by aligning the north south direction of the wind rose with Manheim road and not due north. A map of the O'Hare Airport area with the windroses superimposed is shown in Figure 8.

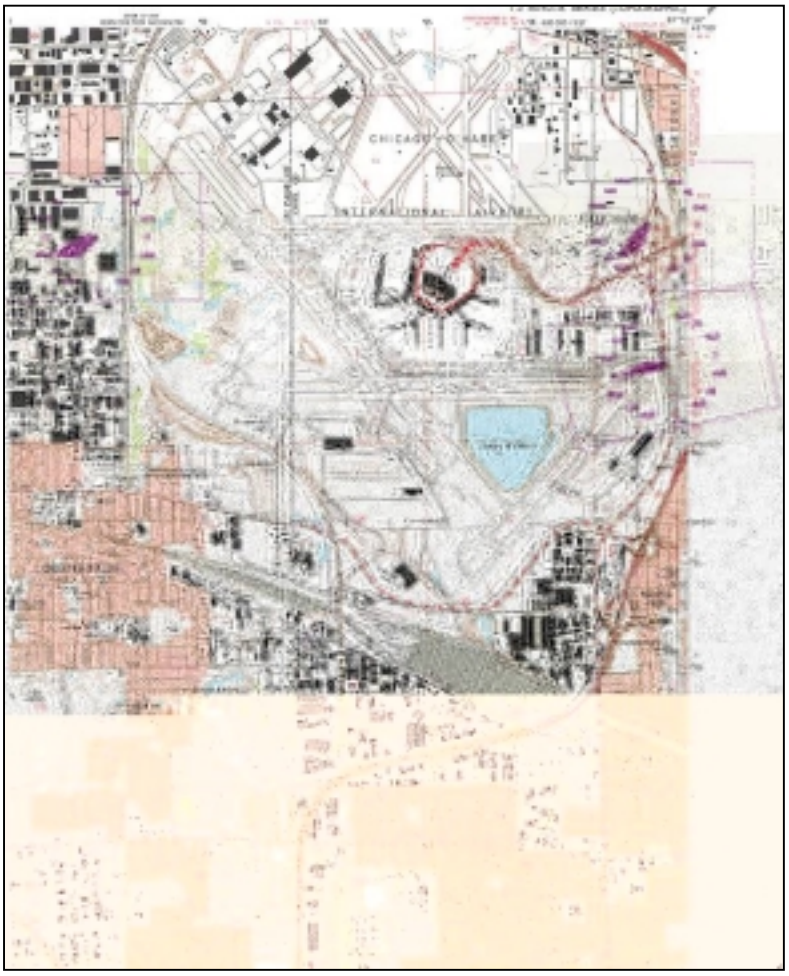


Figure 8. Map of O'Hare showing the location and windroses of Field Test #1.

Field Test #2

Test #2 was to take place the next morning. While it was hoped to get all sampling modules running by 7:00 a.m., delays prevented this, so the most critical sampling modules were started first, DWNa (7:00 a.m.), DWS (7:12 a.m.) and UPW (7:40 a.m.). The sampling modules were checked throughout the day and the samples were collected eight hours later, DWNa (3:00 p.m.), DWS (3:12 p.m.) and UPW (3:40 p.m.). A map of O'Hare Airport with the locations and windroses for Field Test #2 is shown in Figure 9.

Samples that were collected during these two events were shipped to the laboratory for analysis.

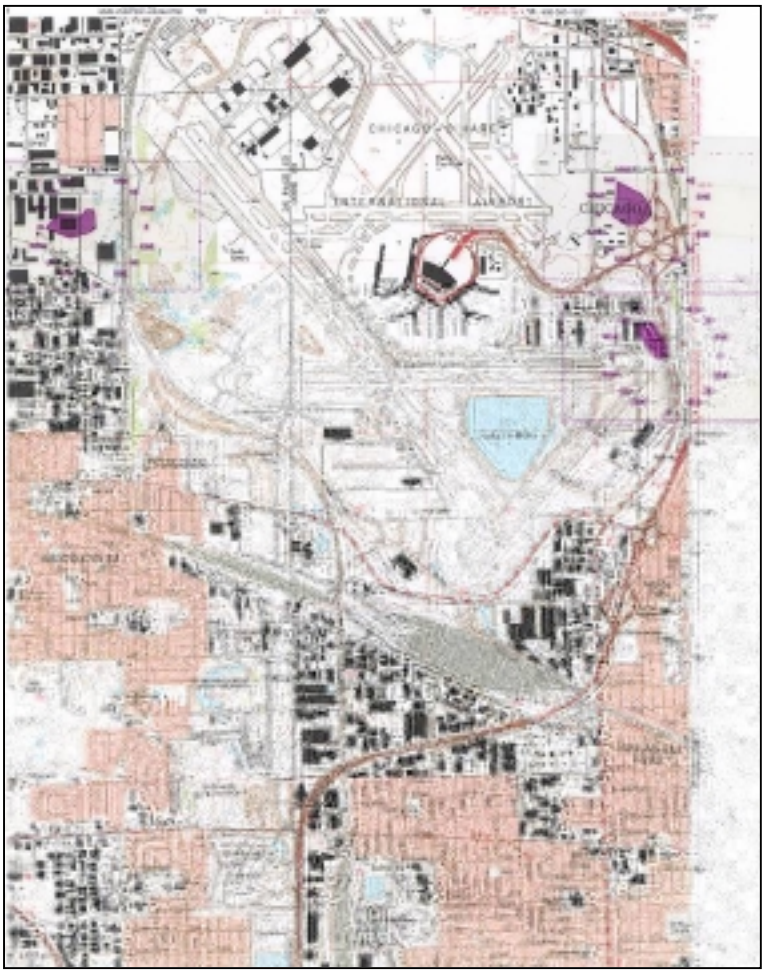


Figure 9. Map of O'Hare showing the location and windroses of Field Test #2.

Background Sampling Events

Background samples were taken during the week of September 20-24, 1999. A single sampling module was located in the backyard of a residence in southwestern Naperville, IL. The sampling module was not moved for the entire duration of the background sampling. The samples were 24-hour composites with each day's sample immediately succeeding the previous day's sample. It became apparent, that the DNPH cartridges could not handle this much air flow, and the time of sampling for aldehydes was reduced to approximately two hours and this data was taken from about 12:30 p.m. each day until about 2:30 p.m. Also, the batteries did not last for the full 24 hours and since there was no way to know when the pumps stopped working, it was decided to scrap the first test and add an additional test at the end of the week to obtain the three samples desired.

The area immediately north of the Background sampling location is residential. A forest preserve is due north and downtown Naperville is north of the forest preserve. The area west and southwest of the Background location is light residential and farms. The most notable feature south of the Background location is a large quarry. The entire area contains a lot of new construction of both homes and businesses. There was also road repaving that was occurring on a main east-west road south southwest of the background location.

Background Sample #1.

The first background sampling event was designated as BKD #1. There was no precipitation for the entire background sampling Sept. 21-24, 1999. The ground in the background location was very wet as it was near the back of the property and the sump pumps from the houses on the block flow towards the swale between the properties at the back. The wind on the first day (that was scrapped) was directly out of the north the entire day at about 2 miles per hour with gusts of up to 13 miles per hour. The average temperature was 60.4 F with a high of 75.7 and a low of 47.4. The second day, which is actually the first day that sample data is available produced winds again predominantly out of the north at about 2.2 miles per hour on average with gusts up to 13 miles per hour. The wind during the first part of the 24-hour sampling was out of the north. The wind began to die down and at about 8:00 p.m. ceased altogether. The wind speed remained nil until around 7:30 a.m. when it began to pick up and was now predominantly WSW at about 3 miles per hour average with gusts to 10 miles per hour.

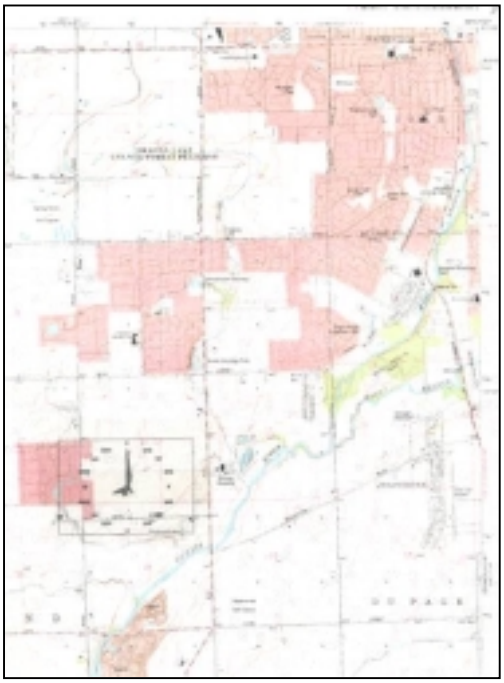


Figure 10. Map of background location BKD #1 with wind rose.

Background sample #2

The second background sampling event was designated as BKD #2. During the servicing of the sampler set up, the connection to the data logger for the weather station was pulled loose, and data was lost from 12:40 p.m. until the sampler was again visited to remove the DNPH cartridge at about 3:00 p.m. The weather data for the second background sample produced winds predominantly out of the south-southwest at speeds that averaged 3 miles per hour with gusts to 10 miles per hour. During the evening and night time hours, the wind speed again dropped to nil from about 8:00 p.m. until about 5:00 a. m. at which time the wind speed again picked up with the winds remaining predominantly from the south southwest. The wind rose is shown in Figure 11.

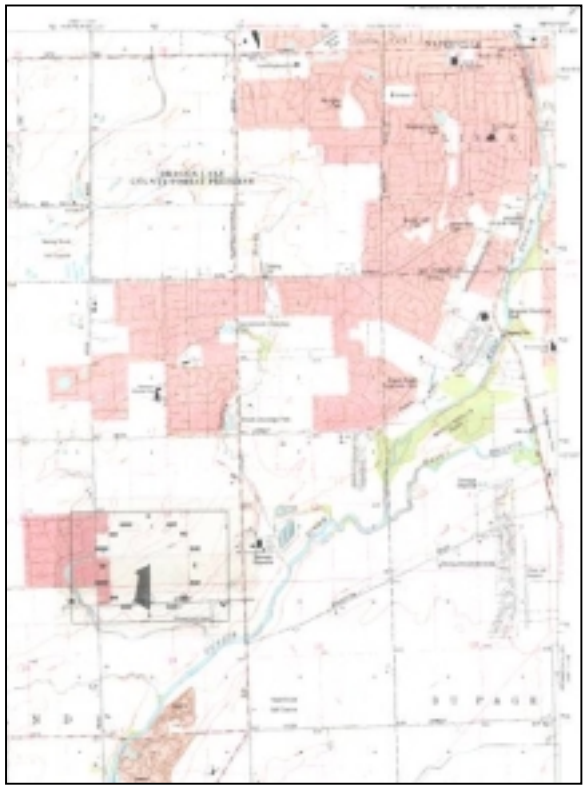


Figure 11. Map of background location BKD #2 with wind rose.

Background sample #3

The third background sampling event was designated as BKD #3. The winds continued out of the south southwest at about 3.5 miles per hour with gusts as high as 21 miles per hour from approximately 12:30 p.m. until about 10:00 p.m. when the winds abruptly changed direction and began coming from the north northeast. The winds remained out of

this direction for the duration of sampling #3 at approximately 3 miles per hour on average with gusts as high as 13 miles per hour. The wind rose is shown in Figure 12.

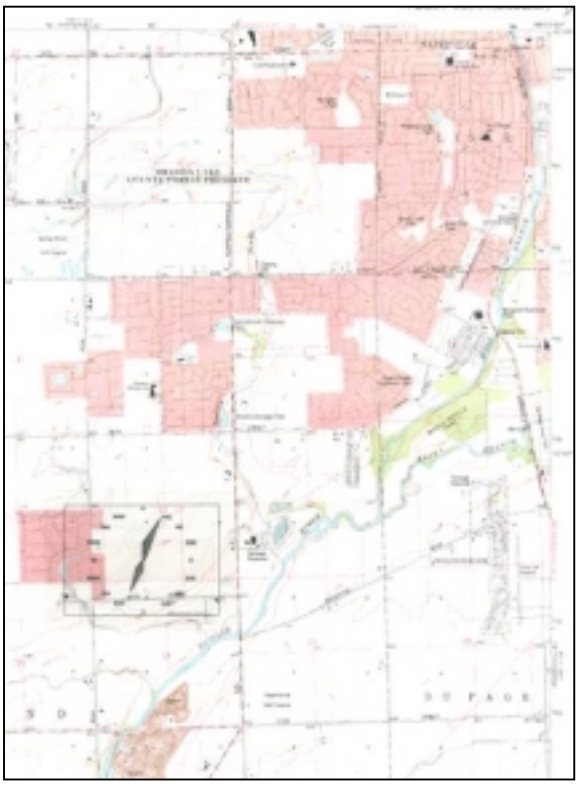


Figure 12. Map of background location BKD #3 with wind rose.

Subsequent Sampling Events at O'Hare Airport

Subsequent sampling events were undertaken as the wind direction allowed. It is very difficult to predict wind directions and at 4:00 a.m. when there generally is no wind at all. However, most of the subsequent sampling events were begun around 6:00 a.m. The fifth test was begun around noon.

Field Test #3

Test #3 was conducted on October 12, 1999. The sample modules had been deployed previously with the DWN sampling module now located nearer to the airport and west of the entrance ramp to the airport from southbound Manheim road. This location was designated DWNb. The other modules were placed in essentially the same locations that had been used previously, with the DWS location moved about 50-100 feet north of the first location in order to be more in line with the approach to the runways 22L and 27 L.

Collection devices were placed in the sampling modules at UPW (6:15 a.m.), DWNb (6:41 a.m.) and DWS (6:59 a.m.). Initial flow rates were adjusted on the pumps, and the devices were checked during the sampling period to ensure that everything was operating properly. The sampling event was completed at UPW (2:15 p.m.), DWNb (2:43 p.m.) and DWS (2:59 p.m.) or after exactly eight hours except for DWNb which was 482 minutes. A map of O'Hare Airport with the locations and windroses for Field Test #3 is shown in Figure 13.

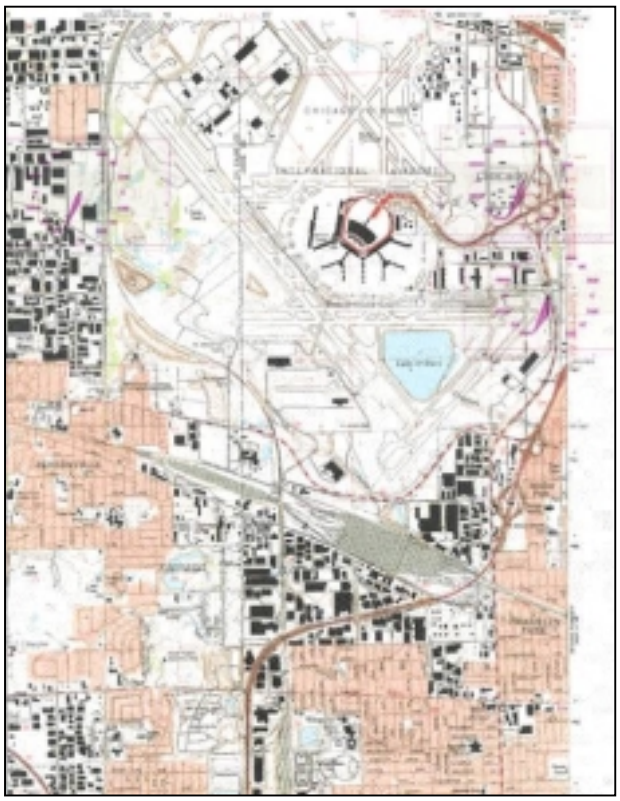


Figure 13. Map of O'Hare showing the location and windroses of Field Test #3.

Field Test #4

Test #4 was conducted on October 20, 1999. The sample modules had been deployed since prior to the October 12, 1999 event and would remain in place until January 21, 2000.

Collection devices were placed in the sampling modules at UPW (6:55 a.m.), DWNb (6:08 a.m.) and DWS (6:25 a.m.). Initial flow rates were adjusted on the pumps, and the devices were checked during the sampling period to ensure that everything was operating properly. The sampling event was completed at UPW (3:11 p.m.), DWNb (2:08 p.m.) and DWS (2:25 p.m.) or after exactly eight hours except for UPW #4 which was 496 minutes.

A map of O'Hare Airport with the locations and windroses for Field Test #4 is shown in Figure 14.

Figure 14. Map of O'Hare showing the location and windroses of Field Test #4.

Field Test #5

Test #5 was conducted on October 26, 1999. The sample modules had been deployed since prior to the October 12, 1999 event and would remain in place until January 21, 2000.

Collection devices were placed in the sampling modules at UPW (11:44 a.m.), DWNb (12:08 p.m.) and DWS (12:20 p.m.). Initial flow rates were adjusted on the pumps, and the devices were checked during the sampling period to ensure that everything was operating properly. The sampling event was completed at UPW (7:15 p.m.), DWNb (6:51 p.m.) and DWS (6:33 p.m.). This event was cut short as the wind direction abruptly changed in the afternoon around 6:00 p.m. Up until that time, the wind direction had been out of the west-northwest. At about this time the wind abruptly changed to the north-northeast and within a short time was coming out of the east. The downwind samples were retrieved first. The total sampling time for this event was UPW (451 minutes),

DWNb (403 minutes) and DWS (373 minutes). A map of O'Hare Airport with the locations and windroses for Field Test #5 is shown in Figure 15.

Figure 15. Map of O'Hare showing the location and windroses of Field Test #5.

At this point it became more and more difficult to obtain a wind from the west with any reliability. It also became apparent that the Summa canister data was producing the most dramatic and interesting results. Since the airplanes only spend a brief amount of time queued up for take-off and that the concentration of some of the compounds seemed to be more diluted than one might expect, it was decided that grab samples might yield additional interesting data that might assist in the interpretation of the results from the composite samples.

Field Test #6

Test #6 was a grab sample test that was conducted on November 3, 1999 at approximately 6:30 p.m. The test was done at the DWS location. Two samples were taken within the space of a minute or so and were designated DWS #6A and DWS #6B. While approximately 15 planes were observed in the queue on the approach to runway 22L, at no time was a characteristic airport odor detectable. The wind was about 8-10 mph due out of the west.

Field Test #7

A second grab sample test was conducted on November 24, 1999 between 6:30 p.m. and 7:00 p.m. November 24, 1999 is described as the busiest day of the year at O'Hare as it is the evening before Thanksgiving and hundreds of thousands of travelers use the airport on this holiday eve. This time, the first sample was taken with approximately 20 planes lined up on the tarmac waiting their turn on runway 27L. The first sample was taken with a distinct characteristic airport odor present, this sample was designated DWS #7 odor. After this sample was taken and placed in the vehicle, a second sample was taken. The sampler noticed that now the distinct airport odor had disappeared and thought that this was due to olfactory fatigue. As it turns out from the data, the odor truly was not present. This sample was designated DWS #7 no odor. The data from this event will serve to demonstrate how intermittent the vapors from the jet exhaust can be and how little time during the eight hour sampling events, that vapors from jet exhaust were actually being sampled.

Sample Collection Media

Volatiles

Volatiles is a class of compounds that have very high vapor pressures at ambient temperature and, therefore, remain in the gaseous state. Volatiles were collected in SUMMA canisters following procedures in USEPA Method TO-14. SUMMA canisters are specially designed stainless steel spheres that are passivated on the inside to ensure that the interaction between the collected gas and the walls of the container are kept to a minimum. In practice, a controller or critical orifice allows sampled gas to slowly bleed into the evacuated SUMMA canister at a constant rate over a time period that is determined by calibrating the controller. Any time period can be selected. For this project, three 8 hour controllers were used for the O'Hare sampling, and a 24 hour controller was used for the background sampling.

Semi-Volatiles

Semi-Volatiles are a class of compounds that typically have lower vapor pressures than volatiles, and may exist only as mists or on particulate matter in ambient air. Semi-volatiles were collected on XAD/PUF cartridges following procedures described in USEPA Method TO-13 . XAD is a porous polymer resin with the capability of trapping compounds, usually large molecules, that may be present in ambient atmospheres passed though the resin. PUF stands for polyurethane foam and is included in the XAD/PUF cartridge to provide an additional trapping media for other types of large molecules such as pesticides, herbicides and PCBs. Actually, the PUF is a convenient way to hold the XAD resin in the glass cartridge. The XAD/PUF cartridge does not have an upper limit to

the volume of sample that may be passed through the cartridge, but is generally limited to about 5 L/min sampling volume.

Aldehydes

Aldehydes are a class of compounds that includes. Aldehydes were collected on a DNPH coated silica gel cartridge following procedures described in USEPA Method TO-11. DNPH (diphenylhydrazine) reacts readily with aldehydes to form the more stable hydrozone. The analysis is conducted by extracting the hydrozones from the sampling media and analyzing them on a high performance liquid chromatograph (HPLC). The cartridge containing the DNPH coated silica gel is sealed until it is used at which time the ends are broken off of the glass cartridge and the sample introduced. Two layers of sampling media are contained in each tube, and this provides a method for determining if the sample has been collected quantitatively as each section is analyzed separately, and the presence of equal amounts in each section indicates that the sample breakthrough volume has been exceeded. One drawback to this method, is that DNPH is such a good absorber of aldehydes, and because formaldehyde is a ubiquitous contaminant not only in the atmosphere, but in the laboratory, a background of formaldehyde is almost always present and must be subtracted from the experimental results. For this project, the best available commercial sampling media as determined by the contract laboratory was used. Also, field blanks and media blanks (lab blanks) were used throughout in order to monitor the background concentration of formaldehyde during these sampling events.

Particulate

Particulate was collected on RoTrac Capillary Pore Membrane media that was selected because of its ability to provide high porosity, uniform collection of particulate and ease of removing quantitatively as much collected material as possible. This material is a Hydrophobic Laminate of 120 g/m^2 PET. The pore size is 0.8 μ. The purpose of collecting the particulate was not only to determine the total mass of particulate that was in the ambient air at each location, but also to conduct an analysis using the Coulter priciple. This technique would take the collected particulate and provide a profile of the various sizes of the collected particles.

Each type of collection media had different requirements with regard to obtaining the sample and each of these were accommodated in the design of the sampling module.

Analysis of Samples

Particulate Samples

Particulate samples were analyzed gravimetrically and by a technique known as ELZONE analysis that is based on the Coulter principle. Particles are analyzed in a particle sensing transducer based upon the electrozone detection method. Electozone analysis provides the highest resolution of any type of analyzer. Analytical data is essentially distortion free over a working range of about 0.5 microns through 400 microns diameter. The technique is not sensitive to color, refractive index, density, conductivity, or particle opacity. It is sensitive to the envelope volume of the individual particles that are counted and sized in a serial fashion. A typical statistical report is composed of a population base of approximately 250,000 particles over the analytical range with the data being presented on the basis of the equivalent spherical diameter.

In the electrozone measurement principle, particles suspended in an electrolyte are caused to flow through a small orifice in a non-conductive material (sapphire), along with an electric current. Particles traverse the orifice essentially singly, causing electrical pulses at rates from a few thousand to a few hundred per second or lower, depending upon the orifice size and particle concentration. The amplitude of each voltage pulse is directly proportional to the volume of the particle as sensed by its "electrical envelope" displacement within the sensing orifice. While the system responds to particle volume, the computer reports the diameter of a sphere of equal volume; the term "equivalent spherical diameter" is often used.

Since electrozone analyzers are true particle counters, data can be reported in two formats. Data is presented on a population basis, which is like performing a microscope analysis in which the numbers of particles are reported as a function of size. Data is also presented on the basis of mass which is like performing a sieve analysis in which the weight of particles are reported as a function of size.

After sampling, the filters were removed from the plastic holders and reweighed prior to the ELZONE analysis. Unfortunately, most of the filters had been pre-weighed to only three decimal places, and the results were compromised due to a lack of accuracy. Some of the filters were weighed to 4 places and these data are analyzed relative to the concentration of particulate collected.

Aldehyde Analysis using DNPH Absorption Tubes

The DNPH absorption tubes were analyzed by breaking open the tube and extracting the DNPH resin coated particles with acetonitrile. This solution was then analyzed by HPLC.

Polynuclear Aromatic Analysis using XAD-PUF Cartridges

The XAD-PUF cartridges were analyzed by removing the XAD and PUF from the cartridges and extracting with hexane. This solvent is used since it does not cause shrinkage of the PUF material. The hexane extract is then reduced in volume and the extract injected into a gas chromatograph/mass spectrometer (GC/MS) for analysis. The largest drawback to this technique, is that the hexane is not obtainable in pure form which results in a lot of extraneous peaks in the early part of the chromatogram. The focus of this analysis, however, were PNAs, and these are detectable without difficulty even with the contamination present in the hexane.

Volatile Organic Analysis of Summa Canisters

Volatile organic compounds (VOCs) collected in passivated Summa canisters were analyzed using the following analytical technique.

Concentrations for each compound were determined as follows. If the compound was a compound that the laboratory used for calibration, then the compound was quantitated using the response factor determined in calibration of the instrument. For compounds that the laboratory was not calibrated for, the compound was identified by its mass spectrum (qualitative analysis) and then the height of the peak representing that compound was compared to the nearest internal standard and a value determined (semi quantitative analysis). After all of the data was obtained from the laboratory and the ninety-two compounds identified, the chromatograms for all samples that were run on the same analytical instrument were visually inspected and additional compounds identified by retention time. Once all of the ninety-two peaks had been identified in the chromatograms, they were semi-quantitatively analyzed by comparison to other peaks that had been evaluated by the laboratory.

Discussion of Particulate Results

Background Sample #1

The particulate sample showed approximately 0.0006 grams of material that translates into 21.93 ug/m3 of particulate. The elzone analysis in Figure 16 shows that there are two distinct distributions of particulate. The first and smaller amount is centered at approximately 15 microns with a total weight of about 0.0002 grams. The larger amount is centered at approximately 3 microns with a total weight of about 0.0004 grams. The larger distribution is in the particulate diameter that is thought to produce nucleating sites for airborne organics and is associated with the PM2.5 particulate that is most thought to cause respiratory problems and results from industrial and transportation activities. This correlates well with the results that will be discussed later for this sampling event in which a larger than normal amount of exhaust related compounds were detected during this sampling event.

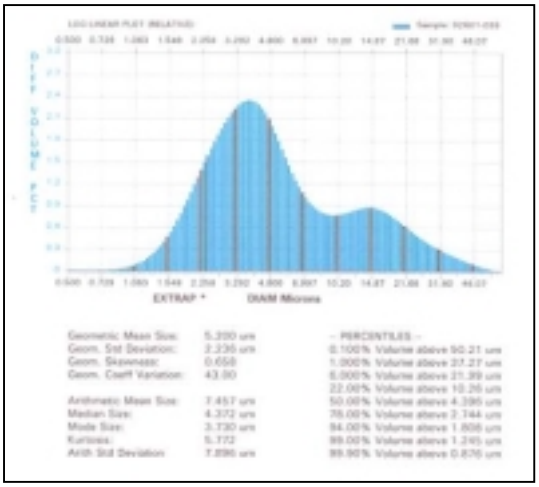


Figure 16. Elzone Analysis of Background Sample #1.

Background Sample #2

The particulate sample showed approximately 0.0007 grams of material that translates into 25.58 ug/m3 of particulate. The elzone analysis shown in Figure 17 shows that there is only one distinct distribution of particulate. This distribution is centered at approximately 17 microns, and indicates a great deal of large wind blown dust. Since the wind was from the south-southwest during this entire sampling event, it is probable that the source of this wind blown dust is from the quarry. The contribution from the PM 2.5 type particulate was minimal in this sample and correlates well with the results from other sampling media collected during this sampling event.

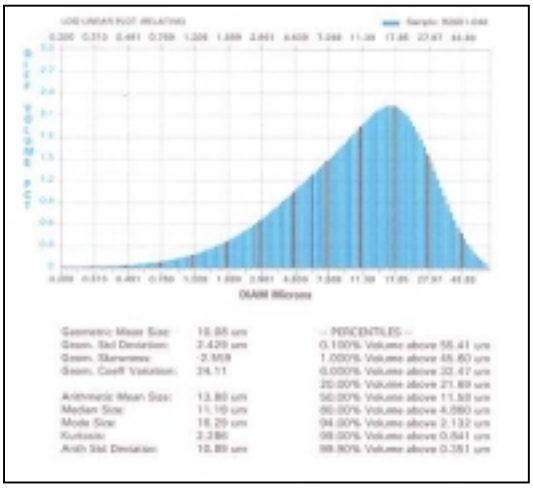


Figure 17. Elzone Analysis of Background Sample #2.

Background Sample #3

The particulate sample showed approximately 0.0002 grams of material that translates into 7.12 ug/m3 of particulate. This particulate loading is much lower than was obtained on the first two days. The elzone analysis in Figure 18 shows that there are two distinct distributions of particulate. The first distribution is centered at approximately 15 microns with a total weight of about 0.0001 grams. This distribution is roughly the same distribution as in the first sample; however, it is much larger in relative proportion to the second distribution than found in the first sample. The second distribution is centered at approximately 3 microns with a total weight of about 0.0001 grams. The second distribution is in the particulate diameter that is thought to produce nucleating sites for airborne organics and is associated with the PM2.5 particulate that is most thought to cause respiratory problems and results from industrial and transportation activities. Both of these distributions are much lower in total weight than obtained on the first two days of sampling. This reflects typical rural dust coupled with a moderate amount of PM 2.5 from exhaust.

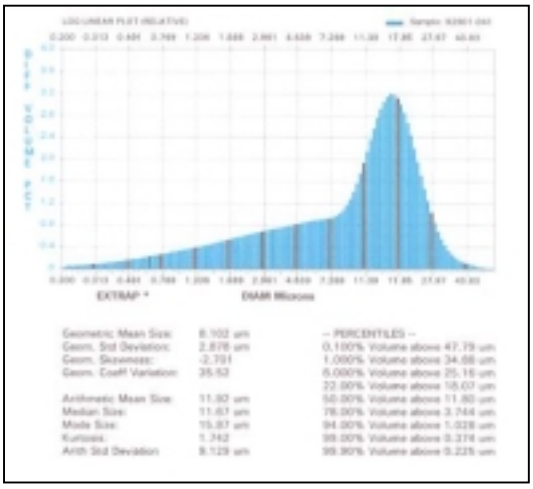


Figure 18. Elzone Analysis of Background Sample #3.

Test #1 Upwind

The particulate sample for Test #1 UPW showed approximately 0.002 grams of material that translates into 242 ug/m3 of particulate. This value is extremely high and is probably a result of the lack of sensitivity of the gravimetric measurement of the particulate loading on the filter rather than a true reflection of the actual particulate present. These values will only be used as a reference and should not be considered as real values of the true particulate concentration. The elzone analysis in Figure 19 shows a distribution of particulate that is quite similar to that obtained in the second sampling event in the background. The distribution is centered at about 12 microns and shows little evidence of material at PM2.5.

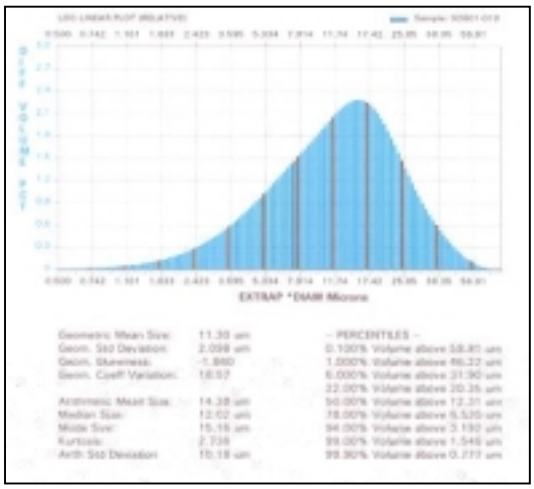


Figure 19. Elzone Analysis of Test #1 Upwind.

Test #1 Downwind North

The particulate sample for Test #1 Downwind North showed approximately 0.002 grams of material that translates into 238 ug/m3 of particulate. The elzone analysis in Figure 20 shows that there are two distinct distributions of particulate. The first amount is centered at approximately 15 microns. An almost equal amount is centered at approximately 3 microns. The larger distribution is in the particulate diameter that is typical dust particulate. The other distribution is in the range of PM 2.5 that is thought to be the area of the nucleating sites for that is thought to produce respiratory problems. There is a curious additional peak in the range of PM 2.5 that is found in this sample that is not understood. This feature will reproduce in the next sample, Downwind South and also appears in Test #2. It may be indicative of particulate emanating from and unique to the airport environment.

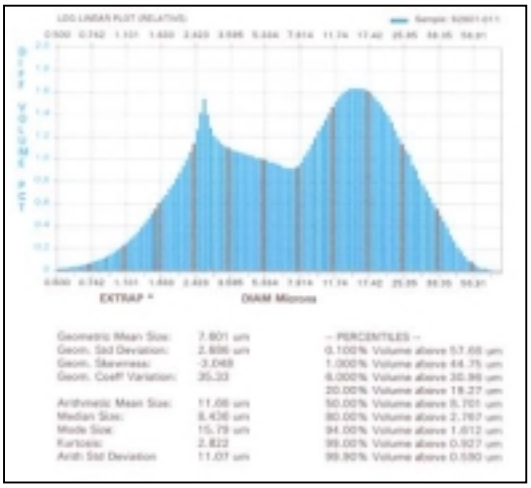


Figure 20. Elzone Analysis of Test #1 Downwind North.

Test #1 Downwind South

The particulate sample for Test #1 Downwind South showed no measurable particulate at the level of sensitivity used for the gravimetric measurement. The elzone analysis in Figure 21 shows that there are two distinct distributions of particulate. The first amount is centered at approximately 15 microns. An almost equal amount is centered at approximately 3 microns. The larger distribution is in the particulate diameter that is typical dust particulate. The other distribution is in the range of PM 2.5 that is thought to be the area of the nucleating sites for that is thought to produce respiratory problems. There is a curious additional peak in the range of PM 2.5 that is found in this sample that is not understood. This feature is much larger than in the previous sample. It may be indicative of particulate emanating from and unique to the airport environment.

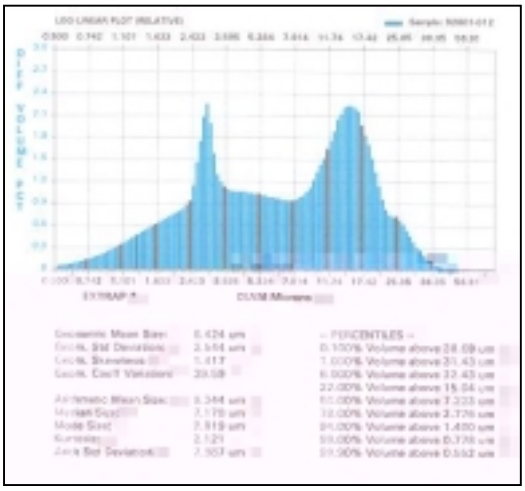


Figure 21. Elzone Analysis of Test #1 Downwind South.

Test #2 Upwind

The particulate sample for Test #2 UPW showed no measurable particulate by gravimetric analysis. The elzone analysis in Figure 22 shows a distribution of particulate that is quite similar to that obtained in the second sampling event in the background. The main distribution is centered at about 12 microns and shows little evidence of material at PM2.5. There is a curious additional distribution at higher particle size. This could be due to larger particulate that may be related to the location which is near a field of overgrown weeds, such as pollen.

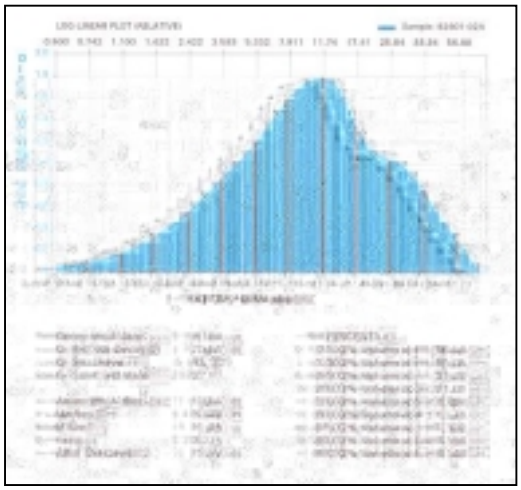


Figure 22. Elzone Analysis of Test #2 Upwind.

Test #2 Downwind North

The particulate sample for Test #2 Downwind North showed approximately 0.002 grams of material that translates into 211 ug/m3 of particulate. The elzone analysis in Figure 23 shows that there are three distinct distributions of particulate. The first amount is centered at approximately 25 microns and resembles the distribution in the previous sample. A slightly larger amount is centered at about 15 microns as in previous samples and these two distributions make up about one third of the total particulate. The largest amount is centered at approximately 3 microns. The larger distribution is in the particulate diameter that is typical of PM 2.5 that is thought to be the area of the nucleating sites for that is thought to produce respiratory problems. The curious additional peak in the range of PM 2.5 that is found in this sample is the largest relative to the total distribution found in any sample so far discussed. It may be indicative of particulate emanating from and unique to the airport environment.

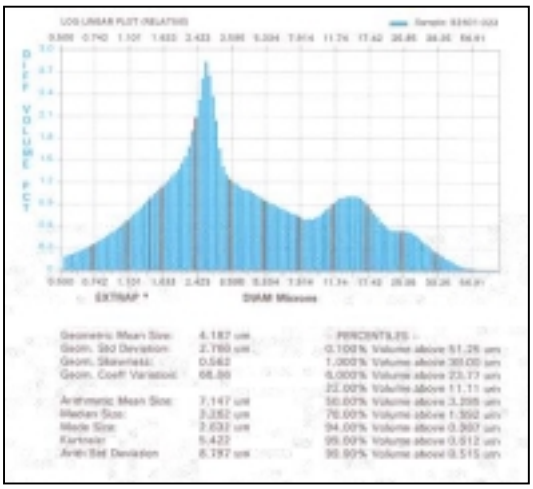


Figure 23. Elzone Analysis of Test #2 Downwind North.

Test #2 Downwind South

The particulate sample for Test #2 Downwind South showed approximately 0.002 grams of material that translates into 203 ug/m3 of particulate. The elzone analysis in Figure 24 shows that there are two distinct distributions of particulate. The first amount is centered at approximately 15 microns. An slightly lower amount is centered at approximately 3 microns. The larger distribution is in the particulate diameter that is typical dust particulate. The other distribution is in the range of PM 2.5 that is thought to be the area of the nucleating sites for that is thought to produce respiratory problems. The curious additional peak in the range of PM 2.5 that is found in this sample is as large as in the previous sample. It may be indicative of particulate emanating from and unique to the airport environment.

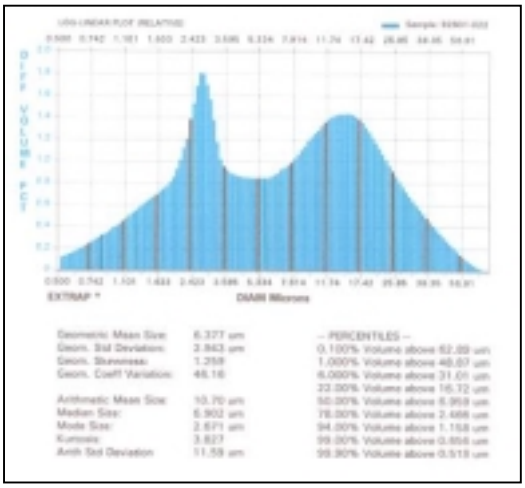


Figure 24. Elzone Analysis of Test #2 Downwind South.

Test #3 Upwind

The particulate sample for Test #3 UPW showed very little particulate by gravimetric analysis of 0.0001 grams. The amount calculated to 10.28 ug/m3 which is low for an urban environment. The elzone analysis in Figure 25 shows a distribution of particulate that is quite similar to that obtained in previous upwind sampling events. The main distribution is centered at about 15 microns and shows little evidence of material at PM2.5.

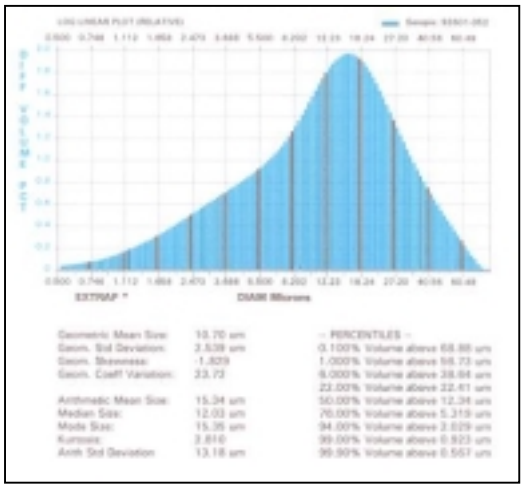


Figure 25. Elzone Analysis of Test #3 Upwind.

Test #3 Downwind North

The particulate sample for Test #3 Downwind North showed approximately 0.0003 grams of material that translates into 32.05 ug/m3 of particulate. The elzone analysis in Figure 26 shows that there are three distinct distributions of particulate. The first amount is centered at approximately 50 microns and is almost 50% of the particulate collected. These are quite large particles indicative of wind born dust. A slightly smaller amount is centered at about 15 microns as in previous samples and these two distributions make up about 80% of the total particulate. The smallest amount is centered at approximately 4 microns that is typical of PM 2.5 that is thought to be the area of the nucleating sites for that is thought to produce respiratory problems. There does not appear to be anything unusual about the wind direction or wind speeds on this day that would account for the large amount of large particulate that was collected. Since this sample occurred in a downwind direction from O'Hare, it must be concluded that this unusual occurrence has something to do with activities on the O'Hare property. Also, this location had been moved closer to the O'Hare property with the commencement of this event.

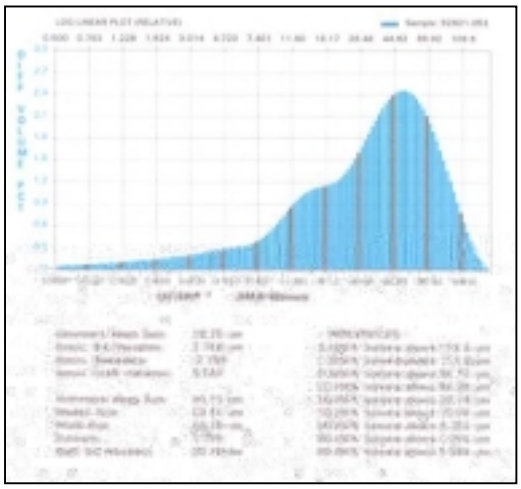


Figure 26. Elzone Analysis of Test #3 Downwind North.

Test #3 Downwind South

The particulate sample for Test #3 Downwind South showed no measurable weight of particulate material. The elzone analysis in Figure 27 shows that there are two distinct distributions of particulate. The first amount is centered at approximately 15 microns. A slightly lower amount is centered at approximately 4 microns. The larger distribution is in the particulate diameter that is typical dust particulate. The other distribution is in the range of PM 2.5 that is thought to be the area of the nucleating sites for that is thought to produce respiratory problems.

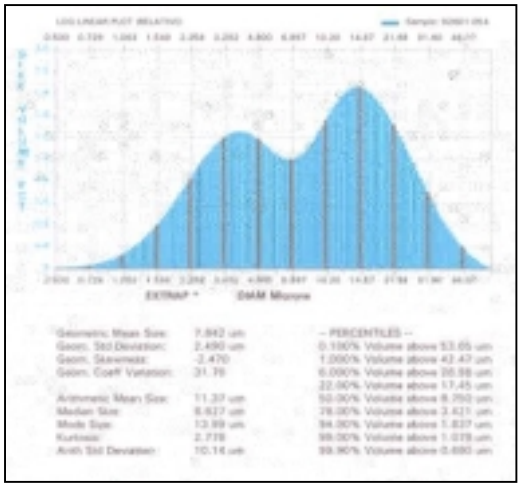


Figure 27. Elzone Analysis of Test #3 Downwind South.

Test #4 Upwind

The particulate sample for Test #4 UPW showed 0.0003 grams of particulate by gravimetric analysis. The amount calculated to 31.25 ug/m3 which is about the same as at Test #3 Downwind North. The elzone analysis in Figure 28 shows a distribution of particulate that is quite similar to that obtained in Test #3 Downwind North. The first amount is centered at approximately 50 microns and is almost 30% of the particulate collected. These are quite large particles indicative of wind born dust. A slightly smaller amount is centered at about 15 microns as in previous samples and these two distributions make up about 70% of the total particulate. The smallest amount is centered at approximately 2 microns that is typical of PM 2.5 that is thought to be the area of the nucleating sites for that is thought to produce respiratory problems. There does not appear to be anything unusual about the wind direction or wind speeds on this day that would account for the large amount of large particulate that was collected. Since this sample occurred in an upwnd direction from O'Hare, it must be concluded that this unusual occurrence happens from time to time and is not related to O'Hare.

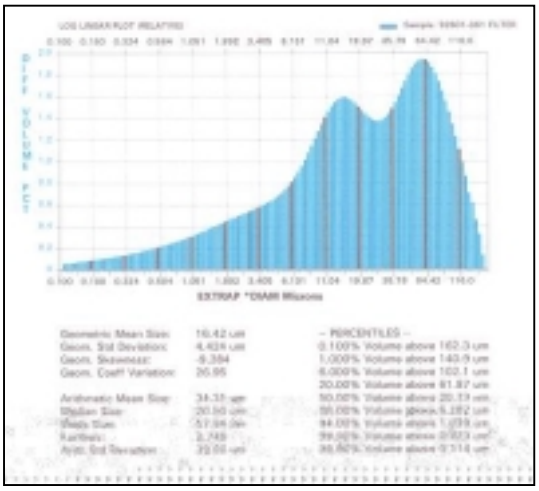


Figure 28. Elzone Analysis of Test #4 Upwind.

Test #4 Downwind North

The particulate sample for Test #4 Downwind North showed approximately 0.0001 grams of material that translates into 10.28 ug/m3 of particulate. The elzone analysis in Figure 29 shows that there appears to be only one distinct distribution of particulate. However, there are actually two distributions. The first is centered at about 15 microns as in previous samples and makes up about 75% of the total particulate. The smaller amount is centered at approximately 2-3 microns that is typical of PM 2.5 that is thought to be the area of the nucleating sites for that is thought to produce respiratory problems. The latter distribution makes up about 25% of the sample. It is unusual that the two distributions do not clearly separate in this sample. Why this occurs is not known. It should be noted that

other evidence points to an unusual occurrence that has been associated with the auto rental facility that was immediately downwind of this location. It is possible that this may have contributed to the particulate distribution obtained in this sample.

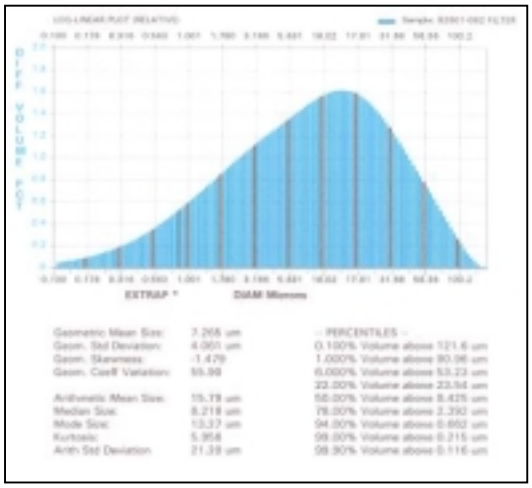


Figure 29. Elzone Analysis of Test #4 Downwind North.

Test #4 Downwind South

The particulate sample for Test #4 Downwind South resulted in a weight of particulate of 0.0003 grams. This translates into a particulate concentration of 31.25 ug/m3 which is approximately the same as found at other locations. The elzone analysis in Figure 30 shows that there are three distinct distributions of particulate. The first and largest amount is centered at approximately 50 microns indicative of large particles of wind born dust. A slightly smaller amount is centered at about 15 microns as in previous samples and these two distributions make up about 60% of the total particulate.

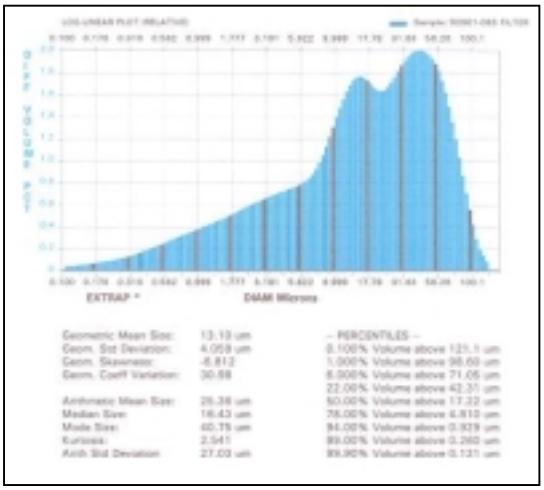


Figure 30. Elzone Analysis of Test #4 Downwind South.

The smallest amount is centered at approximately 2.5 microns that is typical of PM 2.5 that is thought to be the area of the nucleating sites for that is thought to produce respiratory problems. This distribution is similar to distributions that have been seen in previous samples. The most notable feature in this Elzone analysis is that the amount of particulate that is in the PM 2.5 area is very much higher than in some of the previous samples. This may be related to the exhaust of airplanes.

Test #5 Upwind

The particulate sample for Test #5 UPW showed no measurable particulate by gravimetric analysis. The elzone analysis in Figure 31 shows a distribution that is similar to those obtained previously. The first amount is centered at approximately 15 microns and is almost 60% of the particulate collected. The smaller amount is centered at approximately 4 microns that is typical of PM 2.5 that is thought to be the area of the nucleating sites for that is thought to produce respiratory problems. The amount of particulate at PM 2.5 is higher on a percentage basis than has been found in previous samples from the upwind location. The only unusual occurrence was that during this sampling event, the wind unexpectedly shifted from westerly to more north easterly which may account for the higher PM 2.5.

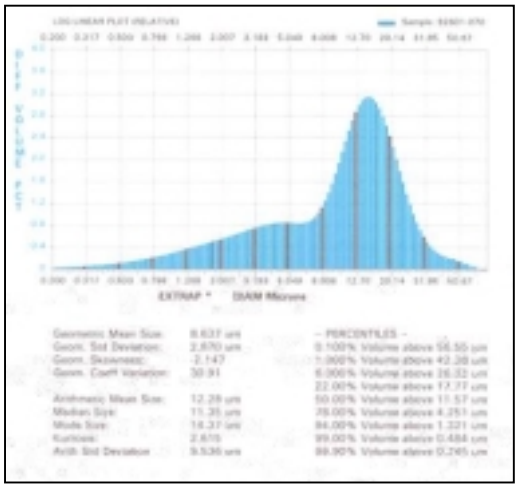


Figure 31. Elzone Analysis of Test #5 Upwind.

Test #5 Downwind North

The particulate sample for Test #5 Downwind North showed approximately 0.0002 grams of material that translates into 24.81 ug/m3 of particulate. The elzone analysis in Figure 32 shows that there are three distinct distributions of particulate. The first amount is centered at approximately 30 microns and is almost 15% of the particulate collected. These are quite large particles indicative of wind born dust. A larger amount is centered at about 15 microns as in previous samples and these two distributions make up about

55% of the total particulate. A large amount is centered at approximately 4 microns that is typical of PM 2.5 that is thought to be the area of the nucleating sites for that is thought to produce respiratory problems. The large amount of PM 2.5 is indicative of particulate that provides nucleating sites for organic material. This large amount is probably a result of operations at O'Hare airport.

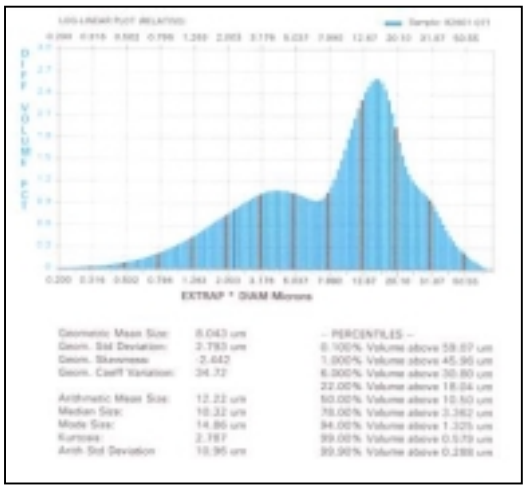


Figure 32. Elzone Analysis of Test #5 Downwind North.

Test #5 Downwind South

The particulate sample for Test #5 Downwind South resulted in no measurable amount of particulate. The elzone analysis in Figure 33 shows that there are two distinct distributions of particulate. The first amount is centered at approximately 15 microns and is about 30% of the total particulate distribution. A larger amount is centered at approximately 4 microns. The larger distribution is in the particulate diameter that is typical of PM 2.5.

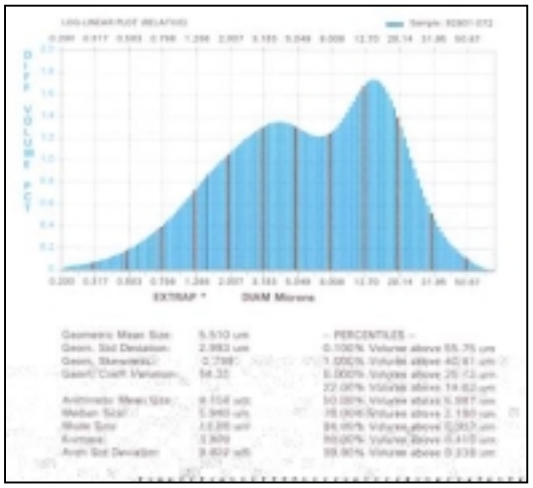


Figure 33. Elzone Analysis of Test #5 Downwind South.

Discussion of Aldehyde Results

Background Sample #1

The aldehyde sample using the DNPH cartridge showed the lowest concentration of aldehydes of all usable samples. The formaldehyde was at 0.30 ug/m3, acetaldehyde was at 0.32 ug/m3 and valeraldehyde was at 0.03 ug/m3.

Background Sample #2

The aldehyde sample using the DNPH cartridge showed concentrations of aldehydes that were double that of the Background #1 sample for formaldehyde at 0.76 ug/m3 and acetaldehyde at 0.57 ug/m3. Valeraldehyde was undetected in this sample.

Background Sample #3

The aldehyde sample using the DNPH cartridge showed concentrations of aldehydes that were double that of the Background #1 and equal to that of the Background #2 sample for formaldehyde at 0.76 ug/m3 and acetaldehyde at 0.57 ug/m3. Valeraldehyde was detected in this sample at 0.024 ug/m3 that was comparable to that of Background #1. Based on the wind direction and the types of activities that were going on in each wind direction, it appears that the activities that are south southwest of the Background location produce more formaldehyde and acetaldehyde than does the northerly direction. Valeraldehyde results are inconclusive since they are near the detection limit for the method, but this compound also probably has an origin in the south-southwest direction from the Background location.

Test #1 Upwind

The aldehyde sample for Test #1 in the upwind location resulted in higher concentrations than the background for most of the aldehydes detected in the upwind samples as well as the appearance of several more that were not found in the upwind samples. Formaldehyde was found at a concentration of 0.85 ug/m3, a 46% increase over the average of the background concentration. Acetaldehyde was found at a concentration of 0.53 ug/m3, a 10% increase over the background. Valeraldehyde was found at a concentration of 0.051 ug/m3, a 100% increase over the background. Crotonaldehyde was found at 0.051 ug/m3, Benzaldehyde was found at 0.058 ug/m3 and Hexaldehyde was found at a concentration of 0.047 ug/m3. All were not found previously in the background.

Test #1 Downwind North

Formaldehyde was found at a concentration of 1.05 ug/m3. This was a 24% increase over the upwind location and a 72% increase over the background. Acetaldehyde was found in this sample at a concentration of 0.52 ug/M3. This was a concentration comparable to the

UPW sample and a 10% increase over the background Valeraldehyde was found at 0.038 ug/m3 which was slightly less than in the upwind location and 60% higher than in the average of the background. Crotonaldehyde was found at 0.075 ug/m3 which was an increase of 47% over the upwind location. Benzaldehyde was found at a concentration of 0.074 ug/m3, a 28% increase over the upwind location. Hexaldehyde was not found in this sample. Butyraldehyde was found at a concentration of 0.037 ug/m3. This was the first sample in which this compound was found.

Test #1 Downwind South

Formaldehyde was found at a concentration of 1.65 ug/M3. This was a 57% increase over DWN, a 94% increase over the upwind location and a 170% increase over the background average. Acetaldehyde was found at a concentration of 0.66 ug/M3 which is 20% higher than in the UPW or DWN locations and 35% higher than in the back ground. Valeraldehyde was found at 0.089 ug/M3. This is a 125% increase over the DWN sample, an 80% increase over the upwind location and a 260% increase over the background average. Crotonaldehyde was found at a concentration of 0.17 ug/m3. This is a 127% increase over the DWN location and a 233% increase over the upwind location. Benzaldehyde was found at a concentration of 0.1 ug/m3 in this sample. This is a 35% increase over the DWN location and a 72% increase over the upwind location. Hexaldehyde was found at a concentration of 0.052 ug/m3. This compound was not found in the DWN location. This is approximately equal to the concentration found in the upwind location and this compound was not found in the background. Butyraldehyde was found at a concentration of 0.057 ug/m3. This was an increase of 54% over the DWN location. This compound was not found in the upwind or background locations.

Test #2 Upwind

Formaldehyde was found at a concentration of 0.95 ug/m3, a 56% increase over the average of the background concentration. Acetaldehyde was found at a concentration of 0.44 ug/m3, which is approximately equal to the background. Valeraldehyde was found at a concentration of 0.05 ug/m3, a 100% increase over the background. Crotonaldehyde was found at 0.044 ug/m3, Benzaldehyde was found at 0.065 ug/m3 and Hexaldehyde was found at a concentration of 0.055 ug/m3. All were not found previously in the background. Butyraldehyde was found for the first time in an upwind sample at a concentration of 0.041 ug/m3. This compound was not found in the background.

Test #2 Downwind North

Formaldehyde was found at a concentration of 1.05 ug/m3. This was an 11% increase over the upwind location and a 72% increase over the background. Acetaldehyde was found in this sample at a concentration of 0.52 ug/M3. This was 18% higher than the UPW location and 6% higher than the average of the background. Valeraldehyde was found at 0.051 ug/m3 which was equal to the upwind location and 60% higher than in the

average of the background. Crotonaldehyde was found at 0.068 ug/m3 which was an increase of 55% over the upwind location. Benzaldehyde was found at a concentration of 0.082 ug/m3, a 26% increase over the upwind location. Hexaldehyde was found in this sample at a concentration of 0.063 ug/m3. This was an increase of 15% over the upwind location. Butyraldehyde was found at a concentration of 0.052 ug/m3. This was an increase of 27% over the upwind location.

Test #2 Downwind South

Formaldehyde was found at a concentration of 1.84 ug/M3. This was a 75% increase over DWN, a 94% increase over the upwind location and a 202% increase over the background average. Acetaldehyde was found at a concentration of 0.78 ug/M3 which is 50% higher than the DWN location, 77% higher than the UPW location and 59% higher than the background location. Valeraldehyde was found at 0.11 ug/M3. This is a 120% increase over the DWN sample, a 120% increase over the upwind location and a 34% increase over the background average. Crotonaldehyde was found at a concentration of 0.13 ug/m3. This is a 91 % increase over the DWN location and a 195% increase over the upwind location. Benzaldehyde was found at a concentration of 0.11 ug/m3 in this sample. This is a 34% increase over the DWN location and a 69% increase over the upwind location. Hexaldehyde was found at a concentration of 0.073 ug/m3. This was an increase of 16% over the DWN location and a 33% increase over the upwind location. This compound was not found in the background. Butyraldehyde was found at a concentration of 0.076 ug/m3. This was an increase of 46% over the DWN location and an increase of 85% from the upwind location.

Test #3 Upwind

Formaldehyde was found at a concentration of 0.78 ug/m3, a 28% increase over the average of the background concentration. Acetaldehyde was found at a concentration of 0.53 ug/m3, which is a 8% increase over the background. Valeraldehyde was found at a concentration of 0.004 ug/m3, which is less than the background. Crotonaldehyde was found at 0.049 ug/m3, Benzaldehyde was found at 0.16 ug/m3 and Hexaldehyde was found at a concentration of 0.042 ug/m3. All were not found in the background. Butyraldehyde was found at a concentration of 0.038 ug/m3. This compound was not found in the background.

Test #3 Downwind North

Formaldehyde was found at a concentration of 1.45 ug/m3. This was an 86% increase over the upwind location and a 138% increase over the background. Acetaldehyde was found in this sample at a concentration of 0.66 ug/m3. This was an increase of 24% over the upwind location and a 34% increase over the background. Valeraldehyde was not reported in this sample. Crotonaldehyde was found at 0.11 ug/m3 which was an increase of 124% over the upwind location. Benzaldehyde was found at a concentration of 0.14

ug/m3, a 12% decrease over the upwind location. Hexaldehyde was found in this sample at a concentration of 0.038 ug/m3. This was approximately equal to the upwind location. Butyraldehyde was found at a concentration of 0.041 ug/m3. This was approximately equal to the upwind location.

Test #3 Downwind South

Formaldehyde was found at a concentration of 1.44 ug/M3. This was approximately equal to the DWN location, a 85% increase over the upwind location and a 136% increase over the background average. Acetaldehyde was found at a concentration of 0.67 ug/m3. This is equal to the DWN location, a 24% increase over the upwind location and a 34% increase over the background average. Valeraldehyde was not reported in this sample. Crotonaldehyde was found at a concentration of 0.06 ug/m3. This is a 45% decrease over the DWN location and a 22% increase over the upwind location. Benzaldehyde was found at a concentration of 0.086 ug/m3 in this sample. This is a 39% decrease over the DWN location and a 46% decrease over the upwind location. Hexaldehyde was not reported in this sample. Butyraldehyde was found at a concentration of 0.041 ug/m3. This was equal to the concentration in the DWN location and an increase of 8% from the upwind location.

Test #4 Upwind

Formaldehyde was found at a concentration of 0.78 ug/m3, a 28% increase over the average of the background concentration. Acetaldehyde was found at a concentration of 0.52 ug/m3, which is a 6% increase over the background. Valeraldehyde was found at a concentration of 0.011 ug/m3, a concentration less than the background. Crotonaldehyde was found at 0.044 ug/m3, Benzaldehyde was found at 0.075 ug/m3 and Hexaldehyde was found at a concentration of 0.052 ug/m3. All were not found in the background. Butyraldehyde was found at a concentration of 0.043 ug/m3. This compound was not found in the background.

Test #4 Downwind North

Formaldehyde was found at a concentration of 1.15 ug/m3. This was an 47% increase over the upwind location and a 88% increase over the background average. Acetaldehyde was found in this sample at a concentration of 0.63 ug/m3. This was an increase of 21% over the upwind location and a 28% increase over the background. Valeraldehyde was reported at a concentration of 0.046 ug/M3 in this sample. This is an increase of 318% over the upwind location and a 130% increase over the background. Crotonaldehyde was found at 0.079 ug/m3 which was an increase of 80% over the upwind location. Benzaldehyde was found at a concentration of 0.024 ug/m3, a 68% decrease over the upwind location. Hexaldehyde was found in this sample at a concentration of 0.053 ug/m3. This was approximately equal to the upwind location. Butyraldehyde was found at a concentration of 0.055 ug/m3. This was an increase of 28% over the upwind location.

Test #4 Downwind South

The Downwind South sample for this test was compromised. The tip was broken in such a way that the tube could not be inserted into the tubing leading to the pump properly. This sample was therefore not collected properly and the results have not been included in the averages.

Test #5 Upwind

Formaldehyde was found at a concentration of 0.72 ug/m3, a 18% increase over the average of the background concentration. Acetaldehyde was found at a concentration of 0.51 ug/m3, which is a 4% increase over the background. Valeraldehyde was found at a concentration of 0.00 ug/m3. Crotonaldehyde was found at 0.045 ug/m3, Benzaldehyde was found at 0.058 ug/m3 and Hexaldehyde was found at a concentration of 0.05 ug/m3. All were not found in the background. Butyraldehyde was not reported in this sample.

Test #5 Downwind North

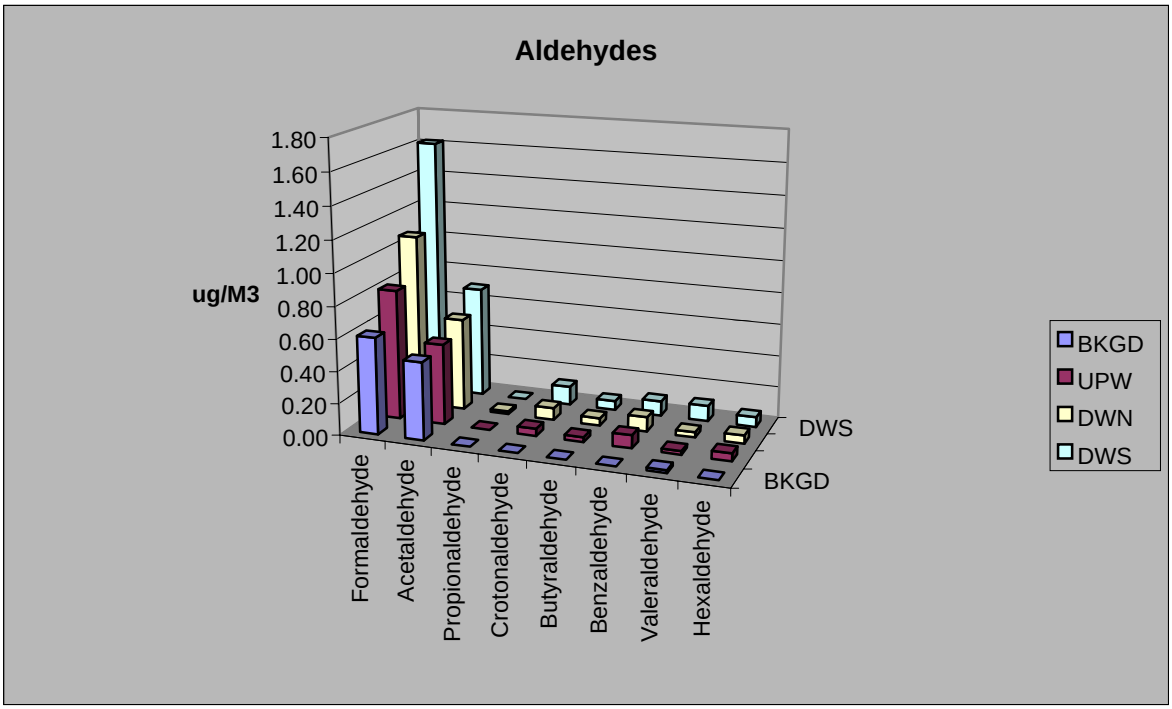
Formaldehyde was found at a concentration of 0.72 ug/m3. This was equal to the upwind location and a 18% increase over the background average. Acetaldehyde was found in this sample at a concentration of 0.56 ug/m3. This was an increase of 10% over the upwind location and a 14% increase over the background. Valeraldehyde was reported at a concentration of 0.00 ug/M3 in this sample. Crotonaldehyde was found at 0.055 ug/m3 which was an increase of 22% over the upwind location. Benzaldehyde was found at a concentration of 0.068 ug/m3, a 17% increase over the upwind location. Hexaldehyde and Butyraldehyde were not reported in this sample.

Test #5 Downwind South

Formaldehyde was found at a concentration of 1.54 ug/M3. This was an increase of 114% over the DWN location, a 114% increase over the upwind location and a 152% increase over the background average. Acetaldehyde was found at a concentration of 0.68 ug/m3. This is an increase of 21% to the DWN location, a 33% increase over the upwind location and a 39% increase over the background average. Valeraldehyde was not reported in this sample. Crotonaldehyde was found at a concentration of 0.147 ug/m3. This is a 172% decrease over the DWN location and a 227% increase over the upwind location. Benzaldehyde was found at a concentration of 0.098 ug/m3 in this sample. This is a 44% increase over the DWN location and a 69% increase over the upwind location. Hexaldehyde and Butyraldehyde were not reported in this sample.

Summary of Aldehyde Results

It is obvious from the data that the number of aldehyde compounds found and the concentrations increase from the background to the upwind and then to the downwind locations. In almost all of the sampling events, the downwind concentrations of aldehydes are higher than in the upwind or background locations. This is demonstrated by the data graphed in Figure 34 below that shows the average of the background, the upwind and the two downwind locations. One can only arrive at the conclusion that O'Hare airport contributes aldehyde compounds to the ambient environment downwind from its location above that created by any other source.



Averages by Location
ug/M3

	BKGD	UPW	DWN	DWS
Formaldehyde				0.61
				0.81
				1.08

	1.62
Acetaldehyde	
	0.49
	0.51
	0.58
	0.70
Propionaldehyde	
	0.00
	0.00
	0.02
	0.00
Crotonaldehyde	
	0.00
	0.05
	0.08
	0.12
Butyraldehyde	
	0.00
	0.03
	0.05
	0.06
Benzaldehyde	
	0.00
	0.08
	0.09
	0.09
Valeraldehyde	
	0.02
	0.02
	0.03
	0.10
Hexaldehyde	
	0.00
	0.05
	0.05
	0.06

Figure 34. Graph of the Average Aldehyde Data From Each Sampling Location.

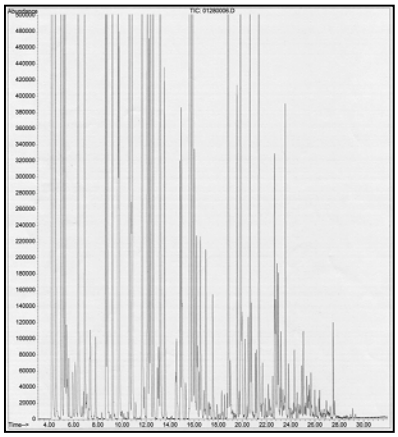
None of the samples that were taken on the XAD/PUF cartridges produced any detectable concentrations of polynuclear aromatics (PNAs). The sampling conditions did not allow

for enough air to pass through the cartridges to produce a detectable concentration. This result does not imply that PNAs are not present in the atmosphere nor does it imply that O'Hare airport does not contribute to the ambient concentrations of these compounds downwind of the airport. It merely says that the sampling effort was not sufficient to provide data that could be used in making an assessment of the impact of operations of the airport for this class of compounds.

Discussion of Volatile Organic Results

Automobile Exhaust Analysis

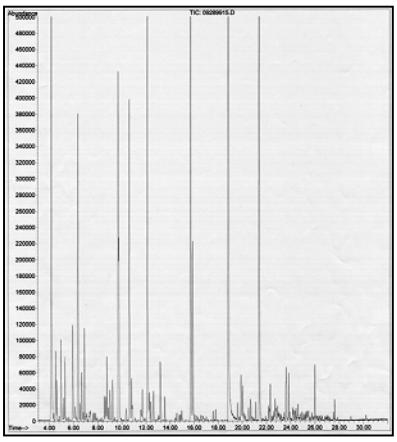
Rather than rely on the literature, which did not appear to be readily available, it was decided to analyze auto exhaust of an automobile, thus ensuring that the same sampling technique and instrumental analysis was being performed as would be done on the ambient samples from the airport. The sampling was accomplished using a single grab sample taken at the exhaust pipe of a 1993 Cadillac Seville STS. The auto had been at idle for approximately 1 hour prior to taking the sample. The sample was taken without inserting any type of device into the exhaust pipe, therefore, some ambient air may have also been taken along with the exhaust products, though the relative concentration of ambient air was minimal. The automobile is in good working order, and should be typical of the type of automobile that is currently on the road in the Chicago Metropolitan area. The compounds found in the auto exhaust will be discussed in the discussion of results for each volatile organic compound.



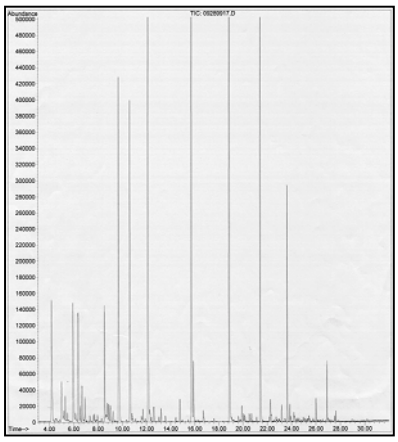
Auto Exhaust Sample

Background Sampling Results

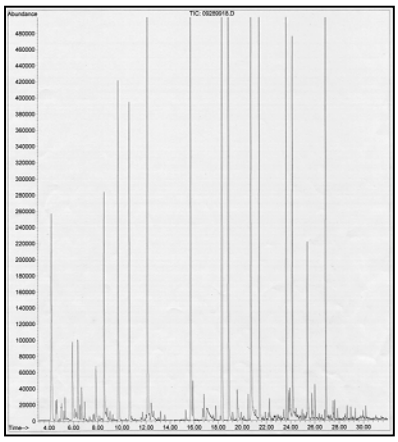
Three 24-hour composite samples for volatile organics were obtained on the three days of sampling.



Background Sample #1



Background Sample #2



Background Sample #3

Background sampling event BKD #1 on the first day of background sampling showed much higher concentrations of many compounds than was obtained on the other two days of background sampling. The majority of these compounds were found in the sample of auto exhaust analyzed for this investigation. These higher concentrations may be attributed to activity near the background sampling location in which automobile exhaust was being generated in what appears to be higher than normal amounts. Since the purpose of the background sampling was to provide an evaluation of the components and concentrations of typical background air, this first day's results for the auto exhaust components were determined not to be representative of normal activity in the Naperville area. Therefore, the data is evaluated with all three background locations averaged, and then a new average is calculated omitting the first day's contribution where the compound can be attributed to this higher than normal amount of auto exhaust for the purpose of comparing to the upwind and downwind locations. Percent increases or decreases are determined using this adjusted background average.

Background sample BKD #3 contained several compounds that were found at extremely high concentrations that are probably related to some type of construction activity. These compounds were alcohols and silicone containing compounds that are associated with caulking materials and other construction related materials.

Upwind and Downwind Results at O'Hare Airport

A total of 219 compounds were identified by their unique retention time by inspection of the chromatograms from each test. Of these compounds, 92 compounds were identified by mass spectrometry and are the major focus of the data analysis. The majority of the

127 compounds that were not identified by mass spectrometry are at concentrations that are very low and the scope of this investigation did not provide for detailed analysis of these compounds. Future studies, however, should endeavor to identify as many of these compounds as possible to ensure that the potential impact of these compounds on the health of residents in the vicinity can be evaluated.

In reviewing the data, several unusual results surfaced and are discussed here. In some cases the averages were calculated omitting these unusual events as not being representative in other cases the data was used in the average with the appropriate qualification.

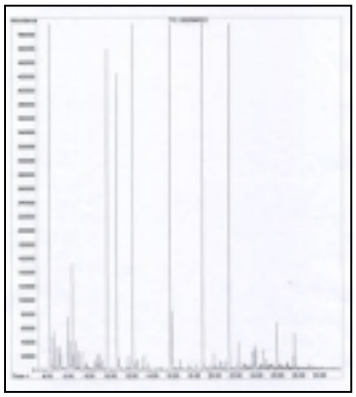
An unusual event occurred during the upwind sampling event UPW #3. An unusually large amount of construction related compounds were identified and may be attributable to some maintenance activity that occurred at one of the warehousing operations in the area. The compounds found were the alcohols and silicone compounds associated with caulking that was also found at elevated levels in the background sample BKD #3. Since these samples were not taken on the same day or even exposed to each other it is known that the existence of these compounds is not an artifact of sampling or analysis.

An unusual event occurred in downwind sampling event DWN #4. An unusually large concentration of several compounds such as butane, iso-pentane, and pentane as well as others found in the auto exhaust sample were found in this sample. These compounds were not usually found at these high concentrations, and the likely source is the auto rental facility located immediately to the west of this location. These compounds indicate that there may have been a fuel spill, or that a large number of autos were idling during the sampling event. The average values for these compounds were qualified where appropriate. However, this event did occur as a result of airport activities and is indicative of the kinds of non-normal activity releases that can occur.

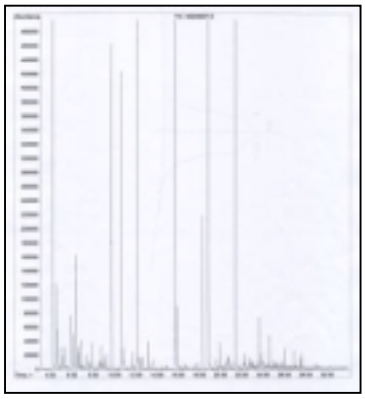
The upwind sample UPW#4 was compromised when the baseline on the chromatograph dropped below the edge of the recording page. Data for minor compounds were, therefore, not able to be estimated. It would not be fair to include the values for these minor components in the average as zero since this would tend to lower the overall average. Therefore, for minor compounds in this sample, the values were left blank which did not figure into the average for the upwind location.

Sampling event #5 for UPW, DWN and DWS and sampling event #6 which were the first grab samples were run on a different analytical instrument than the other samples. This resulted in two anomalies. First, some of the chlorinated compounds that were undetected and only estimated in the other sampling events were reported at significantly higher values in these samples. Since these compounds are quantitated against standards, it is unclear why they were not found at similar levels in the other samples. Also, the data that was not specifically quantified by the laboratory could not be estimated by the investigative staff on this project, since the precise retention time for these compounds

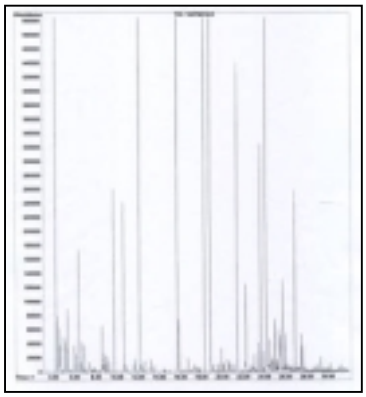
was not known. Since there were not sufficient funds to investigate every compound in these samples, their identification was not attempted, and for these samples no value was entered for these compounds. If additional funds become available, it might be worthwhile to investigate these compounds in these two sampling events. Below are the total ion current chromatograms obtained from the five sampling events at the upwind location UPW.



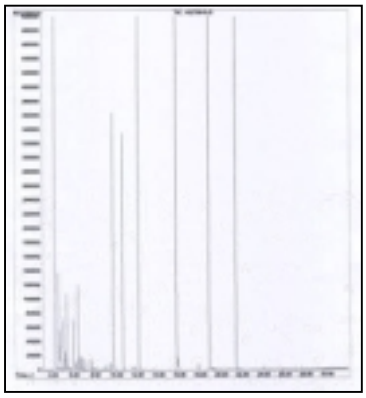
UPW #1



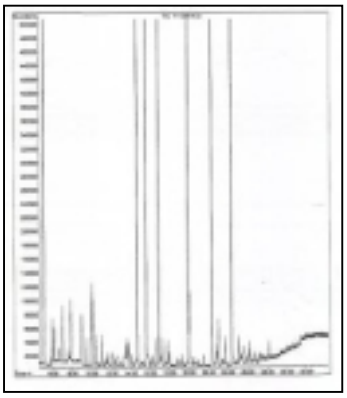
UPW #2



UPW #3

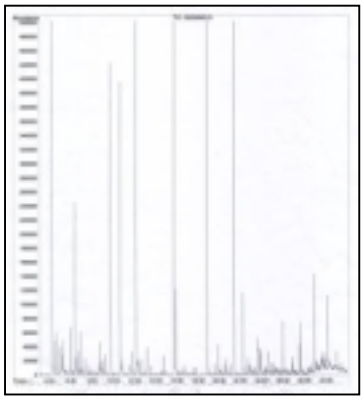


UPW #4

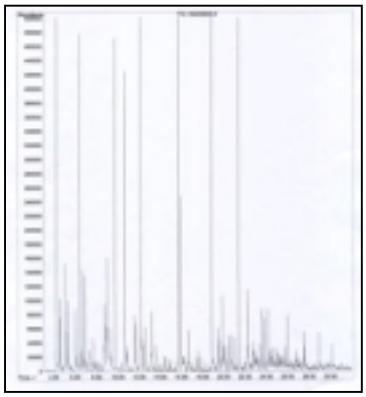


UPW #5

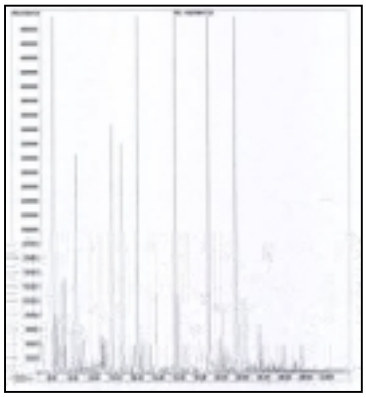
Below are the total ion current chromatograms obtained from the five sampling events at the downwind location DWN.



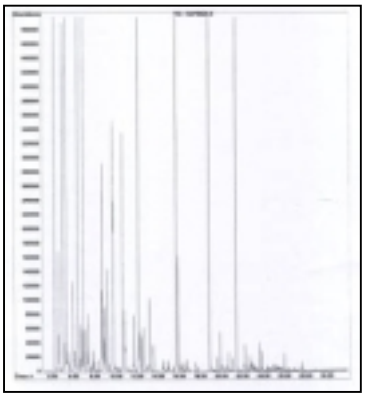
DWN #1



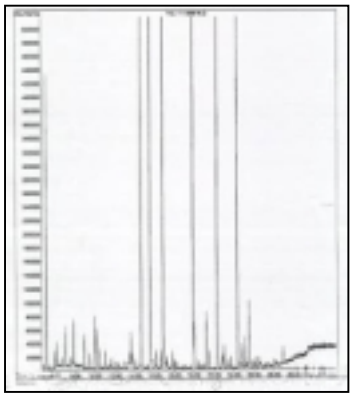
DWN #2



DWN #3

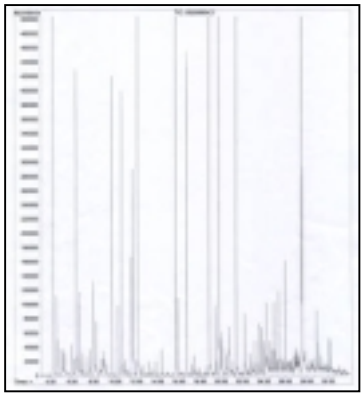


DWN #4

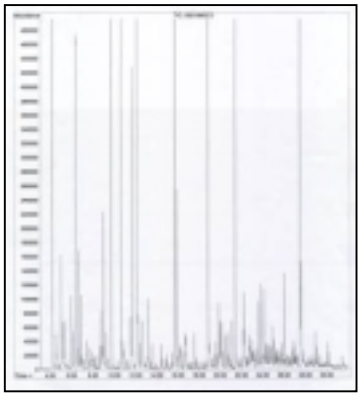


DWN #5

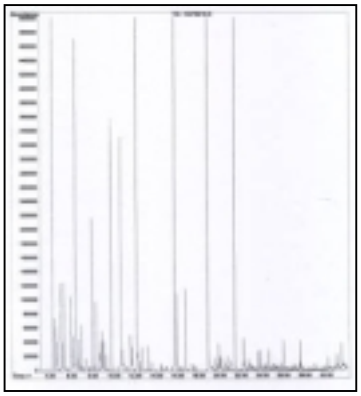
Below are the total ion current chromatograms obtained from the five sampling events at the downwind location DWS.



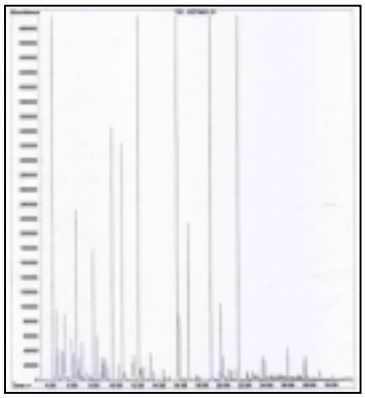
DWS #1



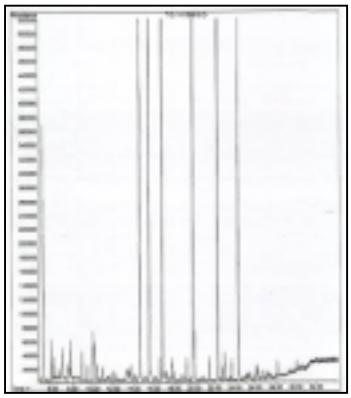
DWS #2



DWS #3

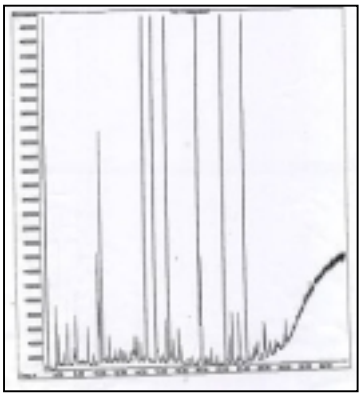


DWS #4

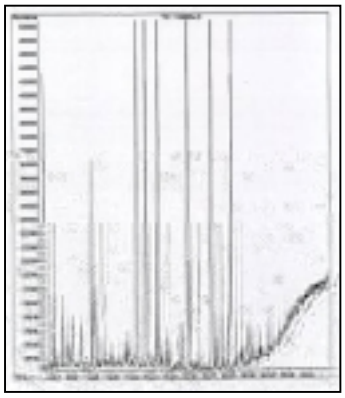


DWS #5

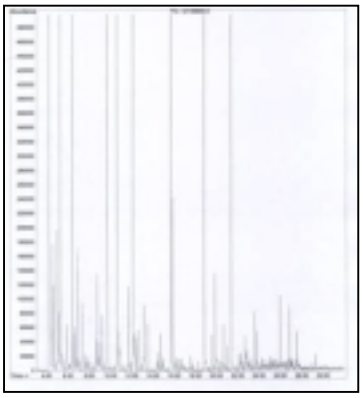
Below are the total ion current chromatograms obtained from the four grab samples at the downwind location DWS.



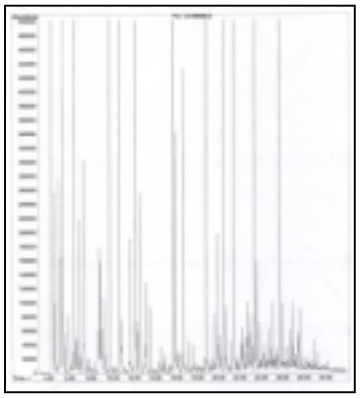
DWS #6A



DWS #6B



DWS #7 no odor



DWS #7 odor

Discussion of All Volatile Organic Results by Compound

In the following discussion, each compound or co-eluting compounds will be discussed. Each heading contains the retention time of the compound for the chromatographic conditions that were used for most of the samples. In one sampling event and for two of the grab samples, a different set of chromatographic conditions were used, and the retention times are different.

Under each heading, a brief description of the compound is provided along with an evaluation of whether this compound was a target compound of the investigation, what commercial uses may exist for the compound and a statement as to whether this compound would be expected to be present in the exhaust of combusted fuel. A target compound is one that was defined in the original proposal as being a component of jet exhaust.

The results for each sample location are then presented with the average and the range of values presented. The complete set of data is presented in Table 1. Changes in concentration from one sample location to another are expressed in percent increases or decreases. If there were anomalous results obtained for a sample taken at a location, these results are discussed, and if appropriate, the average for that location is adjusted. The volatile results of the 1998 Illinois Annual Air Quality Report for the compounds that are the same between this report and the Illinois report will also be compared.

Finally, the results are interpreted and a determination made as to whether the compound is found in concentrations downwind of the airport in excess of the background and/or upwind locations. Also, the results of the grab samples are interpreted with respect to the composite samples taken at the various locations.

4.56 Propane + Propene

Propane and Propene are both target compounds for this study. Propane is produced by aircraft engines at approximately 540 ug/m3 and propene is produced by aircraft engines at approximately 12,210 ug/m3. Clearly, propene is the more significant compound produced and would be expected to be found in samples taken downwind of O'Hare Airport. Propene was also found in the automobile exhaust sample analyzed for this investigation at a concentration of 700 ug/m3.

Propane + Propene co-elute under the chromatographic conditions used to analyze samples during this project. The analysis reported by the laboratory reports the peak at 4.56 minutes sometimes as Propane, Propane + Propene and Propene. While the compound of interest for this study would be Propene, it could not be differentiated from Propane. In future studies or in future analysis of this data, it would be appropriate to use the mass spectral data to differentiate between these two compounds and to report them separately.

Propane + Propene were present in almost all samples tested. In two of the samples, Background #2 and DWS #7 odor, Propane + Propene appeared as unresolved peaks near the baseline. This was probably due in the former case and definitely due in the latter case to the fact that the injection was not done properly. In chromatography with gas samples, it is possible that early eluting compounds (in the first few minutes) can be lost when the injection is not done properly, while not affecting the rest of the chromatogram. Fortunately, in the latter case above, a laboratory duplicate was run confirming that propane + propene were indeed present and that the rest of the chromatogram was unaffected.

Propane + Propene were found in two out of the three background samples. It probably would have been present in the other background sample except for the bad injection. Unfortunately, the laboratory did not choose to rerun this sample. The background sample in which Propane + Propene was not found was eliminated from the average, since this low value would bring the average of the three samples down. The average of the two samples was 2.7 ug/m3. The value of Propane + Propene was 4.0 ug/m3 on the first day, while the value when the wind had shifted to a more southwesterly direction was 1.3 ug/m3. This is a factor of three lower. Recalculating the average omitting the first day's contribution results in a new average of 1.3 ug/m3.

All of the samples taken in the upwind sampling location in Bensenville showed Propane + Propene at an average level of 3.6 ug/m3 which was close to the highest value seen in the background, and about 180% higher on average than the corrected background average. Values ranged from a low of 2.0 ug/m3 to a high of 5.0 ug/m3 in the upwind direction and did not seem to be related to wind direction.

Samples taken at the two downwind locations, DWN and DWS, produced average concentrations of Propane + Propene of 3.6 ug/m3 and 3.8 ug/m3 respectively. These values are similar to the average upwind with the DWS location slightly higher. Again, the values for each event ranged from a low of 1.0 ug/m3 to 8.0 ug/m3 at the DWN location and from 3.0 ug/m3 to 5.0 ug/m3 at the DWS location. The four grab samples taken at the DWS location produced an average concentration of 3.8 ug/m3 with the individual samples ranging from 2.0 ug/m3 to 6.0 ug/m3. This is the same value found for the DWS location, which was closer to the active runways than DWN.

Propane + Propene are about 180% higher at the upwind and downwind locations as compared to the background. However, there was only a slight increase from downwind of the airport compared to the upwind location. The highest concentration was found in the DWS #7 Odor sample that was taken immediately downwind of several idling aircraft. This indicates that the aircraft are contributing to the atmospheric burden of this compound downwind from the airport as a result of airport operations, specifically idling aircraft. It is not possible from this investigation to determine whether one or both of these compounds are at increased levels at the fence line.

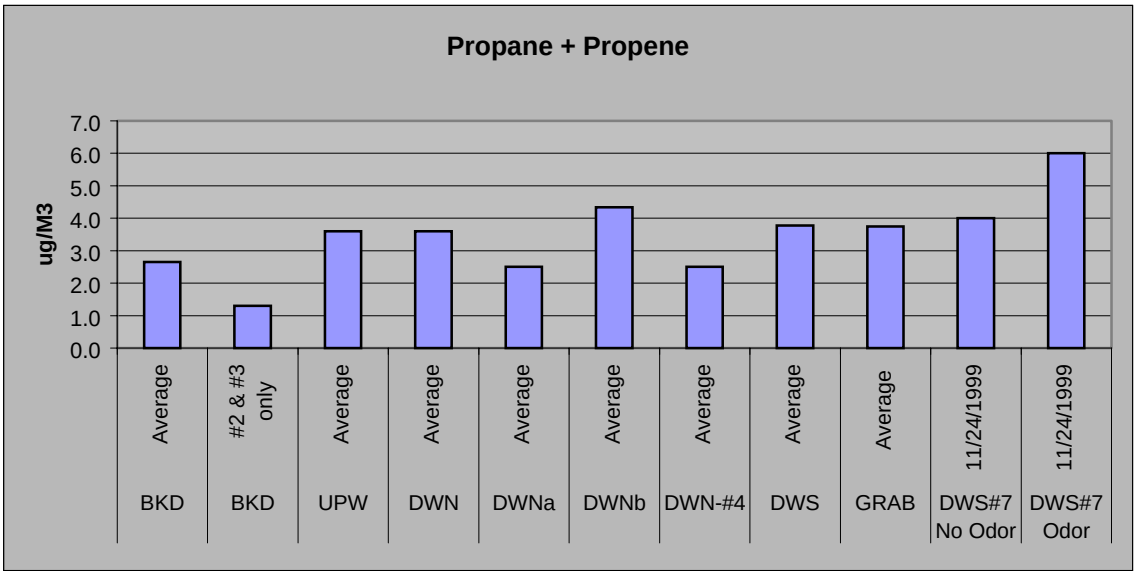


Figure 35. Results of VOC Analysis for Propane + Propene

The average for the Jardine Station in the 1998 Illinois Annual Report for Propane + Propene was reported to be 5 ug/M3. This is higher than found in any of the averages from this study. This indicates that Propane + Propene is a rather common air pollutant associated with the Chicago urban atmosphere.

4.64 Dichlorodifluoromethane

Chlorinated compounds are not target compounds of this investigation, as they are not known to be present in combustion products of either vehicles or airplanes. This compound was not found in the analysis of auto exhaust, or reported as a component of jet exhaust. Dichlorodifluoromethane is more commonly known as the refrigerant, Freon 12, which is no longer manufactured, but is still in use in air conditioners.

The average background concentration of Dichlorodifluoromethane was found to be 1.9 ug/m3. The two values found were 2.5 ug/m3 and 1.3 ug/m3 with the higher value being from the first day's sampling event.

The upwind location, which is much, more densely populated, than the background area and also was in an area of light industry rather than residential produced an average of 2.6 ug/m3, which is 37% higher than the background. The range of values found were from 2.0 ug/m3 to 3.0 ug/m3. The range of values does not show much variation, which would tend to indicate a source that is constant and not localized to one particular activity in one direction from the sampling module.

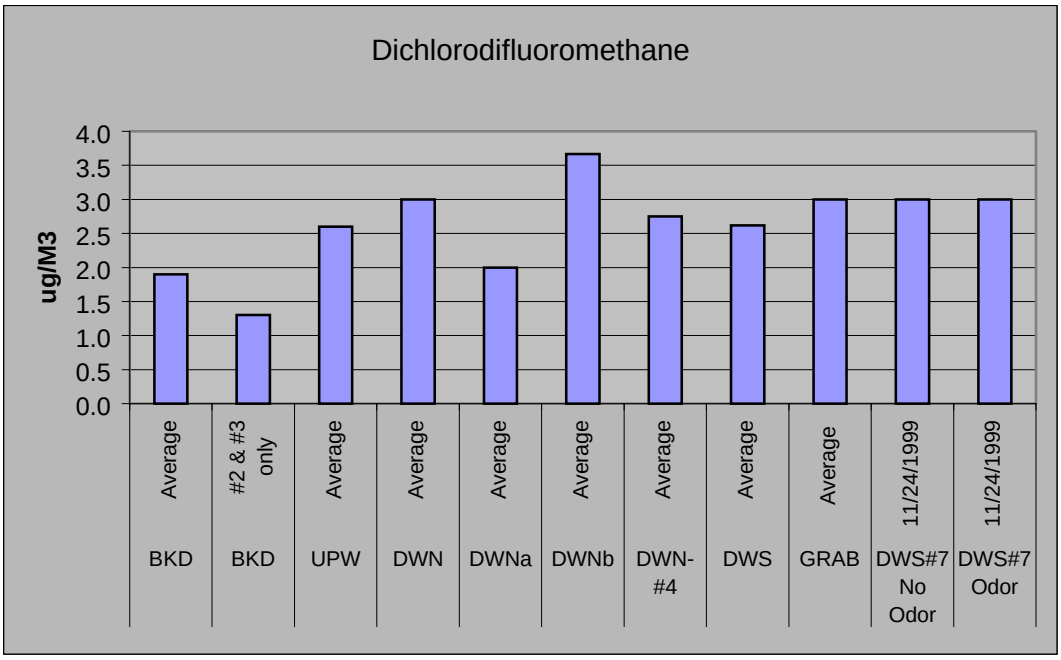


Figure 36. Results of VOC Analysis for Dichlorodifluormethane.

The downwind location DWN average for Dichlorodifluoromethane was 3.0 ug/m3. The range of values was from 2.0 ug/m3 to 4.0 ug/m3. The average of the downwind location DWS was 2.8 ug/m3 with the range of values from 2.0 ug/m3 to 4.0 ug/m3. Both of these averages are slightly higher than the upwind location and are 57% and 47% higher respectively than the background location.

While Dichlorodifluoromethane is not associated with vehicular or airplane combustion, it does appear that there is an increase of this compound downwind from O'Hare airport. This may be due to leakage from the air conditioners used to cool the terminals, airplanes, etc.

4.84 Chloromethane

Chloromethane also known, as methyl chloride is another chlorinated compound that is not associated with combustion processes from vehicles or airplanes, however, it is used as a refrigerant and is a byproduct of some industrial activities.

Chloromethane was found to be present in most samples in concentrations of less than 0.3 ug/m3. During the course of this study, all of the samples from the Background, and the first four eight hour sampling events at UPW, DWN and DWS as well as the DWS #7 grab samples were analyzed by the laboratory on a single analytical instrument. Unfortunately, the fifth sampling event, and the DWS #6 grab samples were analyzed on

a different instrument. While the analytical process should be independent of the analytical method used, it appears that in the case of Chloromethane, the instrument had something to do with the magnitude of the concentrations found for this compound.

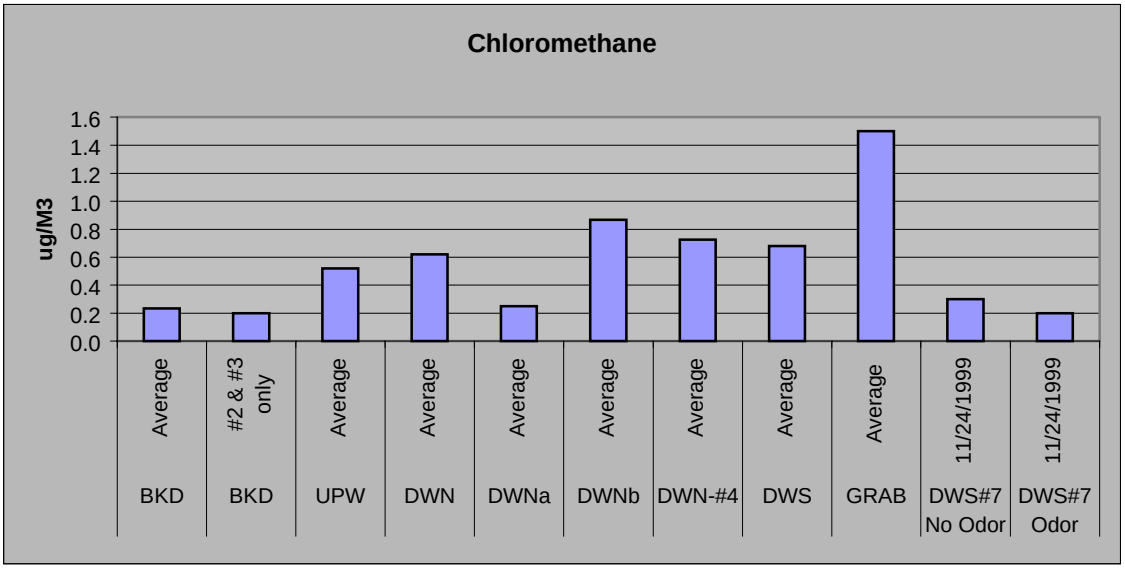


Figure 37. Results of VOC Analysis for Chloromethane.

Chloromethane was found at 1.7 ug/m3 in UPW #5, 2.2 ug/m3 in DWN #5 and 2.5 ug/m3 in DWS #5. It was also found at 2.3 ug/m3 in DWS #6 and at 3.2 ug/m3 in DWS #6 DUP. This data shows that the magnitude of chloromethane is increasing slightly from the upwind location to the downwind locations, consistent with the results found for Dichlorodifluoromethane. Since only these samples exist with this magnitude of chloromethane reported, it is unclear if this trend would have been found in all of the samples had they all reported chloromethane at the same level. From the data it appears that the concentration of chloromethane is increased downwind by activities at the airport.

5.00 Isobutane + Acetaldehyde

Acetaldehyde was a target compound for this study since it is a known component of jet exhaust at 6,750 ug/m3. Unfortunately, it co-elutes with isobutane which was found in the analysis of the auto exhaust at 1000 ug/m3.

The background average for these two compounds was 2.7 ug/m3, with the range of values from 1.0 ug/m3 to 5.0 ug/m3. As discussed earlier, the highest concentration found was on the first day of sampling. The concentration then trended lower during the

three days of background sampling. Recalculating the average omitting the first day's contribution results in an average of 1.5 ug/m3.

The average for the five upwind measurements was 2.7 ug/m3, with the range of values being from 1.2 ug/m3 to 5 ug/m3. This average is an 80% increase over the background.

The average for the five DWN locations was 8.2 ug/m3 with the range of values being 1.0 ug/m3 to 20.0 ug/m3. The average at the DWN location was high because of a single high result for isobutane reported for DWN #4. Removing this high result from the average results in an average for DWN of 5.3 ug/m3. It is possible that the activity discussed earlier at the DWN location on this sampling day resulted in the anomalously high value for these two compounds. The sampling module was located directly east of the rental car facilities at O'Hare airport.

The average of the five DWS locations was 4.7 ug/m3 with the range being 1.5 ug/m3 to 7.0 ug/m3. This average is in line with that found in the DWN location with the anomalously high value omitted.

The average for the four DWS grab samples was 4.8 ug/m3 with the range of values from 4.0 ug/m3 to 6.0 ug/m3.

Isobutane + Acetaldehyde is approximately 100% higher downwind from the airport compared to either the upwind location and 250% higher than the upwind location. This clearly indicates that these two compounds are being produced by activities at the airport above background and upwind levels. It is not clear from this investigation which one of these compounds is more dominant upwind versus downwind.

The average value from the 1998 study of the Jardine location in Chicago resulted in a concentration of Isobutane of 2.96 ug/M3 which is considerably less than that obtained at the downwind and grab samples at O'Hare airport.

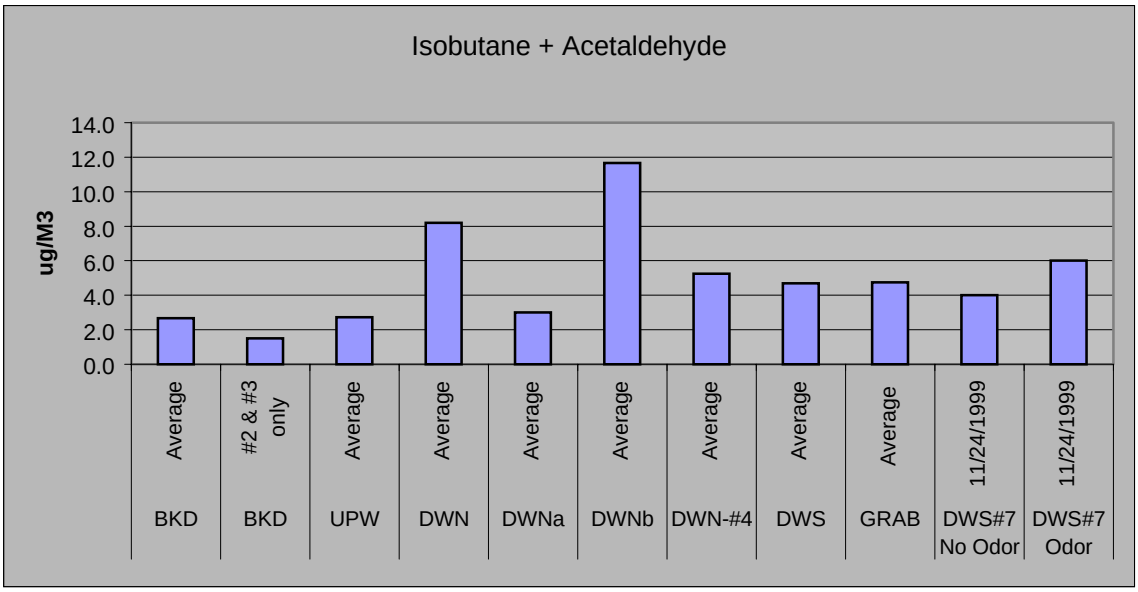


Figure 38. Results of VOC Analysis for Isobutane + Acetaldehyde.

5.2 Butene or Isobutene Isomer

Butene is a target compound for this study. The laboratory, however, was unable to determine if the compound at 5.2 minutes was a butene isomer or an isobutene isomer. This compound was found at 500 ug/m3 in the auto exhaust sample. Butene compounds are also components of jet exhaust. One compound that was not identified in our investigation that was reported to be a component of jet exhaust was 1,3-butadiene. This compound has a retention time of 5.26 minutes under the conditions of this investigation. It would be present between this peak and the next peak, butane. While we have identified this compound in other investigations, this compound, if present, was present at less than the detection limit of 1 ug/m3.

The background average for this compound is 0.8 ug/m3 with the range of values from 0.5 ug/m3 to 1.5 ug/m3. As with other compounds found in the background, the sample taken with the wind predominantly out of the north is the highest concentration found for this compound, with the values trending lower over the three days of sampling. Recalculating the average omitting the first day's contribution would yield an average of 0.6 ug/m3.

The average at the upwind location UPW was found to be 1.6 ug/m3 for the five events. This is an increase of 167% over the concentration found in the background. The range of values was from 0.8 ug/m3 to 3 ug/m3.

The average at the downwind location DWN was found to be 1.7 ug/m3 which is not much different than that found for the upwind location. The range of values was from 1 ug/m3 to 2 ug/m3. The average at the downwind location DWS was found to be 2.0 ug/m3 with the range of values from 1.5 ug/m3 to 2.3 ug/m3. Again, this is not much of an increase over the UPW location.

The average of the DWS grab samples was 3.0 ug/m3 with the range of values between 2 ug/m3 and 4.0 ug/m3.

The trends indicate, that the concentration of this butene compound increases downwind of the airport, presumably as a result of the activities at the airport. The average of the grab samples is 50% higher than the downwind or upwind locations and 400% higher than the background. The UPW, DWN and DWS eight-hour composite samples showed levels of this auto and jet exhaust related compound at approximately the same average concentrations. The grab samples are significantly higher pointing to jet exhaust as a contributor of this compound to the atmosphere. The background of this compound in the area surrounding the airport is roughly 1.6 ug.m3, the increases in the downwind samples is a result of the additional contribution from activities at the airport.

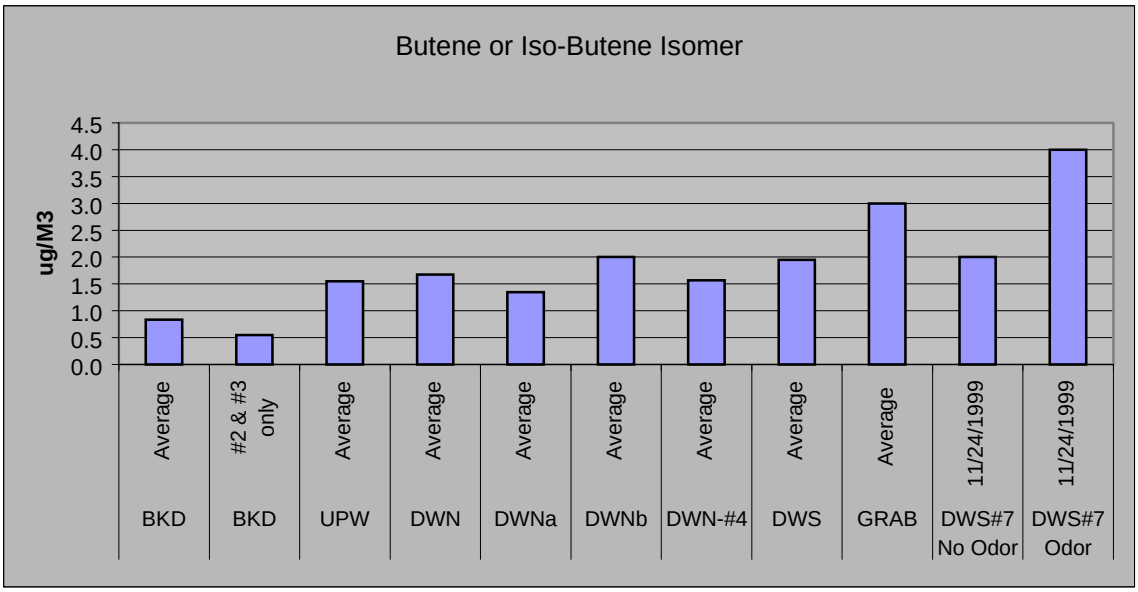


Figure 39. Results of VOC Analysis for Butene or Iso-Butene Isomer.

5.31 n-Butane

Butane was a target compound for this study since it is a component of jet exhaust. It is also present as a major component of auto exhaust at 4,000 ug/m3.

The background concentration of butane was found to be 2.4 ug/m3. The range of concentrations found was from 1.5 ug/m3 to 4 ug/m3. As with the other compounds found in the background sample, the highest concentration was found on the first day and the concentration was lower on the second and third days. Recalculating a new average omitting the first day's contribution would yield an average of 1.6 ug/m3.

The average concentration of butane in the upwind location UPW was found to be 3.7 ug/m3. This value is 131% higher than what was found in the background. The range of values was from 1.0 ug/m3 to 6.0 ug/m3.

The average concentration of butane in the downwind location DWN was found to be 44.2 ug/m3. The range of values was from 2.0 ug/m3 to 200.0 ug/m3. The average for the DWN location was affected by a single value of butane of 200.0 ug/m3 that occurred on the same day and location as the large concentration of isobutane + acetaldehyde discussed earlier. It is presumed that since butane and isobutane are closely related compounds, that their increased concentration in this sample is related and resulted from the same activity at the airport or rental car facilities. All of the compounds are related to auto exhaust. Removing this high value from the average results in an average value for butane at DWN of 5.3 ug/m3 that is more in line with the values found in the DWS samples. This average value is 43% higher than the upwind location and 231% higher than the background location.

The average value for butane found in the DWS downwind location was 4.9 ug/m3, with the range of values from 1.4 ug/m3 to 9.0 ug/m3. This value is 32 % higher than the upwind location and 206% higher than the background.

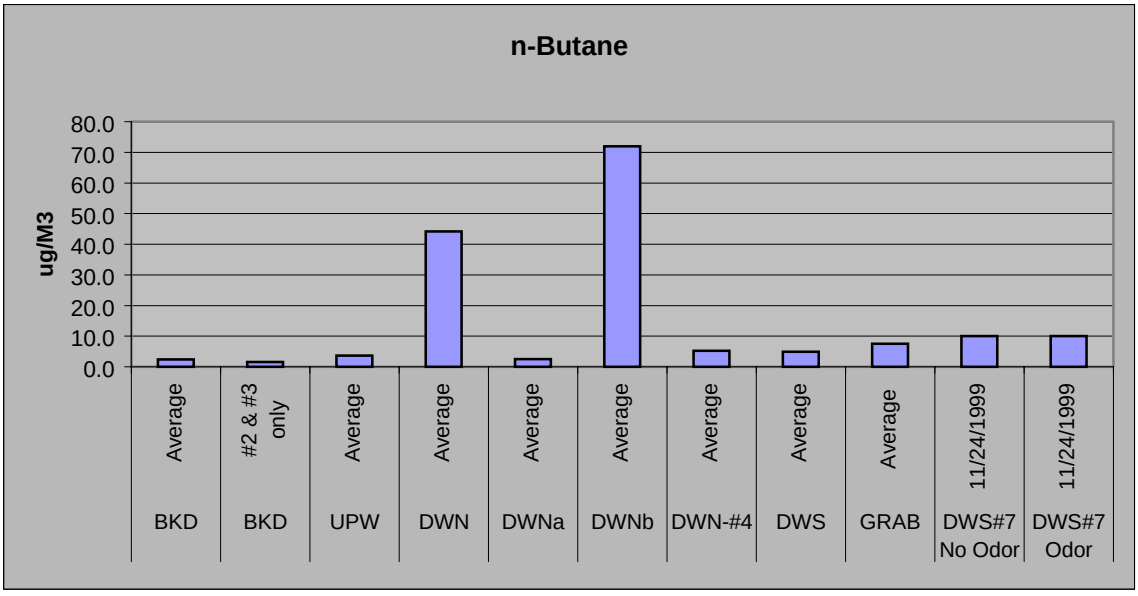


Figure 40. Results of VOC Analysis for n-Butane.

The average for the DWS grab samples was found to be 7.5 ug/m3 with the range from 5 ug/m3 to 10 ug/m3. This is a 369% increase over the background concentration and a 103% increase over the upwind location. It is also an approximately 50% increase over the eight hour composite samples. This fact clearly indicates that this compound results from the combustion of jet fuel while jets are idling waiting to take off.

n-Butane was found in the annual average of Jardine location in Chicago at a concentration of 3.44 ug/M3. This value is considerably lower than that found for the averages at any of the O'Hare downwind locations.

5.95 Ethanol

Ethanol was not one of the target compounds for this study. It was found in the analysis of the auto exhaust as a minor component. It is present in most gasoline at approximately 10%. It also can appear in atmospheric samples as a result of the decay of vegetation.

The concentration of ethanol was the same in all background samples, 30 ug/m3, which was also the highest value reported for any of the samples.

The average concentration of ethanol in the upwind location UPW was 10 ug/m3, with all values identical.

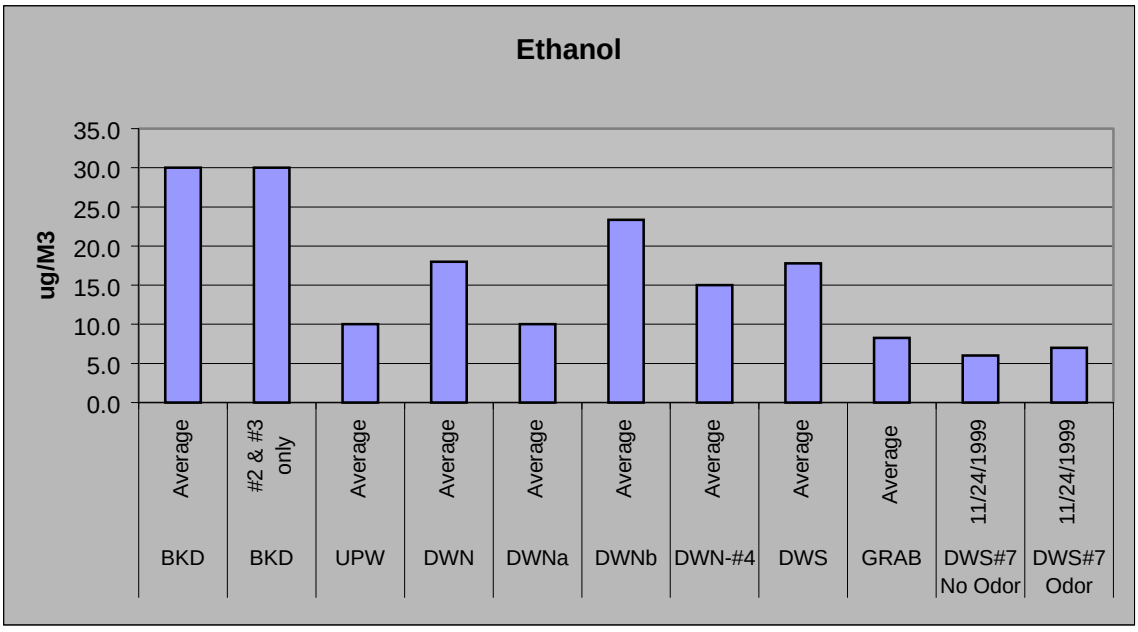


Figure 41. Results of VOC Analysis for Ethanol.

The average concentration of ethanol in the downwind location DWN was 18 ug/m3 with the range of values from 10 ug/m3 to 30 ug/m3. The average concentration of ethanol in the downwind location DWS was 17.8 ug/m3 with the range of values falling between 9 ug/m3 and 30 ug/m3. Finally the average of the downwind grab samples was found to be 8.3 with the range of values between 6 ug/m3 and 10 ug/m3. This compound does not appear to be associated with any activities at O'Hare airport above background levels.

6.15 Acetonitrile

Acetonitrile or methyl cyanide was not a target compound for this study. It was found as a minor component of auto exhaust. It also used in several commercial and industrial activities.

The average value for acetonitrile in the background samples was 0.6 ug/m3 with the range of values from 0.1 to 0.9 ug/m3. Unlike some of the combustion related compounds, this compound was not as obviously dependent on the wind direction.

The average value for acetonitrile in the upwind location UPW was 2.2 ug/m3 with the range of values from 0.5 ug/m3 to 4.0 ug/m3. This is a 267% increase over the background levels.

The average value for this compound in the downwind location DWN was 1.3 ug/m3 with the range of values from 0.3 ug/m3 to 3.0 ug/m3. This is a 116% increase over the background, but a 40% decrease over the upwind location.

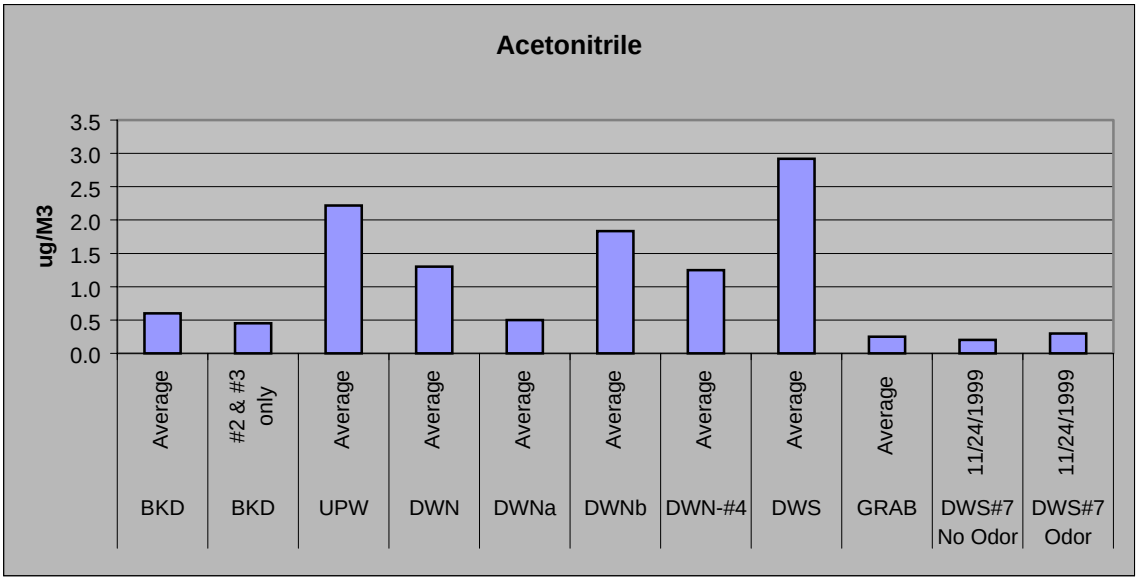


Figure 42. Results of VOC Analysis for Acetonitrile.

The average value for this compound in the DWS location was 2.9 ug/m3 with the range of values from 0.9 ug/m3 to 5.0 ug/m3. This is a 383 % increase over the background concentration, and a 32% increase over the upwind location.

The average of the DWS grab samples was 0.3 ug/m3 with the range of values from 0.2 ug/m3 to 0.3 ug/m3. This is comparable to the background.

From this data it appears that this compound is not related to jet fuel combustion. The fact that the grab samples have very low concentrations of acetonitrile, about the same as the background, compared to the eight-hour composites indicates that the exhaust from the aircraft is not significantly contributing to the ambient concentration of acetonitrile. The data does indicate that there are significant sources of this compound in the area around the airport (and possibly even at the airport) that are increasing the concentration of this compound over the background concentration by at least 200-380%. The DWS location is much higher than the DWN location indicating that some activity in this area of the airport may be contributing acetonitrile to the environment.

6.25 Acrolein

Acrolein was a target compound for this investigation. Acrolein is an aldehyde compound which is very reactive and has a disagreeable, choking odor. It has been identified as a minor component of auto exhaust and a major component of jet exhaust.

The average concentration of acrolein in the background samples was 0.3 ug/m3 with the values ranging from 0.2 to 0.6 ug/m3. Two values were found on the first two days of testing at 0.2 ug/m3 with a value of 0.6 ug/m3 found on the third day of testing.

The average concentration of acrolein in the upwind samples was 0.2 ug/m3. This corresponds to the value that was found in the background on the first two days of testing. Values ranged from not detected to 0.3 ug/m3.

The average concentration of acrolein in the DWN location was found to be 0.3 ug/m3. This value was the same even with the event that occurred on the fourth day of testing removed indicating that the source was not from auto exhaust. This value is similar to the values found at the upwind and background locations. The value of 0.3 ug/m3 was found on four out of the five days of testing. The fifth day produced no detectable amounts of acrolein. This is consistent with the sampling in the upwind location with the fifth day producing no detectable amount of acrolein. Since sample from this sampling event were analyzed on a different mass spec, the conditions could have precluded the detection of this peak, or there was overlap by another compound that was not resolved.

The average concentration of acrolein in the DWS location was found to be 0.2 ug/m3. This value is in line with the upwind, background and DWN locations. The range of

values was from 0.1 ug/m3 to 0.4 ug/m3 with a non-detectable amount found on the fifth day of sampling.

The values found in the grab samples taken at the DWS location were 0.4 ug/m3 for the no odor present sample and 0.7 ug/m3 for the odor present sample. This latter value is 133% higher than the values found at the other locations. The conclusion from this data is that acrolein is emitted by airport activities and that the jet exhaust is the likely source. This compound also probably is a component of the distinct airport odor.

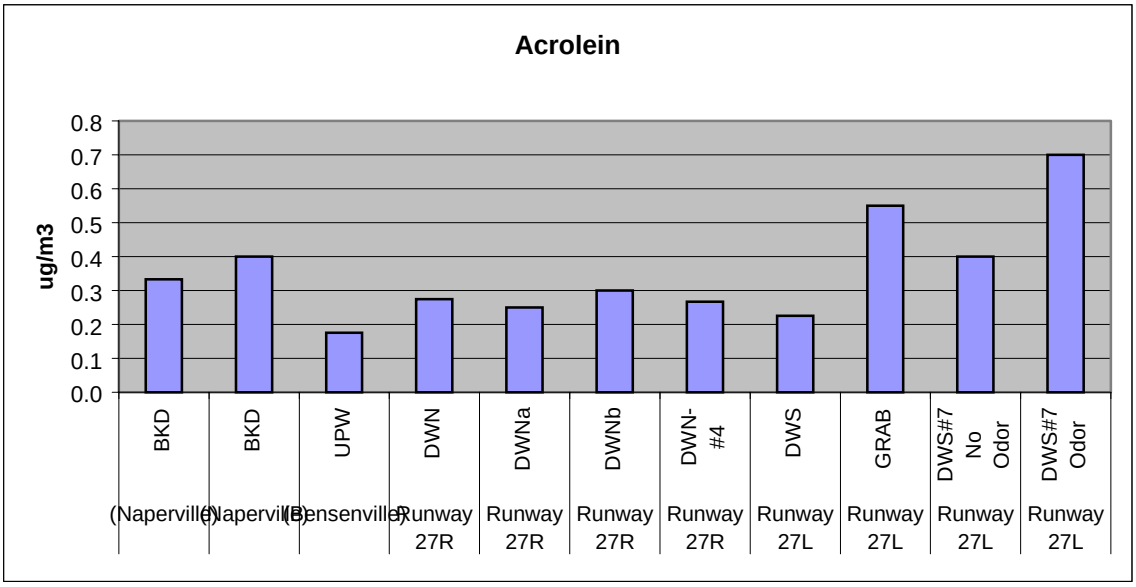


Figure 43. Results of VOC Analysis for Acrolein.

6.39 IsoPentane (2-Methylbutane)

Isopentane was not a target compound for this investigation. Isopentane is a branched alkane that is a major component of found in the auto exhaust analysis. Isopentane and Acetone co-elute and consequently isopentane was not quantitated in all samples.

The average concentration for isopentane in the background samples was 13 ug/m3 with the values ranging from 6 ug/m3 to 20 ug/m3. Isopentane was only reported in two of the three samples with the background sample on the third day having no value reported for isopentane. The trend that has been seen for other compounds identified in the background was present for this compound as well with the first day having the highest concentration and the subsequent two days having mush less. Even though isopentane was not quantitated in the third sample, the combined peak is much lower than in the first sample and lower than in the second. Mass spec investigation of this peak in the third sample could yield a value for isopentane on the order of that found in the second sample. The value of 20 ug/m3 in the first background sample is high and indicates some type of

activity in the vicinity of the background sampling location that is producing higher than normal background levels of isopentane. Recalculating the average omitting the contribution from the first day's sampling results in an average of 6.0 ug/m3.

The average concentration for isopentane in the upwind sample location UPW was 6.0 ug/m3. Only two of the five samples reported isopentane, both at 6.0 ug/m3. This is lower than the overall average for the background samples, but is in line with what was found in the second sample and what would be expected in the third sample.

The average concentration for isopentane in the downwind sample location DWN was 34.0 ug/m3. Isopentane was found at 100.0 ug/m3 in DWN #4 which also contained other compounds that were anomalously high as a result of some activity on that day in the vicinity of the airport or rental car service areas. If this value is removed from the average, the new average is then 12.0 ug/m3 with the range of values from 8.0 ug/m3 to 20.0 ug/m3. This average is 100% higher than the background and upwind locations.

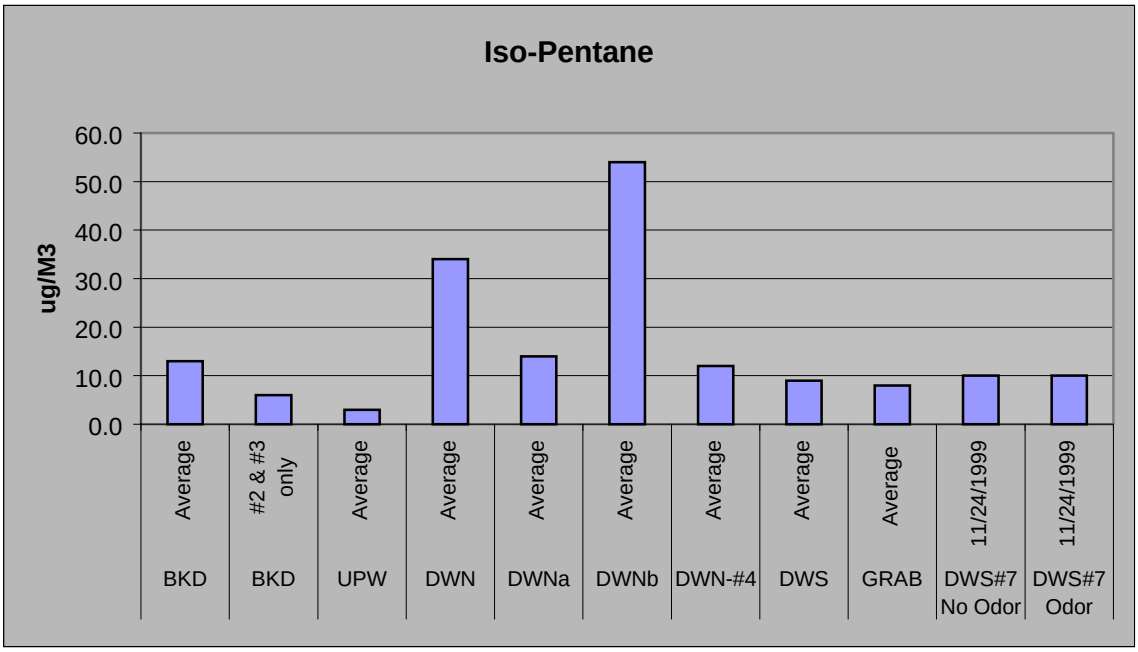


Figure 44. Results of VOC Analysis for Iso-Pentane.

The average concentration for the downwind sample location DWS was 9.0 ug/m3 which was the only value reported. This value is 50% higher than that found for the background and upwind locations and 75% of the value found in the DWN location.

The average concentration for the downwind grab samples was 8 ug/m3 with the range of values from 6 ug/m3 to 10 ug/m3. This was comparable to the DWS location and 33% higher than the background or the upwind locations.

From the data, it appears that the background concentration is probably near 6 ug/m3. Activities that produce isopentane as a byproduct appear to be occurring on some days at the airport and some of this isopentane is probably a result of incomplete combustion of jet fuel since two out of the four grab samples had concentrations of 10 ug/m3 which is higher than background of 6 ug/m3. The DWN location had the highest average that is consistent with the fact that this location was close to the auto rental facility with auto exhaust having a high concentration of isopentane. It is clear from this data that the activities of the airport are contributing to the overall atmospheric concentration of isopentane downwind of the airport. Iso-Pentane was found in the annual average of Jardine location in Chicago at a concentration of 6.53 ug/M3. This value is considerably lower than that found for the averages at any of the O'Hare downwind locations.

6.43 Acetone

Acetone was a target compound for this study. Acetone is present in jet exhaust at 553 ug/m3, but was not found in the analysis of auto exhaust. Acetone was found to be present in all samples. Acetone is used as a paint solvent and this use may also contribute to the concentrations that were found in this study.

The average concentration of acetone in the background samples was 8.6 ug/m3 with the range from 6.8 ug/m3 to 9.6 ug/m3. The first two samples were the higher with the third sample being lower. This compound did not seem to be dependent on wind direction as much as some other compounds. The background area is full of new homes and homes that are under construction in all directions from the background monitoring location.

The average concentration of acetone in the upwind samples UPW was 8.0 ug/m3 with the range of values from 5.2 ug/m3 to 15 ug/m3. This is not much different than what was found in the background sample, but in this case the sources may be the light industry in the area or some painting that was occurring.

The average concentration of acetone in the downwind samples DWN was 16.2 ug/m3 with the range of values from 8 ug/m3 to 25 ug/m3. This is an approximate 100% increase over the background and upwind locations. The average concentration of the acetone in the downwind samples DWS was 25 ug/m3 with the range from 10 ug/m3 to 43 ug/m3. This is an approximate 212% increase over the upwind and background locations.

The average concentration of acetone in the downwind grab samples was 12.1 ug/m3. This is 50% higher than in the background or upwind locations, but not as high as found in the DWN or DWS locations. This would tend to support the contention that the

increased concentration of acetone in the downwind composite samples is due to other activities at the airport and not just on air traffic alone.

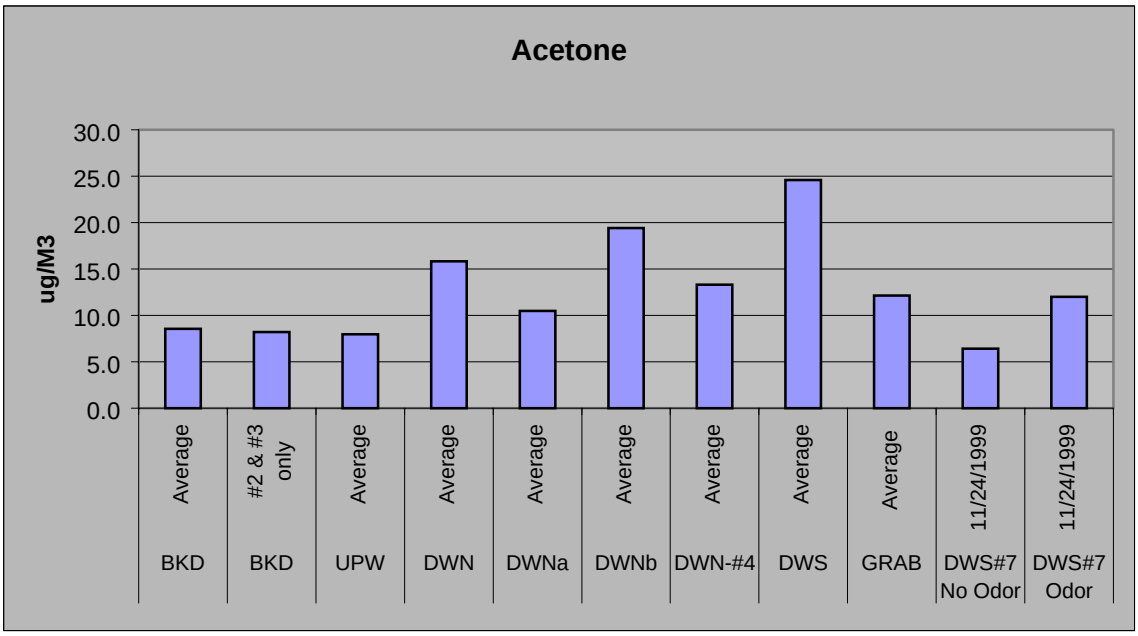


Figure 45. Results of VOC Analysis for Acetone.

The concentrations of acetone were higher downwind of the airport than for either the upwind or background locations. While acetone is a component of jet engine exhaust, it probably does not exist at this source in large enough concentrations to make the large differences observed. The additional acetone seen downwind from the airport may be due to maintenance activities being performed on the airplanes, such as painting and parts cleaning.

6.56 Trichlorofluoromethane

Trichlorofluoromethane (TCFM) is known as Freon 11 a no longer manufactured compound used primarily as a solvent. It was not a target compound of this study, and would not be expected to be a product of combustion of either gasoline or jet fuel. It was not found in the analysis of auto exhaust.

The average concentration of TCFM in the background samples was 1.7 ug/m3 with the range of values ranging from 1.6 ug/m3 to 1.7 ug/m3. There was no apparent dependence on wind direction.

The average concentration of this compound in the upwind sample location UPW was 1.8 ug/m3 with the range of values from 1.5 ug/m3 to 2.4 ug/m3. This average is comparable to that found in the background.

The average concentration of this compound in the downwind location DWN was also 1.8 ug/m3 with the range of values 1.5 ug/m3 to 2.4 ug/m3. The average concentration of this compound in the downwind location DWS was 1.9 ug/m3 with the range of values from 1.6 ug/m3 to 2.9 ug/m3. Finally, the average for the downwind grab samples was 1.9 ug/m3 with all of the values found at 1.9 ug/m3.

It is obvious from the data, that no matter where the sample was taken, this compound was found at about the same concentration. This compound is not present as a result of airport activities.

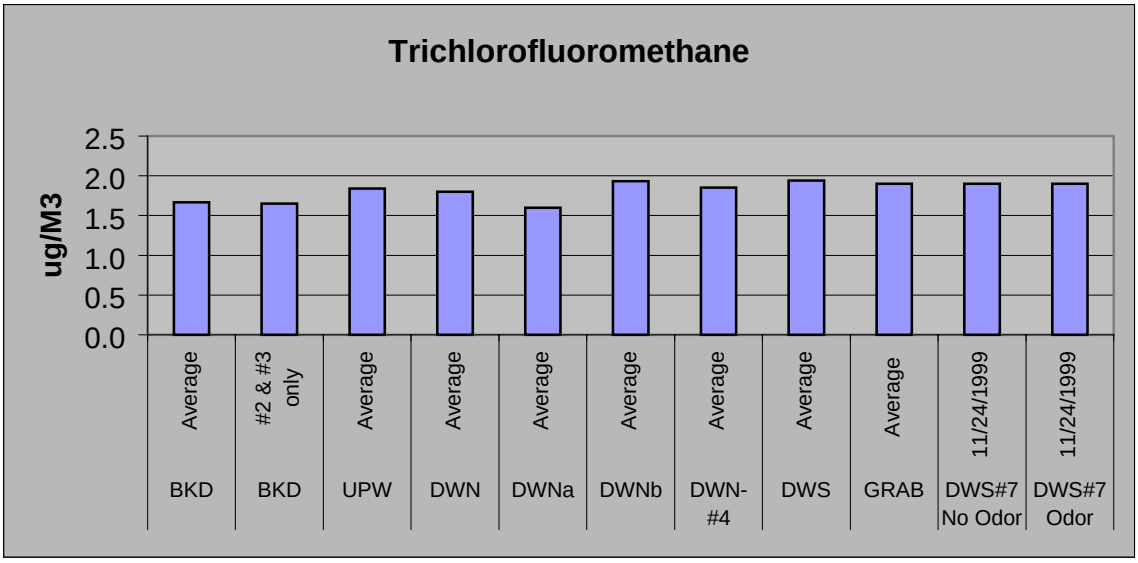


Figure 46. Results of VOC Analysis for Trichlorofluoromethane.

6.69 Isopropanol

Isopropanol was not a target compound for this investigation. It is used in industry extensively and would not be expected as a combustion product of either gasoline or jet fuel, however, isopropanol is used as a deicing agent in liquid fuels to keep the fuel from freezing at low temperatures, so that if this compound does show increased levels downwind of the airport, its source might be the fuel that is used in either the jets or ground vehicles at the facility.

The concentration of isopropanol found in the background samples was 3.0 ug/m3. All three samples had the same concentration.

The average concentration of isopropanol found in the upwind location UPW was 2.1 ug/m3 with the range of values from 0.7 ug/m3 to 5.0 ug/m3. This average value is slightly lower than that found in the background.

The average concentration of isopropanol found in the downwind location DWN was 3.3 ug/m3 with the range of values from 1.4 ug/m3 to 7.0 ug/m3. The average concentration of isopropanol in the downwind location DWS was 4.9 ug/m3 with the range of values 1.5 ug/m3 to 8.0 ug/m3.

The average concentration of the downwind grab samples was 7.3 ug/m3 with the range of values from 1.0 ug/m3 to 20.0 ug/m3. The highest value was found in sample DWS #6Dup of 20.0 ug/m3. This value is much higher than found in any other sample. Recalculating the average for these samples omitting this high value results in an average of 3.0 ug/m3 which is in line with that found in the background.

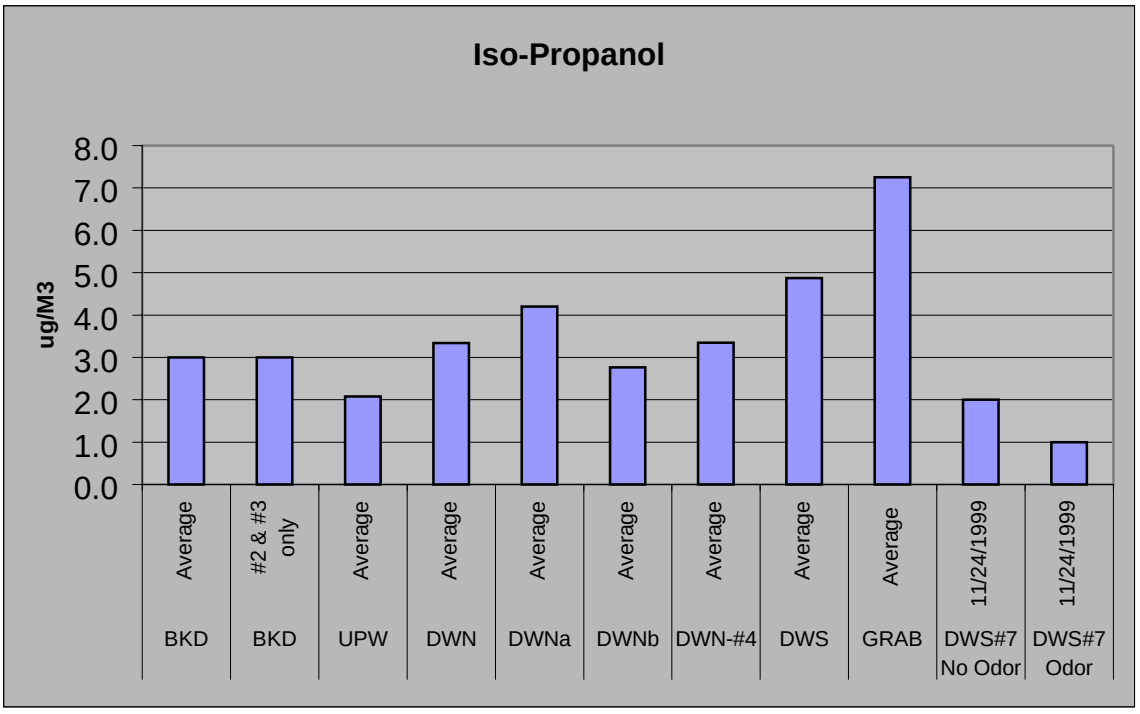


Figure 47. Results of VOC Analysis for Iso-Propanol.

It appears from the data, that the largest average concentrations of isopropanol are found downwind from the airport compared to either the upwind or background locations. The

DWS location is the highest. This area of the airport has other compounds that have been high relative to other locations that are not directly attributable to jet exhaust. This would indicate some activity at this location at the airport that is resulting in these compounds. The fact that the downwind locations are higher than the upwind or back ground indicate that airport activities are contributing isopropanol to the downwind environment.

6.93 n-Pentane

n-Pentane was a target compound for this investigation. It would be expected to occur as a byproduct of all gasoline or jet fuel combustion processes. It was found in the auto exhaust sample at 1000 ug/m3 and is present in jet exhaust at 471 ug/m3.

The average concentration of pentane in the background samples was found to be 2.6 ug/m3 with the range of values from 1.2 ug/m3 to 5.0 ug/m3. As with many of the other compounds in the background samples, the highest value was obtained on the first day when the wind was from the north, with significantly lower values obtained on the second and third days. Recalculating the average without the first day's contribution would yield a new average of 1.4 ug/m3.

The average concentration of pentane in the upwind sample location UPW was found to be 1.8 ug/m3 with the range of values from 0.6 ug/m3 to 3.0 ug/m3. This value is 28% higher than found in the background.

The average concentration of pentane in the downwind sample location DWN was found to be 14.8 ug/m3 with the range of values from 2 to 60 ug/m3. The average was again affected by the DWN #4 result. Removing this value from the average yields an average of 3.5 ug/m3 that is more in line with the other averages. This value is 94% higher than the upwind location and 150% higher than the background.

The average concentration of pentane in the downwind sample location DWS was found to be 2.8 ug/m3 with the range of values from 1.3 ug/m3 to 4 ug/m3. This value is 100% higher than the background and 20% lower than the DWN location.

The average concentration of pentane in the downwind grab samples at the DWS location was 3.8 ug/m3 with the range of values from 3 ug/m3 to 5 ug/m3. This value is 171% higher than the background and 111% higher than the upwind location.

Pentane is product of combustion and can be attributed to all combustion processes at the airport. The grab samples show elevated levels of pentane due in to the jet engine exhaust. The DWN location has a slightly higher average than the DWS location primarily due to the contribution of the autos at the auto rental facility. The level of pentane downwind of the airport is definitely higher than the upwind or background locations as a result of activities at the airport. n-Pentane was found in the annual average of Jardine location in Chicago at a concentration of 2.00 ug/M3. This value is

considerably lower than that found for the averages at any of the O'Hare downwind locations.

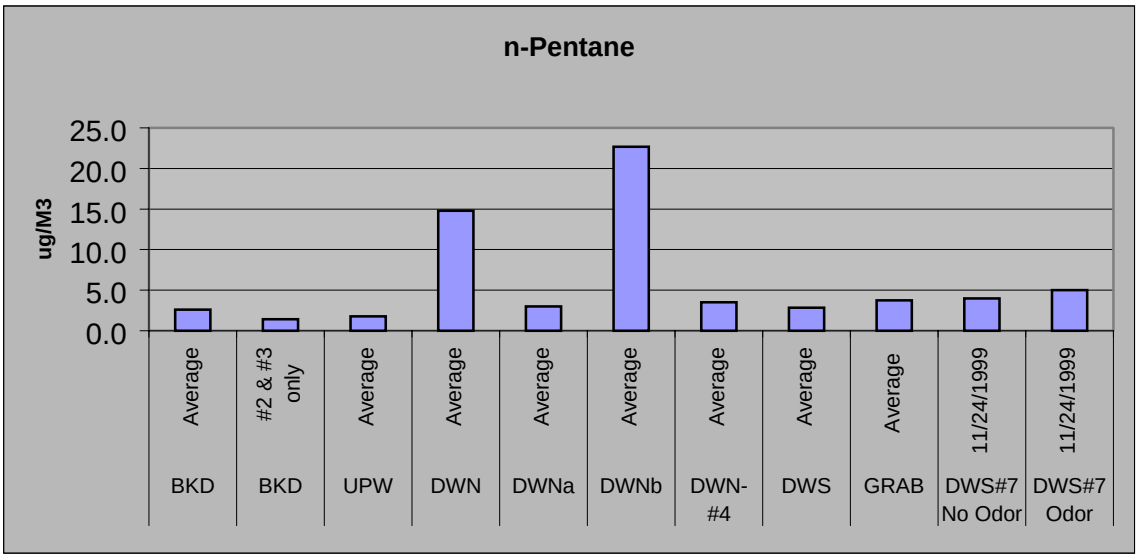


Figure 48. Results of VOC Analysis for n-Pentane.

7.36 Methylene Chloride

Methylene chloride is a solvent used in all types of industrial applications including degreasing and paint removal. It was not a target of this investigation. It was found in the analysis of the auto exhaust at a concentration of 120 ug/m3.

The average concentration of Methylene chloride in the background was 0.4 ug/m3 with the range of concentration from 0.3 ug/m3 to 0.6 ug/m3. As with some of the other compounds in the background, the highest concentration was found on the first day with the subsequent samples have lower amounts. Recalculating the average without the first day's concentration included would yield a new average of 0.4 ug/m3.

The average concentration of methylene chloride in the upwind sample was 1.2 ug/m3 with the range from 0.97 ug/m3 to 1.6 ug/m3. This is 300% higher on the average and is what would be expected in moving from a rural to an urban location.

The average concentration of methylene chloride in the downwind location DWN was found to be 1.2 ug/m3 with the range of values from 0.83 ug/m3 to 2 ug/m3. This is the same value as found in the upwind location.

The average concentration of methylene chloride in the downwind location DWS was found to be 1.3 ug/m3 with the range of values from 0.5 ug/m3 to 1.5 ug/m3. This also is not much different than the other urban locations.

The average concentration of methylene chloride in the downwind DWS grab samples was found to be 4.4 ug/m3 with the range of values from 0.98 ug/m3 to 12 ug/m3. This was rather surprising since this compound was not expected to be associated with jet exhaust. Three of the grab samples had concentrations that were comparable of the other locations. Removing the high value would yield an average of 1.8 ug/m3. This average is still higher than the other averages and could be attributed to the use of methylene chloride for parts cleaning and other maintenance activities at the airport.

The sample in which the high value of 12 ug/m3 was found, was in the grab sample that was taken at the fence line near location DWS when there were 10-15 planes lined up waiting for clearance to use runway 27L and the presence of a distinct odor was detected by the sampler during the duration of the sampling (about 15 seconds). Since this was such a short duration sample, it would be interesting to learn what activity at O'Hare using methylene chloride could have produced such a high concentration or maybe it is a by product of some jet idling activity. This remains to be further investigated and verified.

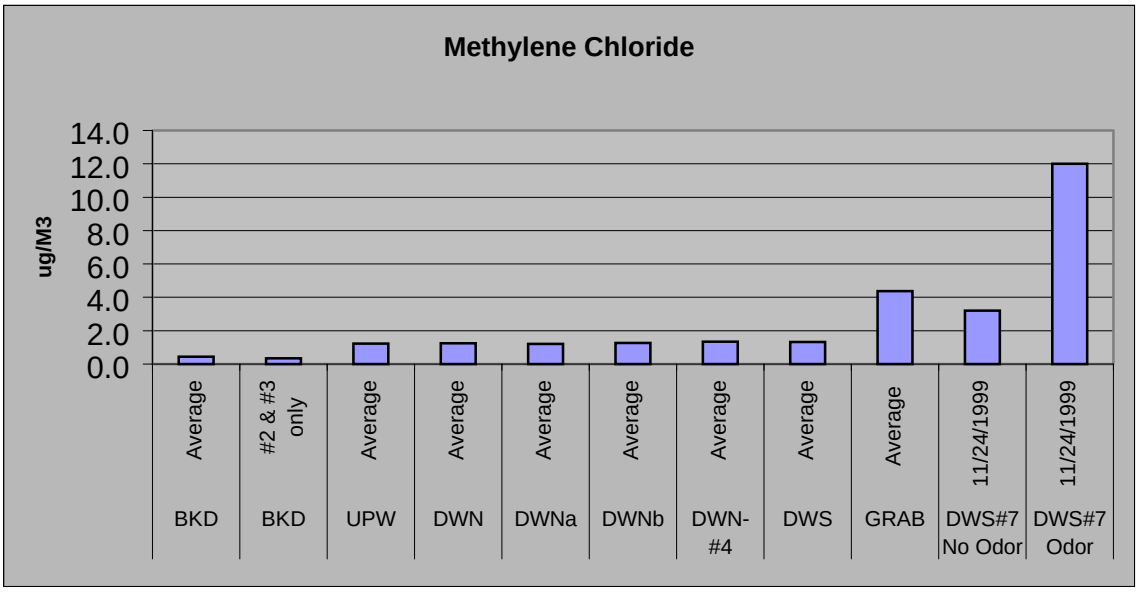


Figure 49. Results of VOC Analysis for Methylene Chloride.

7.40 C5H10 Alkene

This compound was not specifically identified, but compounds of this type were a target of this investigation.

The average of this compound in the background was zero. It was not detected.

Similarly, the average for this compound in the upwind location UPW was 0.1 ug/m3 as a result of this compound being found in only one of the upwind samples.

The average for this compound in the downwind location DWN was found to be 1.4 ug/m3 with values that range from 0.5 ug/m3 to 4.0 ug/m3. The sample DWN #4 was the sample with the high concentration of this alkene compound. The average without this sample would be 0.5 ug/m3. 500% higher than in the upwind location.

The average for this compound in the downwind location DWS was found to be 0.6 ug/m3 with the range of values from 0.5 ug/m3 to 0.8 ug/m3. This average value is slightly higher than the value at the DWN location with the anomalously high value removed from the average.

The average for this compound in the downwind grab samples was 1.2 ug/m3 with the range of values from 0.3 ug/m3 to 2 ug/m3.

This data clearly associates this compound with the combustion products of the jet engines and may be one of the compounds responsible for the distinct odor of this process. The compound was nonexistent in the background and only very slightly present in the upwind location. Other than the one anomalously high value obtained in the sample DWN#4, the downwind locations both have comparable averages of 0.5 and 0.6 ug/m3 respectively which is 500% and 600% higher than upwind. The two grab samples taken at the DWS location show a value of 0.3 ug/m3 in the sample that was taken when no odor was present, but planes were in the cue to take off on runway 27L. This value is fully 300% higher than for the upwind location. The grab sample taken while odor was present has a value of 2 ug/m3, which is 1900% higher than the upwind location and 300% higher than the average values of the eight-hour composites at the two downwind locations.

Clearly this compound is a component of jet engine exhaust and is probably a component of the odor characteristic of the airport.

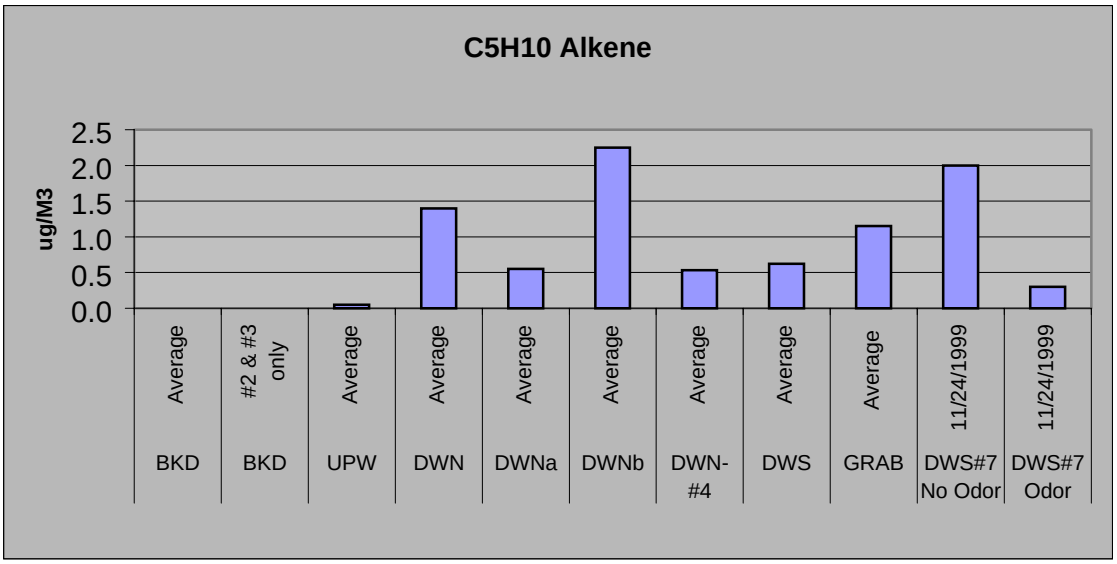


Figure 50. Results of VOC Analysis for C_5H_{10} Alkene.

7.64 Trichlorotrifluoroethane

Trichlorotrifluoroethane (TCTFE) is primarily a dry cleaning solvent. It was not a target compound of this study, and would not be expected to be a product of combustion of either gasoline or jet fuel.

The average concentration of TCTFE in the background samples was 0.6 ug/m3 with the range of values ranging from 0.5 ug/m3 to 0.7 ug/m3.

The average concentration of this compound in the upwind sample location UPW was 0.5 ug/m3 with the range of values from 0.3 ug/m3 to 1.3 ug/m3.

The average concentration of this compound in the downwind location DWN was 0.7 ug/m3 with the range of values 0.4 ug/m3 to 1.9 ug/m3. The average concentration of this compound in the downwind location DWS was 0.9 ug/m3 with the range of values from 0.3 ug/m3 to 2.5 ug/m3. Finally, the average for the downwind grab samples was 1.1 ug/m3 with the range of values from 0.76 ug/m3 to 1.5 ug/m3.

This compound appears to be similar to the explanation for Chloromethane. Samples run on one analytical instrument produced values that were of one average, and those run on a different instrument produced a second set of values.

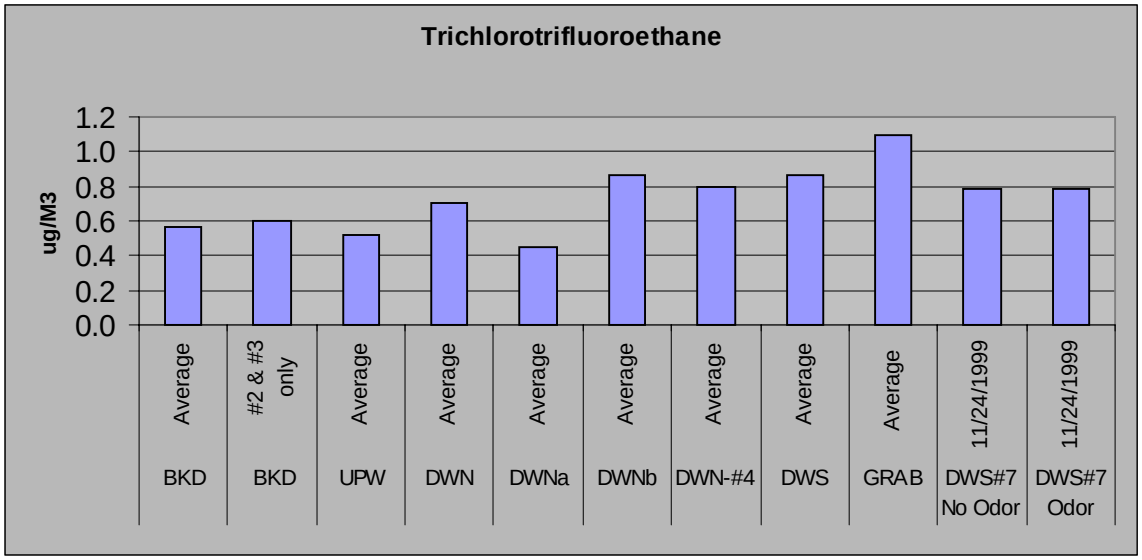


Figure 51. Results of VOC Analysis for Trichlorotrifluoroethane.

7.70 Carbon Disulfide

Carbon Disulfide was not a target compound in this investigation. This compound would not be expected as a combustion product of the burning of gasoline or jet fuel.

The average concentration of carbon disulfide in the background was 0.6 ug/m3 with the range from 0.5 ug/m3 to 0.7 ug/m3. There did not appear to be any relationship with the wind direction.

The average concentration of carbon disulfide in the upwind location UPW was 0.4 ug/m3 with the range of values from 0.2 ug/m3 to 0.5 ug/m3. These values are similar to those found in the background.

The average concentration of carbon disulfide in the downwind location DWN was 0.9 ug/m3 with the range of values from 0.2 ug/m3 to 2.3 ug/m3. The largest value was obtained on Test #2 at the DWN location. The other values are all in the range of the background and upwind samples.

The average concentration of carbon disulfide in the downwind location DWS was 1.2 ug/m3 with the range of values from 0.2 ug/m3 to 2.6 ug/m3. A value of 2.6 ug/m3 was obtained in Test #1 and a value of 1.7 ug/m3 was obtained in Test #2.

The detection of carbon disulfide at the DWN and DWS locations during the first two tests far in excess (400%) of the values obtained in other tests is not understood. The source is probably located at O'Hare, but it is probably not a result of normal operations.

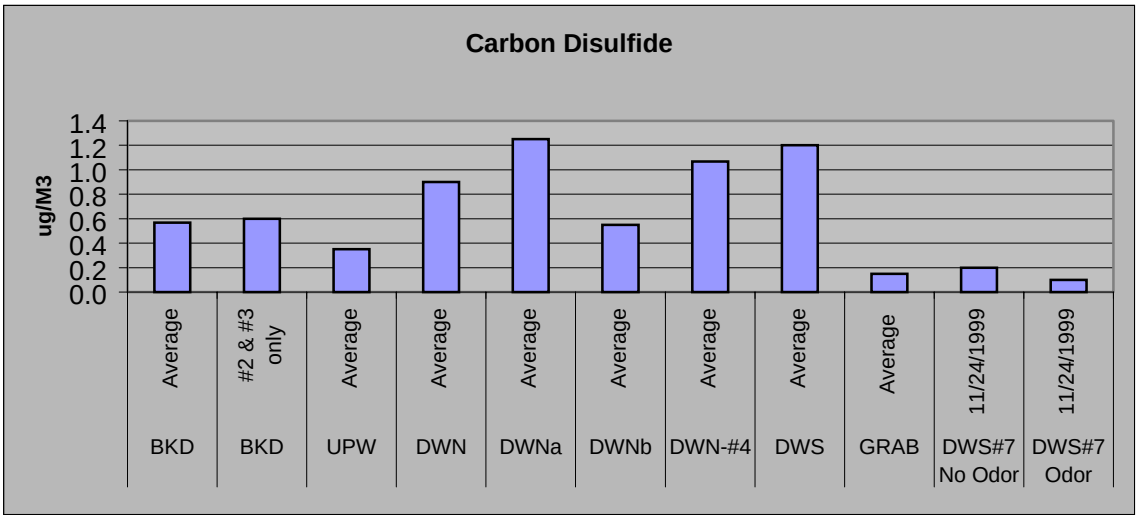


Figure 52. Results of VOC Analysis for Carbon Disulfide.

7.96 2-Methylpropanal (isobutyraldehyde)

2-Methylpropanal is an aldehyde that is not commonly used in industrial applications. It is used as an intermediate in the manufacture of rubber antioxidants. It was not a target compound for this investigation. This compound has a pungent odor and an odor detection threshold reported as low as 0.9 ppb (2.65 ug/m3). This compound was not found in the analysis of the auto exhaust.

The average concentration of isobutyraldehyde in the background was 0.3 ug/m3 with the range from 0.2 ug/m3 to 0.5 ug/m3. There was no obvious relationship to wind direction, though the highest level was obtained when the wind was out of the southwest.

The average concentration of this compound in the upwind location UPW was found to be 0.2 ug/m3 with the range of values from 0 ug/m3 to 0.2 ug/m3.

The average concentration of this compound in the downwind location DWN was found to be 0.6 ug/m3 with the range of values from 0.3 ug/m3 to 1 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 6.2 ug/m3 with the range of values found from 0.8 ug/m3 to 10 ug/m3.

The average concentration of this compound in the downwind grab samples was 0.3 ug/m3 with the range of values from 0.2ug/m3 to 0.3 ug/m3.

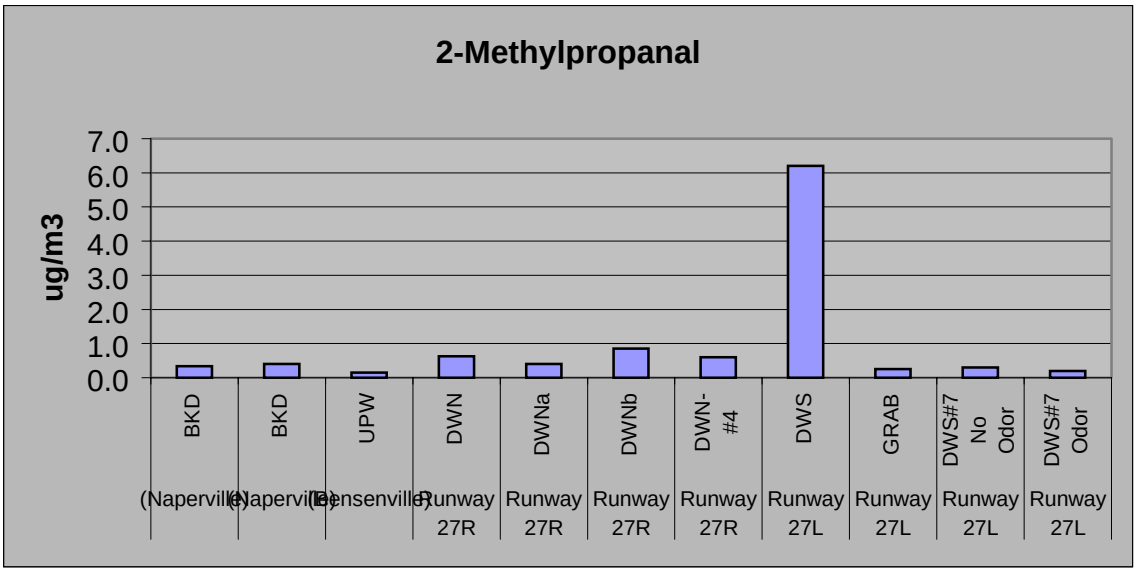


Figure 53. Results of VOC Analysis for 2-Methyl Propanal.

The fact that the concentration of this compound at the DWS location for eight-hour composites was significantly higher than at any other location and higher than from the grab samples indicates that this compound is probably not associated with the combustion of aviation fuel. It is definitely associated with some activity that is occurring at the southeast area of O'Hare airport. This investigator noticed a peculiar odor that was not associated with the typical O'Hare odor at two locations during the duration of this investigation. Both times this odor was quite pungent. The first location was just prior to the ramp that merges from the Bessie Coleman drive near the International Terminal to southbound Manheim road, and the second time was at the intersection of Manheim and Lawrence. While there is no evidence that this compound is related to the odor, it does indicate that there are other activities at O'Hare that are creating organic air pollutants in concentrations that exceed their odor detection thresholds and can be detected in surrounding communities.

8.29 Methacrolein (methacrylaldehyde)

Methacrolein is an aldehyde that is not commonly used in industrial applications. It is used in the manufacture of copolymers and resins. It was not a target compound for this investigation. This compound is a strong irritant. It was found in auto exhaust at an extremely low level.

The average concentration of this compound in the background was 0.2 ug/m3 with the range of values from 0.1 ug/m3 to 0.2 ug.m3. There does not appear to be any relationship with wind direction.

The average concentration of this compound in the upwind location UPW was 0.1 ug/m3 with all values found at this level.

The average concentration of this compound in the downwind location DWN was 0.6 ug/m3 with the range of values from 0.3 ug/m3 to 0.8 ug/m3. The average concentration of this compound in the downwind location DWS was 2.9 ug/m3 with the range of values from 0.6 ug/m3 to 5 ug/m3. The average concentration of this compound in the downwind grab samples was 0.3 ug/m3 with the range of values from 0.2 ug/m3 to 0.3 ug/m3.

This compound appears to be related to the previous compound isobutyraldehyde. It appears at significantly higher levels in the same samples that isobutyraldehyde does and is not found in the grab samples. The source of this compound is most likely the same source as the isobutyraldehyde.

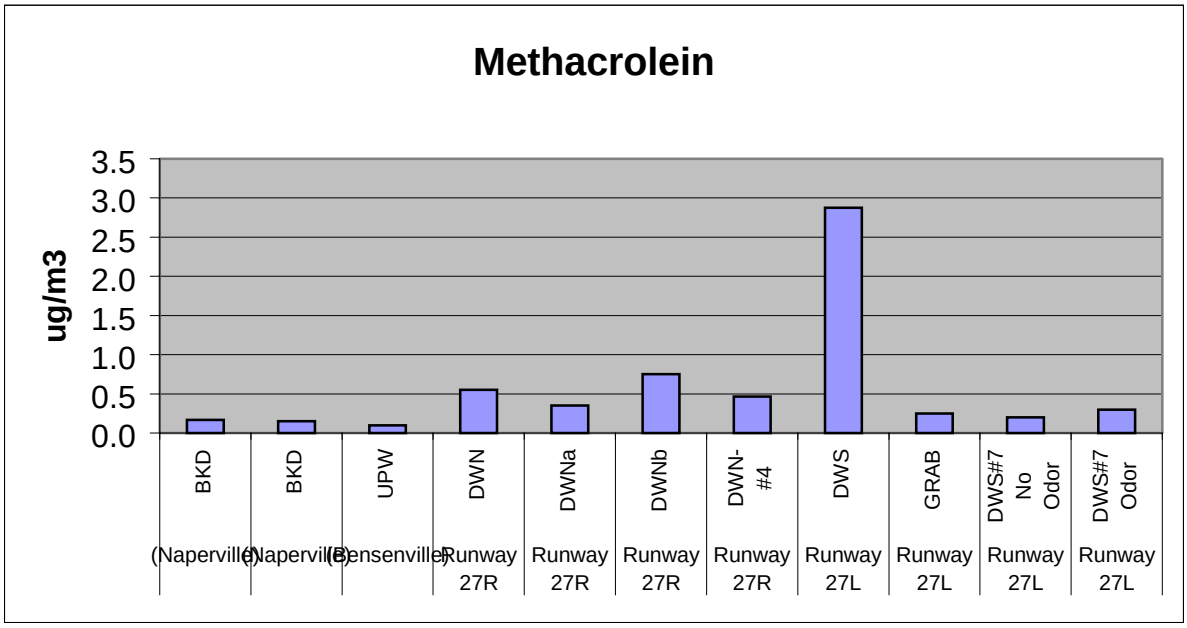


Figure 54. Results of VOC Analysis for Methacrolein.

8.56 Trimethylsilanol

This compound was not a target compound for this investigation. Little could be found in the literature about this compound. Since it is a silicon containing compound it may be related to silicone based adhesives or caulking material. It is probably not a product of combustion processes.

The average concentration of this compound in the background was 5.8 ug/m3 with the range of values from 1.5 ug/m3 to 10 ug/m3. The concentration increased from the first day until the last day indicating that it may be associated with activity more southerly from the background location.

The average concentration in the upwind location UPW was found to be 1.3 ug/m3 with the range of values from 0.4 ug/m3 to 4 ug/m3.

The average concentration in the downwind location DWN was found to be 0.3 ug/m3 with the range of values from 0.1 ug/m3 to 0.8 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 0.2 ug/m3 with the range of values from 0.1 ug/m3 to 0.3 ug/m3. The average concentration in the downwind grab samples was found to be 0.1 ug/m3 with all values found at that level.

This compound is clearly associated with some activity in the area of the background sampling location. Other compounds that will be discussed that are also silicon-containing compounds appeared in the background at significantly higher concentrations than in the urban areas sampled. These compounds may be associated with the used of adhesives and caulking materials in new home construction which was high in the area of the background, but very mush reduced in the urban areas sampled near O'Hare airport.

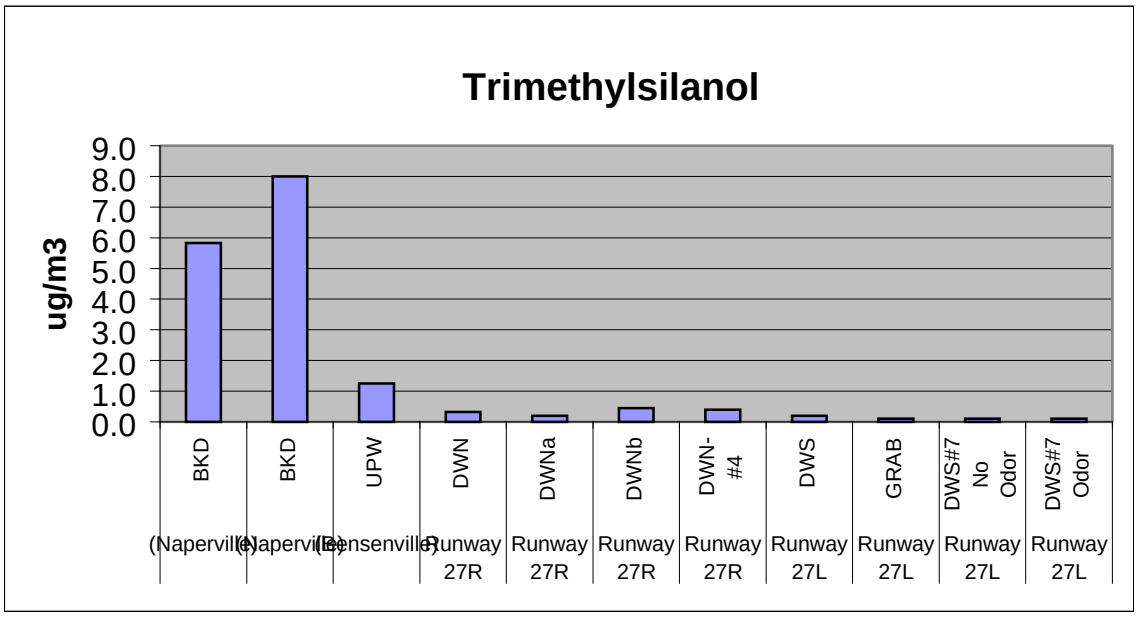


Figure 55. Results of VOC Analysis for Trimethylsilanol.

8.68 2,3-Dimethylbutane (Neohexane)

This compound was not specifically a target compound of this investigation, but should have been, as it is a component of high-octane motor and aviation fuels. It is also used as an intermediate in the manufacture of agricultural chemicals. It would be expected to be present either from spilled fuel, off-gassing during fuel tank filling, or as a component of the exhaust of incompletely combusted fuel. It was found in the auto exhaust sample at 600 ug/m3.

The average concentration of this compound in the background was found to be 0.8 ug/m3 with the range of values from 0.5 to 1.5 ug/m3. As with other background samples, the first days sampling produced significantly higher results with the wind out of the north carrying these compounds from the center of Naperville. Recalculating the average without the first day's concentration included would produce a new average of 0.5 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 0.4 ug/m3 with the range of values from 0.3 ug/m3 to 0.6 ug/m3. This value is similar to the value that would be the average of the background if the first test were not included.

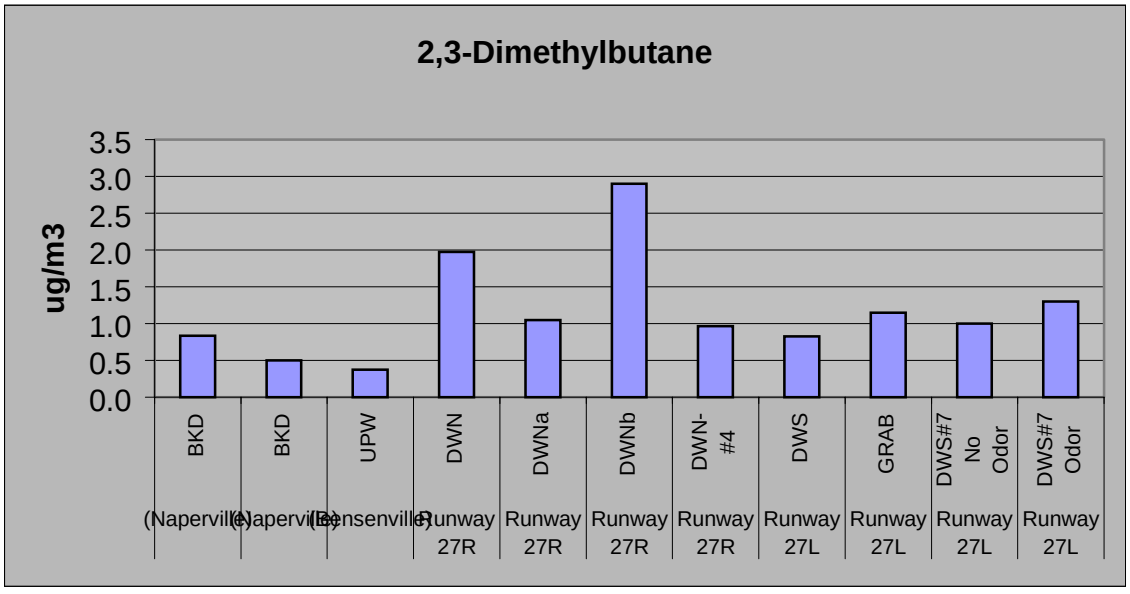


Figure 56. Results of VOC Analysis for 2,3-Dimethylbutane.

The average concentration of this compound in the downwind location DWN was found to be 2.0 ug/m3 with the range of values from 0.5 ug/m3 to 5 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 0.8 ug/m3 with the range of values from 0.3 ug/m3 to 1.3 ug/m3. The average concentration

of this compound in the downwind location grab samples was found to be 1.2 ug/m3 with the range of values from 1 ug/m3 to 1.3 ug/m3.

This compound was found in significantly higher concentrations in the downwind locations including the grab samples. The highest values were found in the DWN location, which was probably a result of the fueling operation at the rental car lot, while the concentrations at the other downwind locations were probably a result of spilled, or incompletely combusted aviation fuel. 2,3-Dimethylbutane was found in the annual average of Jardine location in Chicago at a concentration of 0.28 ug/M3. This value is considerably lower than that found for the averages at any of the O'Hare downwind locations.

8.77 2-Methylpentane

2-Methylpentane was not a target compound of this investigation. It is described as being used in organic synthesis and as a solvent. It was found in the sample of auto exhaust at a concentration of 1000 ug/m3.

The average concentration of this compound in the background was found to be 2.0 ug/m3 with the range of values from 0.8 ug/m3 to 4 ug/m3. As with other fuel and combustion related compounds, a significantly higher concentration was found on the first day of sampling indicating an origin in the downtown Naperville area, possibly gas stations. Recalculating the average produces a result of 1.0 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 1.0 ug/m3 with the range of values from 0 ug/m3 to 1.6 ug/m3. This average value is similar to the average value in the background if the first days' testing is removed from the average.

The average concentration of this compound in the downwind location DWN was found to be 4.0 ug/m3 with the range of values from 1.0 ug/m3 to 10.0 ug/m3. The value of 10.0 ug/m3 was obtained in sample DWN #4, if this value is removed from the average, the new average would be 2.0 ug/m3 which is 100% higher than upwind or the background.

The average concentration of this compound in the downwind location DWS was found to be 2.0 ug/m3 with the range of values between 0.9 ug/m3 and 3 ug/m3. This average is also 100% higher than the upwind or background samples. The average concentration of this compound in the downwind grab samples was 3.5 ug/m3 with the range of values from 3.0 ug/m3 to 4.0 ug/m3. This average is 250% higher than the upwind or background locations.

Ignoring the anomalous result for DWN #4 which has been discussed and attributed to some activity at the auto rental lots, the concentration of this compound downwind of the

airport is significantly higher than in the background or the upwind location and can be attributed to airport operations. 2-Methylpentane was found in the annual average of Jardine location in Chicago at a concentration of 1.41 ug/M3. This value is considerably lower than that found for the averages at any of the O'Hare downwind locations.

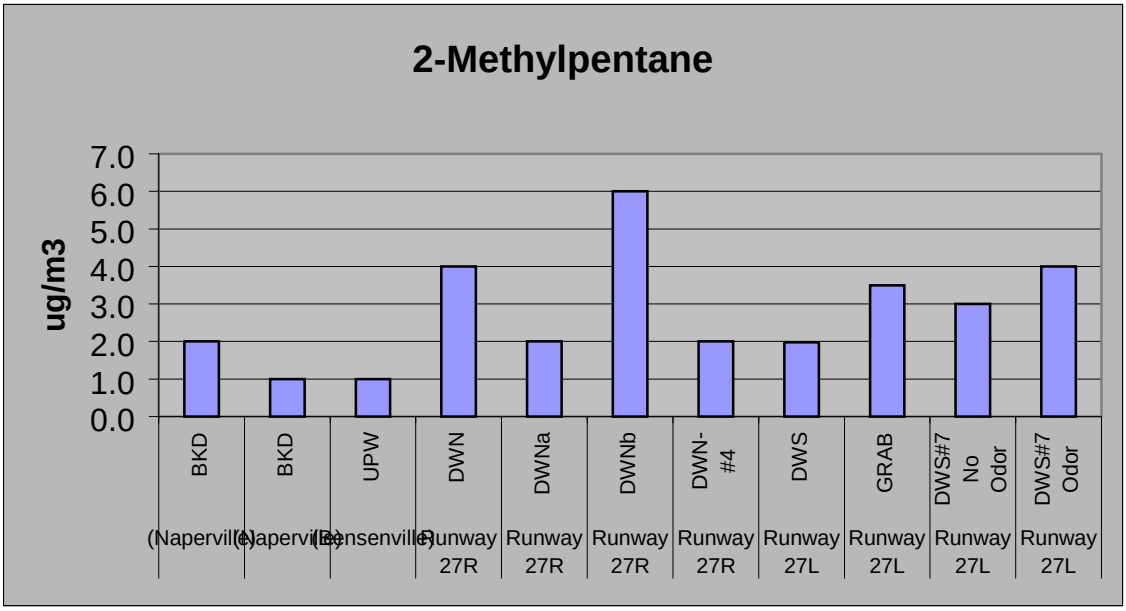


Figure 57. Results of VOC Analysis for 2-Methylpentane.

8.88 Butanal (butyraldehyde)

Butanal is an aldehyde compound that was a target compound of this investigation. It is reported in jet exhaust at a concentration of 2325 ug/m3. This compound was present in the analysis of the auto exhaust at an insignificant concentration. The compound has a characteristic aldehyde odor and a detection odor threshold of 9 ppb (26.49 ug/m3). The industrial use of this compound is as a plasticizer, rubber accelerator or as a solvent.

The average concentration of this compound in the background location was 0.7 ug/m3 with the range of values from 0.2 ug/m3 to 1.1 ug/m3. Unlike the combustion related compounds, the highest concentration for this compound was associated with the southwest wind direction.

The average concentration of this compound in the upwind location UPW was found to be 0.7 ug/m3 with the range of values from 0 ug/m3 to 2.0 ug/m3. Which is comparable to the background.

The average concentration of this compound in the downwind location DWN was found to be 2.8 ug/m3 with the range of values from 0.4 ug/m3 to 7 ug/m3. This is a 300%

increase over the upwind or background locations. The average concentration of this compound in the downwind location DWS was found to be 1.8 ug/m3 with the range of values from 0.9 ug/m3 to 3 ug/m3. This value is 157% higher than in the background or upwind locations, however, it is 35% lower than in the DWN location. The average concentration of this compound in the downwind grab samples was 2.2 ug/m3 with the range of values from 0.4 ug/m3 to 4 ug/m3. This value is slightly higher than the DWS location and slightly lower than the DWN location. This value is 214% higher than the upwind or background locations.

The highest concentrations of this compound were found in the downwind direction. It was found at significantly higher concentrations in the downwind grab sample associated with the odor of the airport, though the concentration is significantly below the odor detection threshold. The average concentrations of this compound were significantly higher in the downwind location than in either the upwind or background location. This compound is associated with the airport operations and specifically with the exhaust of the aircraft.

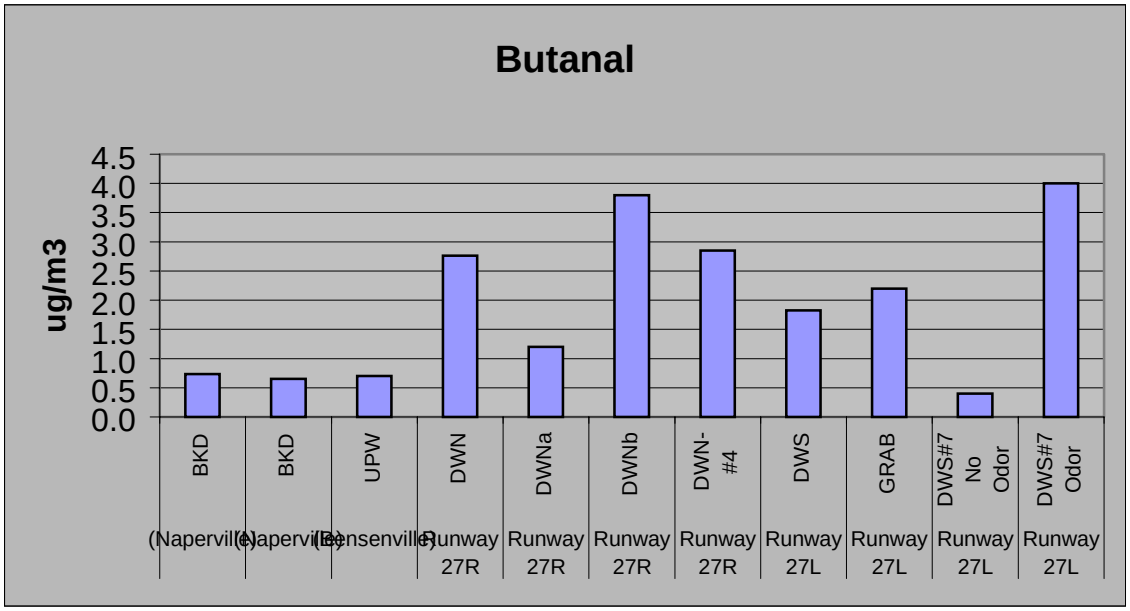


Figure 58. Results of VOC Analysis for Butanal.

9.04 2-Butanone (methyl ethyl ketone, MEK)

2-Butanone is a ketone that is used extensively in paints and coatings, paint removers, cements and other adhesives and cleaning fluids. This compound was not a target of this investigation.

The average concentration of this compound in the background was found to be 1.5 ug/m3 with the range of values from 0.5 ug/m3 to 2.6 ug/m3. As with other compounds at this location, the highest value was obtained on the first day of sampling with the concentration on subsequent days trending to lower values indicating an association with the northerly wind direction and the urban community of Naperville. Calculating a new average without the first day's concentration would yield an average of 1.0 ug/m3.

The average concentration of this compound in the upwind UPW location was found to be 1.4 ug/m3 with the range of values from 0.5 ug/m3 to 2.7 ug/m3. These values are similar to those found in the background.

The average concentration of this compound in the downwind location DWN was found to be 4.5 ug/m3 with the range of values from 1.1 ug/m3 to 7.2 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 4.2 ug/m3 with the range of values from 2.1 ug/m3 to 10 ug/m3. The average concentration of this compound in the downwind grab samples was 1.8 ug/m3 with the range of values from 1.2 ug/m3 to 1.8 ug/m3.

These results demonstrate that MEK is associated with airport operations since the values downwind are significantly higher than either the upwind or background locations. Also, since the values in the grab samples were lower, but still significant, the compound is probably not associated with the jet exhaust or other combustion processes, but is associated with aircraft or building maintenance, that is painting or parts cleaning.

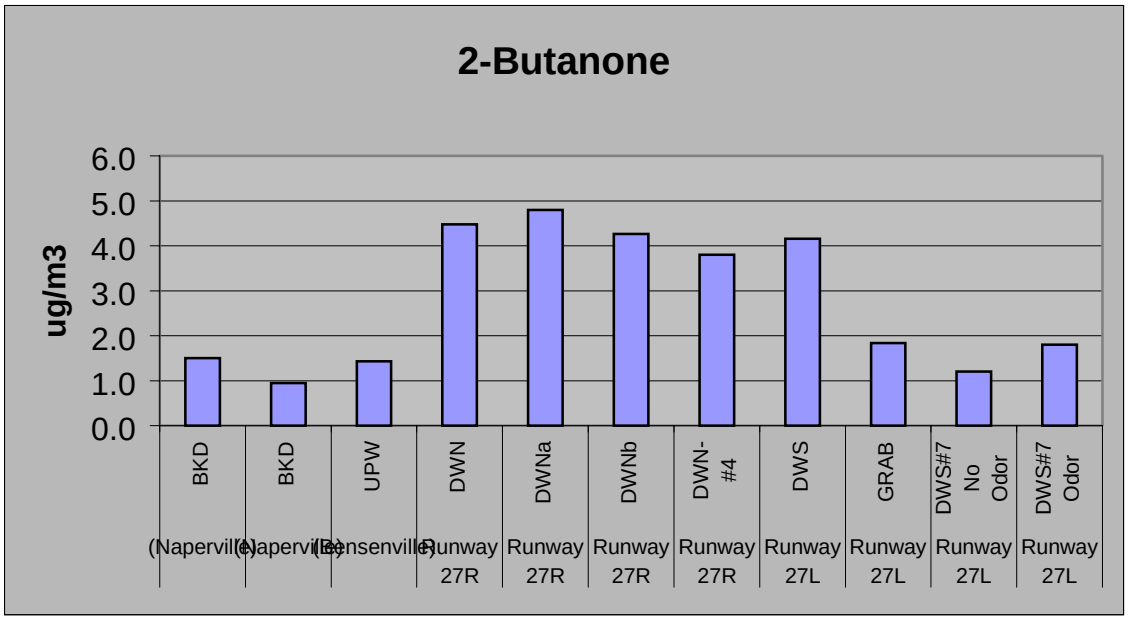


Figure 59. Results of VOC Analysis for 2-Butanone.

9.22 3-Methylpentane

3-Methylpentane is a branched hydrocarbon not unlike 2-methylpentane discussed above. 3-Methylpentane was not a target compound of this investigation. It is described as being used in organic synthesis and as a solvent. It was found to be present in auto exhaust at a concentration of 600 ug/m3.

The average concentration of this compound in the background location was found to be 1.2 ug/m3 with the range of values from 0.4 ug/m3 to 2.6 ug/m3. As with most other compounds identified in the background, the highest concentration was found in the first test day, which indicates that this concentration is associated with activities that are occurring in downtown Naperville. Removing this concentration from the average results in an average of 0.6 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 0.6 ug/m3 with the range of values from 0 ug/m3 to 1 ug/m3. This value is similar to that which was found in the background with the high value removed from the average.

The average concentration of this compound in the downwind location DWN was found to be 2.9 ug/m3 with the range of values from 1.2 ug/m3 to 7.0 ug/m3. The highest value was associated with DWN #4 and with its removal the average becomes 1.5 ug/m3, which is 150% higher than found in the upwind or background locations. The average

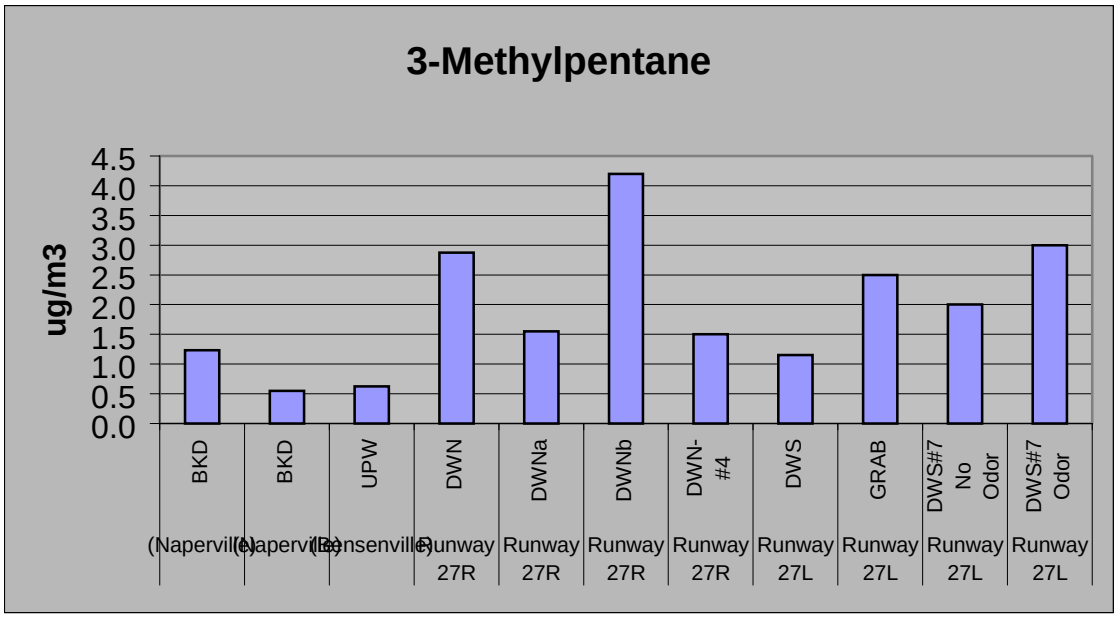


Figure 60. Results of VOC Analysis for 3-Methylpentane.

concentration of this compound in the downwind location DWS was found to be 1.2

ug/m3 with the range of values from 0.7 ug/m3 to 1.6 ug/m3. Which is approximately the same as at the DWN location with the DWN #4 value removed from the average. The average of the downwind grab samples was found to be 2.5 ug/m3 with the range of values from 2.0 ug/m3 to 3.0 ug/m3.

The highest values except for the value at DWN #4 was found in the grab samples. The average concentrations found in the downwind samples were significantly higher than in either the background or the upwind location. This would indicate that this compound is associated with jet exhaust and is being emitted by these operations into communities surrounding the airport. 3-Methylpentane was found in the annual average of Jardine location in Chicago at a concentration of 1.16 ug/M3. This value is considerably lower than that found for the averages at any of the O'Hare downwind locations.

9.60 2-Methylfuran

2-Methylfuran was not a target compound of this investigation. The compound has an ether-like odor and is used industrially as a chemical intermediate. It was not found in the analysis of auto exhaust.

This compound was not found to be present in any of the three samples taken in the background location.

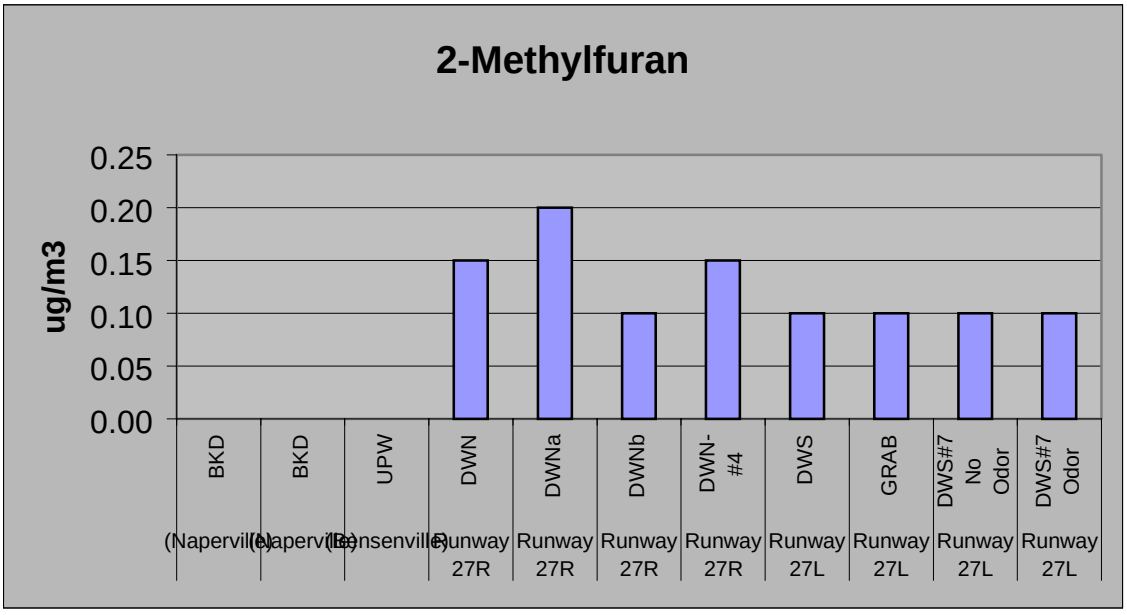


Figure 61. Results of VOC Analysis for 2-Methylfuran.

The average concentration of this compound in the upwind location was similarly found to be undetected.

The average concentration for this compound at the DWN location was found to be 0.15 ug/m3 with the range of values from 0.1 ug/m3 to 0.2 ug.m3. The higher of the two concentrations found was when the location was east of the access road to O'Hare from Manheim Road. The lower concentration was found nearer the airport.

The average concentration for this compound at the DWS locations including both grab samples was found to be 0.1 ug/m3. This is less than that found at the DWN location .

The conclusion is that this compound is associated with activity at O'Hare airport. The source of this compound is unknown.

9.78 n-Hexane

Hexane co-elutes with one of the internal standards that are added in order to quantify the data. It was not quantified or identified in many of the samples, and there is no way without reinvestigating the data that values can be assigned to this compound. Hexane would be expected to be a component of auto or jet exhaust and was found in the analysis of the auto exhaust at a concentration of 300 ug/m3 and was reported in jet exhaust at a concentration of 1,863 ug/m3.

10.34 2-Methyl-1-propanol (isobutyl alcohol)

Isobutyl alcohol was not a target compound of this investigation. It is an alcohol compound that is used extensively in paints and lacquers and is used as a substitute for n-butanol that will be discussed below. It was not found in the analysis of the auto exhaust.

The average concentration of this compound in the background was found to be 0.3 ug/m3 with the range of values from 0.1 ug/m3 to 0.8 ug/m3. As with most of the compounds found in the background, the highest value was found on the first day of sampling. The average without this value would be 0.1 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 0.1 ug/m3 with the range of values from 0 ug/m3 to 0.1 ug/m3, which is the same as was found in the background without the affect of the first day's sample.

The average concentration of this compound in the downwind location DWN was found to be 0.3 ug/m3 with the range of values from 0.1 ug/m3 to 0.4 ug/m3. This is a 200% increase over the background and upwind locations. The average concentration of this compound in the downwind location DWS was found to be 1.5 ug/m3 with the range of values from 0.3 ug/m3 to 4.0 ug/m3. This is a 1400% increase over the background or upwind locations. The average concentration of this compound in the downwind grab samples was found to be 0.2 ug/m3 with the range of values from 0.1 ug/m3 to 0.2 ug/m3. Which is 100% higher than the background or upwind locations.

This compound shows increased concentrations downwind from the airport that is significantly higher at the DWS location than for the other locations. Since this compound was found in the grab samples at concentrations comparable to the background, the origin of this compound is probably not the jet exhaust or auto exhaust but is attributable to some activity that occurs sporadically in the southeast area of the airport. The activity does not occur everyday as the highest values were found in Test # 1 and Test #4, with background levels being found in Test #2 and Test #3.

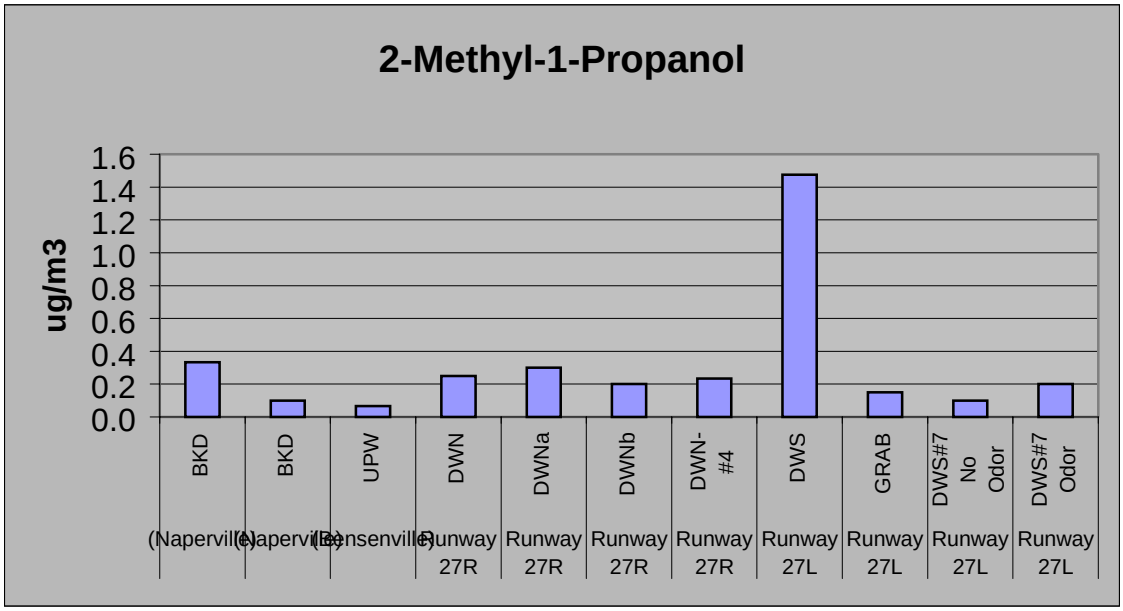


Figure 62. Results of VOC Analysis for 2-Methyl-1-Propanol.

10.82 Methylcyclopentane

Methylcyclopentane is a cyclic hydrocarbon that was not a target compound for this investigation. It was found in the analysis of the auto exhaust at approximately 300 ug/m3. The compound is listed as being a potential irritant and narcotic and is used in organic synthesis and as an extractive solvent. It would not be expected to occur downwind from the airport except as a result of airport operations.

The average concentration of this compound in the background was found to be 1.2 ug/m3 with the range of values from 0.3 ug/m3 to 2.7 ug/m3. As with most of the compounds identified in the background, the highest value was found on the first day of testing and is associated with the urban activities in Naperville. Removing the first days result from the average the new average becomes 0.4 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 0.6 ug/m3 with the range of values from 0 ug/m3 to 1.2 ug/m3. This is the same as that found in the background.

The average concentration of this compound in the downwind location DWN was found to be 1.8 ug/m3 with the range of values from 0.9 ug/m3 to 4.0 ug/m3. The highest value was found in sample DWN #4. Removing this from the average results in an average of 1.0 ug/m3. This average is 67% higher than the upwind location and 150% higher than the background The average of this compound in the downwind location DWS was found to be 1.0 ug/m3 which is the same value as found at the DWN location. Both of these values are about 67% and 150% higher respectively than the upwind or the background locations. The average value of this compound found in the downwind grab samples was 1.5 ug/m3 with the range of values from 1.2 ug/m3 to 1.7 ug/m3. The average value in the grab samples is 50% higher than in the downwind composite samples, 150% higher than the upwind and 275% higher than the background samples. This compound is attributable to airport operations mainly the idling of jet aircraft. Methylcyclopentane was found in the annual average of Jardine location in Chicago at a concentration of 1.47 ug/M3. This value is approximately the same as that found for the averages at the O'Hare downwind locations.

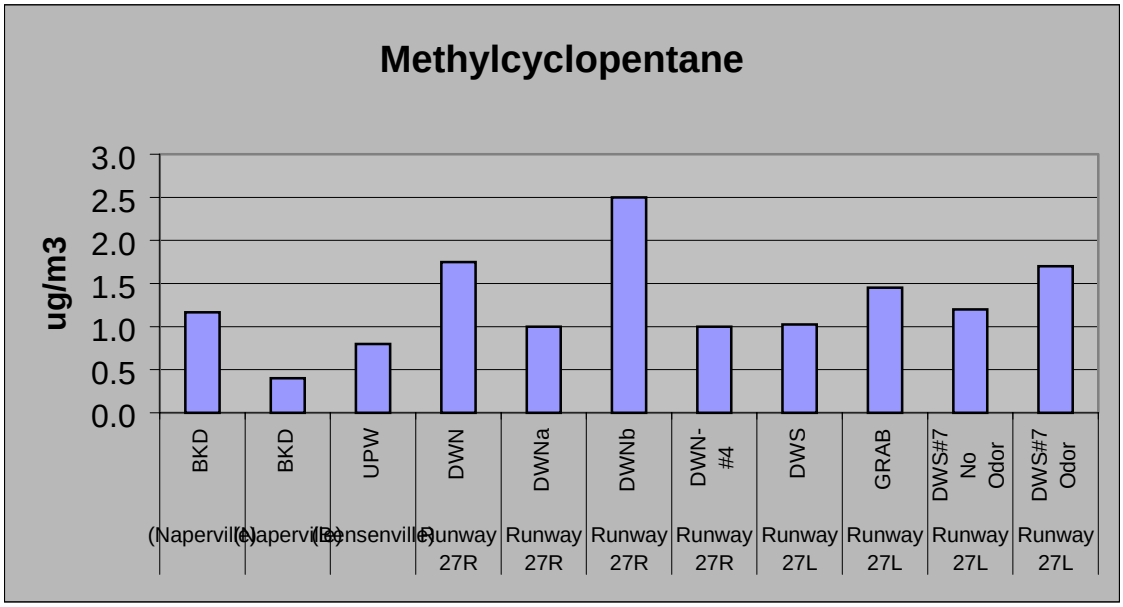


Figure 63. Results of VOC Analysis for Methylcyclopentane.

10.87 2,4-Dimethylpentane

This compound was found to be present as a major component of the auto exhaust that was analyzed for this investigation at a concentration of 700 ug/m3. It was not originally a target compound as it was not reported as a component of jet exhaust in the literature. It does not have any commercial uses. Therefore its presence in this investigation is strictly as a combustion product of fuel.

The average concentration of this compound in the background was found to be 0.4 ug/m3 with the range of values from 0.1 ugm3 to 1.0 ug/m3. As with many other compounds identified in the background, the highest concentration was found on the first day of sampling and is attributed to activity north of the background location. Recalculating the average omitting the first day's contribution results in an average of 0.2 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 0.3 ug/m3 with the range of values from 0.2 ug/m3 to 0.4 ug/m3. This value is 50% higher than the average for the background.

The average concentration of this compound in the downwind location DWN was found to be 0.9 ug/m3 with the range of values from 0.5 ut/m3 to 1.7 ug/m3. The highest value was found in the DWN #4 sample in which some activity attributed to the auto rental facility resulted in higher than normal values for auto exhaust related compounds. The average omitting this value would be 0.6 ug/m3 which is 100% higher than the upwind location and 300% higher than the background.

The average concentration of this compound in the downwind location DWS was found to be 0.5 ug/m3 with the range of values from 0.3 ug/m3 to 0.9 ug/m3. This value is comparable to that found in the DWN location and about 67% higher than the upwind location.

The average concentration of this compound in the downwind grab samples was found to be 0.8 ug/m3 with the range of values from 0.7 ug/m3 to 0.9 ug/m3. This average is about 50% higher than either the DWN or DWS locations, 167% higher than the upwind location and 300% higher than the background.

The data appears to indicate that this compound is a component of jet exhaust and that the activities at the airport are contributing to the increase of this compound downwind of the airport. 2,4-Dimethylpentane was found in the annual average of Jardine location in Chicago at a concentration of 0.30 ug/M3. This value is considerably lower than that found for the averages at any of the O'Hare downwind locations.

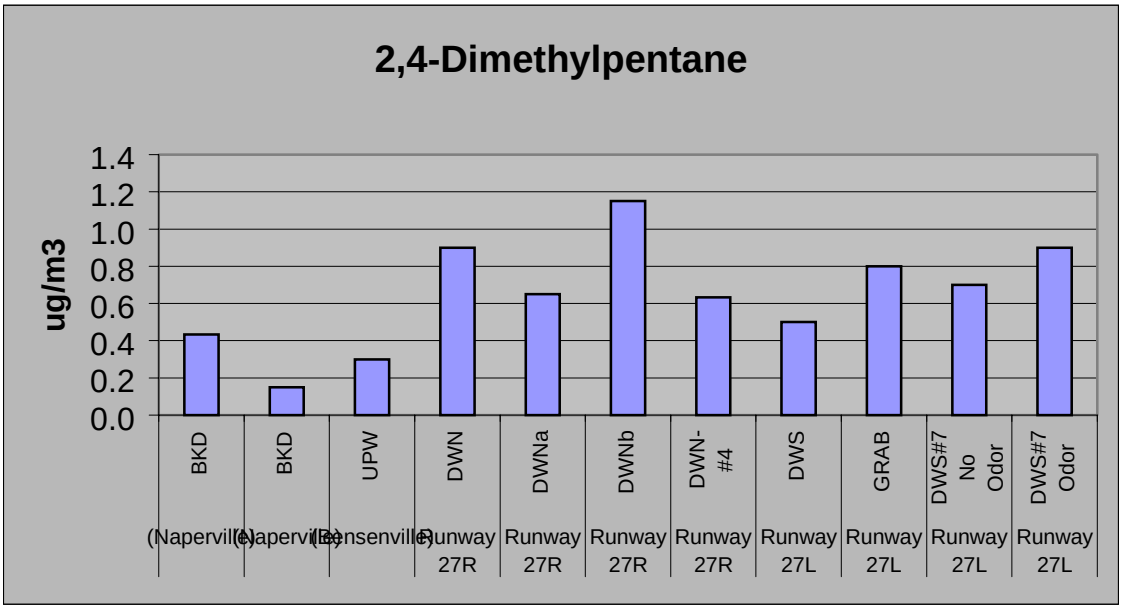


Figure 64. Results of VOC Analysis for 2,4-Dimethylpentane.

11.58 n-Butanol (n-butyl alcohol)

Butanol is an alcohol that was not a target compound for this investigation. This compound is used in hydraulic fluids and in detergent formulations.

The average concentration of this compound in the background was found to be 0.4 ug/m3 with the range of values from 0.2 ug/m3 to 0.7 ug/m3. As with other compounds in the background, the highest concentration was found in the sample from the first day and is associated with urban activities in the down town Naperville area. The average without the first day's concentration included would be 0.3 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 0.3 ug/m3 with the range of values from 0.2 ug/m3 to 0.7 ug/m3. The average value is comparable to that in the background.

The average concentration of this compound in the downwind location DWN was found to be 1.1 ug/m3 with the range of values from 0.5 ug/m3 to 3.0 ug/m3. All of the values were at 0.5 ug/m3 except for one value in sample DWN #2. This value was significantly higher than the average of the other three samples of 0.5 ug/m3, which was slightly higher than the background and the upwind locations. The average concentration of this compound in the downwind location DWS was found to be 3.2 ug/m3 with the range of values from 1.2 ug/m3 to 6.0 ug/m3. The values at the DWS location are significantly higher than the values (except for the one value DWN #2) at the DWN location, the

upwind location and the background location. The average concentration of this compound in the downwind grab samples was found to be 0.2 ug/m3, which was comparable to the background.

This compound was found at a significantly elevated level in the southeast area of the airport. One significant value was found in the DWN #2 location. This compound is attributable to activities at the airport but does not appear to be related to jet engine exhaust.

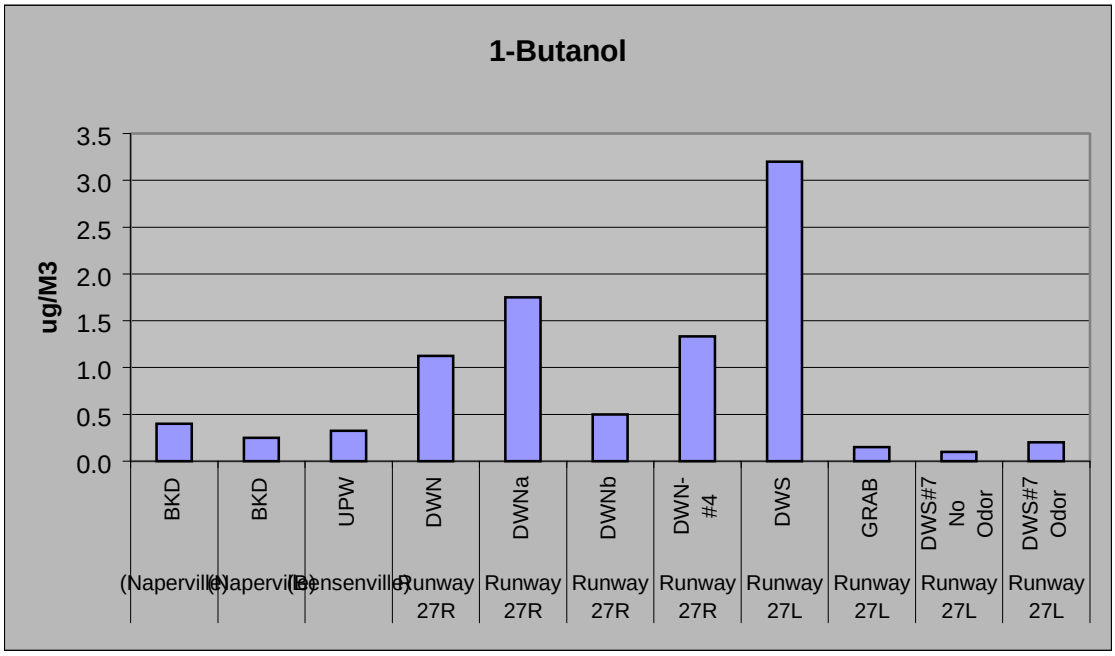


Figure 65. Results of VOC Analysis for 1-Butanol.

11.73 Benzene

Benzene, which is a suspected carcinogen, is a cyclic aromatic hydrocarbon. It occurs and is frequently identified in urban environments and is the result of combustion processes on fuels, but is most closely associated with automobile and diesel exhaust. This compound was a target compound of this investigation. It was reported to be present in jet exhaust at 3,954 ug/m3 and in auto exhaust at 2,800 ug/m3.

The average concentration of benzene in the background location was found to be 1.0 ug/m3 with the range of values from 0.5 ug/m3 to 1.6 ug/m3. As with most of the compounds that were identified in the background, the highest value was obtained in the first day's testing and is associated with the urban activity of Naperville. The average not including the first day's result would be 0.8 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 0.8 ug/m3 with the range of values from 0.2 ug/m3 to 1.2 ug/m3. This value is identical to the value found in the background.

The average concentration of this compound in the downwind location DWN was found to be 1.9 ug/m3 with the range of values from 0.91 ug/m3 to 3.5 ug/m3. The highest concentration of this compound was found in DWN #4 which was associated with an unusual event that probably occurred in the auto rental lot during this sampling period. Removing this value from the average results in a new average of 1.5 ug/m3, which is 88% higher than either the background or the upwind locations. The average value of this compound in the downwind direction DWS was found to be 5.2 ug/m3 with values that ranged from 1.5 ug/m3 to 11 ug/m3. This average is 550% higher than the upwind or background locations and 246% higher than the DWN location. The average value of this compound from the grab samples was found to be 2.2 ug/m3 with a value of 1.9 found in the DWS #7 no odor sample and with 3.4 ug/m3 found in the DWS #7 odor sample.

The highest concentrations of this compound were found in the downwind samples. It appears from this data, that a ubiquitous compound like benzene, which is a component of all types of combustion processes, can be detected in excess concentrations and attributed to the activities of O'Hare airport. Since higher values were obtained for the eight-hour composites than in the grab samples, some of the benzene results from jet exhaust, while the rest results from automobile and truck exhaust. Benzene was found in the annual average of Jardine location in Chicago at a concentration of 1.18 ug/M3. This

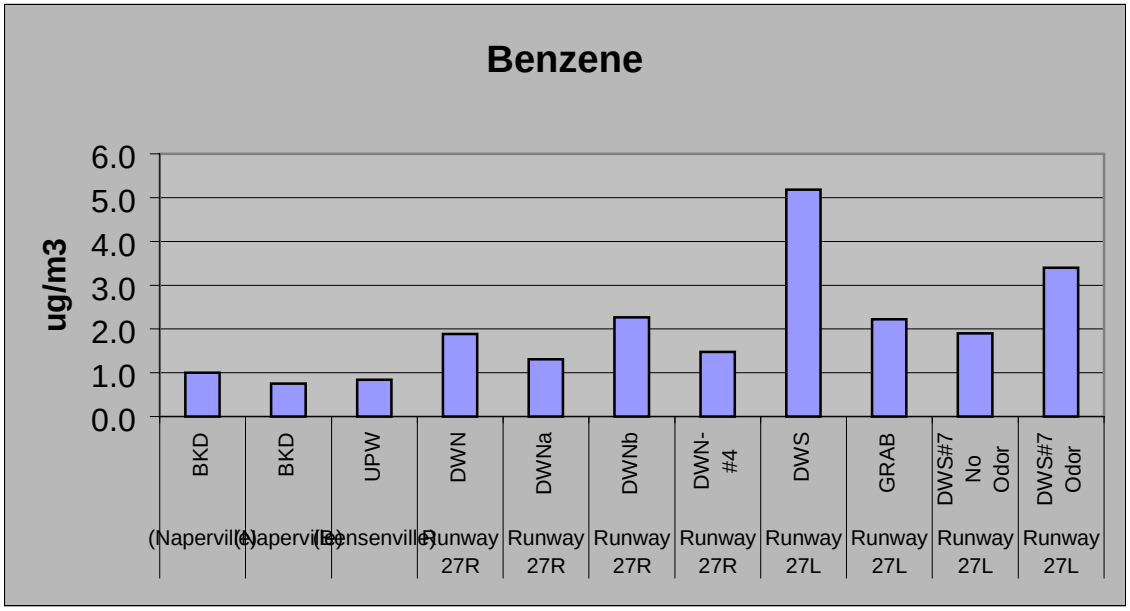


Figure 66. Results of VOC Analysis for Benzene.

value is considerably lower than that found for the averages at any of the O'Hare downwind locations.

11.92 Carbon Tetrachloride.

Carbon tetrachloride is a chlorinated hydrocarbon that was not a target compound in this investigation and would not be expected to be a component of the exhaust of a combustion process. Carbon tetrachloride is a carcinogen that is used as refrigerant, in metal degreasing and as an agricultural fumigant. It was found at an insignificant concentration in the analysis of the auto exhaust sample.

The average concentration of this compound in the background was found to be 0.2 ug/m3 with all values being at that level.

The average concentration of this compound in the upwind location UPW was found to be 0.3 ug/m3 with the range of values from 0.1 ug/m3 to 0.84 ug/m3.

The average concentration of this compound in the downwind location DWN was found to be 0.4 ug/m3 with the range of values from 0.1 ug/m3 to 1.1 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 0.2 ug/m3 with the range of values from 0.1 ug/m3 to 0.2 ug/m3. The average concentration of the downwind grab sample was found to be 0.5 ug/m3 with the range of values from 0.3 to 0.77 ug/m3.

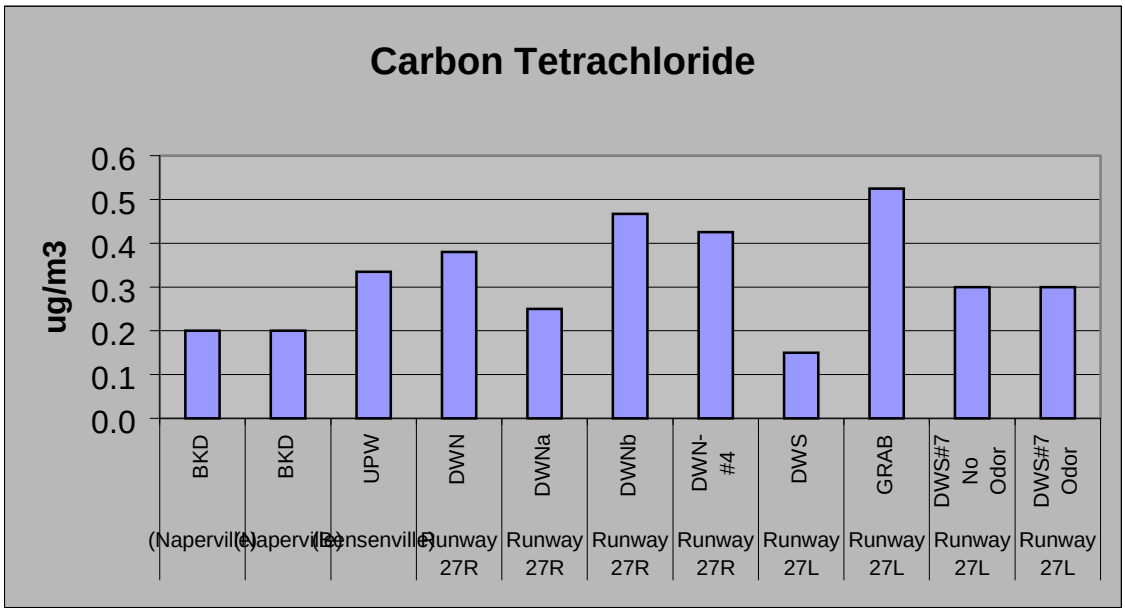


Figure 67. Results of VOC Analysis for Carbon Tetrachloride.

The data for this compound indicate that it is a component of all urban atmospheres and there is a slight increase in the concentrations that were detected downwind of the airport as a result of activities at the airport, probably from auto and truck exhaust.

12.28 2-Methylhexane

This compound was not a target compound for this investigation as it was not reported as a component of jet exhaust in the literature. It was not found as a major component of auto exhaust. It is used industrially in compound synthesis. Its presence in samples from this investigation can only be attributed to airport activities.

The average concentration of this compound in the background was found to be 1.0 ug/m3 with the range of values from 0.5 ug/m3 to 1.8 ug/m3. As with many other compounds identified in the background, the highest concentration was found on the first day of sampling and it decreased until the third day. It is attributed to some activity north of the sampling site. Recalculating the average omitting the first day's contribution results in an average of 0.7 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 0.5 ug/m3 with the range of values from 0 ug/m3 to 0.7 ug/m3. The first day and the fourth and fifth days of sampling, this compound was not found, while the second and third days this compound was found at 0.7 ug/m3 which is the same as in the background.

The average concentration of this compound in the downwind location DWN was found to be 1.6 ug/m3 with the range of values from 0.8 to 2.9 ug/m3. The highest value was found in the DWN #4 sample in which some activity attributed to the auto rental facility resulted in higher than normal values for auto exhaust related compounds. The average omitting this value would be 1.2 ug/m3 which is 75% higher than the upwind or the background locations.

The average concentration of this compound in the downwind location DWS was found to be 1.3 ug/m3 with the range of values from 0.5 to 2.4 ug/m3. This value is slightly higher than the DWN location and 85% higher than the background or upwind locations.

The average concentration of this compound in the downwind grab samples was found to be 1.4 ug/m3 with the range of values from 1.2 ug/m3 to 1.6 ug/m3. The highest value was found in the sample DWS #7 odor which was clearly taken when there was jet exhaust present. The average value for the grab samples is 100% higher than the background and the upwind locations and this compound is clearly a component of jet exhaust and results from activities at the airport.

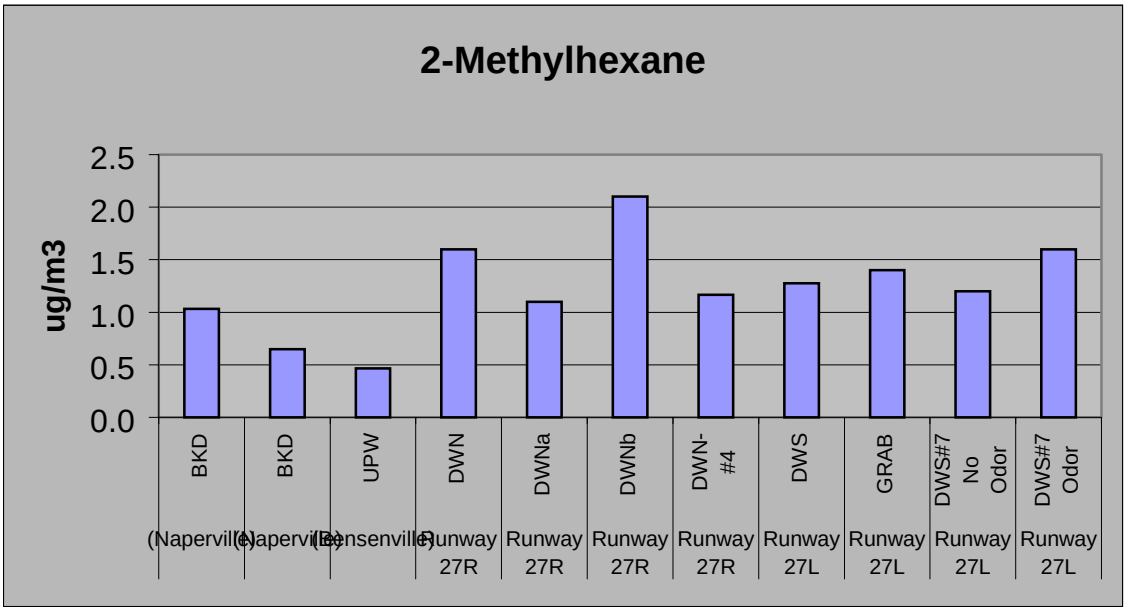


Figure 68. Results of VOC Analysis for 2-Methylhexane.

12.40 2,3-Dimethylpentane

This compound was found to be present as a major component of the auto exhaust that was analyzed for this investigation at a concentration of 1,000 ug/m3. It was not originally a target compound as it was not reported as a component of jet exhaust in the literature. It does not have any commercial uses. Therefore its presence in this investigation is strictly as a combustion product of fuel.

The average concentration of this compound in the background was found to be 0.6 ug/m3 with the range of values from 0.2 ugm3 to 1.3 ug/m3. As with many other compounds identified in the background, the highest concentration was found on the first day of sampling and is attributed to activity north of the background location. Recalculating the average omitting the first day's contribution results in an average of 0.3 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 0.4 ug/m3 with the range of values from 0.3 ug/m3 to 0.6 ug/m3. This value is 50% higher than the average for the background.

The average concentration of this compound in the downwind location DWN was found to be 1.3 ug/m3 with the range of values from 0.7 ut/m3 to 2.5 ug/m3. The highest value was found in the DWN #4 sample in which some activity attributed to the auto rental

facility resulted in higher than normal values for auto exhaust related compounds. The average omitting this value would be 0.9 ug/m3 that is 150% higher than the upwind location and 300% higher than the background.

The average concentration of this compound in the downwind location DWS was found to be 0.8 ug/m3 with the range of values from 0.4 ug/m3 to 1.1 ug/m3. This value is comparable to that found in the DWN location and about 100% higher than the upwind location.

The average concentration of this compound in the downwind grab samples was found to be 1.2 ug/m3 with the range of values from 1.0 ug/m3 to 1.3 ug/m3. This average is about 50% higher than either the DWN or DWS locations and 200% higher than the upwind location and 300% higher than the background.

The data appears to indicate that this compound is a component of jet exhaust and that the activities at the airport are contributing to the increase of this compound downwind of the airport. 2,3-Dimethylpentane was found in the annual average of Jardine location in Chicago at a concentration of 0.85 ug/M3. This value is lower than that found for the averages at any of the O'Hare downwind locations.

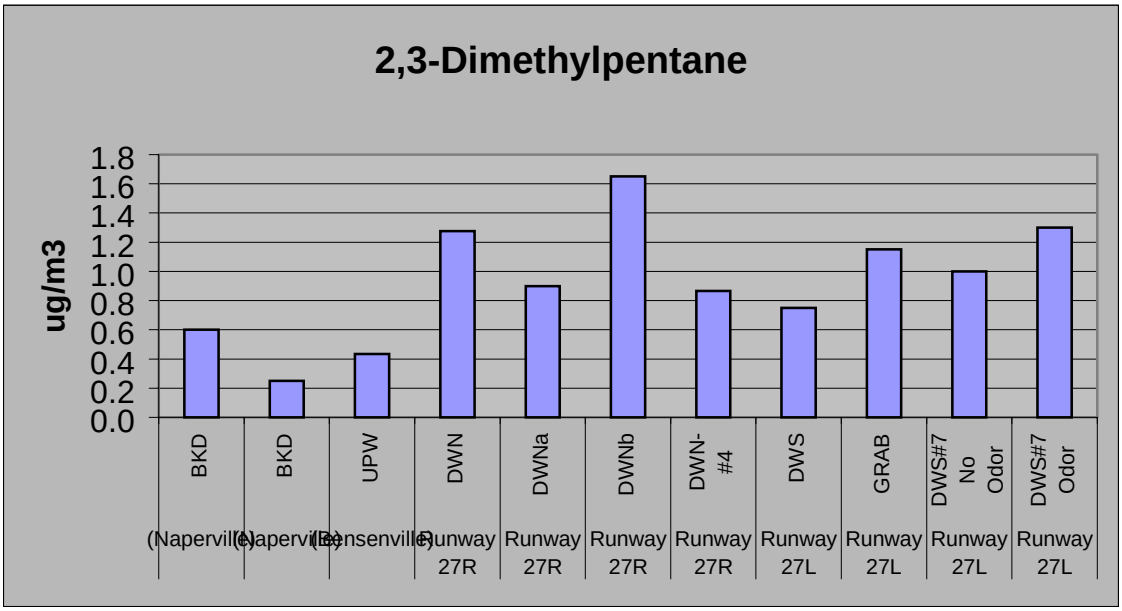


Figure 69. Results of VOC Analysis for 2,3-Dimethylpentane.

12.58 Pentanal + 12.63 3-Methylhexane

Pentanal is also known as Valeraldehyde an aldehyde that was a target compound in this investigation. Commercial uses of the compound are as a flavoring and in rubber

manufacturing. 3-Methylhexane is a branched alkane hydrocarbon that is used as an oil extender solvent and was found in the analysis of auto exhaust at a concentration of 500 ug/m3. These two compounds co-elute and were not able to be separated and therefore the results are reported together.

The average concentration of these compounds in the background was found to be 1.1 ug/m3 with the range of values from 0.4 ug/m3 to 1.9 ug/m3. As with other compounds identified and reported in the background, the highest value was found on the first day of sampling when the wind was out of the north and the compounds are suspected of originating in the downtown area of Naperville. Adjusting the average by not using the value from the first day results in an average of 0.7 ug/m3.

The average concentration of these compounds in the upwind sample was found to be 0.6 ug/m3 with the range of values from 0.0 ug/m3 to 1.0 ug/m3. The average is very similar to the average of the background without the first day of sampling included.

The average concentration of these compounds in the downwind sample location DWN was found to be 2.0 ug/m3 with the range of values from 0.9 ug/m3 to 3.0 ug/m3. The average concentration of these compounds in the downwind location DWS was found to be 1.3 ug/m3 with the range of values from 0.5 ug/m3 to 2.0 ug/m3. The average of the downwind grab samples was found to be 3.5 ug/m3 where the two values were 1.0 ug/m3 in the DWS #7 no odor sample and 6.0 ug/m3 in the DWS #7 odor sample.

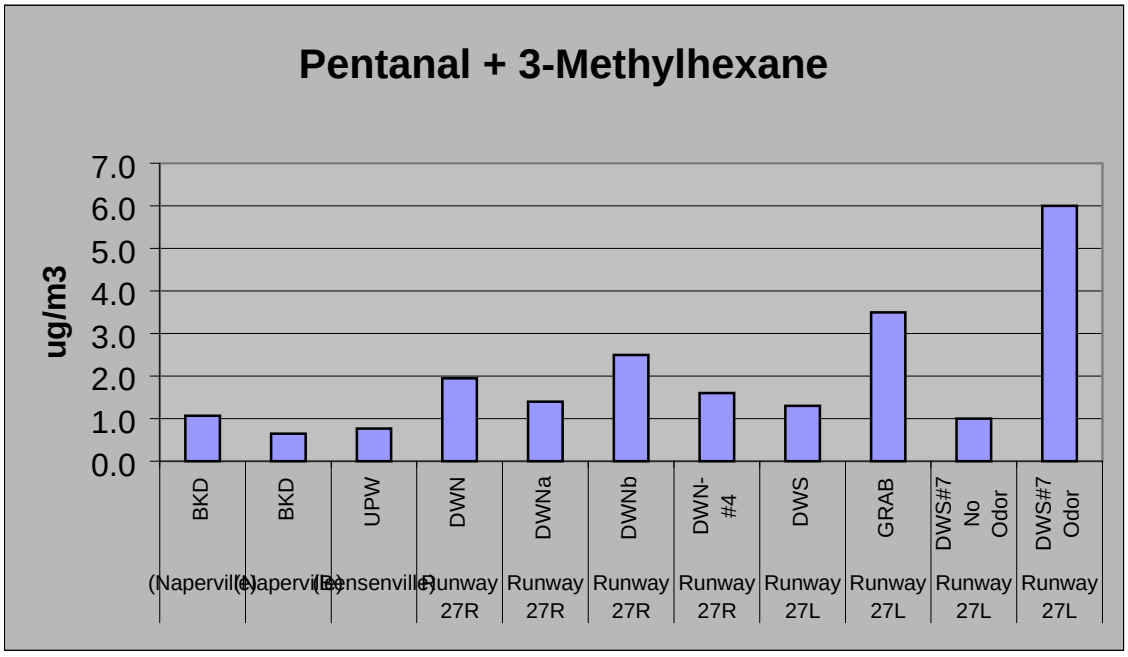


Figure 70. Results of VOC Analysis for Pentanal + 3-Methylhexane.

From the data it is obvious that this compound in being generated by activities at O'Hare above the background and upwind levels that were found. Also, since the DWS #7 sample taken when it was clear that jet exhaust was being sampled contains the highest concentration, it is probable that this compound is being generated by jet exhaust. Also, depending on how much of the co-eluting peak is actually pentanal, this could be contributing to the characteristic odor that is present at O'Hare from jet exhaust. 3-Methylhexane was found in the annual average of Jardine location in Chicago at a concentration of 0.98 ug/M3. This value is lower than that found for the averages at any of the O'Hare downwind locations.

13.15 Trichloroethene

Trichloroethene (TCE) is a chlorinated hydrocarbon that was not considered as a target compound in this investigation. It was found as a minor component in the analysis of the auto exhaust but was not reported as a component of jet exhaust. It is used industrially in metal degreasing, in dry cleaning, as a refrigerant and heat-exchange fluid, cleaning and drying of electronic parts, and diluent in paints and adhesives.

The average concentration of TCE in the background was found to be 0.2 ug/m3 with the range from 0.0 ug/m3 to 0.3 ug/m3. There did not appear to be any relationship to the wind direction.

The average concentration of TCE in the upwind location UPW was found to be 0.3 ug/m3 with the range of values found from 0.0 ug/m3 to 1 ug/m3.

The average concentration of TCE in the downwind location DWN was found to be 0.5 ug/m3 with the range of values from 0.2 ug/m3 to 1.2 ug/m3. The single high value of 1.2 ug/m3 was found in the sample from DWN #3. The average concentration of TCE in the downwind location DWS was found to be 0.2 ug/m3 with the range of values from 0.0 ug/m3 to 0.4 ug/m3. The average concentration of TCE in the downwind grab samples was found to be 0.7 ug/m3 with the range of values from 0.4 ug/m3 to 0.9 ug/m3.

It was surprising to see that the downwind grab samples were higher than the eight-hour composites. This investigator is not sure where precisely this compound would be coming from on the aircraft, but the data indicates the higher concentrations found in the grab samples is coming from the airplane operations.

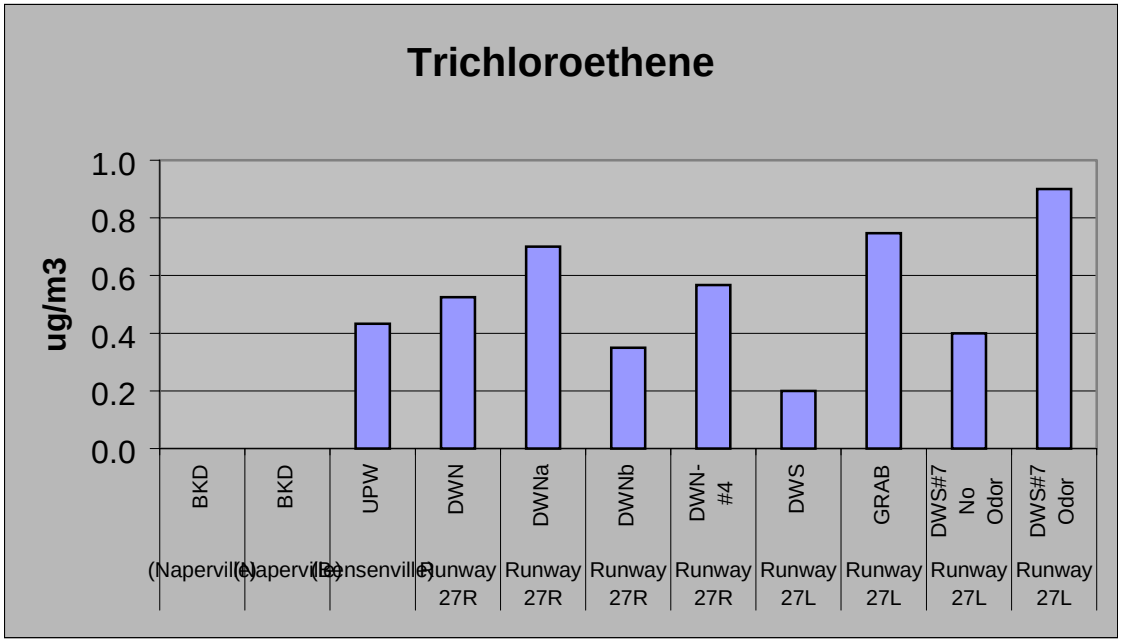


Figure 71. Results of VOC Analysis for Trichloroethene.

13.21 Isooctane

Isooctane is a branched hydrocarbon that would be expected to be a combustion product of fuels. It was not a specific target compound of this investigation, but would be expected to show increased levels downwind of combustion sources. It was found as a major component in the auto exhaust at a concentration of 3,000 ug/m3.

The average concentration of isooctane in the background was found to be 1.5 ug/m3 with the range of values from 0.5 ug/m3 to 3.0 ug/m3. As with most other compounds identified in the background, the highest value was obtained on the first sampling day when the wind was out of the north. Recalculating the average without the contribution from the first day results in an average for the background of 0.7 ug/m3

The average concentration of isooctane in the upwind location UPW was found to be 0.9 ug/m3 with the range of values from 0.0 ug/m3 to 1.6 ug/m3. The average in the upwind location is 29% higher than that of the background.

The average concentration of isooctane in the downwind location DWN was found to be 2.8 ug/m3 with the range of values from 1.0 ug/m3 to 5.0 ug/m3. Eliminating the value found in sample DWN #4, the average becomes 2.0 ug/m3. This is 185% higher than the background and 122% higher than the upwind location. The average concentration of isooctane in the downwind location DWS was found to be1.9 ug/m3 with the range of values from 0.8 ug/m3 to 3.0 ug/m3. This average of isooctane in the downwind grab

samples was found to be 2.0 ug/m3 with the range of values from 2.0 ug/m3 to 3.0 ug/m3.

The data indicates that higher concentrations of isooctane are found downwind of O'Hare that are significantly higher than the background or the upwind location. Isooctane was found at levels in the grab samples that were comparable to the eight-hour composites, which would indicate that this compound is attributable to general airport activities. The fact that a higher average concentration was found in the DWN location also indicates a contribution from the auto rental activities especially during the DWN #4 sampling.

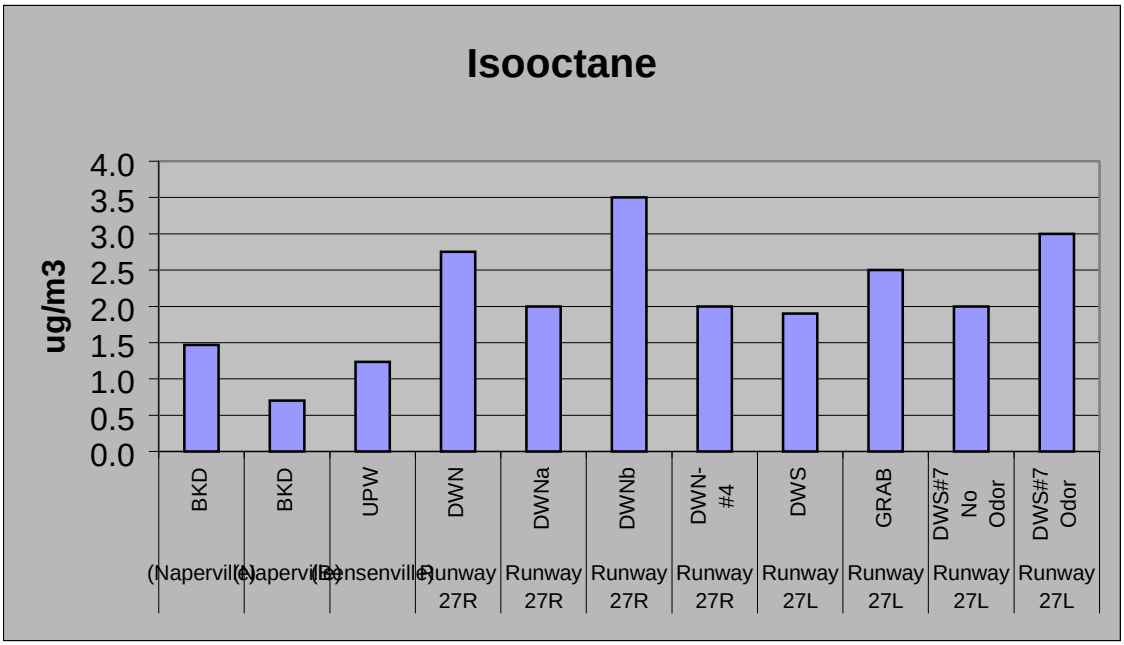


Figure 72. Results of VOC Analysis for Isooctane.

13.55 n-Heptane

Heptane is a component of fuel, and exhaust and was a target compound for this investigation. It was present in the auto exhaust sample at 400 ug/m3 and in jet exhaust at 164 ug/m3.

The average concentration of heptane in the background location was found to be 0.7 ug/m3 with the range of values from 0.3 ug/m3 to 1.5 ug/m3. As with other compounds identified in the background, the highest value was obtained on the first day of sampling when the wind was from the north. Recalculating the average results in an average of 0.3 ug/m3.

The average concentration of heptane in the upwind location UPW was found to be 0.3 ug/m3 with the range of values from 0.0 ug/m3 to 0.6 ug/m3, which is the same as that found in the background.

The average concentration of heptane in the downwind location DWN was found to be 1.1 ug/m3 with the range of values from 0.5 ug/m3 to 1.9 ug/m3. This value is 267% higher than in the background or upwind locations. Eliminating the high value found in the DWN #4 sample results in a new average of 0.7 ug/m3. This new value is only about 133% higher than the background or upwind locations. The average concentration of heptane in the downwind location DWS was found to be 0.5 ug/m3 with the range of values from 0.3 ug/m3 to 0.7 ug/m3. This value is 67% higher than the background or upwind locations, and slightly lower than the DWN location. The average concentration of heptane in the downwind grab samples was found to be 2.0 ug/m3 with both values found at this concentration. This value is 566% higher than the background or upwind locations and about 230% higher than either the DWN or DWS locations.

The fact that the concentration of heptane in the grab samples is higher than the average at either downwind location indicates that this compound is a result of jet exhaust. The fact that the average at the DWN location was higher than the DWS location indicates a contribution from the activities of the auto rental facility. n-Heptane was found in the annual average of Jardine location in Chicago at a concentration of 0.76 ug/M3. This value is lower than that found for the averages at any of the O'Hare downwind locations.

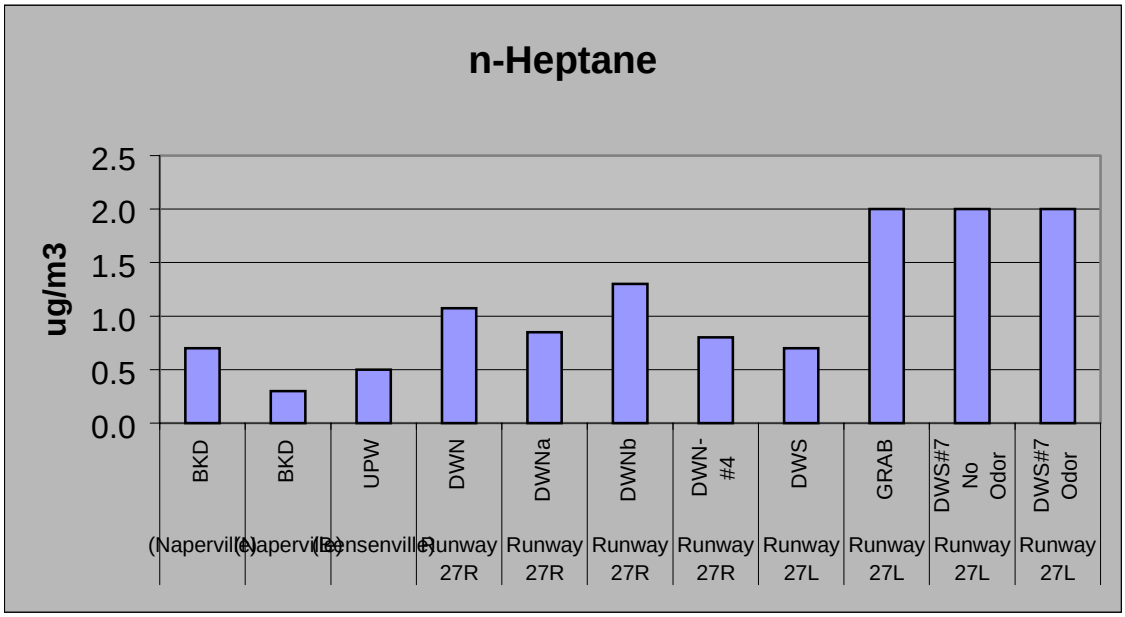


Figure 73. Results of VOC Analysis for n-Heptane.

14.43 4-Methyl-2-pentanone (methyl isobutyl ketone, MIBK)

MIBK is a branched ketone compound that was not a target compound of this investigation. The compound is used extensively as a paint solvent, and in varnishes and lacquers. It would not be expected as a major combustion product from auto or jet fuel, but might be expected to occur as a result of maintenance activities.

The average concentration of MIBK in the background location was found to be 0.2 ug/m3 with the range of values from 0.0 ug/m3 to 0.3 ug/m3. There apparently was no relationship to wind direction.

The average concentration of MIBK in the upwind location UPW was found to be 0.1 ug/m3 with the range of values from 0.0 ug/m3 to 0.3 ug/m3. This value is essentially the same as that found in the background.

The average concentration of MIBK in the downwind location DWN was found to be 0.4 ug/m3 with the range of values from 0.1 ug/m3 to 0.6 ug/m3. This average value is about twice that of the background and four times higher than the upwind location. The average concentration of MIBK in the downwind location DWS was found to be 1.0 ug/m3 with the range of values from 0.5 ug/m3 to 1.4 ug/m3. The average value of MIBK in the downwind grab samples was found to be 0.4 ug/m3 with the range of values from 0.3 ug/m3 to 0.5 ug/m3.

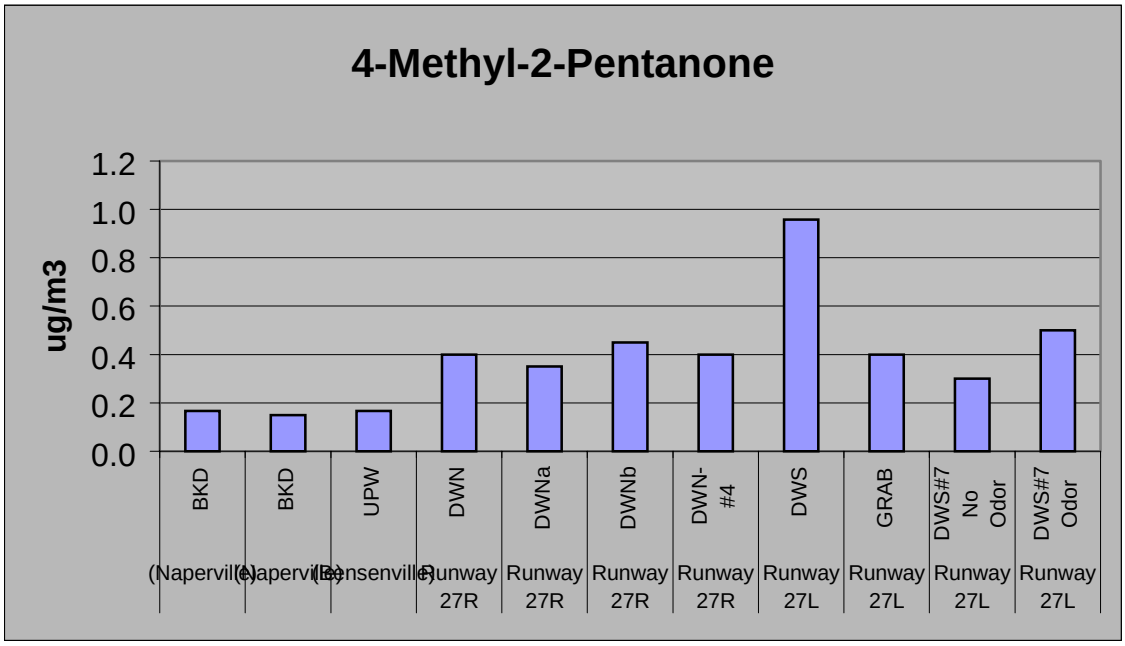


Figure 74. Results of VOC Analysis for 4-Methyl-2-Pentanone.

The data clearly indicate that downwind of O'Hare, MIBK was detected at significantly higher levels than in the background or in the upwind samples. This compound was not detected in the downwind grab sample at elevated levels, indicating that this compound is not a component of jet exhaust, but is a result of maintenance activities that are being conducted at the airport.

14.55 Methyl Cyclohexanone

This compound was not a target compound of this investigation. It was found in the auto exhaust sample at relatively low levels and was not reported in the literature as a component of jet exhaust. It is used commercially as a solvent and in lacquers.

This compound was not found to be present in any of the background samples.

The average concentration of this compound in the upwind location UPW was found to be 0.2 ug/m3 with the range of values from 0.1 ug/m3 to 0.2 ug/m3. The highest concentrations were found on the first and third days of sampling.

The average concentration of this compound in the downwind sample location DWN was found to be 0.6 ug/m3 with the range of values from 0.3 ug/m3 to 0.9 ug/m3. The highest value found was in DWN #4 which was attributed to activity at the auto rental facility. Omitting this value, the average is recalculated to be 0.4 ug/m3 which is 100 % higher than found in the upwind location.

The average concentration of this compound in the downwind sample location DWS was found to be 0.3 ug/m3 with the range of values from 0.2 ug/m3 to 0.5 ug/m3. This value is slightly lower than that found in the DWN location and 50% higher than that found in the UPW location.

The average concentration of this compound in the downwind grab samples was found to be 0.8 ug/m3 with the range of values from 0.6 ug/m3 to 0.9 ug/m3. The highest value was found in the sample DWS #7 odor which was taken when jet exhaust was clearly present. The average is 300% higher than the upwind location, 100% higher than the DWN location and 166% higher than the average of the DWS location. From this data it is clear that the higher values obtained in the grab samples can be attributed to the emission of this compound from jet exhaust. Also, because this compound is a ketone, it would have a distinct odor and may be a component of the odor associated with airports.

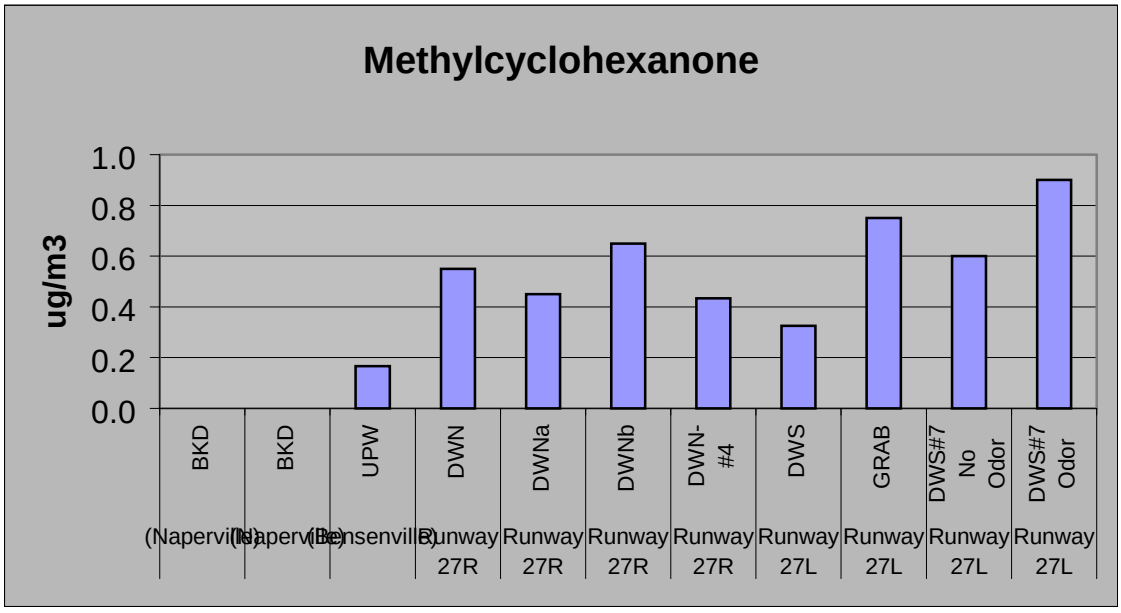


Figure 75. Results of VOC Analysis for Methylcyclohexanone.

14.73 Dimethyl Disulfide (DMDS)

Dimethyl disulfide is an organic sulfur compound that was not a target compound of this investigation. It was not found as a component in the analysis of auto exhaust or reported as a component of jet exhaust.

The average concentration of DMDS in the background was found to be 0.6 ug/m3 with the range of values from 0.0 ug/m3 to 1.5 ug/m3. The highest concentration was found on the second day of testing when the wind was out of the southwest.

The average concentration of DMDS in the upwind sample location UPW was found to be 0.0 ug/m3. This compound was not detected in any of the upwind samples.

The average concentration of DMDS in the downwind sample location DWN was found to be 0.3 ug/m3 with the range of values from 0.1 ug/m3 to 1.0 ug/m3. The average concentration of DMDS in the downwind sample location DWS was found to be 0.1 ug/m3 with the range of values from 0.0 ug/m3 to 0.1 ug/m3. The average concentration of DMDS in the downwind grab samples was found to be 1.1 ug/m3 with the range of values from 0.2 to 2.0 ug/m3.

DMDS was found at levels above background in four samples BKD #2 at 1.5 ug/m3, DWN #1 at 1.0 ug/m3, DWS#6dup at 2.0 ug/m3 and DWS#7 at 1.0 ug/m3. While most of these significantly higher levels were found in samples that were taken downwind of

O'Hare with one sample being an eight-hour composite and two sample being grab samples, a high value was found in a background sample. This compound does not seem to be associated with either jet exhaust or auto exhaust. Since it also is not a common chemical that would be used in maintenance of either facilities, aircraft or autos, it does not appear to be an emission from O'Hare airport operations. The source of this compound in these samples must remain a mystery until further studies can be done.

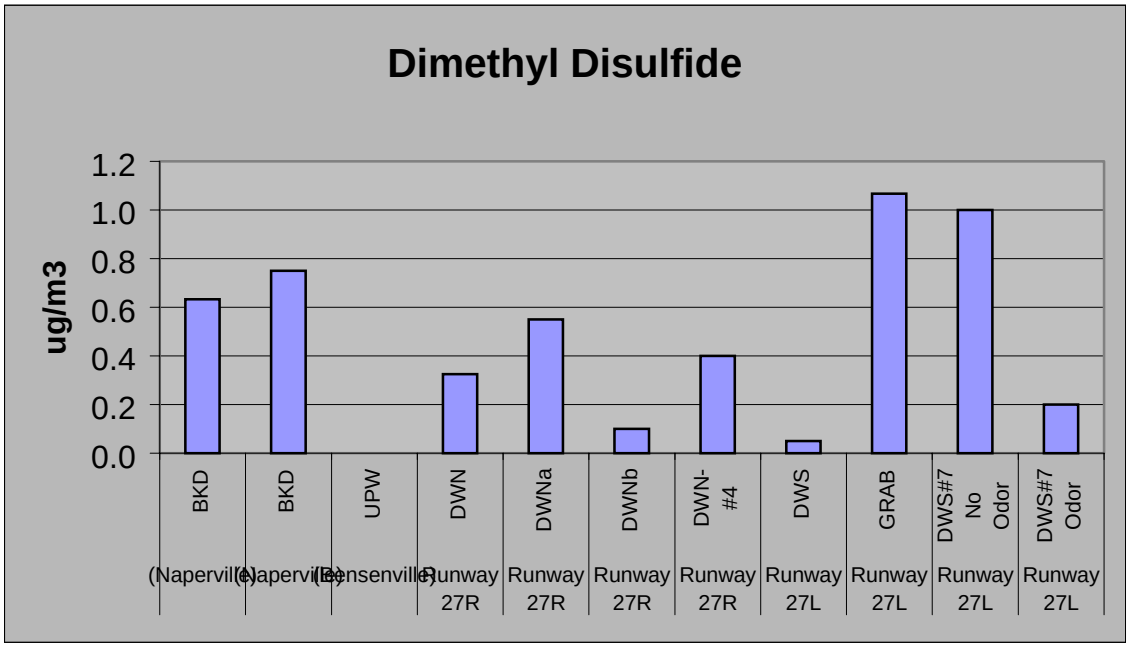


Figure 76. Results of VOC Analysis for Dimethyl Disulfide.

14.85 C8H18 Compound

A number of C8H18 compounds were identified during this study. They are methylated alkanes from pentane to heptane. They cannot be specifically identified by mass spectrometry. These compounds like other methylated alkanes would be expected to be components of exhaust. This compound was found in auto exhaust at a concentration of 300 ug/m3.

The average concentration of this compound in the background was found to be 0.2 ug/m3 with the range of values from 0.1 ug/m3 to 0.4 ug/m3. The highest value was found on the first day of sampling and since this compound is found in auto exhaust is associated with the activities from the north of the sampling location on that day. The average omitting this value is 0.1 ug/m3.

The average concentration of this compound in the upwind sample location UPW was found to be 0.1 ug/m3 with all values from the sampling events found at that level. This is the same value as that found in the background.

The average concentration of this compound in the downwind sample location DWN was found to be 0.3 ug/m3 with the range of values from 0.2 ug/m3 to 0.4 ug/m3. The highest value was found on the fourth day of sampling and is attributed to activity at the auto rental facility. Omitting this value, the average then becomes 0.2 ug/m3. This value is 100% higher than that found in the background or in the upwind location.

The average concentration of this compound in the downwind sample location DWS was found to be 0.2 ug/m3 with the range of values from 0.1 ug/m3 to 0.4 ug/m3. This average is the same as for the DWN location and 100% higher than for the background or the upwind locations.

The average concentration of this compound in the downwind grab samples was found to be 0.3 ug/m3 with the range of values from 0.2 ug/m3 to 0.4 ug/m3. The highest value was found in the DWS #7 odor sample that was taken when jet exhaust was clearly present. The average value is 150% higher than for either of the DWN composite samples, and 200% higher than for the background or the upwind locations. From this data it can be concluded that this compound results in increase atmospheric levels as a result of activities at the airport.

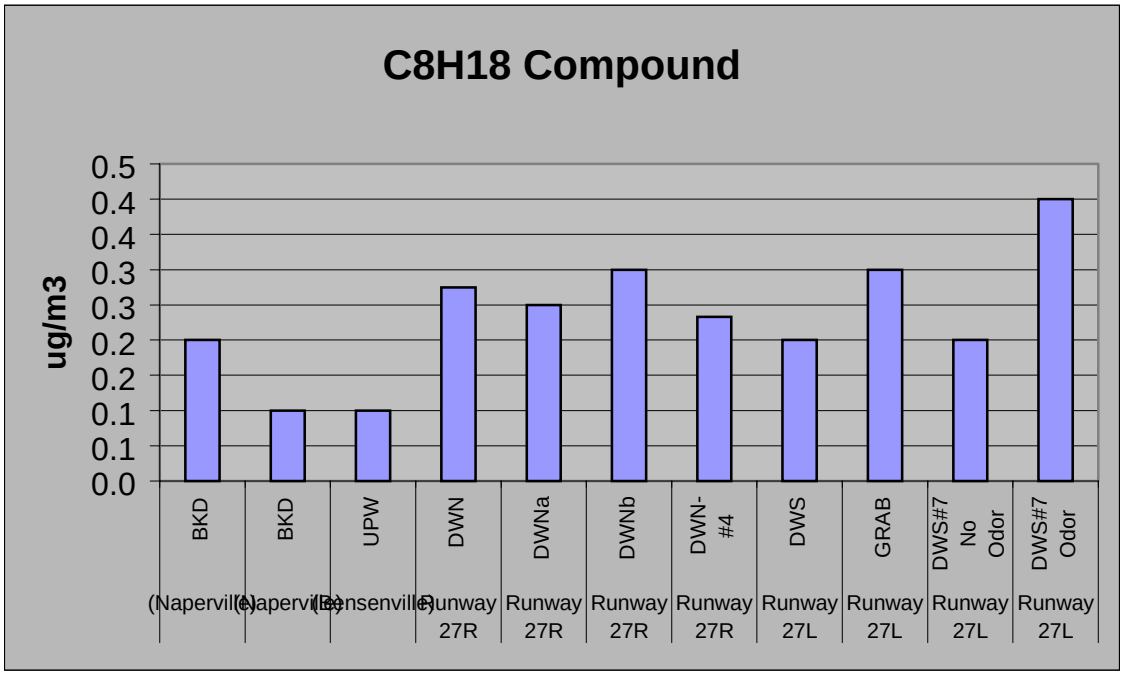


Figure 77. Results of VOC Analysis for C8H18 Compound.

14.95 C8H18 Compound

A number of C8H18 compounds were identified during this study. They are methylated alkanes from pentane to heptane. They cannot be specifically identified by mass spectrometry. These compounds like other methylated alkanes would be expected to be components of exhaust. This compound was found in auto exhaust at a concentration of 300 ug/m3.

The average concentration of this compound in the background was found to be 0.3 ug/m3 with the range of values from 0.1 ug/m3 to 0.7 ug/m3. The highest value was found on the first day of sampling and since this compound is found in auto exhaust is associated with the activities from the north of the sampling location on that day. The average omitting this value is 0.1 ug/m3.

The average concentration of this compound in the upwind sample location UPW was found to be 0.1 ug/m3 with the range of values from 0.1 ug/m3 to 0.2 ug/m3. This is the same value as that found in the background.

The average concentration of this compound in the downwind sample location DWN was found to be 0.5 ug/m3 with the range of values from 0.3 ug/m3 to 0.8 ug/m3. The highest value was found on the fourth day of sampling and is attributed to activity at the auto rental facility. Omitting this value, the average then becomes 0.4 ug/m3. This value is 300% higher than that found in the background or in the upwind location.

The average concentration of this compound in the downwind sample location DWS was found to be 0.4 ug/m3 with the range of values from 0.2 ug/m3 to 0.7 ug/m3. This average is the same as for the DWN location and 100% higher than for the background or the upwind locations.

The average concentration of this compound in the downwind grab samples was found to be 0.5 ug/m3 with the range of values from 0.4 ug/m3 to 0.6 ug/m3. The highest value was found in the DWS #7 odor sample that was taken when jet exhaust was clearly present. The average value is 25% higher than for either of the DWN composite samples, and 400% higher than for the background or the upwind locations. From this data it can be concluded that this compound results in increase atmospheric levels as a result of activities at the airport.

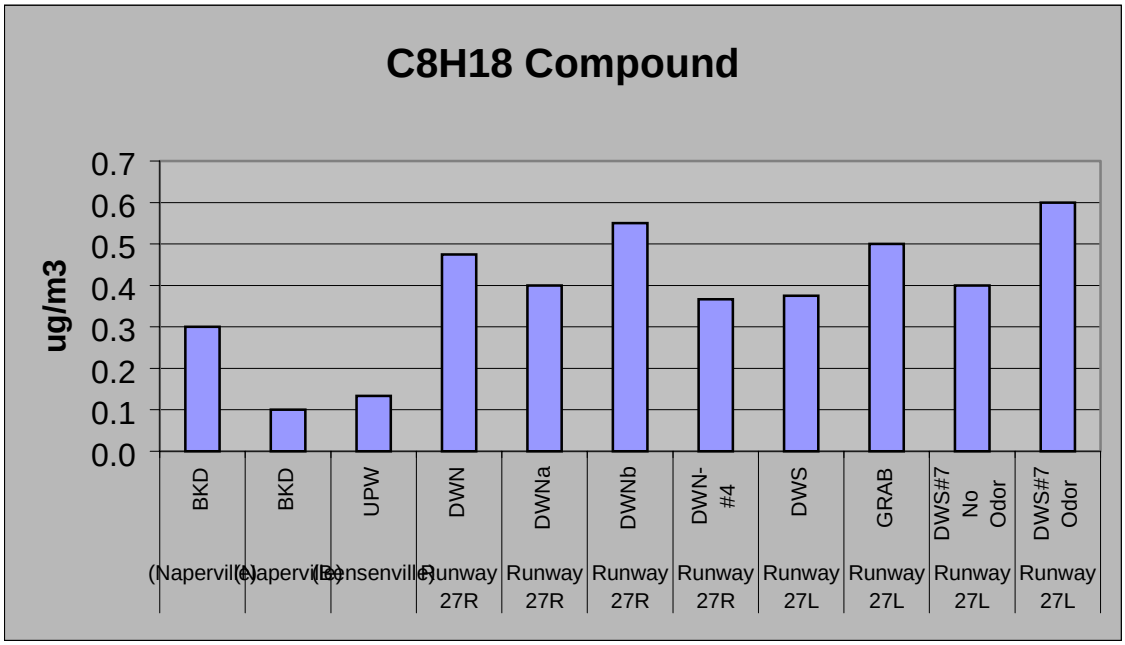


Figure 78. Results of VOC Analysis for C8H18 Compound.

15.92 Toluene

Toluene, like benzene, is a compound that is well characterized as a component of ambient air and the source in thought to be auto exhaust. This compound was a target compound for this investigation as it is also present is jet exhaust. It was found in the auto exhaust at a concentration of 2,300 ug/m3 and was reported as a component of jet exhaust at a concentration of 1,467 ug/m3.

The average concentration of toluene in the background was found to be 3.8 ug/m3 with the range of values from 1.5 ug/m3 to 7.1 ug/m3. As with most compounds identified in the background, the highest value was found in the first day of sampling when the wind was out of the north. Recalculating the average omitting the first day's result, would result in an average of 2.2 ug/m3.

The average concentration of toluene in the upwind location UPW was found to be 2.4 ug/m3 with the range of values from 0.69 ug/m3 to 4.2 ug/m3. This average is only slightly higher than the value for the background.

The average concentration of toluene in the downwind location DWN was found to be 4.5 ug/m3 with the range of values from 2.9 ug/m3 to 6.3 ug/m3. This average is about 100% higher than that of the background and the upwind samples. Eliminating the contribution from sample DWN #4, the average becomes 4.0 ug/m3. The average of the

downwind location DWS was found to be 4.1 ug/m3 with the range of values from 3.3 ug/m3 to 5.7 ug/m3. The average of the downwind grab samples was found to be 4.0 ug/m3 with the range of values from 3.1ug/m3 to 5.7 ug/m3.

From the data, it is clear that toluene is found in all ambient samples. It is a product of both the combustion of auto fuel and jet fuel. The background sample BKD #1 was impacted by the auto fuel derived toluene on the first day of sampling, while the samples taken downwind of O'Hare were impacted by the combustion of both jet fuel and auto fuel. The fact that the downwind locations were all significantly higher than the background or upwind locations indicates that the airport is producing significant amounts of toluene that is impacting the surrounding communities. Toluene was found in the annual average of Jardine location in Chicago at a concentration of 2.26 ug/M3. This value is considerably lower than that found for the averages at any of the O'Hare downwind locations.

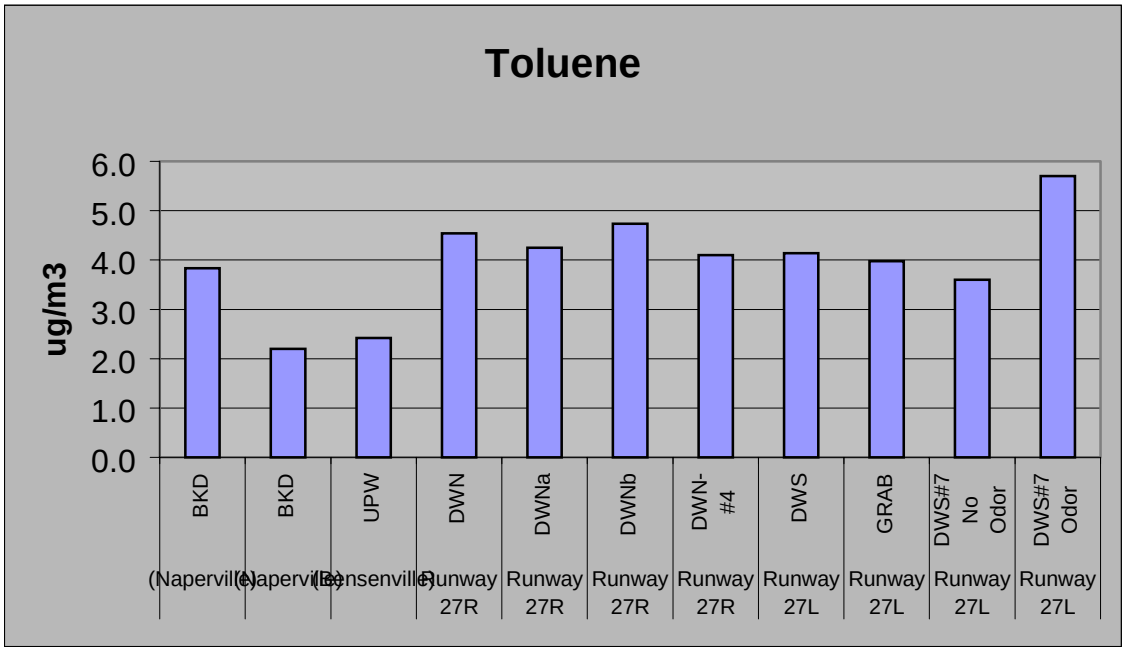


Figure 79. Results of VOC Analysis for Toluene.

16.05 C8H18 Compound

A number of C8H18 compounds were identified during this study. They are methylated alkanes from pentane to heptane. They cannot be specifically identified by mass spectrometry. These compounds like other methylated alkanes would be expected to be components of exhaust. This compound was found in auto exhaust at a concentration of 300 ug/m3.

The average concentration of this compound in the background was found to be 0.2 ug/m3 with the range of values from 0.1 ug/m3 to 0.4 ug/m3. The highest value was found on the first day of sampling and since this compound is found in auto exhaust is associated with the activities from the north of the sampling location on that day. The average omitting this value is 0.1 ug/m3.

The average concentration of this compound in the upwind sample location UPW was found to be 0.1 ug/m3 with the range of values from 0.1 ug/m3 to 0.2 ug/m3. This is the same value as that found in the background.

The average concentration of this compound in the downwind sample location DWN was found to be 0.4 ug/m3 with the range of values from 0.3 ug/m3 to 0.4 ug/m3. Similar values were found on all days of sampling. The average value is 300% higher than that found in the background or in the upwind location.

The average concentration of this compound in the downwind sample location DWS was found to be 0.3 ug/m3 with the range of values from 0.1 ug/m3 to 0.6 ug/m3. This average is slightly lower than for the DWN location and 200% higher than for the background or the upwind locations.

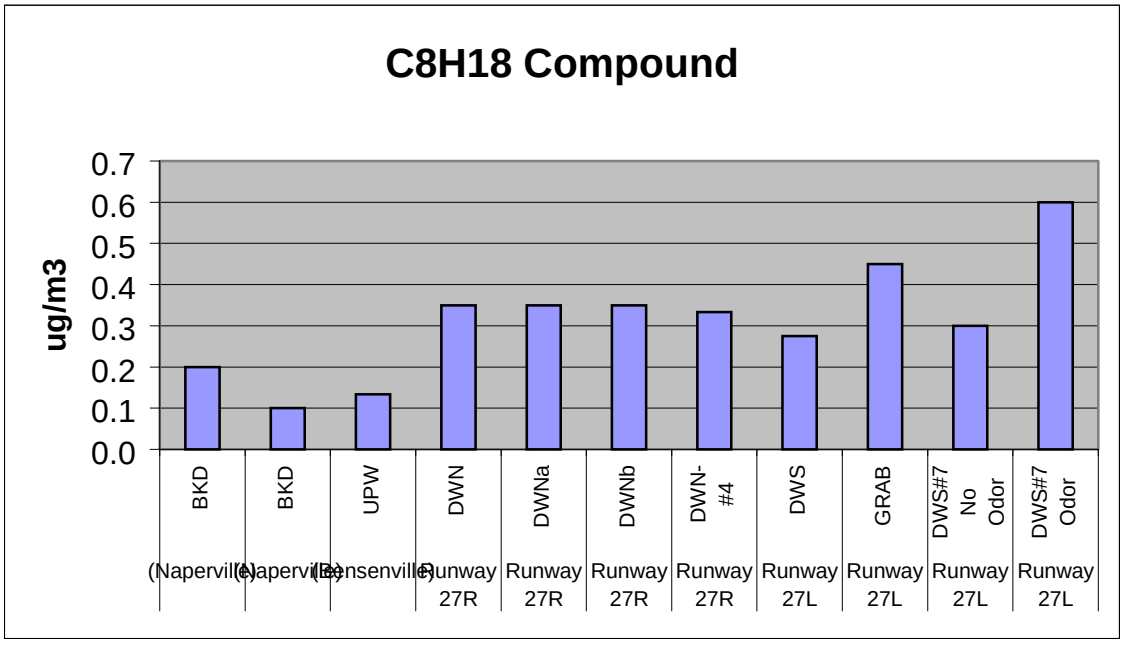


Figure 80. Results of VOC Analysis for C8H18 Compound.

The average concentration of this compound in the downwind grab samples was found to be 0.5 ug/m3 with the range of values from 0.3 ug/m3 to 0.6 ug/m3. The highest value was found in the DWS #7 odor sample that was taken when jet exhaust was clearly

present. The average value is 25% higher than for either of the DWN composite samples, and 400% higher than for the background or the upwind locations. From this data it can be concluded that this compound results in increase atmospheric levels as a result of activities at the airport.

16.25 C8H18 Compound

A number of C8H18 compounds were identified during this study. They are methylated alkanes from pentane to heptane. They cannot be specifically identified by mass spectrometry. These compounds like other methylated alkanes would be expected to be components of exhaust. This compound was found in auto exhaust at a concentration of 200 ug/m3.

The average concentration of this compound in the background was found to be 0.2 ug/m3 with the range of values from 0.1 ug/m3 to 0.3 ug/m3. The highest value was found on the first day of sampling and since this compound is found in auto exhaust is associated with the activities from the north of the sampling location on that day. The average omitting this value is 0.1 ug/m3.

The average concentration of this compound in the upwind sample location UPW was found to be 0.2 ug/m3 with all values from all sampling events found to be 0.2 ug/m3. This value is 100% higher than that found in the background.

The average concentration of this compound in the downwind sample location DWN was found to be 0.3 ug/m3 with the range of values from 0.3 ug/m3 to 0.6 ug/m3. The highest value was found on the second day of sampling. The average value is 200% higher than that found in the background and 50% higher than that found in the upwind location.

The average concentration of this compound in the downwind sample location DWS was found to be 0.4 ug/m3 with the range of values from 0.2 ug/m3 to 0.9 ug/m3. This average is 33% higher than for the DWN location and 100% higher than for the upwind location and 300% higher than for the background location.

The average concentration of this compound in the downwind grab samples was found to be 0.6 ug/m3 with the range of values from 0.4 ug/m3 to 0.7 ug/m3. The highest value was found in the DWS #7 odor sample that was taken when jet exhaust was clearly present. The average value is 50% higher than for the DWS composite samples, 100% higher than for the DWN location, 200% higher than for the upwind location, and 500% higher than the background location. From this data it can be concluded that this compound results in increase atmospheric levels as a result of activities at the airport.

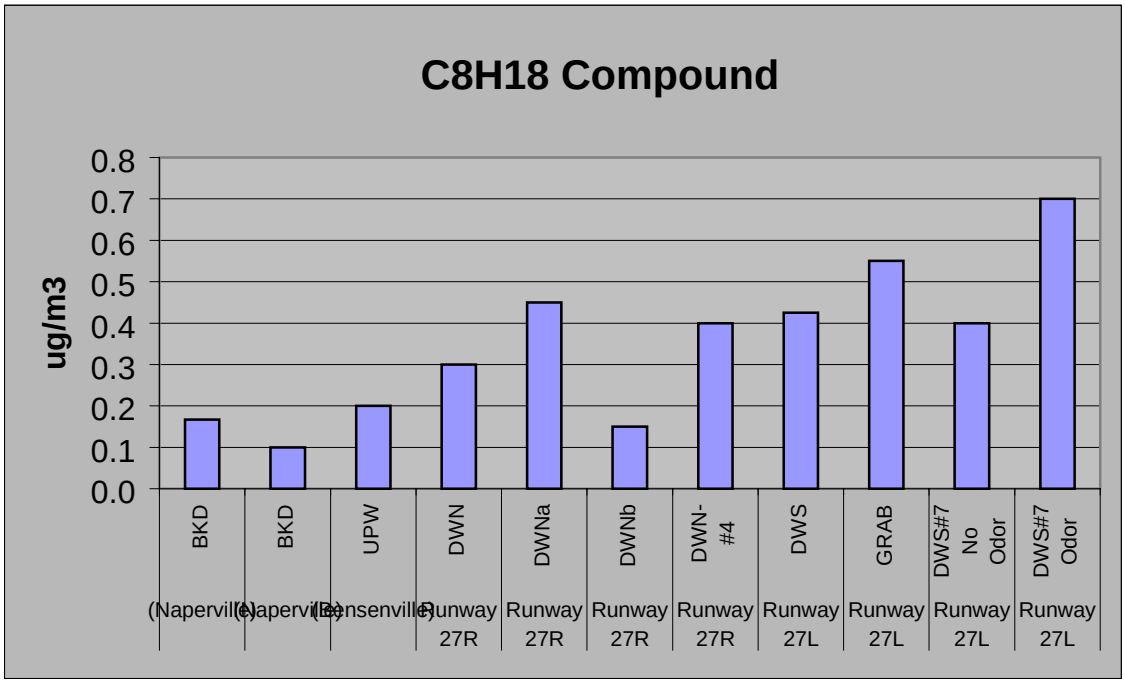


Figure 81. Results of VOC Analysis for C8H18 Compound.

16.32 2-Hexanone (methyl butyl ketone, MBK))

2-Hexanone is a ketone that was not a target compound of this investigation. It was found in the auto exhaust sample at about 50 ug/m3. It was not reported as a component of jet exhaust. Commercially, it is used as a solvent.

The average concentration of MBK in the background was found to be 0.1 ug/m3 with the range of values from 0.0 ug/m3 to 0.2 ug/m3. There was no relationship with the wind direction.

The average concentration of MBK in the upwind sample location UPW was found to be 0.1 ug/m3 with the range of values from 0.0 ug/m3 to 0.2 ug/m3. This average value is the same as that found in the background.

The average concentration of MBK in the downwind location DWN was found to be 0.5 ug/m3 with the range of values from 0.1 ug/m3 to 0.7 ug/m3. This average value is five times higher than the background or the upwind locations. The average concentration of MBK in the downwind location DWS was found to be 0.4 ug/m3 with the range of values from 0.2 ug/m3 to 0.89 ug/m3. The average concentration of MBK in the downwind grab samples was found to be 0.5 ug/m3 with the range of values from 0.4 ug/m3 to 0.6 ug/m3.

The data indicates that MBK is at elevated levels downwind of the airport when compared to the upwind or background locations. The source of this compound is probably from jet exhaust and auto exhaust as relatively high values were obtained in the grab samples.

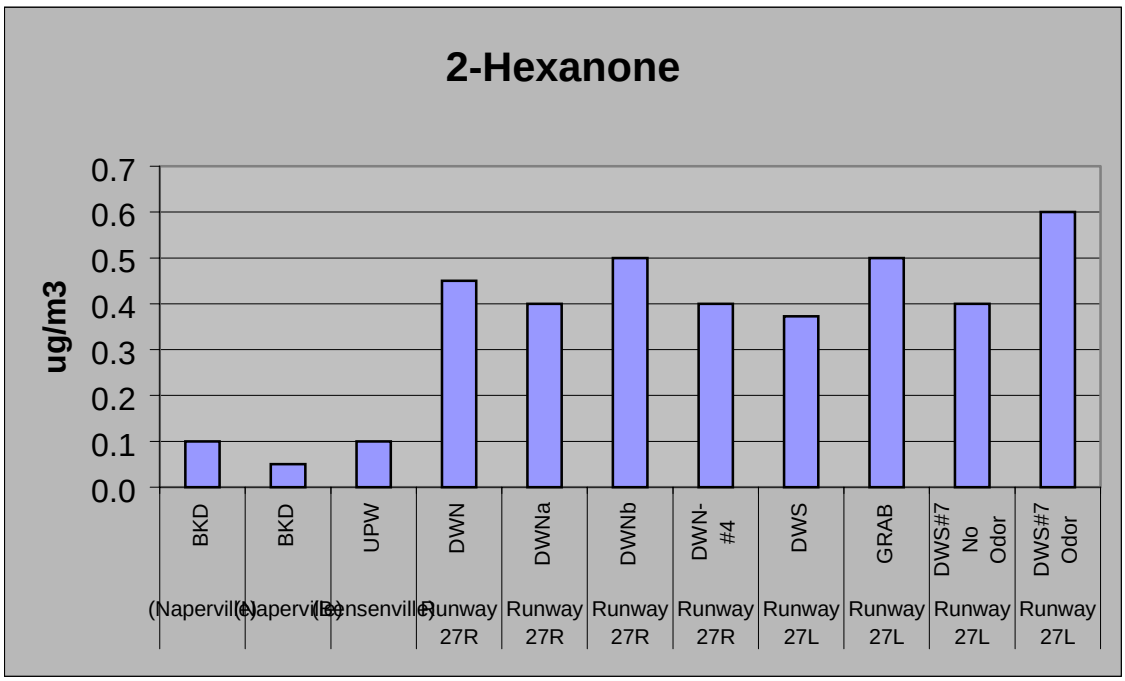


Figure 82. Results of VOC Analysis for 2-Hexanone.

16.55 C8H18 Compound

A number of C8H18 compounds were identified during this study. They are methylated alkanes from pentane to heptane. They cannot be specifically identified by mass spectrometry. These compounds like other methylated alkanes would be expected to be components of exhaust. This compound was found in auto exhaust at a concentration of 200 ug/m3.

The average concentration of this compound in the background was found to be 0.2 ug/m3 with the range of values from 0.1 ug/m3 to 0.3 ug/m3. The highest value was found on the first day of sampling and since this compound is found in auto exhaust is associated with the activities from the north of the sampling location on that day. The average omitting this value is 0.1 ug/m3.

The average concentration of this compound in the upwind sample location UPW was found to be 0.2 ug/m3 with all values found at 0.2 ug/m3. This is the same value as that found in the background.

The average concentration of this compound in the downwind sample location DWN was found to be 0.4 ug/m3 with the range of values from 0.3 ug/m3 to 0.6 ug/m3. The highest value was found on the fourth day of sampling and is attributed to activity at the auto rental facility. Omitting this value, the average then becomes 0.3 ug/m3. This value is 50% higher than that found in the background or in the upwind location.

The average concentration of this compound in the downwind sample location DWS was found to be 0.4 ug/m3 with the range of values from 0.1 ug/m3 to 0.8 ug/m3. This average is the same as for the DWN location and 100% higher than for the background or the upwind locations.

The average concentration of this compound in the downwind grab samples was found to be 0.5 ug/m3 with the range of values from 0.4 ug/m3 to 0.6 ug/m3. The highest value was found in the DWS #7 odor sample that was taken when jet exhaust was clearly present. The average value is 25% higher than for either of the DWN composite samples, and 150% higher than for the background or the upwind locations. From this data it can be concluded that this compound results in increase atmospheric levels as a result of activities at the airport.

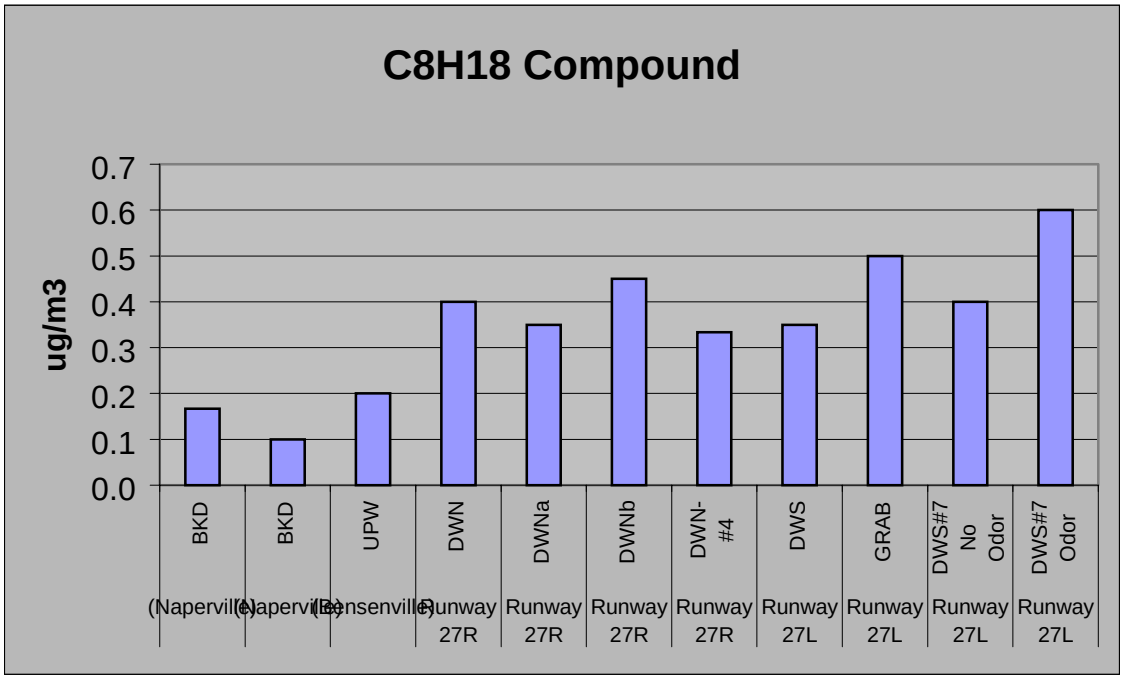


Figure 83. Results of VOC Analysis for C8H18 Compound.

16.69 Hexanal (Caproicaldehyde)

Hexanal is an aldehyde compound that was a target compound for this investigation. This compound has a sharp, pungent odor and a detection odor threshold of 18.4 ug/m3. It was reported to be present in jet exhaust at a concentration of 327 ug/m3. It was not found in the analysis of auto exhaust. Commercially it is used in dyes and insecticides.

The average concentration of hexanal in the background was found to be 0.6 ug/m3 with the range of values from 0.3 ug/m3 to 0.7 ug/m3. The lowest value was found on the first sampling day when the wind was out of the north. The highest value was found on the second and third days

The average concentration of hexanal in the upwind location UPW was found to be 0.3 ug/m3 with the range of values from 0.0 ug/m3 to 1.2 ug/m3. In fact, hexanal was not detected in any of the upwind samples except for one, UPW #3.

The average concentration of hexanal in the downwind location DWN was found to be 1.3 ug/m3 with the range of values from 0.5 ug/m3 to 2.0 ug/m3. This value is 116% higher than either the background and 333% higher than the upwind location. The average concentration of hexanal in the downwind location DWS was found to be 0.9 ug/m3 with the range of values from 0.0 ug/m3 to 1.6 ug/m3. This value is lower than that found at DWN, but was still significantly higher than in the background or the

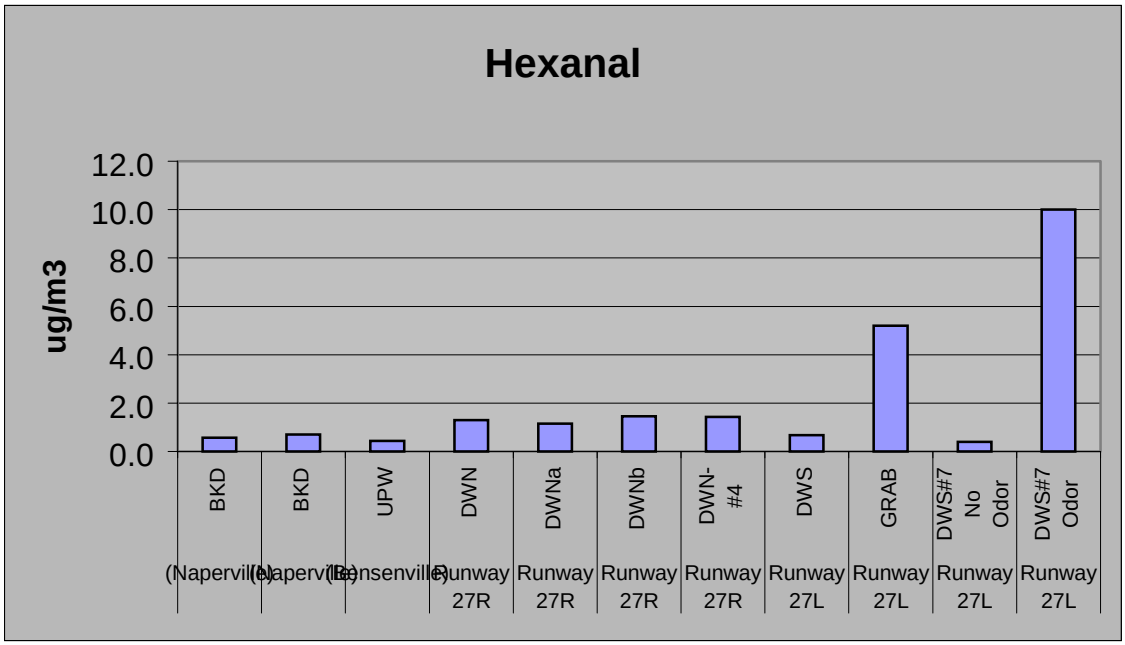


Figure 84. Results of VOC Analysis for Hexananal.

upwind locations. The average concentration of hexanal in the downwind grab samples was found to be 5.2 ug/m3 with the range of values from 0.4 ug/m3 to 10 ug/m3. The sample with the highest concentration was the grab sample that was taken when there was clearly an odor from the jet exhaust present. The grab sample that was taken almost immediately after when there was no odor present contains only a background concentration of hexanal. This indicates that hexanal may be one of the components of the distinct odor of jet exhaust and may be one of the compounds that can be detected in the surrounding communities when odors are present that are associated with the airport. From the data on hexanal, it is clear that this compound is being emitted by jet exhaust and that downwind concentrations are elevated significantly above the background and upwind locations.

16.78 2,4-Dimethyl-3-pentanone (Diisopropylketone, DIPK)

DIPK is a ketone that is used as a solvent similar to other ketones that have been identified in this investigation. It was not a target compound of this investigation. It was found as at a concentration of about 10 ug/m3 in auto exhaust and was not reported to be a component of jet exhaust.

The average concentration of this compound in the background was found to be 0.8 ug/m3 with the range of values from 0.3 ug/m3 to 1.7 ug/m3. Unlike the compounds that have been identified in the background and associated with the first day's sampling, the highest value for this compound was found on the third day of sampling at a significantly higher value than for the first two days.

The average concentration of this compound in the upwind location UPW was found to be 0.3 ug/m3 with the range of values from 0.0 ug/m3 to 1.2 ug/m3. In fact, the only sample in which this compound was identified was UPW #3.

The average concentration of this compound in the downwind location DWN was found to be 0.4 ug/m3 with the range of values from 0.2 ug/m3 to 0.7 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 9.4 ug/m3 with the range of values from 1.4 ug/m3 to 20 ug/m3. All sample taken at this location contained significantly higher concentrations of this compound than at the other locations except for one upwind sample and one background sample. This compound was not detected in any grab samples.

The data would indicate that this compound is the result of some activity that was not going on when the grab samples were taken. The activity that produced the very high results in the DWS samples occurred every day as it appears at elevated concentrations in every sample and that this activity is not occurring in or near the DWN location. The fact that concentrations of this compound were detected in at least one background and one upwind sample at levels that were comparable to the lowest value obtained in the DWS

samples would indicate that this activity is not isolated to O'Hare, but does occur in other locations. These elevated levels in all samples may be attributable to a painting operation.

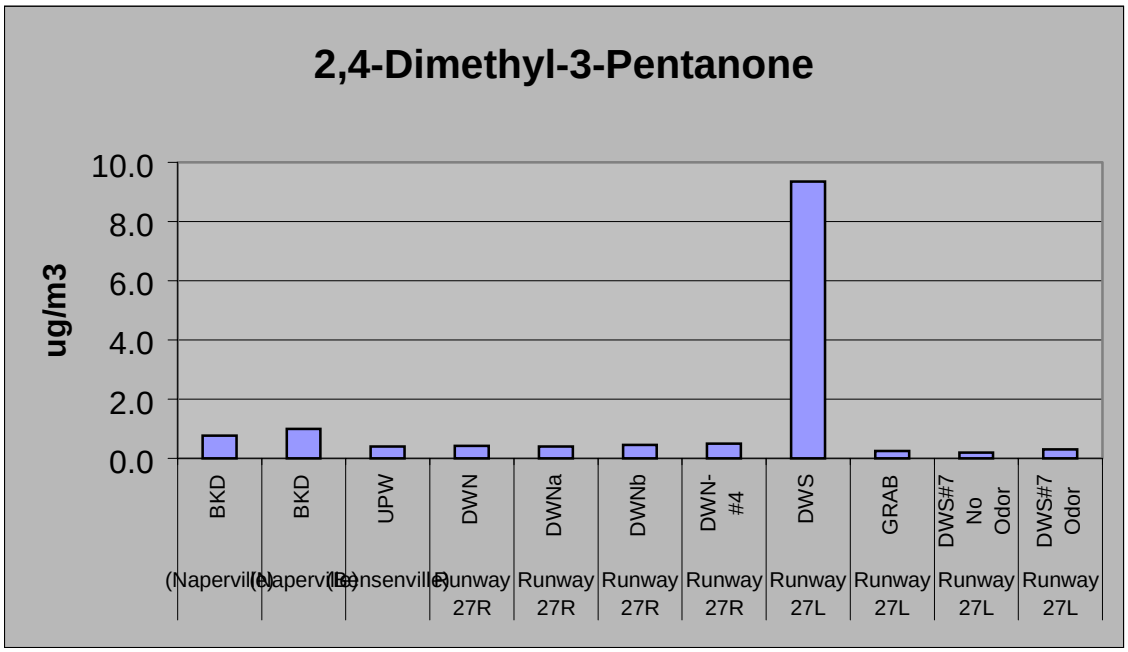


Figure 85. Results of VOC Analysis for 2,4-Dimethyl-3-Pentanone.

17.02 C8H18 Compound

A number of C8H18 compounds were identified during this study. They are methylated alkanes from pentane to heptane. They cannot be specifically identified by mass spectrometry. These compounds like other methylated alkanes would be expected to be components of exhaust. This compound was found in auto exhaust at a concentration of 200 ug/m3.

The average concentration of this compound in the background was found to be 0.1 ug/m3 with the range of values from 0.0 ug/m3 to 0.3 ug/m3. The highest value was found on the first day of sampling and since this compound is found in auto exhaust is associated with the activities from the north of the sampling location on that day. The average omitting this value is 0.0 ug/m3.

The average concentration of this compound in the upwind sample location UPW was found to be 0.1 ug/m3 with the range of values from 0.0 ug/m3 to 0.2 ug/m3. This average value is higher than the adjusted average from the background and the same as the unadjusted background average.

The average concentration of this compound in the downwind sample location DWN was found to be 0.1 ug/m3 with the range of values from 0.1 ug/m3 to 0.2 ug/m3. This value is the same as that found in the background or in the upwind location.

The average concentration of this compound in the downwind sample location DWS was found to be 0.2 ug/m3 with the range of values from 0.1 ug/m3 to 0.3 ug/m3. This average is 100% higher than for DWN, the background or the upwind locations.

The average concentration of this compound in the downwind grab samples was found to be 0.2 ug/m3 with the range of values from 0.1 ug/m3 to 0.2 ug/m3. The highest value was found in the DWS #7 odor sample that was taken when jet exhaust was clearly present. The average value is the same as that for either of the DWS composite samples, and 100% higher than for the DWN, the background or the upwind locations. From this data it can be concluded that this compound results in increase atmospheric levels as a result of activities at the airport.

17.35 n-Octane

n-Octane was a target compound for this investigation having been reported in the literature as a component of jet exhaust. It was not identified as a component of auto exhaust.

This compound was not found to be present in the background sampling location.

This compound was also not found to be present in the upwind sampling location.

This compound was found in one sample taken at the sample location DWN on the first day at a concentration of 0.2 ug/m3. It was not found to be present in subsequent sampling events.

This compound was not found to be present in any of the composite samples taken at sample location DWS. However, it was found in both of the grab samples at an average concentration of 0.2 ug/m3. The largest concentration found was found in sample DWS #7 odor which was taken when it was apparent that jet exhaust was present. This compound is probably a component of jet fuel and its presence is a result of incomplete combustion of this material. From this data it is clear that this compound is a component of jet exhaust and its concentration in the ambient air downwind of the airport is a direct result of activities at the airport.

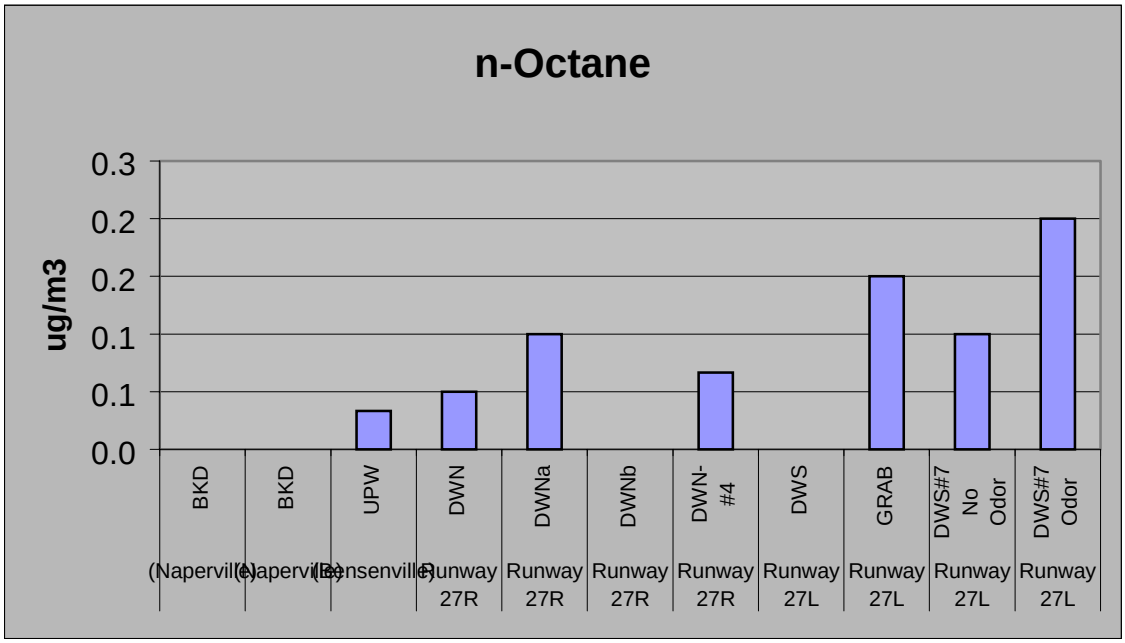


Figure 86. Results of VOC Analysis for n-Octane.

17.81 Tetrachloroethene

Tetrachloroethene is another chlorinated hydrocarbon that was not a target of this investigation and would not be expected to be a component of jet exhaust. It is used industrially as a degreasing solvent and as a dry cleaning solvent.

The average concentration of this compound in the background was found to be 0.8 ug/m3 with the range of values from 0.0 ug/m3 to 1.4 ug/m3. This compound was detected in two of the three samples, BKD #1 and BKD #3 both at levels above 1.0 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 0.4 ug/m3 with the range of values from 0.1 ug/m3 to 0.8 ug/m3.

The average concentration of this compound in the downwind location DWN was found to be 0.9 ug/m3 with the range of values from 0.0 ug/m3 to 2.9 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 1.1 ug/m3 with the range of values from 0.2 ug/m3 to 4.1 ug/m3. The average concentration of this compound in the downwind grab samples was found to be 0.2 ug/m3 with the range of values form 0.1 ug/m3 to 0.3 ug/m3.

This compound as with some of the other chlorinated compounds produced different results by the two different instruments that were used to analyze the samples. In each case, the samples analyzed from Test #5 and Test #6 grab samples resulted in significantly higher concentrations of this compound being reported. From analysis of the data it does not appear that this compound is elevated in any samples taken downwind of the airport.

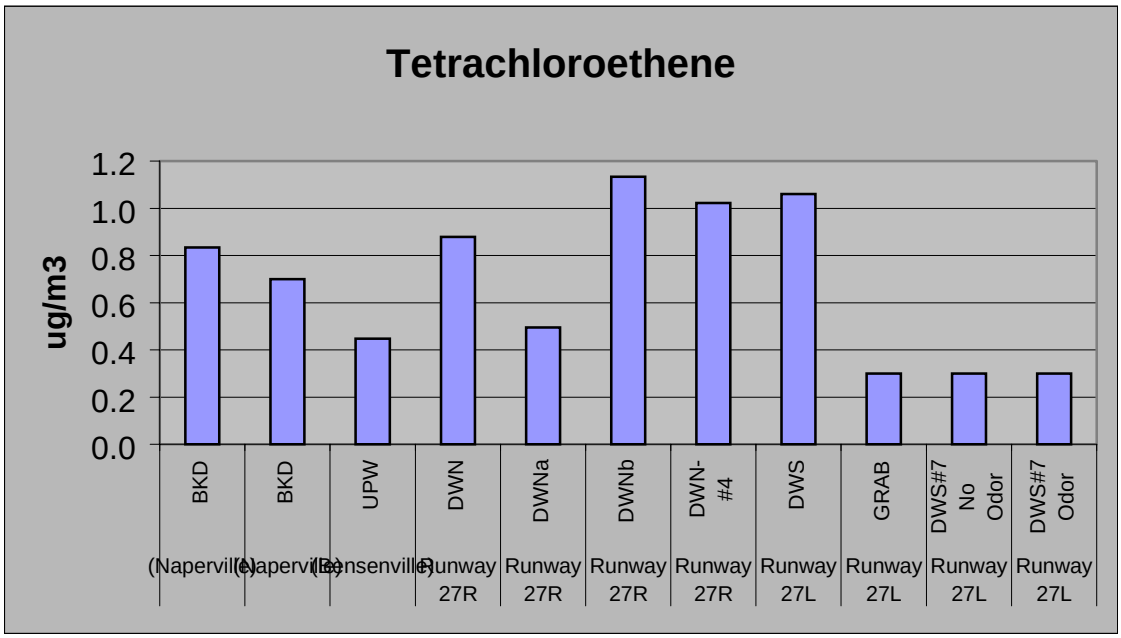


Figure 87. Results of VOC Analysis for Tetrachloroethene.

18.35 Hexamethylcyclotrisiloxane (HMCS)

This compound is a siloxane compound and it along with several other siloxane or silane compounds were identified in this investigation. This compound was not a target compound of this investigation. The compound is used extensively in adhesives, lubricants and coatings. This compound would not be expected to be a component of fuel exhaust and was not found in the analysis of the auto exhaust.

The average concentration of this compound in the background was found to be 26.7 ug/m3 with the range of values from 0.0 ug/m3 to 80 ug/m3. The value of 80 was found on the third day of sampling and was the only background sample in which this compound was found.

The average concentration of this compound in the upwind locations UPW was found to be 12.1 ug/m3 with the range of values from 0.0 ug/m3 to 40 ug/m3.

The average concentration of this compound in the downwind location DWN was found to be 1.7 ug/m3 with the range of values from 0.0 ug/m3 to 8.0 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 0.1 ug/m3 with the range of values from 0.0 ug/m3 to 0.2 ug/m3. The average of the downwind grab samples was found to be 0.3 ug/m3 with the range of values from 0.2 ug/m3 to 0.3 ug/m3.

From the data it is obvious that this compound is not related to activities at O'Hare airport. This compound appears in only one or two samples at each location and at levels that are hundreds of times higher than what is usually found. It is clearly associated with some activity in which material containing this compound was used on the day that it appears and near the location in which it was found. An example would be the use of a silicone based caulking material.

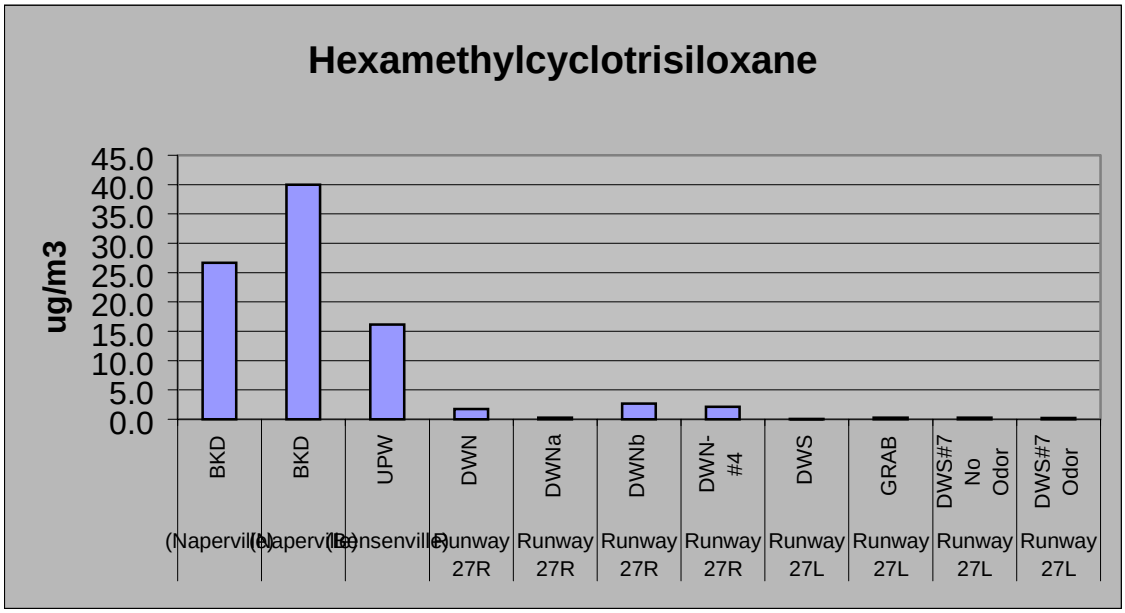


Figure 88. Results of VOC Analysis for Hexamethylcyclotrisiloxane.

19.48 Unidentified Compound

The average concentration of this compound in the background was found to be 0.1 ug/m3 with the range of values from 0.0 ug/m3 to 0.2 ug/m3. The 0.2 ug/m3 value was found in the sample from the first day of sampling, which indicates that this compound is related to others that are associated with the background when the wind is from the north.

The average concentration of this compound in the upwind location UPW was found to be 0.0 ug/m3. This compound was not detected in the UPW location in any of the samples.

The average concentration of this compound in the downwind location DWN was found to be 0.5 ug/m3 with the range of values from 0.0 ug/m3 to 1.84 ug/m3. The high value 1.84 ug/m3 was found in sample DWN #2, other values were close to the background level. The average concentration of this compound in the downwind location DWS was found to be 1.2 ug/m3 with the range of values from 0.0 ug/m3 to 4.0 ug/m3. The value of 4.0 ug/m3 (DWS #1) and a value of 0.6 ug/m3 (DWS #2) were significantly higher than other samples at this location and than the background. The average concentration of the downwind grab samples was found to be 0.2 ug/m3 with the range of values from 0.0 ug/m3 to 0.4 ug/m3.

This compound, whose identity has not been determined, appears to come and go with the highest concentrations detected downwind from the airport. The only conclusion that can be reached is that some activity at the airport is that does not occur on a regular basis is causing this compound to be emitted at significantly higher levels than in the background or upwind of the airport.

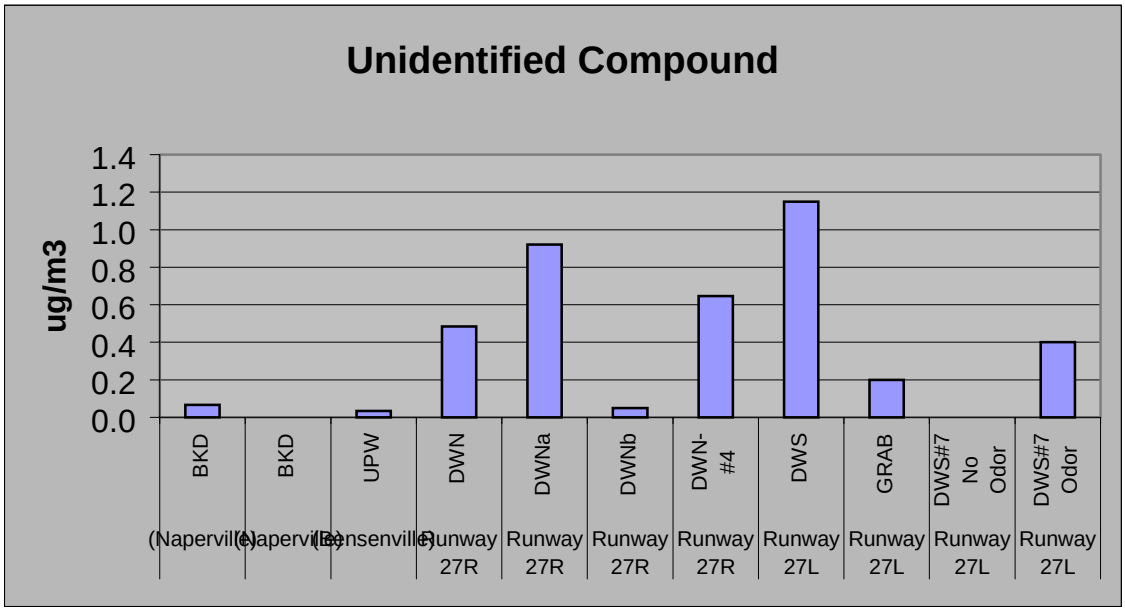


Figure 89. Results of VOC Analysis for Unidentified Comound.

19.62 Ethylbenzene

Ethylbenzene is an aromatic compound that is closely associated with benzene and toluene in atmospheric investigations. It is thought to be generated by combustion of fuel and was a target compound for this investigation. It was found in the analysis of the auto exhaust at a concentration of 280 ug/m3 and reported in jet exhaust at a concentration of 5,937 ug/m3.

The average concentration of this compound in the background was found to be 1.1 ug/m3 with the range of values from 0.3 ug/m3 to 2.0 ug/m3. Values of 1.0 ug/m3 and the high value of 2.0 ug/m3 were found in samples BKD #1 and BKD #3 respectively.

The average concentration of this compound in the upwind location UPW was found to be 0.4 ug/m3 with the range of values from 0.0 ug/m3 to 0.7 ug/m3.

The average concentration of this compound in the downwind location DWN was found to be 0.8 ug/m3 with the range of values from 0.5 ug/m3 to 0.95 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 0.8 ug/m3 with the range of values from 0.7 ug/m3 to 1.0 ug/m3. The average concentration of this compound in the downwind grab samples was found to be 0.9 ug/m3 with the range of values from 0.7 ug/m3 to 1.3 ug/m3.

The background sample contained quantities of ethylbenzene that were higher than that found at O'Hare, and the results did not appear to be associated with wind direction as with many other compounds. This compound is associated with combustion of fuel, and the results indicate that even though higher concentrations existed in the background sample, this compound was detected in higher concentrations downwind from the airport when compared with the upwind location on average as well as higher levels found at the downwind locations. Ethylbenzene was found in the annual average of Jardine location in Chicago at a concentration of 0.48 ug/M3. This value is considerably lower than that found for the averages at any of the O'Hare downwind locations.

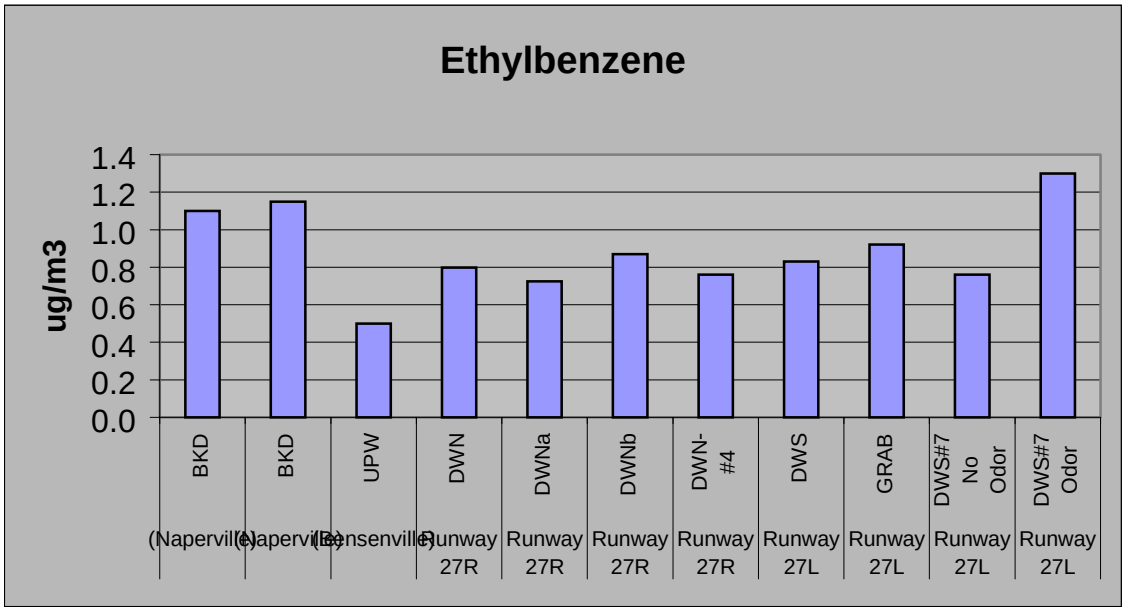


Figure 90. Results of VOC Analysis for Ethylbenzene.

19.82 Unidentified Compound

The average concentration of this compound in the background location was found to be 0.0 ug/m3. The compound was not found in any of the samples.

The average concentration of this compound in the upwind location UPW was found to be 0.3 ug/m3 with the range of values from 0.0 ug/m3 to 1.0 ug/m3. The only upwind sample in which this compound was found was UPW #3.

The average concentration of this compound in the downwind location DWN was found to be 0.2 ug/m3 with the range of values from 0.0 ug/m3 to 0.6 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 11.5 ug/m3 with the range of values from 0.5 ug/m3 to 40.0 ug/m3. In sample DWS #1, this compound was found at 40.0 ug.m3 and in sample DWS #4 this compound was found at 5.0 ug/m3. The average concentration of this compound in the downwind grab samples was found to be 0.7 ug/m3 with the range of values from 0.0 ug/m3 to 2.1 ug/m3.

This compound is associated with some activity in the southeast area of O'Hare. The highest values were found in both eight hour composite samples and in the grab samples, it is not clear from the available data whether this compound is associated with jet exhaust or some other activity, but it is clear that it is significantly higher downwind from the airport than in either the upwind or background locations.

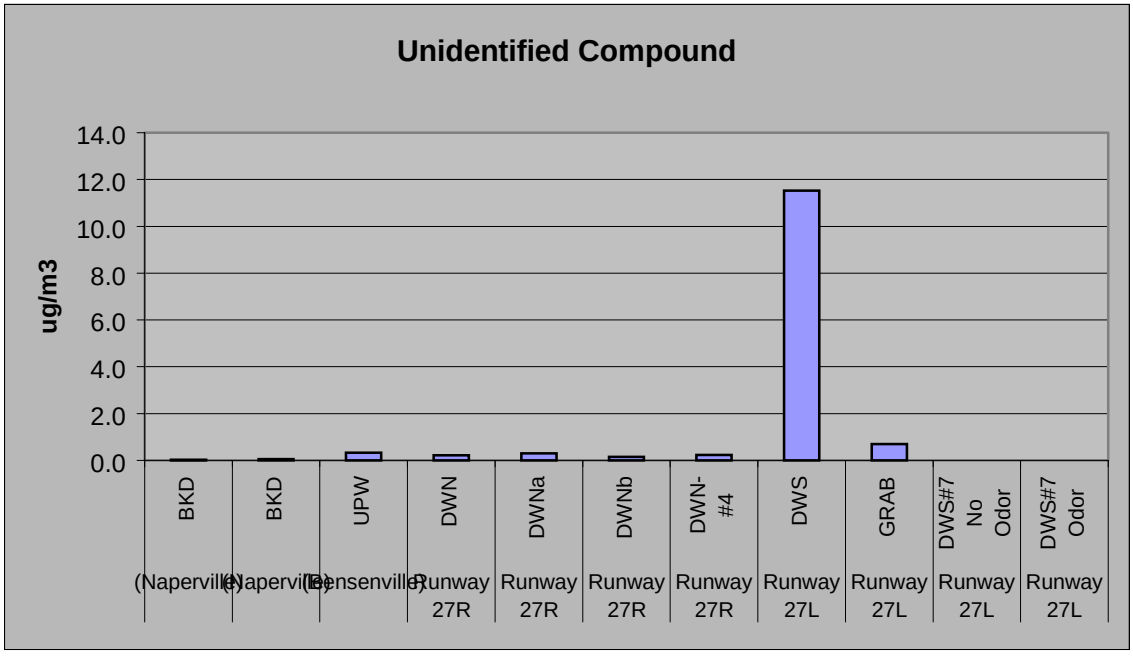


Figure 91. Results of VOC Analysis for Unidentified Compound.

19.94 m & p Xylenes

m & p Xylenes are two isomers of xylene that are associated with benzene, toluene and ethylbenzene and their ambient concentrations in air are generally attributed to the combustion of fuel. This compound was a target compound for this investigation. These compounds were found in the analysis of the auto exhaust at a concentration of 1,000 ug/m3 and were reported in jet exhaust at a concentration of 823 ug/m3.

The average concentration of this compound in the background was found to be 1.3 ug/m3 with the range of values from 0.5 ug/m3 to 2.4 ug/m3. As with many other compounds that have been identified in the background samples, the highest concentration of this compound was found in the first day's sample. Recalculating the average omitting this high value results in a background average of 0.8 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 1.3 ug/m3 with the range of values from 0.0 ug/m3 to 2.5 ug/m3. The average value is 63% higher than the adjusted value found in the background.

The average concentration of this compound in the downwind location DWN was found to be 2.4 ug/m3 with the range of values from 1.4 ug/m3 to 3.1 ug/m3. Eliminating the concentration from the sample DWN #4 results in an average of 2.2 ug/m3. This value is 175% higher than the background and 70% higher than the upwind location. The average concentration of this compound in the downwind location DWS was found to be 2.2 ug/m3 with the range of values from 1.9 ug/m3 to 2.8 ug/m3. This average is identical to the DWN location. The average concentration of this compound in the downwind grab samples was found to be 2.6 ug/m3 with the range of values from 1.7 ug/m3 to 4.0 ug/m3. This average is 225% higher than the background and 100% higher than the upwind location.

This compound is associated with both auto and jet exhaust. From the data, similar average concentrations were found in the background and in the upwind samples. The downwind samples all showed higher average concentrations than the upwind or the background, indicating that the jet exhaust is contributing to the overall background of this compound downwind of the airport. m & p-Xylenes was found in the annual average of Jardine location in Chicago at a concentration of 1.69 ug/M3. This value is considerably lower than that found for the averages at any of the O'Hare downwind locations.

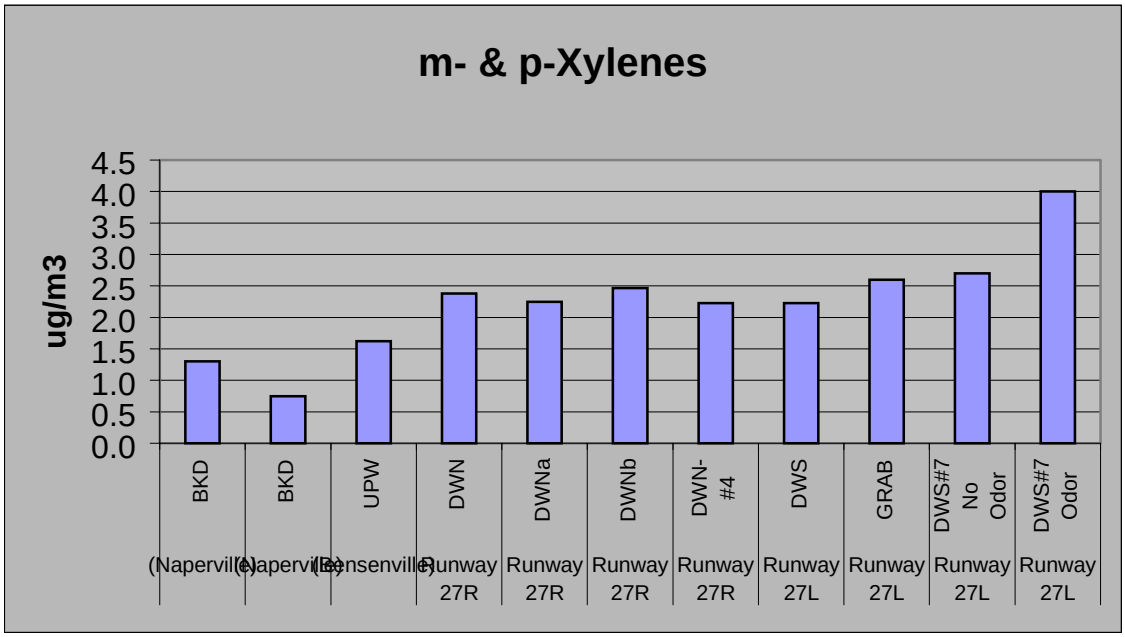


Figure 92. Results of VOC Analysis for m- & p-Xylenes.

20.15 Cyclohexanone

Cyclohexanone was not a target compound of this investigation having not previously been reported in the literature as a component of jet exhaust. It was not found as a component of auto exhaust. It is used commercially in wood stains, paint and varnish removers, spot removers, in metal degreasing and as a lubricating oil additive.

The average concentration of this compound in the background sample locations was found to be 0.4 ug/m3 with the range of values from 0.3 ug/m3 to 0.5 ug/m3. The concentrations decreased linearly from the first days sampling to the third.

The average concentration of this compound in the upwind sample location UPW was found to be 0.4 ug/m3 with the range of values from 0.2 ug/m3 to 0.7 ug/m3. The average value found is the same as that found in the background.

The average concentration of this compound in the downwind sample location DWN was found to be 0.8 ug/m3 with the range of values from 0.3 ug/m3 to 1.5 ug/m3. High values were found on day two and day three. There did not appear to be an impact from the auto rental facility in any of the samples. The average value is 100% higher than for either the background or the upwind locations.

The average concentration of this compound in the downwind sample location DWS was found to be 1.1 ug/m3 with the range of values from 0.3 ug/m3 to 1.6 ug/m3. The average

value is 175% higher than the background or upwind locations, and 37% higher than the DWN location.

The average concentration of this compound in the grab samples was found to be 0.7 ug/m3 with the value of 0.1 ug/m3 found in the sample when no jet exhaust was present, and 1.2 ug/m3 when the jet exhaust was present. The latter is 200% higher than the background or upwind locations. From the data it is clear that this compound is a component of jet exhaust and increases in the ambient concentration of this compound can be attributed to airport activities.

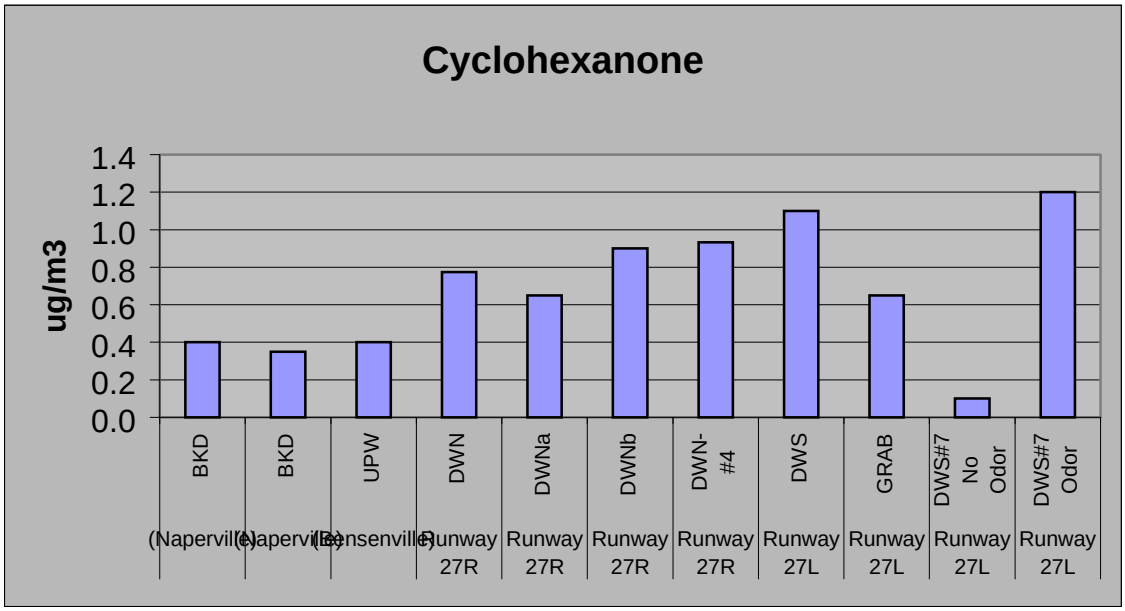


Figure 93. Results of VOC Analysis for Cyclohexanone.

20.49 Heptanal

Heptanal which is an aldehyde was a target compound of this investigation. It was not identified in auto exhaust and was not reported as a component of jet exhaust. It is characterized by a penetrating fruity odor and has a detection odor threshold of 13.98 ug/m3.

The average concentration of this compound in the background was found to be 0.9 ug/m3 with the range of values from 0.4 ug/m3 to 1.7 ug/m3. The highest value was found in the sample on the third day.

The average concentration of this compound in the upwind location UPW was found to be 0.3 ug/m3 with the range of values from 0.0 ug/m3 to 1.2 ug/m3.

The average concentration of this compound in the downwind location DWN was found to be 1.0 ug/m3 with the range of values from 0.0 ug/m3 to 2.0 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 1.0 ug/m3 with the range of values from 0.6 ug/m3 to 1.5 ug/m3. The average concentration of this compound in the downwind grab samples was 10.2 with the range of values from 0.3 ug/m3 to 20.0 ug/m3.

As with Hexanal, this compound was found at the highest concentration in the downwind sample DWS #7 odor. In fact the concentration that it was found at exceeds the published odor detection threshold for this compound. The fact that this compound was not detected above background in the sample DWS #7 no odor reinforces the conclusion that this compound is one of the compounds that contributes to the characteristic odor of jet exhaust at the airport. This compound was also found to be present downwind from the airport in concentrations that were significantly higher on average than in the background or upwind of the airport. This compound is definitely a component of jet exhaust and a contributor to the odor of the airport.

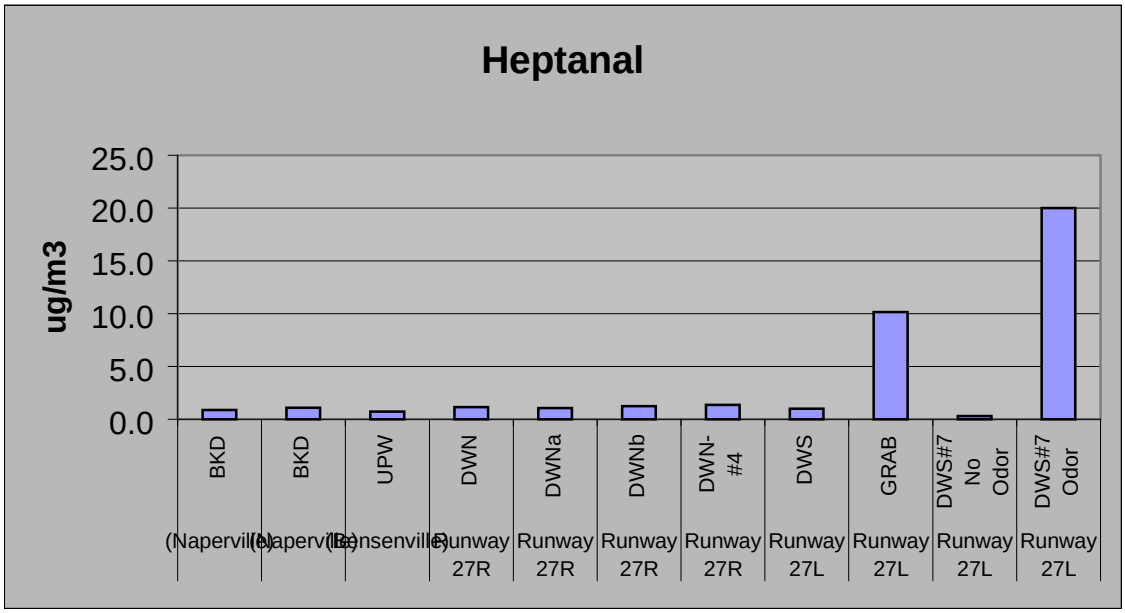


Figure 94. Results of VOC Analysis for Heptanal.

20.52 Styrene (vinylbenzene, cinnamene)

Styrene is one of the highest volume chemicals produced in the United States. It has a characteristic aromatic odor. It is used in the manufacture of polystyrene plastic and various protective coatings such as styrene-butadiene latex and alkyds. It was found in the analysis of the auto exhaust at a concentration of 42 ug/m3 and was reported as a component of jet exhaust at a concentration of 723 ug/m3.

This compound was found to be present at only two sampling locations. It was found in a background sample at a concentration of 0.2 ug/m3. It was also detected in three samples at the DWS location at an average concentration of 0.4 ug/m3 which is a 100 % increase over the background. The range of values found in the DWS location were from 0.2 ug/m3 to 0.9 ug/m3. The fact that this compound was not found at detectable concentrations in, for example, the DWS #7 odor sample is not surprising, as its retention time is very close to that of the previous compound heptanal which was found at many of the locations at elevated levels, thus masking the existence of this compound. It appears from the data that increased levels of this compound can be expected in the ambient air downwind from the airport as a result of airport activities.

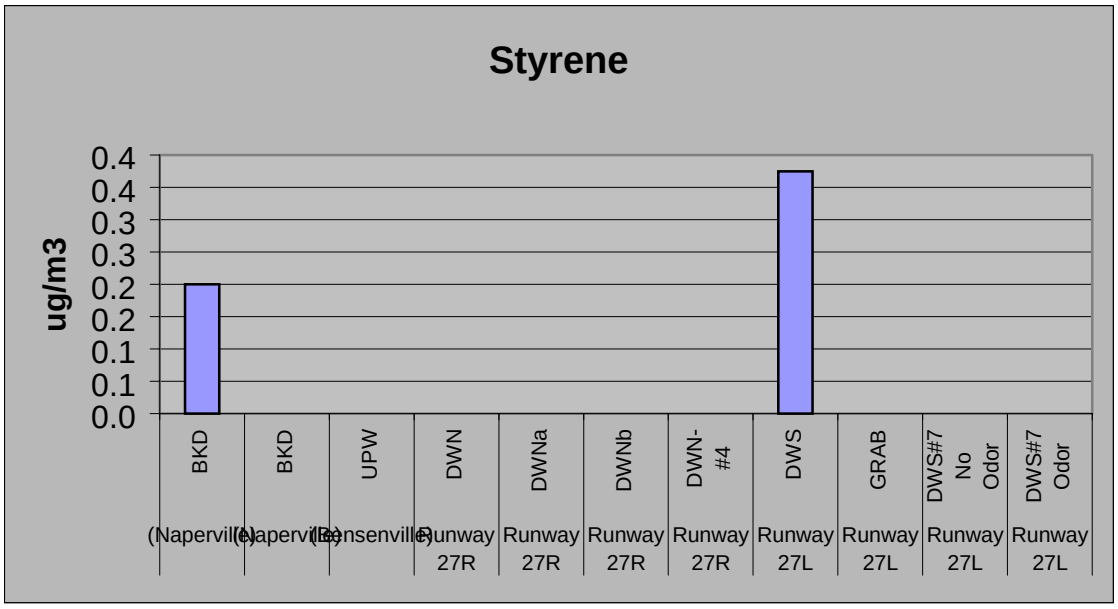


Figure 95. Results of VOC Analysis for Styrene.

20.70 o-Xylene

o-Xylene is the other isomer of xylene that is related to the combustion of fuels and is present in the ambient air as a result of this activity. It was found in the auto exhaust sample at a concentration of 380 ug/m3 and was reported as a component of jet exhaust at a concentration of 433 ug/m3.

The average concentration of this compound in the background was found to be 0.5 ug/m3 with the range of values from 0.87 ug/m3 to 0.1ug/m3. As with other compounds identified in the background, the highest concentration was found on the first day of sampling. Recalculating the average omitting this day's contribution results in a background average of 0.3 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 0.6 ug/m3 with the range of values from 0.0ug/m3 to 0.88 ug/m3. This average is an increase of 100% over the background concentration.

The average concentration of this compound in the downwind location DWN was found to be 1.0 ug/m3 with the range of values from 0.9 ug/m3 to 1.1 ug/m3. This is a 233% increase over the background and a 67% increase overt the upwind location. The average concentration of this compound in the downwind location DWS was found to be 1.0 ug/m3 with the range of values from 0.7 ug/m3 to 1.35 ug/m3. This average is the same as for the DWN location. The average concentration of this compound in the downwind grab samples was 1.0 ug/m3 with the range of values from 0.71 ug/m3 to 1.5 ug/m3.

As expected, this compound was found in almost all of the samples. The average in the background and upwind locations were around 0.5 ug/m3 with the downwind locations and grab samples all showing a significant increase of double this amount. From the data, it is clear that this compound is being emitted by activities at O'Hare and that the concentration increment over the background or upwind locations is probably due to jet exhaust. This activity effectively doubles the amount of this compound downwind from the airport. o-Xylene was found in the annual average of Jardine location in Chicago at a concentration of 0.69 ug/M3. This value is considerably lower than that found for the averages at any of the O'Hare downwind locations.

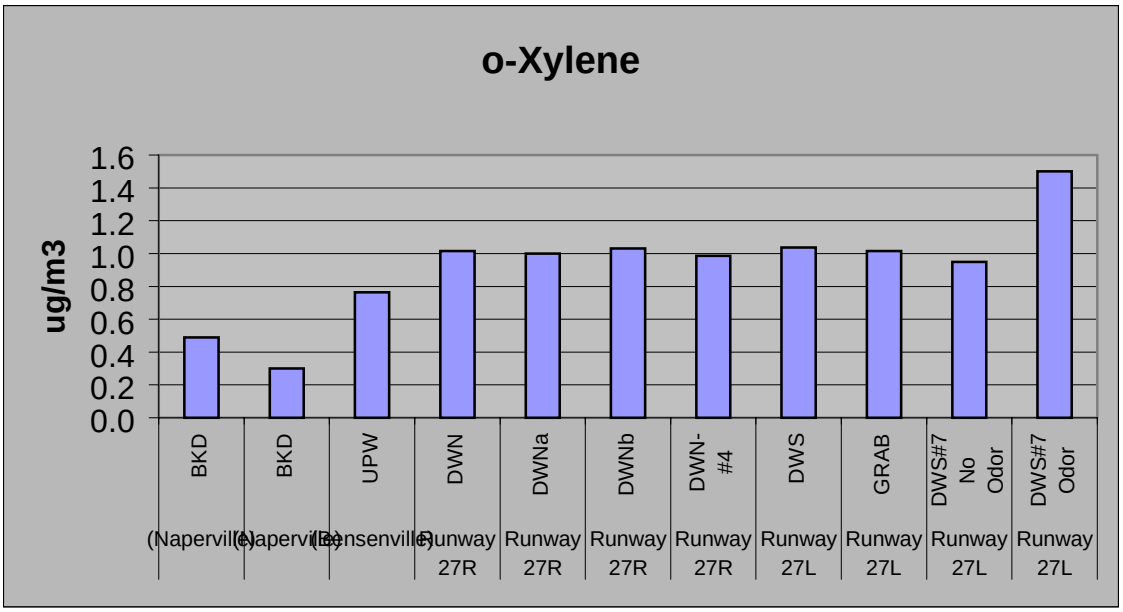


Figure 96. Results of VOC Analysis for o-Xylene.

20.76 Butoxyethanol + Hexylene Glycol

These two compounds co-elute. These compounds were not target compounds of this investigation. Butoxyethanol is also known as ethylene glycol monobutyl ether and is used in spray lacquers, varnishes, enamels and as a dry cleaning compound. Hexylene glycol is used in hydraulic brake fluids, printing inks, as a fuel additive and as an inhibitor for ice formation in carburetors. These compounds were found in the analysis of the auto exhaust at an approximate concentration of 50 ug/m3, they were not reported as a component of jet exhaust.

The average concentration of these compounds in the background was found to be 13.4 ug/m3 with the range of values from 0.0 to 40.0 ug/m3. The highest value was found in the third day's sample.

The average concentration of these compounds in the upwind location UPW was found to be 0.4 ug/m3 with the range of values from 0.0 ug/m3 to 0.7 ug/m3.

The average concentration of these compounds in the downwind location DWN was found to be 0.3 ug/m3 with the range of values from 0.1 ug/m3 to 0.5 ug/m3. The average concentration of these compounds in the downwind location DWS was found to be 0.9 ug/m3 with the range of values from 0.1 ug/m3 to 2.6 ug/m3. A single high value of 2.6 ug/m3 was found in sample DWS #1. The average concentration of these compounds in the downwind grab samples was found to be 0.4 ug/m3 with the range of values from 0.2 ug/m3 to 0.5 ug/m3.

Except for the very high value of 40.0 ug/m3 found in the BKD #3 sample and the 2.6 ug/m3 found in the DWS #1 sample, these compounds were found at levels that were pretty much the same in all samples. The high concentration found in the background is probably associated with several other compounds that were found at elevated levels in this sample and are related to home construction activities such as caulking, painting, etc. This would also lead one to conclude that in this sample (BKD #3) that the concentration reported was primarily butoxyethanol. The high value in the DWS #1 sample could be a result of similar maintenance operations at O'Hare such as painting, or could be related to the other compound which is more closely associated with hydraulic fluids, etc. It appears from the data that it can be concluded that occasionally, this compound would be found downwind from O'Hare as a result of airport activities.

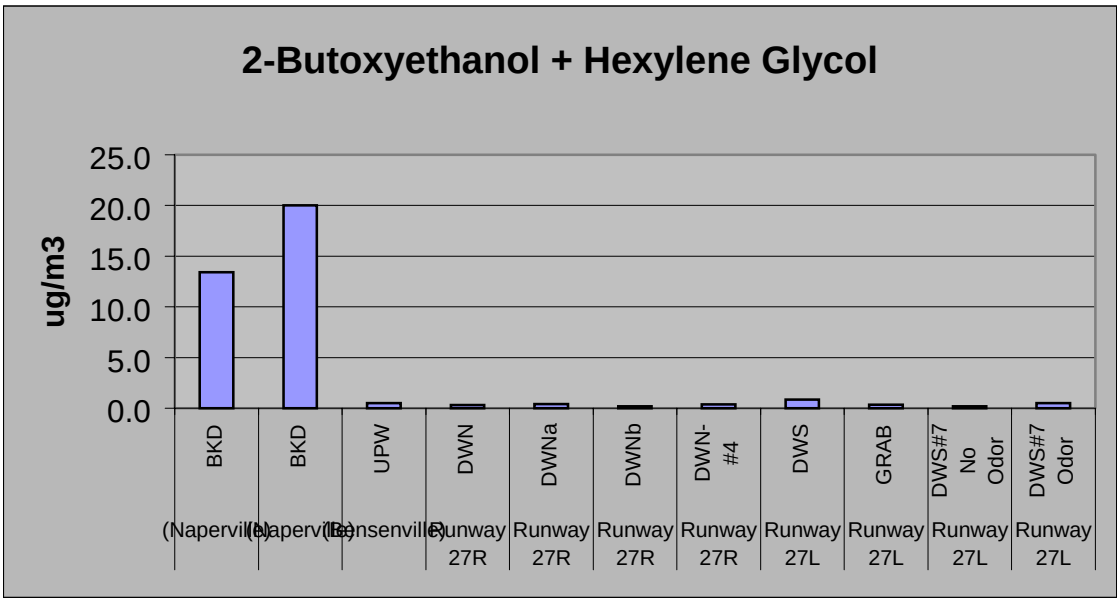


Figure 97. Results of VOC Analysis for 2-Butoxyethanol + Hexylene Glycol.

21.13 n-Nonane

Nonane is a straight chain alkane that was a target compound for this investigation and would be expected to be a compound that might result from the incomplete combustion of fuel. This compound was found in the analysis of the auto exhaust at a concentration of approximately 30 ug/m3 and was reported as a component of jet exhaust at a concentration of 314 ug/m3.

The average concentration of nonane in the background was found to be 0.6 ug/m3 with the range of values from 0.3 ug/m3 to 1.0 ug/m3. As with other compounds identified in the background, the highest value was found in the first day's sample and is attributed to activity in downtown Naperville. Recalculating the average omitting the first day's contribution results in a new average of 0.4 ug/m3

The average concentration of nonane in the upwind location UPW was found to be 0.4 ug/m3 with the range of values from 0.0 ug/m3 to 0.6 ug/m3. The average concentration in this location is the same as that found in the background without the first day's contribution.

The average concentration of nonane in the downwind location DWN was found to be 1.0 ug/m3 with the range of values from 0.3 ug/m3 to 1.4 ug/m3. This average is about 150% higher than that found in the background or the upwind locations. The average concentration of nonane in the downwind location DWS was found to be 1.1 ug/m3 with

the range of values from 0.7 ug/m3 to 2.0 ug/m3. The average concentration of this compound in the downwind grab samples was found to be 0.9 ug/m3 with the range of values from 0.8 ug/m3 to 1.1 ug/m3.

From the data it appears that nonane is a combustion product of fuel and that in all of the downwind locations and grab samples taken at the airport is at significantly higher values than the upwind or background locations. This compound is a result of both jet engine exhaust and other types of engine exhaust at the airport. n-Nonane was found in the annual average of Jardine location in Chicago at a concentration of 0.52 ug/M3. This value is considerably lower than that found for the averages at any of the O'Hare downwind locations.

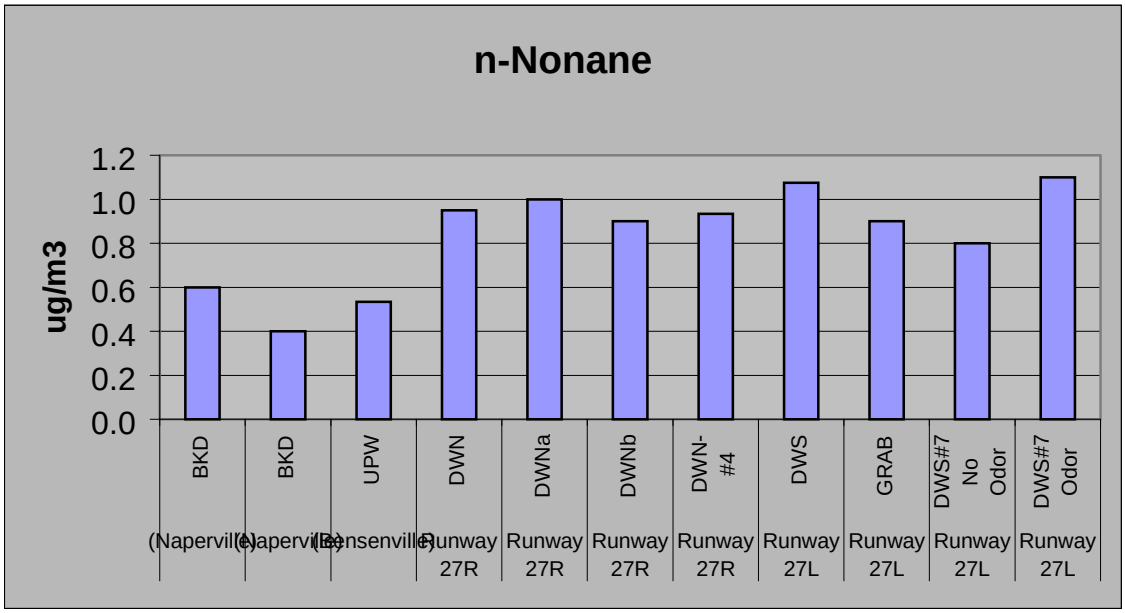


Figure 98. Results of VOC Analysis for n-Nonane.

22.26 Benzaldehyde + 2-Ethylhexanal

These two compounds co-elute. Benzaldehyde and 2-Ethylhexanal are aldehyde compounds that would be expected to occur as a result of the incomplete combustion of fuel. Benzaldehyde was a target compound of this investigation. It was reported to be a component of jet exhaust at a concentration of 1,170 ug/m3 and was found to be present in the auto exhaust sample at an insignificant concentration.

The average concentration of these compounds in the background was found to be 0.8 ug/m3 with the range of values from 0.5 ug/m3 to 1.3 ug/m3. The highest value was found in the second day's sample.

The average concentration of these compounds in the upwind location was found to be 2.7 ug/m3 with the range of values from 0.0 ug/m3 to 8.0 ug/m3. The highest concentration was found in sample UPW #3 which was impacted more than on other days by some activity that was related to fuel combustion.

The average concentration of these compounds in the downwind location DWN was found to be 4.4 ug/m3 with the range of values from 2.0 ug/m3 to 7.0 ug/m3. This average value is significantly higher than either the upwind of background locations. The average concentration of these compounds in the downwind location DWS was found to be 2.4 ug/m3 with the range of values from 0.7 ug/m3 to 4.0 ug/m3. This average concentration is lower than that found in the DWN location, but is significantly higher than in the background location. The average concentration of these compounds in the downwind grab samples was found to be 1.0 ug/m3 with the range of values from 0.6 ug/m3 to 1.4 ug/m3.

The data indicates that these compounds are found at significantly higher concentrations in the vicinity of the airport than in the background. The grab samples did not show elevated levels and consequently these two compounds do not appear to be associated with jet exhaust even though they have been reported as present as a major component. They may, however, be associated with other vehicle exhaust and are found at elevated levels in the DWN location pointing to the auto rental activities as a potential source.

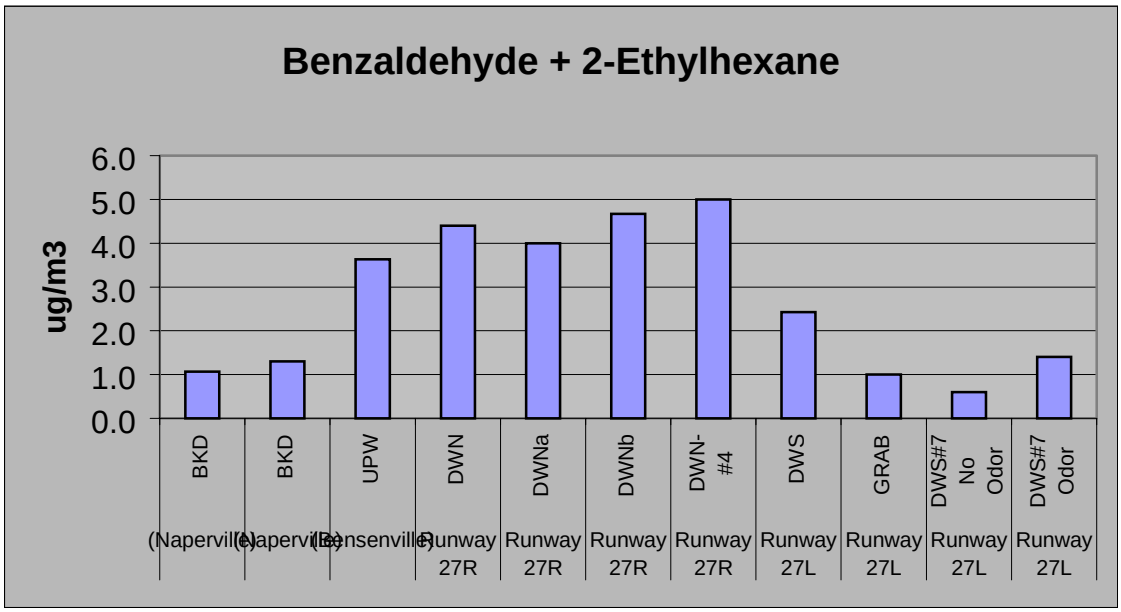


Figure 99. Results of VOC Analysis for Benzaldehyde + 2-Ethylhexane.

22.58 α-Pinene

This compound was not a target compound for this investigation not having been reported as a component in the literature of jet exhaust. It was not found to be present in auto exhaust. It is used commercially as a solvent for protective coatings, as a flavoring agent and as a lube-oil additive.

The average concentration of this compound in the background sampling location was found to be 0.3 ug/m3 with the range of values from 0.1 ug/m3 to 0.6 ug/m3. As with previous samples in the background, the highest concentration was found on the first day of sampling and was associated with an event that occurred north of the sampling location. Omitting this concentration and recalculating the average results in an average background concentration of 0.1 ug/m3.

This compound was not found to be present in any of the samples taken at the upwind location UPW.

The average concentration of this compound found in the downwind sampling location DWN was 0.3 ug/m3 with the range of values from 0.3 ug/m3 to 0.4 ug/m3. The average value is 200% higher than found in the background.

The average concentration of this compound found in the downwind sampling location DWS was 0.3 ug/m3 with the range of values from 0.2 ug/m3 to 0.4 ug/m3. This value is the same as that obtained at the DWN location and 200% higher than in the background.

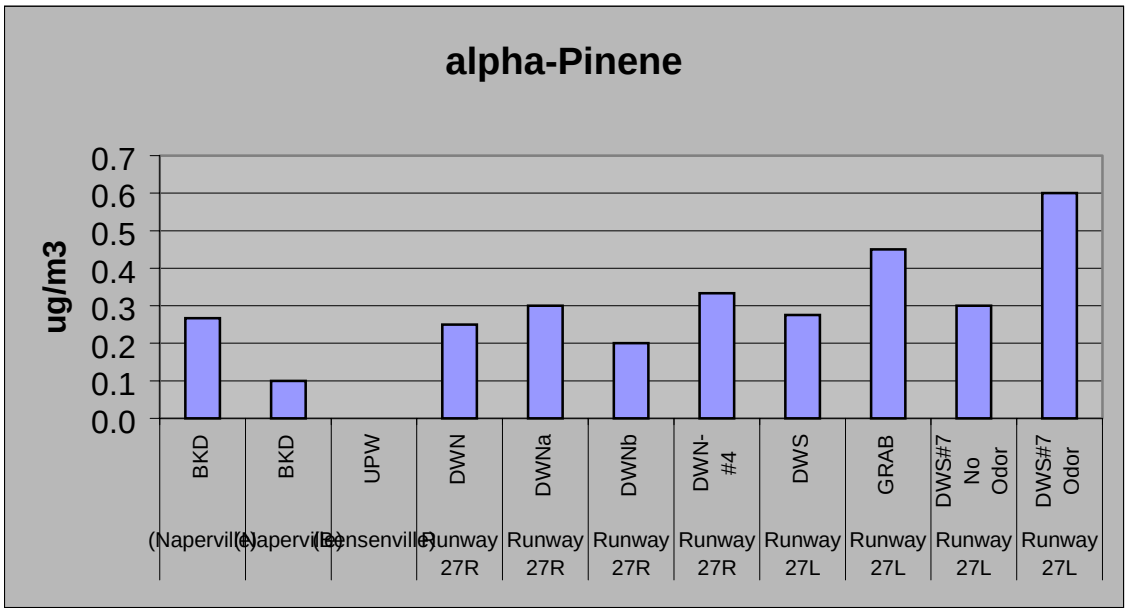


Figure 100. Results of VOC Analysis for α-Pinene.

The average concentration of this compound in the grab samples was found to be 0.5 ug/m3 with the range of values from 0.3 ug/m3 to 0.6 ug/m3. The highest value was found in the DWS #7 odor sample that was taken when jet exhaust was known to be present. The average concentration for the grab samples is 67% higher than for the DWN and DWS composite samples and 400% higher than for the background. From the data it is clear that activities at O'Hare airport are contributing to an increased concentration of this compound in the ambient air downwind from the airport.

22.70 3-Ethyltoluene

This compound was not a target compound of this investigation having not previously been reported in the literature as a component of jet-exhaust. It was found in the analysis of auto exhaust at a concentration of 300 ug/m3.

This compound was not found to be present in the background sampling location.

The average concentration of this compound in the upwind sampling location UPW was found to be 0.3 ug/m3 with the range of values from 0.0 ug/m3 to 0.6 ug/m3. The compound was only found in one upwind sample at the 0.6 ug/m3 concentration.

The average concentration of this compound in the downwind sampling location DWN was found to be 0.8 ug/m3 with the range of values from 0.0 ug/m3 to 1.3 ug/m3. Two samples were found to contain this compound at concentrations of 1 ug/m3 and 1.3 ug/m3. The average concentration is 167% higher than found in the upwind location.

The average concentration of this compound in the downwind sampling location DWS was found to be 0.7 ug/m3 with the range of values from 0.0 ug/m3 to 1.4 ug/m3. Two samples were found to contain this compound at concentrations of 1.2 ug/m3 and 1.4 ug/m3. The average concentration is comparable to that found at the DWN location and 133% higher than that found in the upwind location.

The average concentration of this compound found in the grab samples was 0.6 ug/m3 with the highest concentration found in the DWS #7 no odor sample. This compound was not identified in the DWS #7 odor sample. 3-Ethyltoluene was found in the annual average of Jardine location in Chicago at a concentration of 0.49 ug/M3. This value is considerably lower than that found for the averages at any of the O'Hare downwind locations. From the data it appears that this compound is found at increased concentrations downwind of the airport as a result of airport activities, however, it does not appear to be due to jet exhaust.

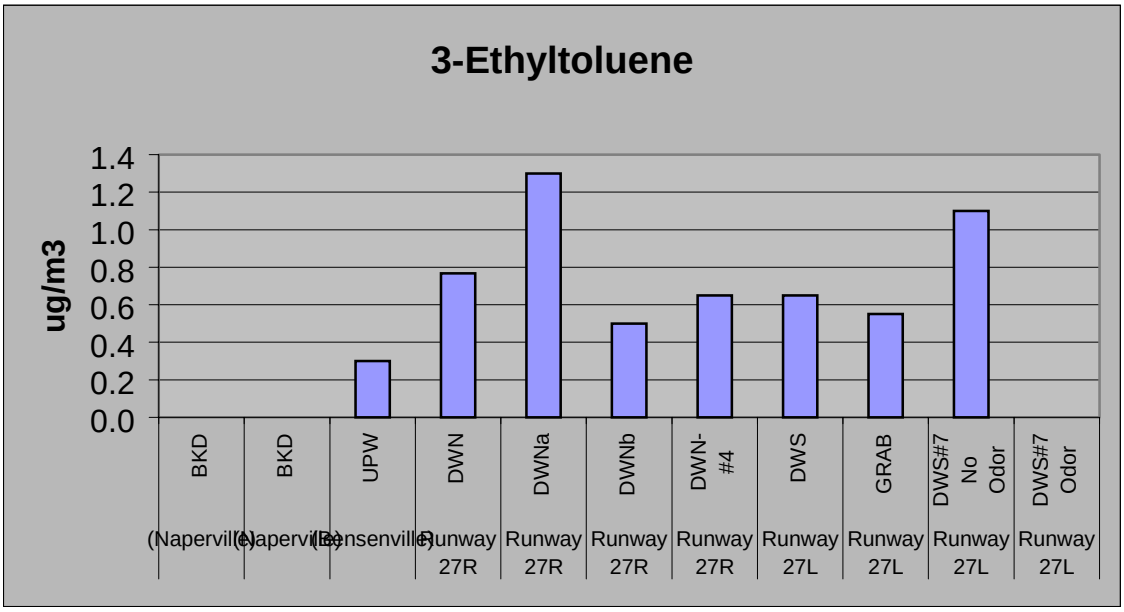


Figure 101. Results of VOC Analysis for 3-Ethyltoluene.

22.80 4-Ethyltoluene

This compound was not a target compound of this investigation having not previously been reported in the literature as a component of jet-exhaust. It was found in the analysis of auto exhaust at an approximate concentration of 100 ug/m3.

This compound was found to be present in one background sampling location from the second day at a concentration of 0.1 ug/m3.

The average concentration of this compound in the upwind sampling location UPW was found to be 0.2 ug/m3 with the range of values from 0.0 ug/m3 to 0.3 ug/m3. The average concentration is 100% higher than that found in the background sample.

The average concentration of this compound in the downwind sampling location DWN was found to be 0.2 ug/m3 with the range of values from 0.0 ug/m3 to 0.5 ug/m3. Two samples were found to contain this compound at concentrations of 0.4 ug/m3 and 0.5 ug/m3. The average concentration is the same as that found in the upwind location.

The average concentration of this compound in the downwind sampling location DWS was found to be 0.3 ug/m3 with the range of values from 0.0 ug/m3 to 0.5 ug/m3. The average concentration is 50% higher than that found at the DWN location and the upwind location.

This compound was not found to be present in any of the grab samples. From the data it appears that this compound is found at increased concentrations downwind of the airport as a result of airport activities, however, it does not appear to be due to jet exhaust.

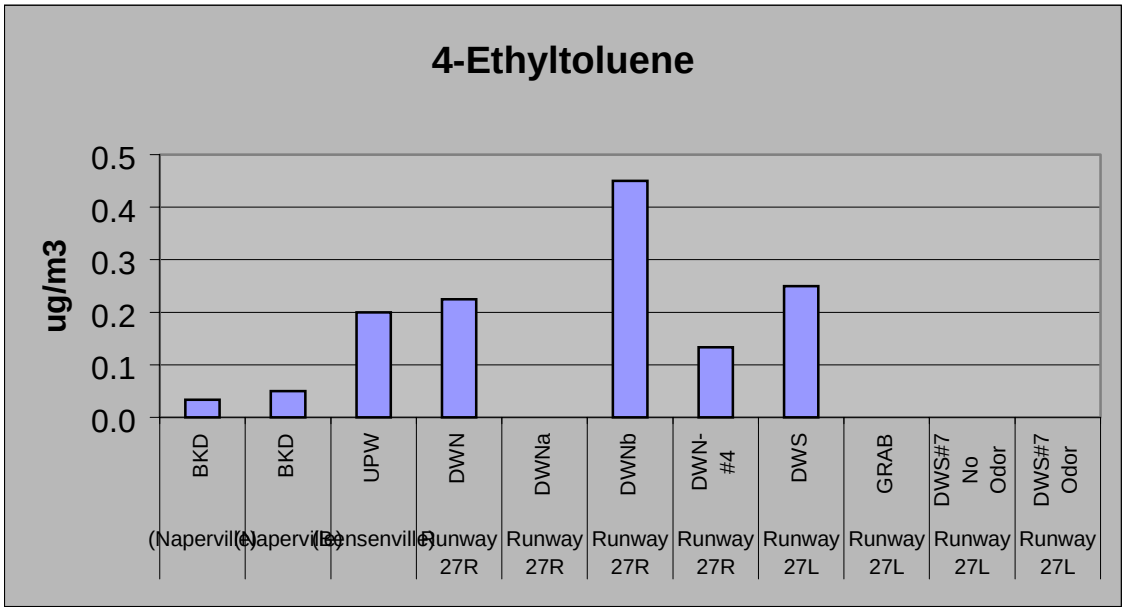


Figure 102. Results of VOC Analysis for 4-Ethyltoluene.

22.90 1,3,5-Trimethylbenzene (Mesitylene)

This compound was not a target compound for this investigation having not previously been reported in the literature as a component of jet exhaust. It was found in the analysis of the auto exhaust at an approximate concentration of 100 ug/m3.

The average concentration of this compound in the background sample location was found to be 0.4 ug/m3 with the range of values from 0.0 ug/m3 to 0.9 ug/m3. As with previous samples, the highest value was found on the first day of sampling and is attributed to some event that occurred north of the sampling location. Recalculating the average omitting this aberration results in a background average for this compound of 0.2 ug/m3.

The average concentration of this compound in the upwind sampling location UPW was found to be 0.5 ug/m3 with the range of values from 0.4 ug/m3 to 0.6 ug/m3. This value is 150% higher than for the background sampling location.

This compound was only found to be present in one sample taken at the DWN location at a concentration of 0.5 ug/m3. This value is comparable to that found in the UPW location.

Similarly, this compound was only identified in one sample taken at the DWS downwind location at a concentration of 0.2 ug/m3. This value is less than half of that found at the DWN location or in the upwind location, and comparable to that found in the background.

The two grab samples in which this compound was identified contained concentrations of 0.7 ug/m3 and 1.3 ug/m3. The higher concentration was found in the DWS #7 odor sample that was taken when jet exhaust was known to be present. The average concentration of this compound for the grab samples is 1.0 ug/m3. This value is 100% higher than that found at the DWN and UPW locations and 400% higher than that found at the DWS and background locations. 1,3,5-Trimethylbenzene was found in the annual average of Jardine location in Chicago at a concentration of 0.29 ug/M3. This value is considerably lower than that found for the averages at any of the O'Hare downwind locations. From the data, it appears that this compound may be present in jet exhaust and that its concentration in the air downwind from the airport is increased as a result of activities at the airport.

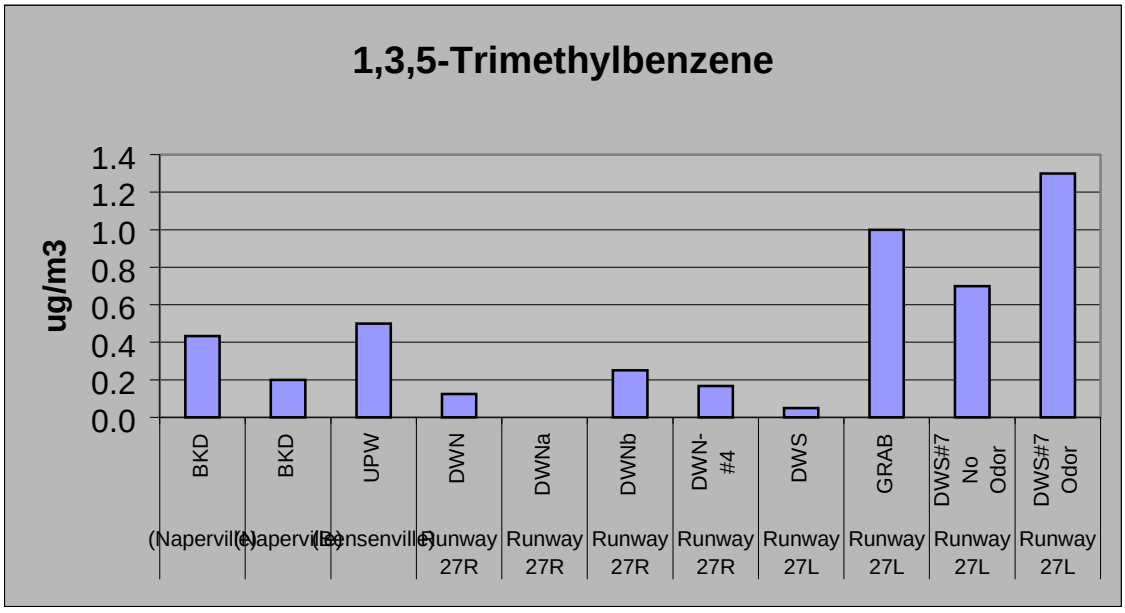


Figure 103. Results of VOC Analysis for 1,3,5-Trimethylbenzene.

23.39 Octanal

Octanal is an aldehyde that was a target compound of this investigation. As with other aldehydes already discussed, it would be expected to be present as a result of combustion of fuel. This compound has a fruity odor and a detection odor threshold of 4 ug/m3. This compound was not found in the analysis of auto exhaust and was not specifically reported as a component of jet exhaust.

The average concentration of this compound in the background was found to be 0.3 ug/m3 with the range of values from 0.0 ug/m3 to 0.7 ug/m3. There does not appear to be an association with wind direction and the concentration found.

The average concentration of this compound in the upwind location UPW was found to be 0.1 ug/m3 with the range of values from 0.0 ug/m3 to 0.1 ug/m3.

The average concentration of this compound in the downwind location DWN was found to be 0.2 ug/m3 with the range of values from 0.1 ug/m3 to 0.3 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 0.2 ug/m3 with the range of values from 0.1 ug/m3 to 0.3 ug/m3. The average concentration of this compound in the downwind grab samples was found to be 15.1 ug/m3 with the range of values from 0.1 ug/m3 to 30 ug/m3. The data indicates that in all locations, the concentration of octanal was essentially at background levels. The only sample in which octanal was found at significant levels was in DWS #7 odor where the concentration was 300 times higher than in other samples.

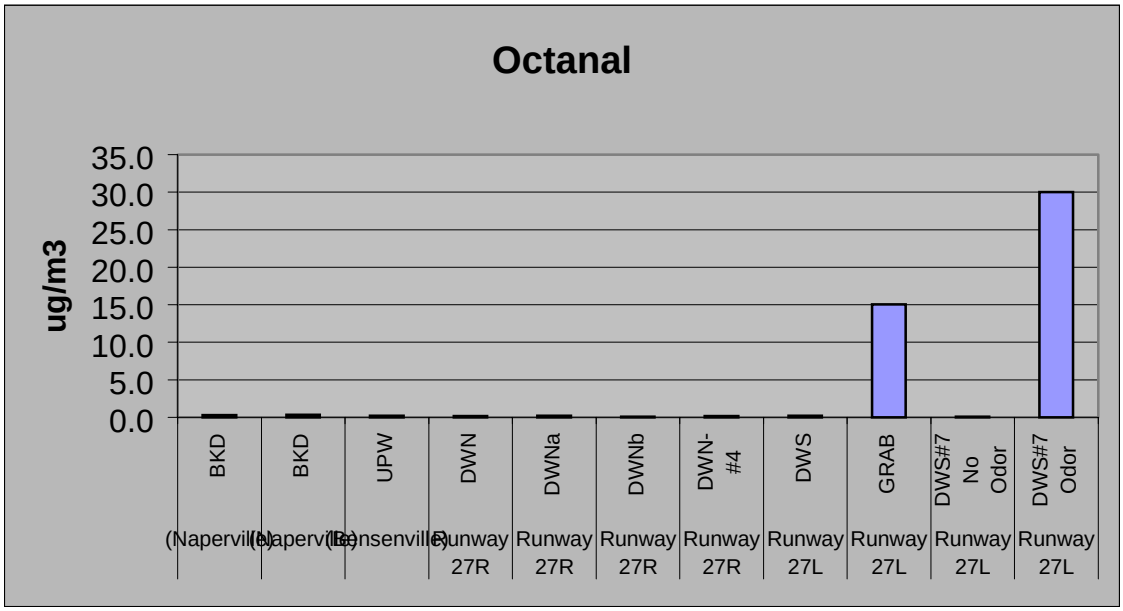


Figure 104. Results of VOC Analysis for Octanal.

This compound is a product of the combustion of jet fuel and is also a component of the characteristic odor of the airport.

23.61 1,2,4-Trimethylbenzene (TMB)

TMB is an aromatic compound that was not a target compound of this investigation. This compound would be expected to be a combustion product of fuel. It was found to be present in the analysis of the auto exhaust sample at a concentration of 300 ug/m3 and was not reported as a component of jet exhaust.

This compound was found in the background at 2.0 ug/m3 only in the sample taken on the first day. It was not identified in either of the other two background samples. Its presence in the first day's sample indicates that it is associated with background activity.

The average concentration of this compound in the upwind location UPW was found to be 0.6 ug/m3 with the range of values from 0.0 ug/m3 to 1.2 ug/m3.

The average concentration of this compound in the downwind location DWN was found to be 1.7 ug/m3 with the range of values from 1.0 ug/m3 to 2.0 ug/m3. This value is 183% higher than the upwind location. The average concentration of this compound in the downwind location DWS was found to be 1.8 ug/m3 with the range of values from 0.8 ug/m3 to 2.8 ug/m3. This value is similar to the value found at DWN and significantly higher than the background or upwind locations.

The average concentration of this compound in the downwind grab samples was found to be 3.0 ug/m3 with the range of values from 2.0 ug/m3 to 4.0 ug/m3. This value is 400% higher than in the upwind location.

The fact that this compound was found in both downwind grab samples at concentrations that were significantly higher than the upwind location points the jet exhaust as the likely source of this compound. Significantly higher concentrations were found at all downwind locations compared to the upwind location indicating that this compound is being emitted into the atmosphere by activities at the airport. The large value found in one of the background samples also points to this compound having an origin associated with auto exhaust as well. 1,2,4-Trimethylbenzene was found in the annual average of Jardine location in Chicago at a concentration of 0.69 ug/M3. This value is considerably lower than that found for the averages at any of the O'Hare downwind locations.

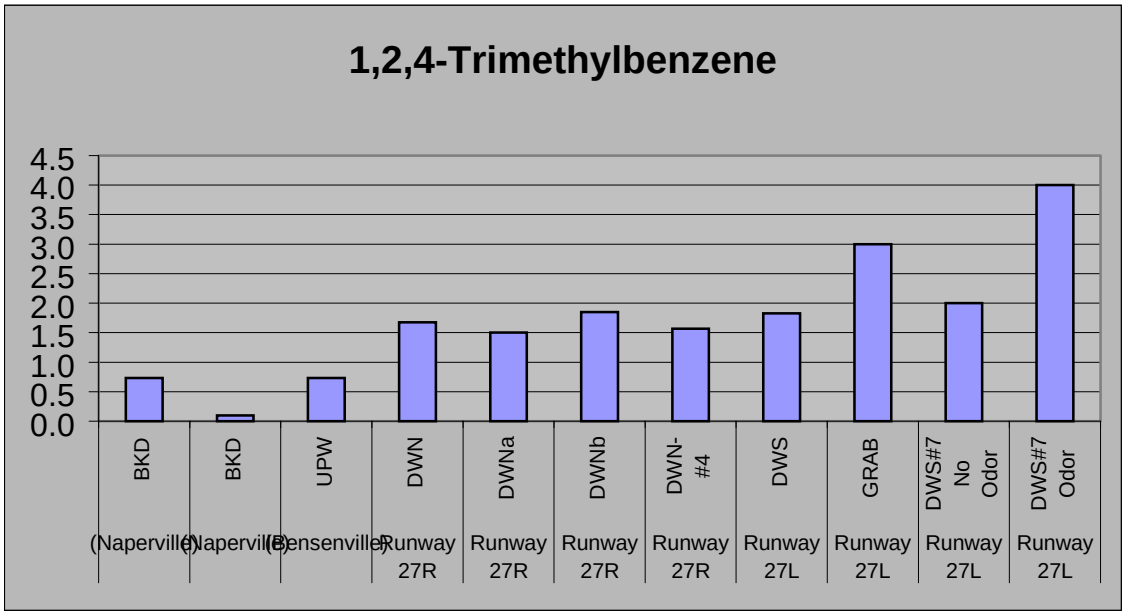


Figure 105. Results of VOC Analysis for 1,2,4-Trimethylbenzene.

23.67 Unidentified compound

The average concentration of this compound in the background was found to be 15.0 ug/m3 with the range of values from 3.0 ug/m3 to 30 ug/m3 with the values increasing from the first day to the third day.

The average concentration of this compound in the upwind location UPW was found to be 6.0 ug/m3 with the range of values from 0.0 ug/m3 to 20.0 ug/m3. The high value is associated with sample UPW #3 which has been previously discussed. This compound appears to be associated with that event.

The average concentration of this compound in the downwind location DWN was found to be 1.0 ug/m3 with the range of values from 0.0 ug/m3 to 3.0 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 0.6 ug/m3 with the range of values from 0.0 ug/m3 to 1.5 ug/m3. The average concentration of this compound in the downwind grab samples was found to be 0.1 ug/m3 with the range of values from 0.0 ug/m3 to 0.1 ug/m3.

This compound does not appear from examination of the data to be associated with either jet exhaust or activities at the airport. The highest concentrations were detected in the background locations and the compound appeared to be associated with activities to the south of the sampling location. It may be associated with the large amount of compounds found that were associated with construction activities such as the siloxanes and alcohols.

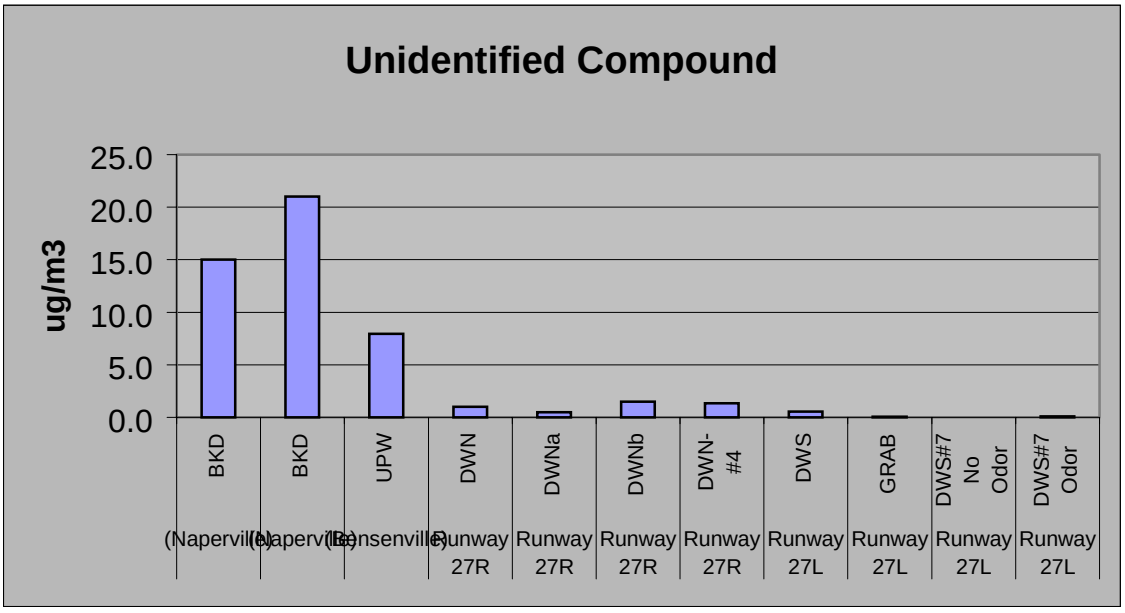


Figure 106. Results of VOC Analysis for Unidentified Compound.

23.85 n-Decane

Decane is a straight chain alkane that is a component of fuels such as gasoline and jet fuel. It would be expected to be present either in the exhaust as a result of the incomplete combustion of fuel or as vapors emitted during the fueling process. This compound was a target compound of this investigation. The concentration of decane that was found in auto exhaust was approximately 30 ug/m3. The concentration that was reported in jet exhaust was 929 ug/m3.

The average concentration of this compound in the background was found to be 2.0 ug/m3 with the range of values from 1.1 ug/m3 to 3.0 ug/m3. The highest value was found in the first day's sample and as with other compounds in that sample is associated with activity from downtown Naperville. Recalculating the average omitting the value from the first day's sample results in an average of 1.5 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 1.1 ug/m3 with the range of values from 0.0 ug/m3 to 1.8 ug/m3. This average is comparable to the value found in the background.

The average concentration of this compound in the downwind location DWN was found to be 1.8 ug/m3 with the range of values from 1.5 ug/m3 to 2.3 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 2.4 ug/m3 with the range of values from 1.5 ug/m3 to 4.0 ug/m3. The average concentration

of this compound in the downwind grab samples was found to be 1.5 ug/m3 with the range of values from 1.0 ug/m3 to 3.0 ug/m3.

The concentration of this compound downwind of the airport is slightly elevated over that found in either the upwind or background locations. This compound is being emitted by activities at the airport in amounts that are greater than what was found in the background or upwind samples. This compound is also a component of auto exhaust and as such is found in the upwind as well as the background samples as a result of pollution by automobiles. n-Decane was found in the annual average of Jardine location in Chicago at a concentration of 0.70 ug/M3. This value is considerably lower than that found for the averages at any of the O'Hare downwind locations.

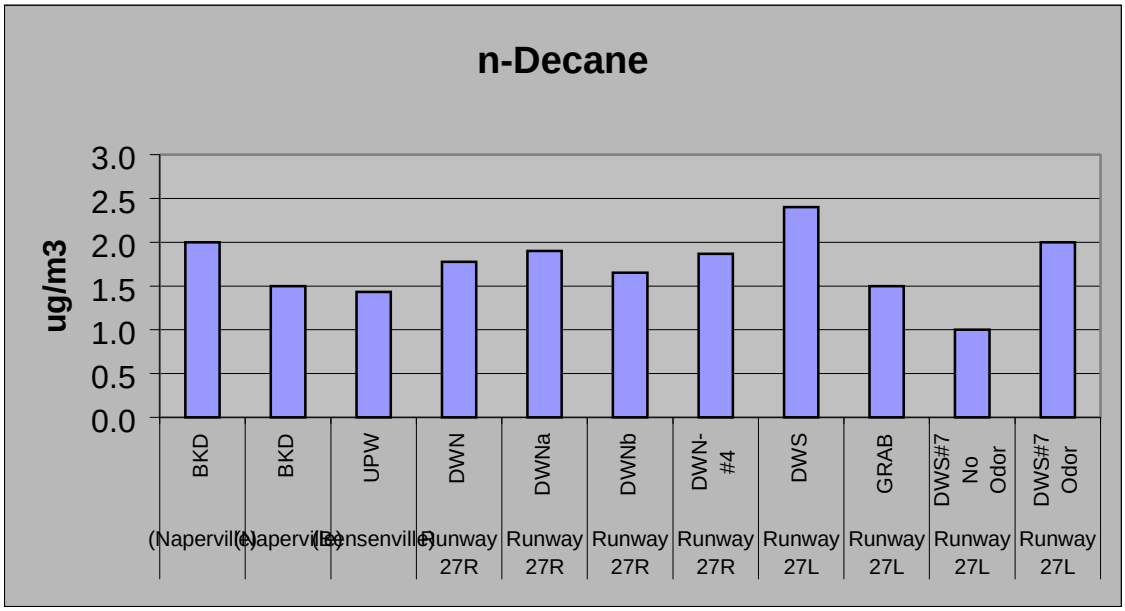


Figure 107. Results of VOC Analysis for n-Decane.

23.97 1,4-Dichlorobenzene (p-dichlorobenzene)

This compound is a chlorinated aromatic compound that would not be expected to be present in combusted fuel. It is highly volatile with a penetrating odor. It is used commercially as a moth repellent, general insecticide, germicide and as a soil fumigant. It was not a target compound of this investigation.

The average concentration of this compound in the background was found to be 0.7 ug/m3 with the range of values from 0.0 ug/m3 to 2.0 ug/m3. The high value was found in the sample from the third day.

The average concentration of this compound in the upwind location UPW was found to be 0.5 ug/m3 with the range of values from 0.1 ug/m3 to 1.2 ug/m3.

The average concentration of this compound in the downwind location DWN was found to be 0.6 ug/m3 with the range of values from 0.3 ug/m3 to 1.3 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 0.8 ug/m3 with the range of values from 0.3 ug/m3 to 1.9 ug/m3. The high value for all upwind and downwind events was found in samples from the first day of testing.

The average concentration of this compound in the downwind grab samples was found to be 0.2 ug/m3 with the range of values from 0.1 ug/m3 to 0.3 ug/m3.

This compound was generally found in all samples at about the same level. One background sample and one eight-hour upwind and downwind sampling event had values for this compound that were significantly higher than the others. This compound is being emitted to the atmosphere as a result of general industrial usage and this compound does not appear to be associated with activities at the airport.

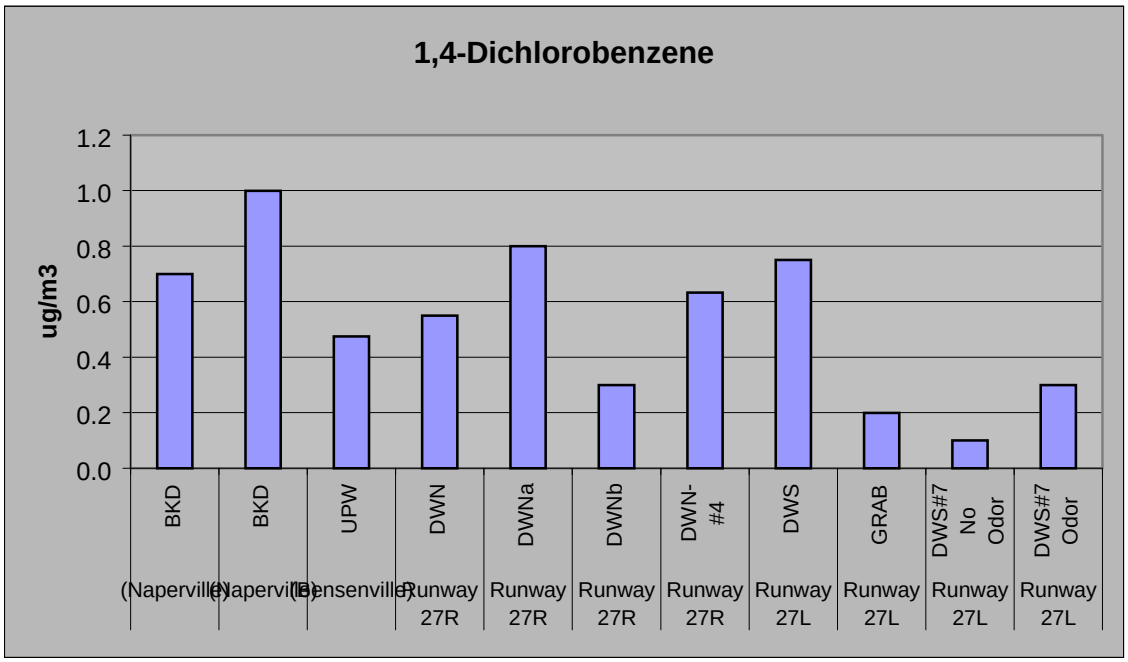


Figure 108. Results of VOC Analysis for 1,4-Dichlorobenzene.

24.19 2-Ethyl-1-Hexanol

This compound is an alcohol, and was not a target of this investigation or would it be expected to be a component of combusted fuel. It is used commercially as a solvent in

paints and lacquers and is also used in inks, lubricants and in dry cleaning. It was not found in the analysis of the auto exhaust nor reported as a component of jet exhaust.

The average concentration of this compound in the background was found to be 7.0 ug/m3 with the range of values from 0.5 ug/m3 to 20 ug/m3. The highest value was found in sample BKD #3 and is probably associated with construction activities that occurred on this day.

The average concentration of this compound in the upwind location UPW was found to be 15.1 ug/m3 with the range of values from 0.0 ug/m3 to 60 ug/m3. The highest value was associated with UPW #3.

The average concentration of this compound in the downwind location DWN was found to be 0.9 ug/m3 with the range of values from 0.0 ug/m3 to 3.0 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 2.1 ug/m3 with the range of values from 0.0 ug/m3 to 4.0 ug/m3. The average concentration of this compound in the downwind grab samples was found to be 0.4 ug/m3 with the range of values from 0.2 ug/m3 to 0.6 ug/m3.

This compound does not appear to be associated with jet exhaust. There may be some activities at the airport that result in a slight increase of this compound downwind of the airport, but much higher values were found in at least two samples one from the upwind and one from the background, both apparently associated with construction activities in the area.

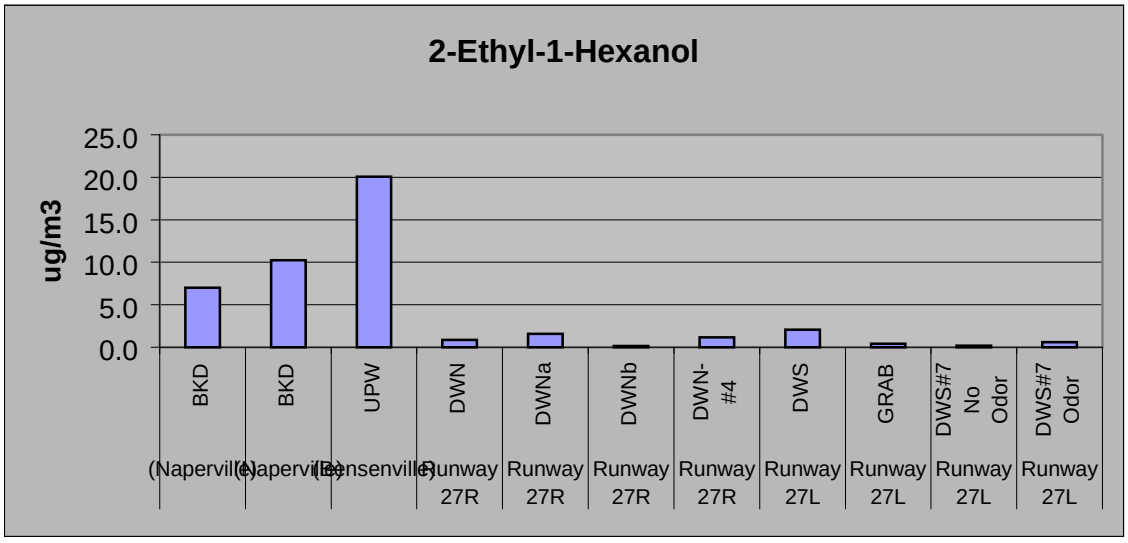


Figure 109. Results of VOC Analysis for 2-Ethyl-1-Hexanol.

24.70 C8H14O aldehyde

This compound is an incompletely identified aldehyde and as such might be expected to be present in the jet exhaust. This compound was not found in the analysis of the auto exhaust.

The average concentration of this compound in the background was found to be zero.

Similarly, this compound was also not found in the upwind location UPW.

The average concentration of this compound in the downwind location DWN was found to be 0.1 ug/m3 with the range of values from 0.1 ug/m3 to 0.4 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 0.2 ug/m3 with the range of values from 0.0 ug/m3 to 0.4 ug/m3. The average concentration of this compound in the downwind grab samples was found to be 0.6 ug/m3 with the range of values from 0.2 ug/m3 to 1.0 ug/m3.

This compound was found in the grab sample DWS #7 odor at five times the concentration of the DWS #7 no odor sample. This compound may contribute to the characteristic odor of the airport. Also it was only found in samples that were taken downwind from the airport, and therefore airport activities are the source of this compound.

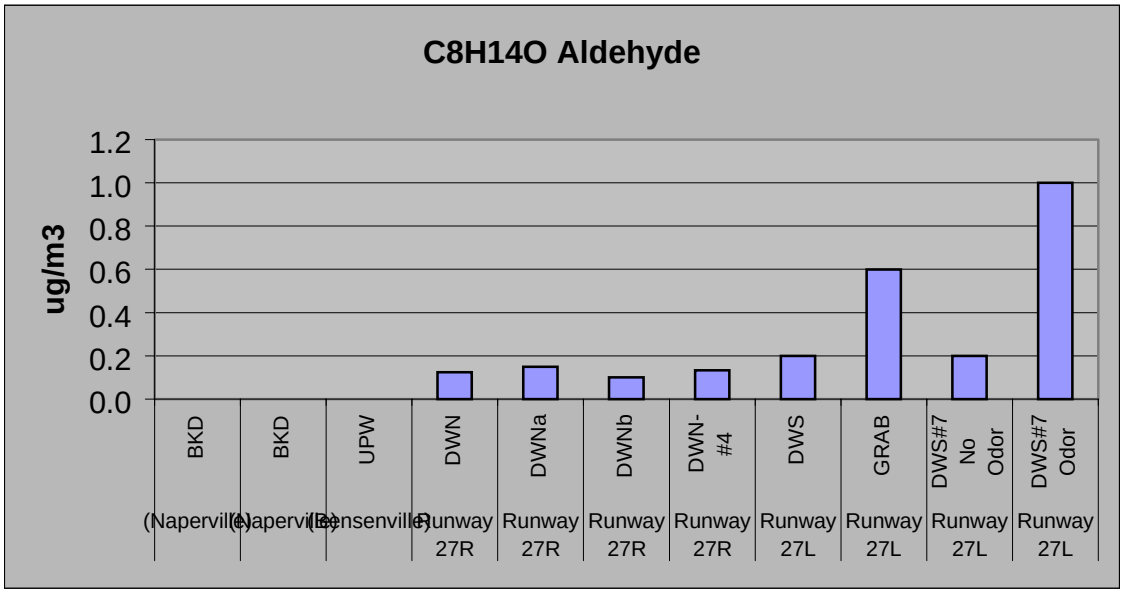


Figure 110. Results of VOC Analysis for $C_8H_{14}O$ Aldehyde.

24.94 Acetophenone + C11H24 Alkane

These two unrelated compounds co-elute. Neither was a target compound of this investigation. Acetophenone is used commercially as a solvent, in perfumery and as a flavoring. These compounds were found in the auto exhaust at an approximate concentration of 20 ug/m3.

The average concentration of these compounds in the background was found to be 0.5 ug/m3 with the range of values from 0.3 ug/m3 to 0.7 ug/m3. The concentrations appear to be independent of wind direction.

The average concentration of these compounds in the upwind location UPW was found to be 1.2 ug/m3 with the range of values from 0.0 ug/m3 to 4.0 ug/m3. The high value was associated with the sample UPW #3.

The average concentration of these compounds in the downwind location DWN was found to be 0.7 ug/m3 with the range of values from 0.4 ug/m3 to 1.4 ug/m3. The average concentration of these compounds in the downwind location DWS was found to be 1.6 ug/m3 with the range of values from 0.2 ug/m3 to 4.0 ug/m3. The average concentration of these compounds in the downwind grab samples was found to be 0.6 ug/m3 with the range of values from 0.3 ug/m3 to 0.8 ug/m3.

Since these two compounds co-elute, data was not available to determine if one or the other of these two compounds was responsible for the concentration from each sample.

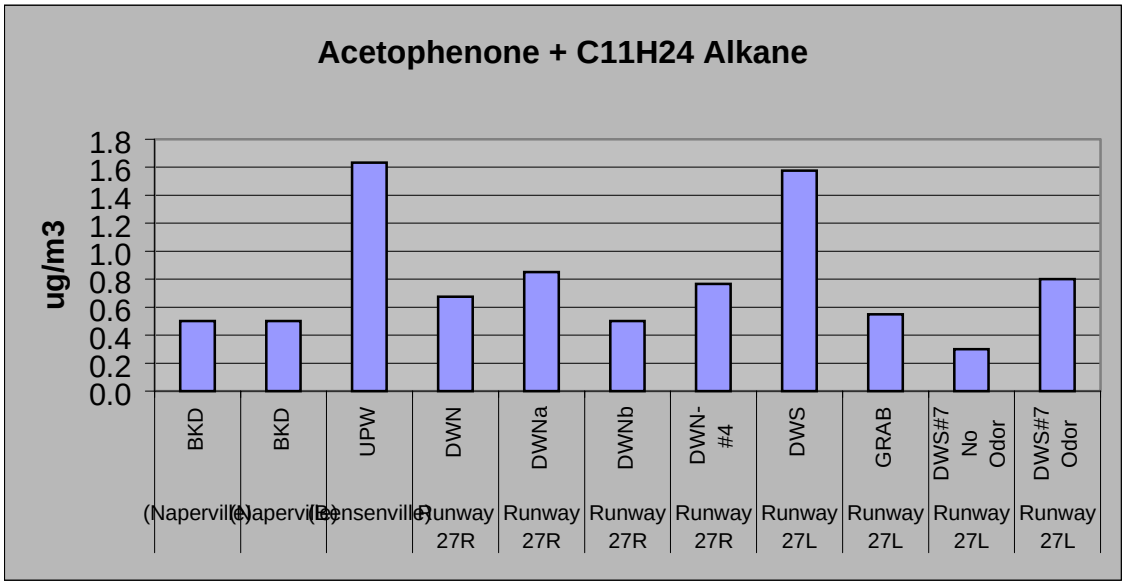


Figure 111. Results of VOC Analysis for Acetophenone + $C_{11}H_{24}$ Alkane.

A slightly higher average was found at the DWS location than for the upwind or background location, but the grab samples did not show increased levels, which would eliminate jet exhaust as the source. The slightly elevated concentration at DWS is a result of some activity at this location.

25.07 C10H14 Aromatic

This compound was found in the analysis of the auto exhaust at a concentration of approximately 50 ug/m3.

The average concentration of this compound in the background was found to be 0.3 ug/m3 with the range of values from 0.2 ug/m3 to 0.4 ug/m3. There was no relationship with the wind direction.

The average concentration of this compound in the upwind location UPW was found to be 0.4 ug/m3 with the range of values from 0.0 ug/m3 to 1.0 ug/m3.

The average concentration of this compound in the downwind location DWN was found to be 0.7 ug/m3 with the range of values from 0.3 ug/m3 to 0.8 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 0.9 ug/m3 with the range of values from 0.5 ug/m3 to 1.4 ug/m3. The average concentration of this compound in the downwind grab samples was found to be 1.2 ug/m3 with the range of values from 0.4 ug/m3 to 2.0 ug/m3.

This compound is a component of jet exhaust. The highest concentration found was in the sample DWS #7 odor. All of the airport downwind locations showed higher average

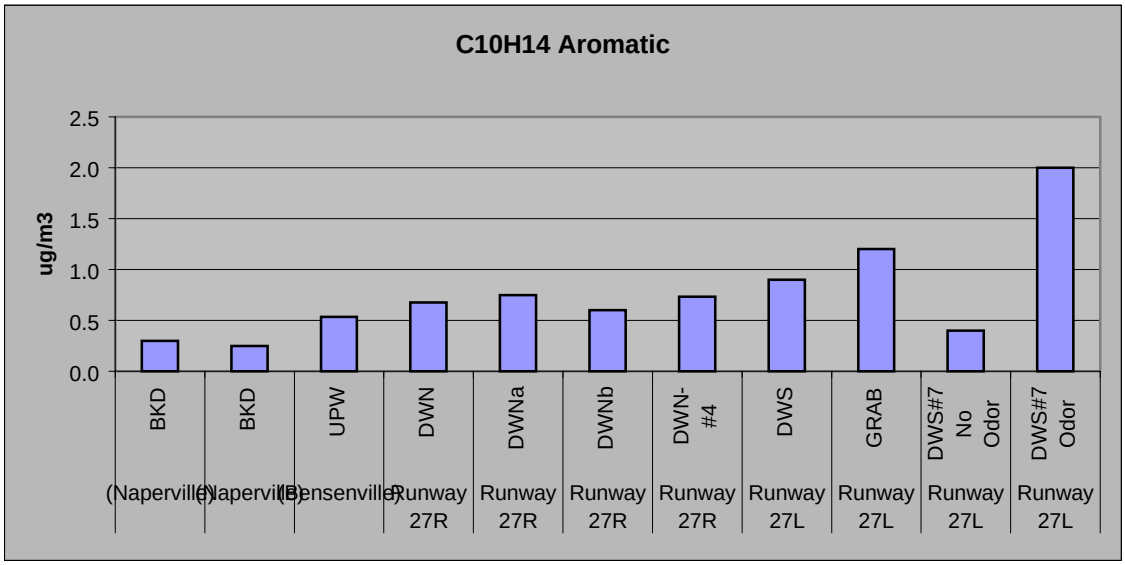


Figure 112. Results of VOC Analysis for $C_{10}H_{14}$ Aromatic.

concentrations than either the upwind or downwind locations.

25.37 C11H24 Alkane

This compound was not found in the background.

The average concentration of this compound in the upwind location UPW was found to be 1.2 ug/m3 with the range of values from 0.0 ug/m3 to 4.0 ug/m3. The highest concentration was found in the UPW#3 sample.

The average concentration of this compound in the downwind location DWN was found to be 0.4 ug/m3 with the range of values from 0.3 ug/m3 to 0.7 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 0.6 ug/m3 with the range of values 0.3 ug/m3 to 0.9 ug/m3. The average concentration of this compound in the downwind grab samples was found to be 0.5 ug/m3 with the range of values from 0.3 ug/m3 to 0.6 ug/m3.

This compound was found in slightly elevated concentrations downwind of the airport as compared to the background or the upwind samples excluding UPW#3. This compound is associated with some activity at the airport.

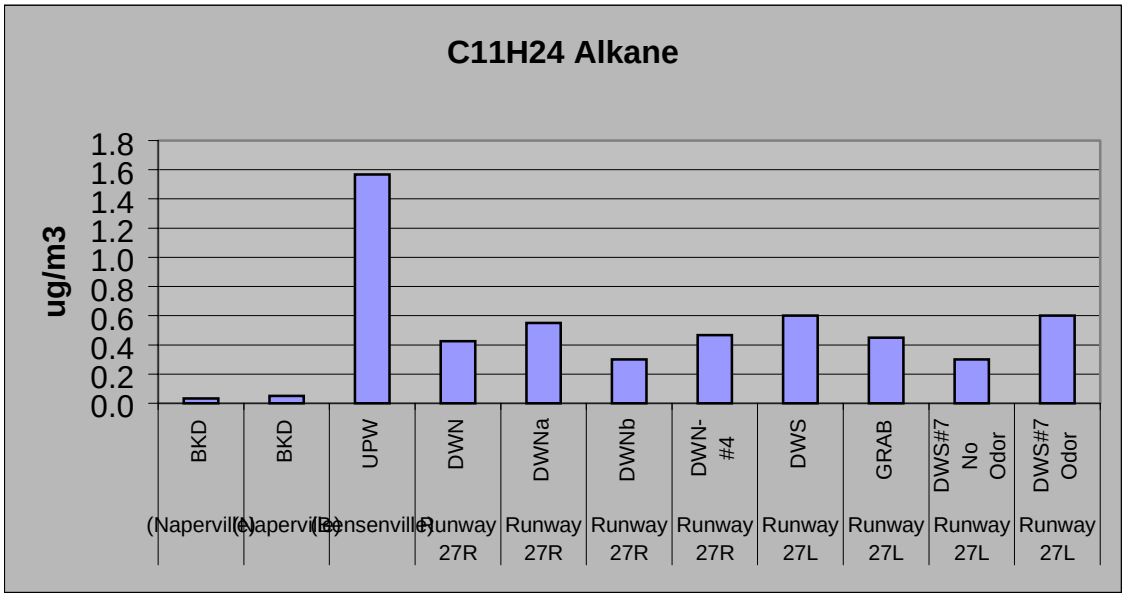


Figure 113. Results of VOC Analysis for $C_{11}H_{24}$ Alkane.

25.42 alpha-Methylstyrene

This compound is a monomer that is used in polymerization especially for polyesters. It might be expected as an off-gas from new polymers as there usually is a small amount of residual monomer present which gives new plastics their smell. It might also be created in the combustion of fuels. It was not a target compound of this investigation. It was not found in the analysis of the auto exhaust sample nor was it reported as a component of jet exhaust.

The average concentration of this compound in the background was found to be 3.5 ug/m3 with the range of values from 0.2 ug/m3 to 10 ug/m3. The highest value was found in the sample on the third day, and this compound is associated with construction activity on that day.

The average concentration of this compound in the upwind location UPW was found to be 0.9 ug/m3 with the range of values from 0.0 ug/m3 to 3.2 ug/m3.

The average concentration of this compound in the downwind location DWN was found to be 0.3 ug/m3 with the range of values from 0.0 ug/m3 to 0.5 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 1.5 ug/m3 with the range of values from 0.3 ug/m3 to 5.0 ug/m3. The average concentration of this compound in the downwind grab sample was found to be 0.4 ug/m3 with the range of values from 0.1 ug/m3 to 0.7 ug/m3.

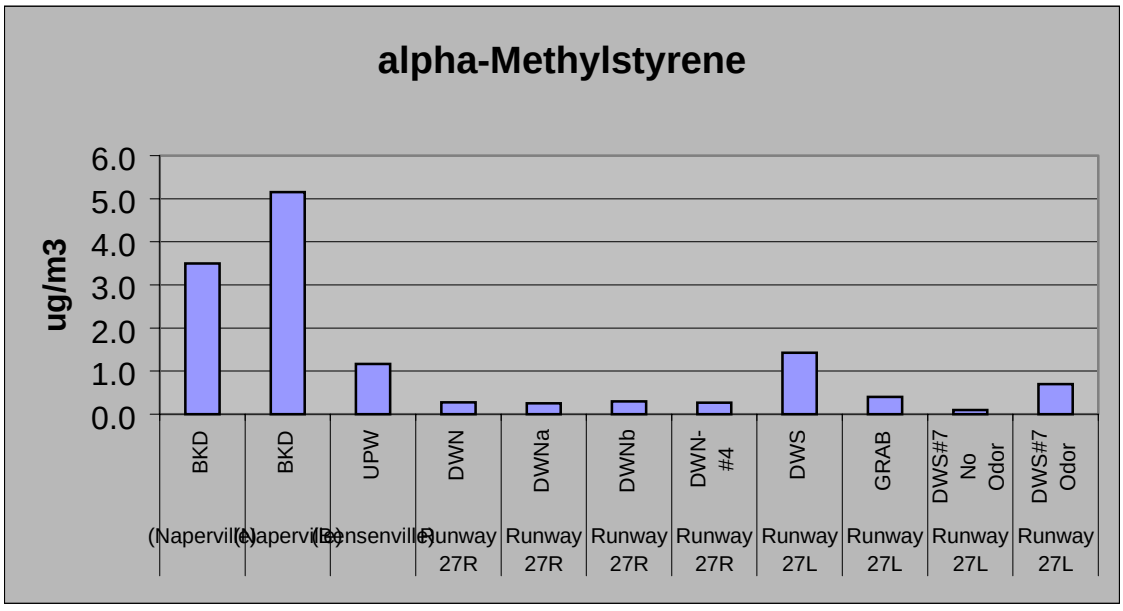


Figure 114. Results of VOC Analysis for alpha-Methylstyrene.

This compound was found at the DWS location at levels comparable to that found in the background and upwind. The high values are associated with maintenance activity or construction activities and not associated with jet exhaust.

25.52 Octamethylcyclotetrasiloxane

This compound is related to hexamethylcyclotrisiloxane and probably came from the same type of source the use of silicone caulks. It was not a target compound of this investigation and would not be expected from the combustion of fuels.

This compound was not found in the background samples.

This compound was found in only one of the upwind samples, UPW #3 at 0.2 ug/m3.

The average concentration of this compound in the downwind location DWN was found to be 2.0 ug/m3 with the range of values from 0.1 ug/m3 to 8.0 ug/m3. The highest value was found in DWN #5. The average concentration of this compound in the downwind location DWS was found to be 0.2 ug/m3 with the range of values from 0.1 ug/m3 to 0.4 ug/m3. The average concentration of this compound in the downwind grab samples was found to be 0.4 ug/m3 with the range of values from 0.2 ug/m3 to 0.5 ug/m3.

This compound was found at slightly higher concentrations downwind from the airport compared to the upwind or background locations. One very high value was found in one of the DWN samples. This high value indicates that some activity using a silicone based caulking material occurred on the airport property, probably the auto rental area on this day of sampling.

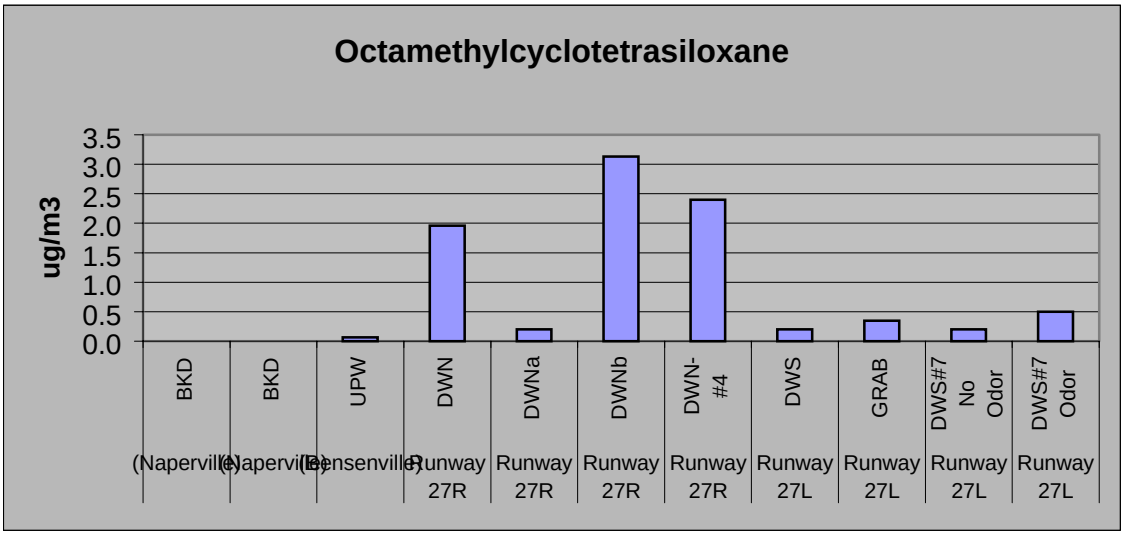


Figure 115. Results of VOC Analysis for Octamethylcyclotetrasiloxane.

25.75 Nonanal

This aldehyde compound would be expected to be a exhaust component of the combustion of fuel and was a target compound of this investigation. This compound was not found in the analysis of the auto exhaust sample and was not reported as a component of jet exhaust.

The average concentration of this compound in the background was found to be 0.8 ug/m3 with the range of values from 0.2 ug/m3 to 1.7 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 2.5 ug/m3 with the range of values from 0.2 ug/m3 to 9 ug/m3. This value is 212% higher than the background.

The average concentration of this compound in the downwind location DWN was found to be 0.7 ug/m3 with the range of values from 0.3 ug/m3 to 1.1 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 0.6 ug/m3 with the range of concentrations from 0.3 ug/m3 to 0.9 ug/m3. The average concentration of this compound in the downwind grab samples was found to be 10.1 ug/m3 with the range of values from 0.1 ug/m3 to 20 ug/m3.

This compound was found at the highest level in the sample DWS #7 odor. It was found for the most part at background levels in other samples. This compound may contribute to the characteristic odor at the airport.

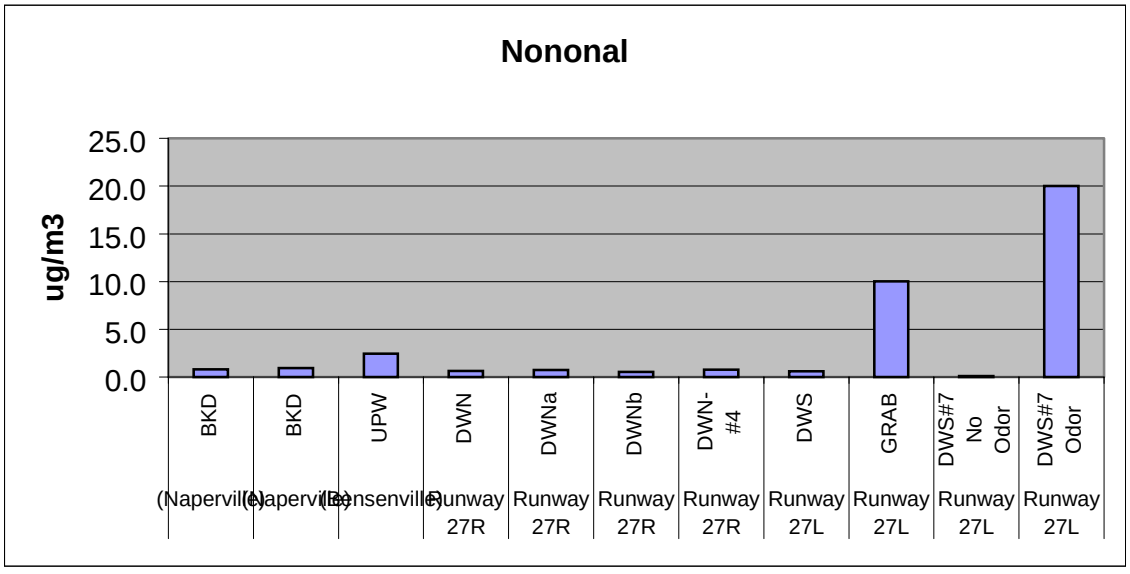


Figure 116. Results of VOC Analysis for Nononal.

26.01 n-Undecane

Undecane is a straight chain hydrocarbon that would be expected to be present in fuel or result from the incomplete combustion of fuel. This compound was a target compound of this investigation. This compound was found to be present in auto exhaust at a concentration of approximately 10 ug/m3 and was reported to be present in jet exhaust at a concentration of 1,406 ug/m3.

The average concentration of undecane in the background was found to be 2.2 ug/m3 with the range of values from 1.5 ug/m3 to 3.0 ug/m3. The highest value was found in the first day's sample and as with other compound already discussed is associated with activities during the first day's sampling. Recalculating the average omitting the first day's contribution results in an average of 1.9 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 1.9 ug/m3 with the range of values from 0.0 ug/m3 to 3.4 ug/m3. This average is similar to what was found in the background.

The average concentration of this compound in the downwind location DWN was found to be 2.1 ug/m3 with the range of values from 1.2 ug/m3 to 3.0 ug/m3. This value is 10% higher than that found in the background and upwind of the airport. The average concentration of this compound in the downwind location DWS was found to be 3.6 ug/m3 with the range of values from 2.0 ug/m3 to 6.0 ug/m3. This value is 90% higher than that found in the background or upwind of the airport. The average concentration of this compound in the downwind grab samples was found to be 2.0 ug/m3 with all values at this concentration.

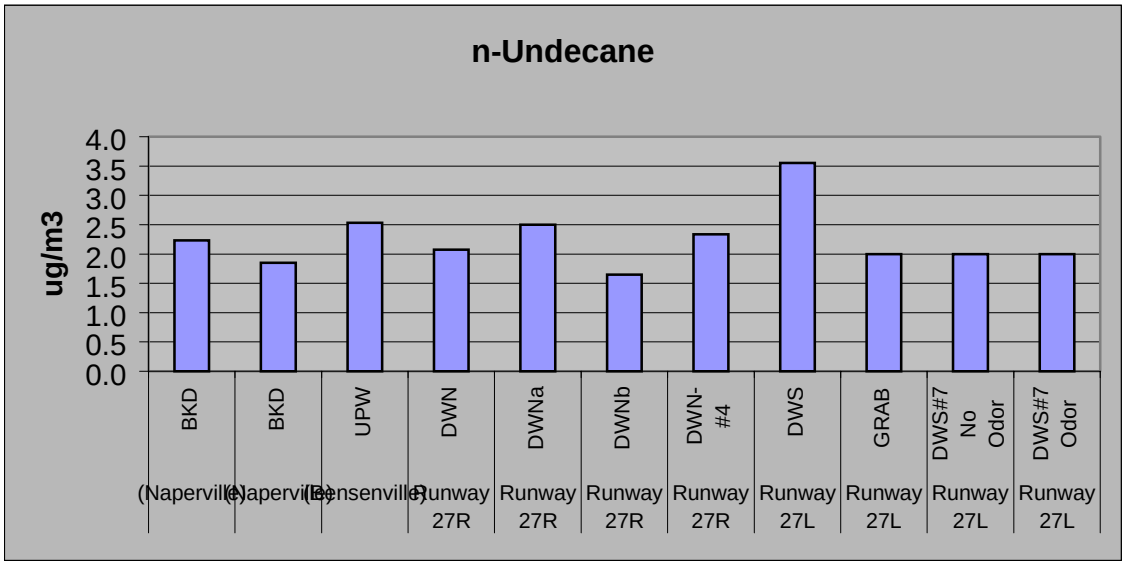


Figure 117. Results of VOC Analysis for n-Undecane.

This compound is found at slightly elevated levels downwind of the airport, which would be expected. This compound is found in both auto and jet exhaust and the activity at the airport would be expected to produce higher concentrations downwind. It should be noted that similarly high values were found in the background and can be attributed to auto traffic in that area. n-Undecane was found in the annual average of Jardine location in Chicago at a concentration of 0.32 ug/M3. This value is considerably lower than that found for the averages at any of the O'Hare downwind locations.

26.73 C9H16O Aldehyde

This unidentified aldehyde was not found in the background.

The average concentration of this compound in the upwind location UPW was found to be 0.0 ug/m3 with only one value found at 0. 1 ug/m3 in the UPW #3 sample.

The average concentration of this compound in the downwind location DWN was found to be 0.1 ug/m3 with the values ranging from 0.0 ug/m3 to 0.1 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 0.1 ug/m3 with the range of values from 0.0 ug/m3 to 0.2 ug/m3. The average concentration of this aldehyde in the downwind grab samples was found to be 0.6 ug/m3 with the value of 0.1 ug/m3 found in DWS #7 no odor and the value of 1.0 ug/m3 found in the DWS #7 odor sample.

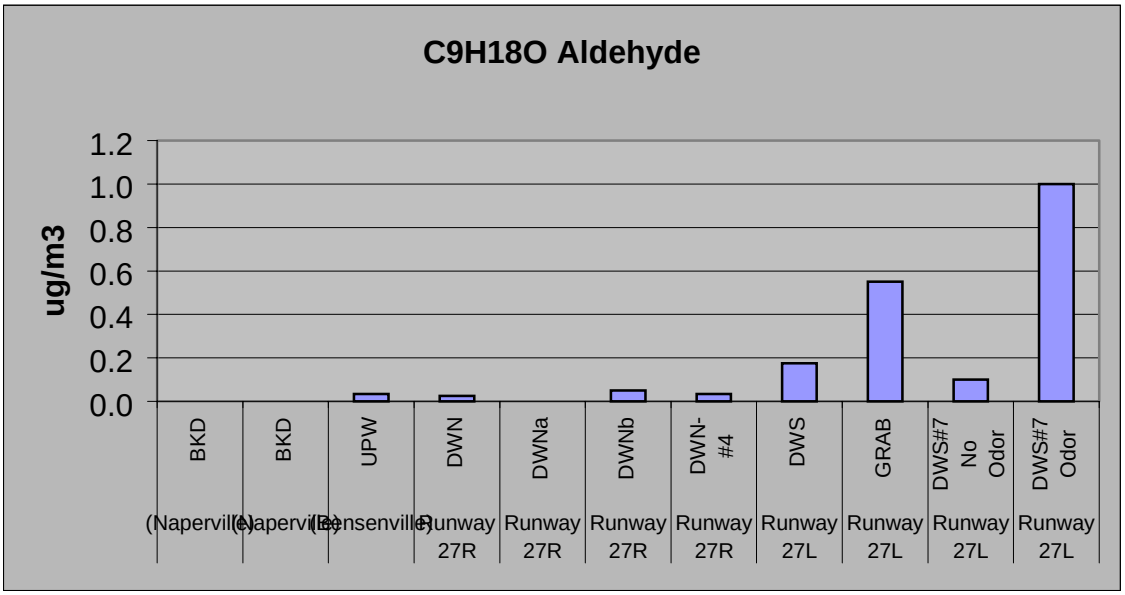


Figure 118. Results of VOC Analysis for $C_9H_{18}O$ Aldehyde.

This compound is associated with jet exhaust and most especially with the odor of jet exhaust. Since its identity is unknown, its odor threshold cannot be compared to the value found in DWS #7 odor, however it was found at elevated levels only in this sample. Its existence in samples taken downwind of the airport is attributable to airport operations.

26.91 Unidentified Siloxane

This siloxane compound is related to the other silicone containing compounds identified in other samples and is probably related to similar activities, i.e. the use of caulking materials in construction.

The average concentration of this compound in the background was found to be 67.7 ug/m3 with the range of values from 0.0 ug/m3 to 200 ug/m3. The extremely high value was found in sample BKD #3, which as discussed before showed very high levels of these types of compounds.

The average concentration of this compound in the upwind location UPW was found to be 5.4 ug/m3 with the range of values from 0.0 ug/m3 to 20 ug/m3. The highest value was found in UPW #3 which has been discussed before.

The average concentration of this compound in the downwind location DWN was found to be 0.8 ug/m3 with the range of values from 0.2 ug/m3 to 1.0 ug/m3. The average concentration of this compound in the downwind location DWS was found to be 0.8 ug/m3 with the range of values from 0.2 ug/m3 to 1.5 ug/m3. The average concentration

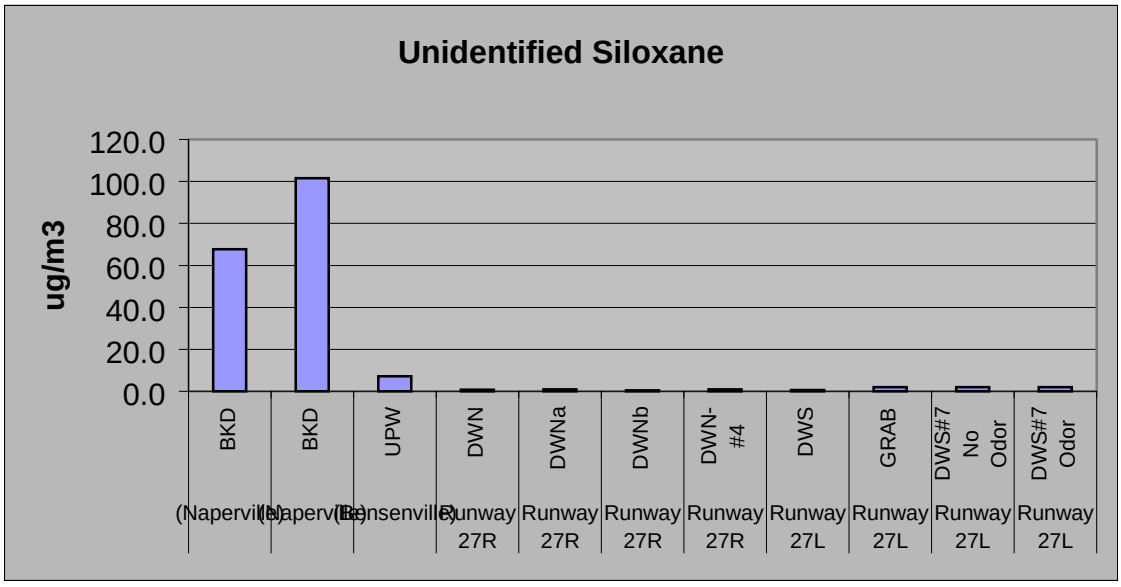


Figure 119. Results of VOC Analysis for Unidentified Siloxane.

of this compound in the downwind grab samples was found to be 2.0 ug/m3 with all values found at this concentration.

This compound is clearly associated with maintenance or construction activities in which caulking materials are applied. There does appear to be some slight increase of this compound downwind of the airport compared to background and upwind samples in which no concentration of this compound is found. However, it appears that this compound is not unique to O'Hare airport.

27.53 Naphthalene

Naphthalene is a polynuclear aromatic that would be expected in the combustion of fuel and was a target compound of this investigation. It was found in the analysis of the auto exhaust at a concentration of 100 ug/m3. It was also reported in the analysis of jet exhaust at a concentration of 1,046 ug/m3.

The average concentration of naphthalene in the background location was found to be 0.4 ug/m3 with the range of values from 0.3 ug/m3 to 0.5 ug/m3. The highest concentration was found in the first day's sample and therefore is associated with activities on the first day. Recalculating the average omitting the first day's contribution would yield an average of 0.3 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 1.1 ug/m3 with the range of values from 0.0 ug/m3 to 3.3 ug/m3. This is a 266% increase over the background. The highest value was found in the UPW #3 sample and is associated with activities on that day.

The average concentration of this compound in the downwind location DWN was found to be 0.9 ug/m3 with the range of values from 0.3 ug/m3 to 1.7 ug/m3. This is a 200% increase over the background. The average concentration of this compound in the downwind location DWS was found to be 68.0 ug/m3 with the range of values from 0.7 ug/m3 to 200.0 ug/m3. Extremely high concentrations for this compound were found in the DWS #1 (200 ug/m3) and DWS #2 (70 ug/m3) samples. These high values must be associated with some activity that was occurring in this area of the airport on the first two days of composite sampling. Values this high did not appear in any other samples taken during this investigation.

The average concentration of this compound in the downwind grab samples was found to be 1.5 ug/m3 with the range of values from 1.0 ug/m3 to 2.0 ug/m3. This average is an increase of 400% over the background.

Ignoring the two extremely high values found for this compound in the DWS location, it appears that the normal concentration of this compound is only elevated downwind of the airport as a result of activities there and is comparable to that found in the UPW location.

The fact that on two sampling days, this compound was found at extremely high levels points to some activity at the airport which resulted in these high concentrations, and therefore, elevated levels of this compound are a result of airport activities.

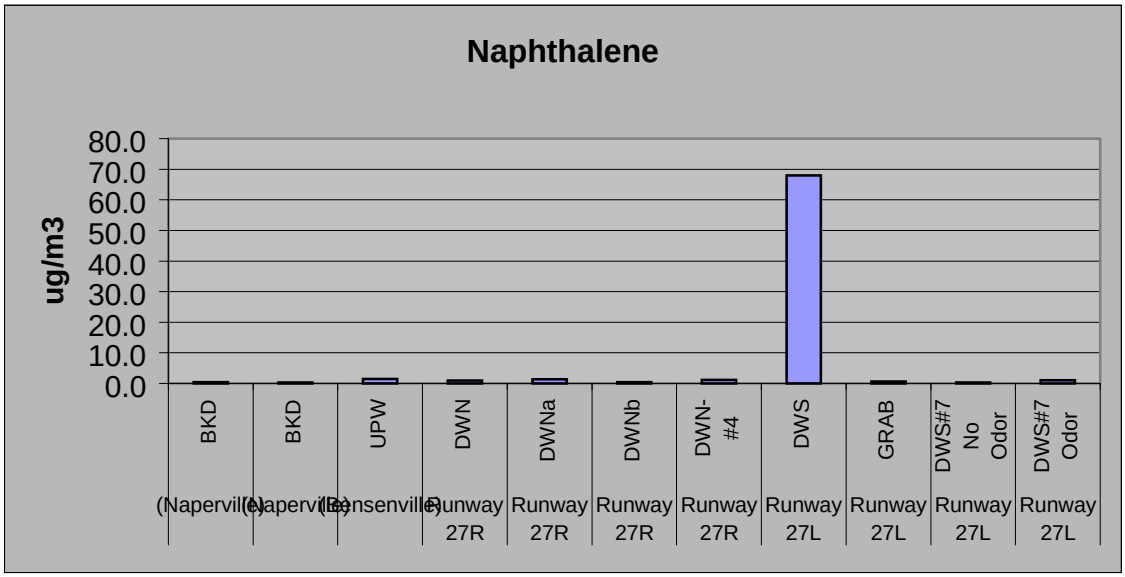


Figure 120. Results of VOC Analysis for Naphthalene.

27.63 n-Dodecane

Dodecane is a straight chain alkane that would be expected to be present in fuels or result from the incomplete combustion of these fuels or during the fueling process. This compound was found in the analysis of the auto exhaust at a very low level of approximately 10 ug/m3. It was reported as a component of jet exhaust at a concentration of 1,550 ug/m3.

The average concentration of this compound in the background location was found to be 1.1 ug/m3 with the range of values from 0.7 ug/m3 to 1.3 ug/m3. The highest concentration of this compound was found in the first day's sampling. Recalculating the average omitting this day's contribution results in the average 1.0 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 1.3 ug/m3 with the range of values from 0.0 ug/m3 to 2.2 ug/m3. This value is 30% higher than that found in the background.

The average concentration of this compound in the downwind location DWN was found to be 1.9 ug/m3 with the range of values from 0.7 ug/m3 to 3.0 ug/m3. This is an increase of 46% over the upwind location and an increase of 72% over the background. The average concentration of this compound in the downwind location DWS was found to be

4.7 ug/m3 with the range of values from 1.7 ug/m3 to 10.0 ug/m3. This is an increase of 370% over the background and an increase of 260% over the upwind location. The average concentration of this compound in the downwind grab samples was found to be 1.5 ug/m3 with the range of values from 1.0 ug/m3 to 2.0 ug/m3.

This compound was found at higher average concentrations downwind from the airport than for either the upwind or background locations. This would be expected from the activities conducted at the airport including spilled fuel and combustion of fuel. The lower concentrations found in the grab samples would tend to indicate that the higher values found in the downwind samples is related to the non-jet exhaust.

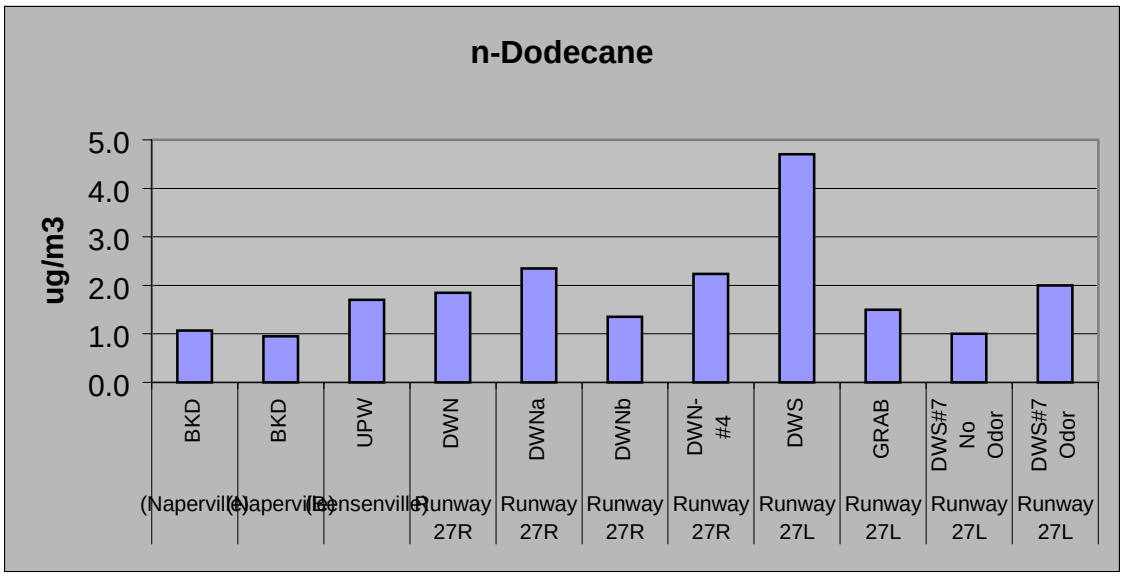


Figure 121. Results of VOC Analysis for n-Dodecane.

28.95 n-Tridecane

Tridecane is a straight chain alkane that would be expected to be present in fuels or result from the incomplete combustion of these fuels or during the fueling process. This compound was found in the analysis of the auto exhaust at a concentration that was insignificant. It was reported as a component of jet exhaust at a concentration of 1,655 ug/m3.

The average concentration of this compound in the background location was found to be 0.4 ug/m3 with the range of values from 0.1 ug/m3 to 0.7 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 0.3 ug/m3 with the range of values from 0.0 ug/m3 to 0.6 ug/m3.

The average concentration of this compound in the downwind location DWN was found to be 1.8 ug/m3 with the range of values from 0.1 ug/m3 to 5.0 ug/m3. This was a 350% increase over the background. The average concentration of this compound in the downwind location DWS was found to be 1.7 ug/m3 with the range of values from 0.5 ug/m3 to 4.0 ug/m3. This was an increase of 325% over the background. The average concentration of this compound in the downwind grab samples was found to be 0.6 ug/m3 with the range of values from 0.1 ug/m3 to 1.1 ug/m3. The highest value was found in the DWS #7 odor sample and is ten times higher than in the DWS #7 no odor sample.

An evaluation of this data indicates that this compound results from activities at the airport and that some contribution from jet exhaust as well as other fueling activities and combustion are contributing. This compound is definitely at increased concentrations downwind from the airport as a result of airport activities.

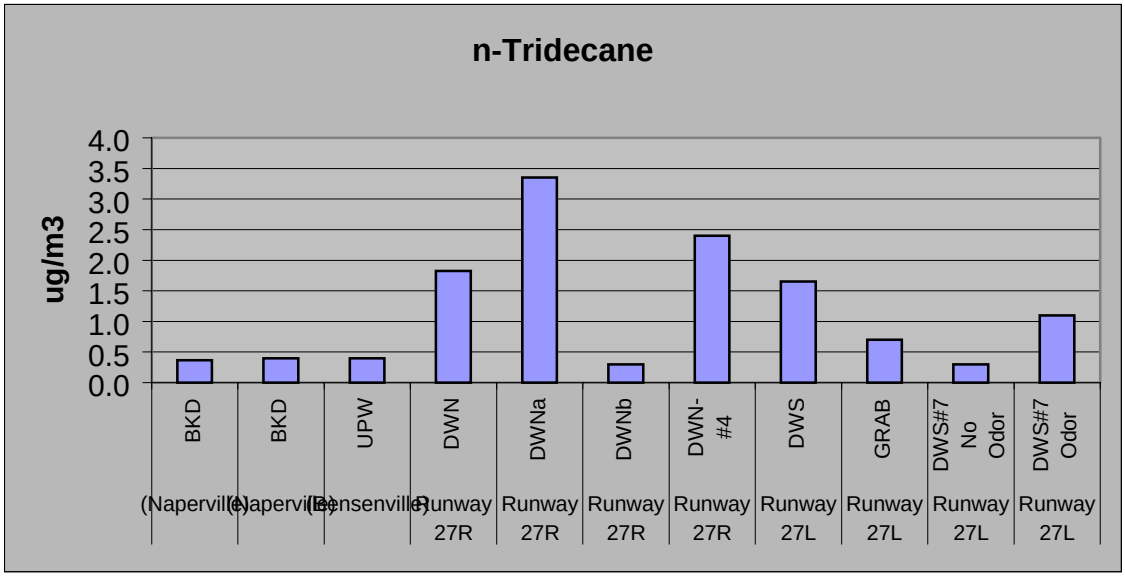


Figure 122. Results of VOC Analysis for n-Tridecane.

30.19 n-Tetradecane

Tetradecane is a straight chain alkane that would be expected to be present in fuels or result from the incomplete combustion of these fuels or during the fueling process. This compound was not found to be present in auto exhaust. It was reported to be present in the jet exhaust at a concentration of 971 ug/m3.

The average concentration of this compound in the background location was found to be 0.4 ug/m3 with the range of values from 0.1 ug/m3 to 0.8 ug/m3.

The average concentration of this compound in the upwind location UPW was found to be 0.3 ug/m3 with the range of values from 0.0 ug/m3 to 0.8 ug/m3.

The average concentration of this compound in the downwind location DWN was found to be 1.4 ug/m3 with the range of values from 0.1 ug/m3 to 4.0 ug/m3. This value is an increase of 250% over the background. The average concentration of this compound in the downwind location DWS was found to be 1.0 ug/m3 with the range of values from 0.3 ug/m3 to 2.0 ug/m3. This is an increase of 150% over the background. The average concentration of this compound in the downwind grab samples was found to be 0.3 ug/m3 with the range of values from 0.1 ug/m3 to 0.4 ug/m3.

This compound is at increased levels downwind from the airport. The increased levels of this compound can be attributed to fueling operations and fuel combustion that occurs as a result of activities at the airport. The contribution of aircraft exhaust is probably the most significant.

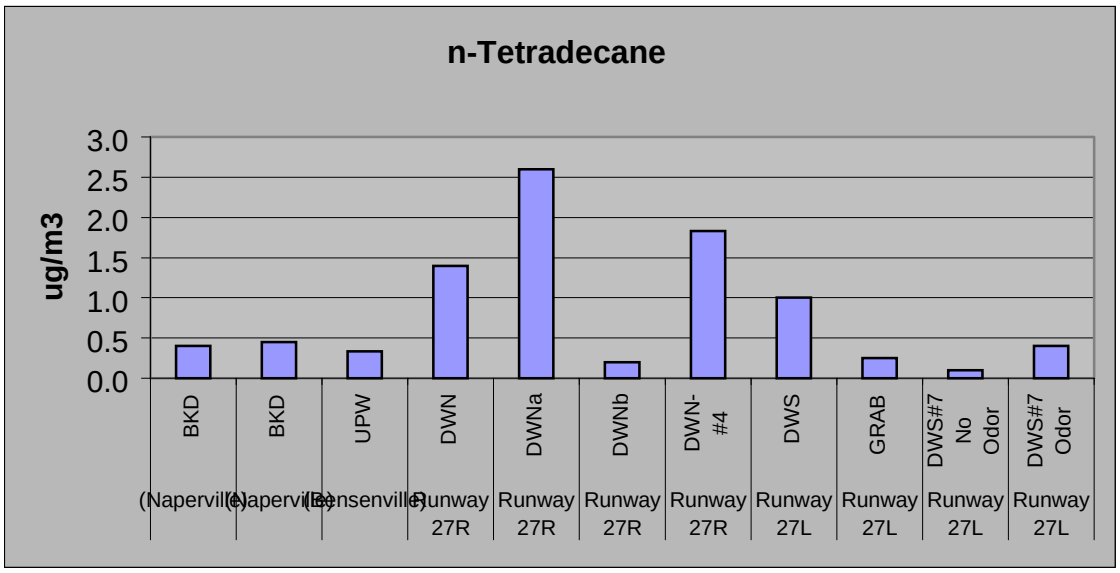


Figure 123. Results of VOC Analysis for n-Tetradecane.

Discussion of Wipe Samples

Many residents of communities surrounding O'Hare have complained about deposits of material that appear on outdoor furniture and other items that are left out of doors that they attribute to aircraft. Our own experience has been that if we leave a perfectly clean automobile in the remote parking lot E at O'Hare, which is directly under the approach to runway 27R for a couple of days the car is covered in an oily film. For example, returning to such a vehicle at night, and looking up through the moon roof, one can see a

coating covering the surface of the glass. In an attempt to try to sample these deposits, several wipe samples were taken at various locations.

The wipe samples were collected by using a sterile gauze pad that is soaked in methylene chloride as a solvent. Some of the samples were then analyzed for the pattern that they produce using gas chromatography. All of the samples were analyzed using combined gas chromatography and mass spectrometry (GC/MS). Samples of diesel fuel and NIST Urban Dust were also analyzed under the same conditions as a comparison. The target compounds were polynuclear aromatic hydrocarbons (PAH). No attempt was made to exhaustively identify any of the other compounds that were present.

Samples were taken in various locations.

The first location sampled was the previously mentioned moon roof of an auto that had been parked in remote parking lot E for two days. The glass roof was sampled as described above and the sample was analyzed by GC/MS. The sample was analyzed specifically for PAHs and none were found to be present. This does not mean that they are not there, but only that sufficient sample was not available to detect this class of compounds.

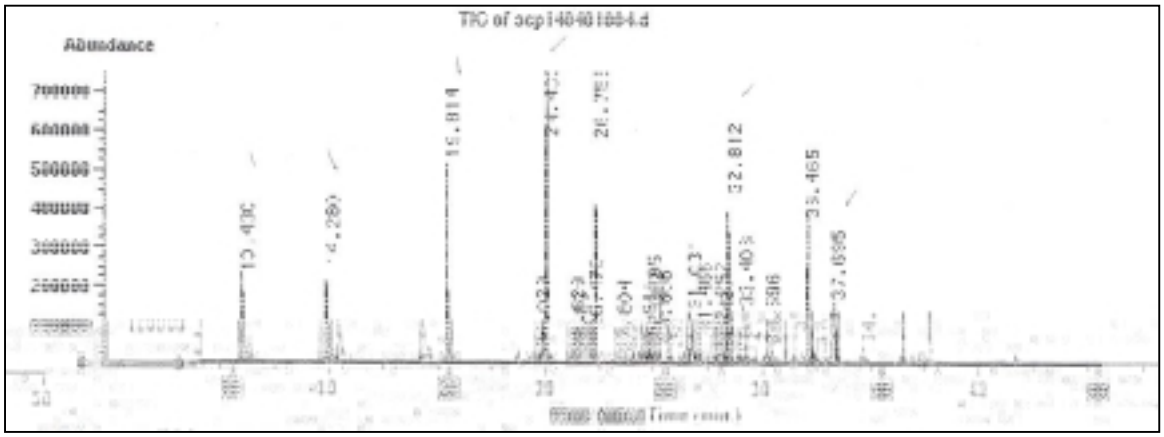


Figure 124. Results of Analysis of Wipe Sample from Moon Roof Parked at O'Hare.

The second location was an apartment residence in Des Plaines. The occupant was concerned about black soot material that was being deposited on various items in and around the home. The occupant frequently left the windows open to bring in fresh air. A sample was taken from the blades of a ceiling fan, the tops of which had not been cleaned for some time. A second sample was taken from the railing of the balcony outside of this fourth floor apartment. The sample was analyzed for PAHs and none were found.

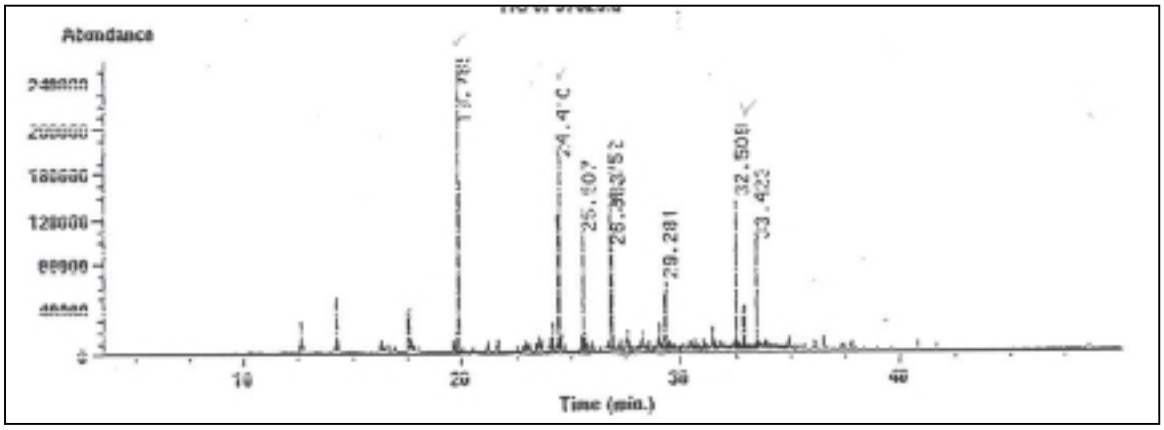


Figure 125. Results of Analysis of Wipe Sample from Apartment Railing in DesPlaines.

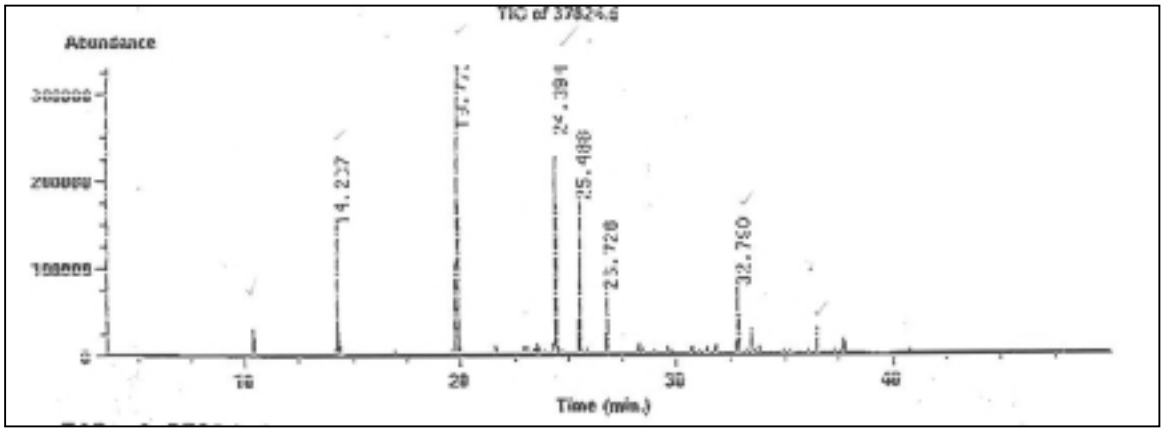


Figure 126. Results of Analysis of Wipe Sample from Apartment Ceiling Fan.

The larger peaks with the check marks are internal standards. A comparison of the results of these two analyses demonstrate that at least eight of the compounds are the same. This indicates that the deposits on the inside of the home are from the same source or sources as the deposits from the railing outside of the home.

The third location sampled was the roof of an office building that is near the approach to runway 27L. The building fronts on Manheim Road. An air conditioner on the roof was surrounded by a sheet metal enclosure the inside surface of which was protected by an overhang. This surface was coated with sooty material, and two samples were taken on the inside surface.

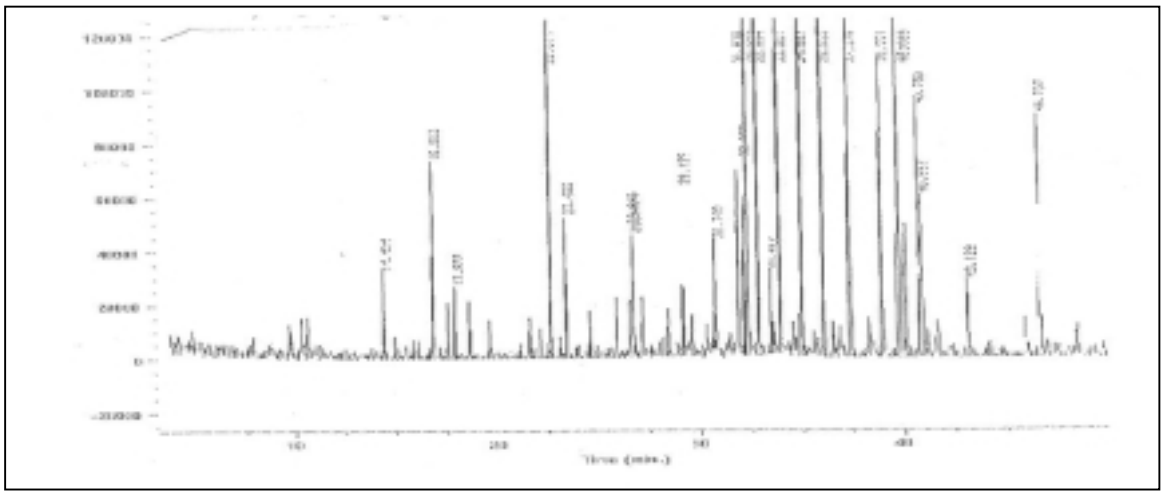


Figure 127. Results of Analysis of Wipe Sample from
Roof of Building Near Runway 27L.

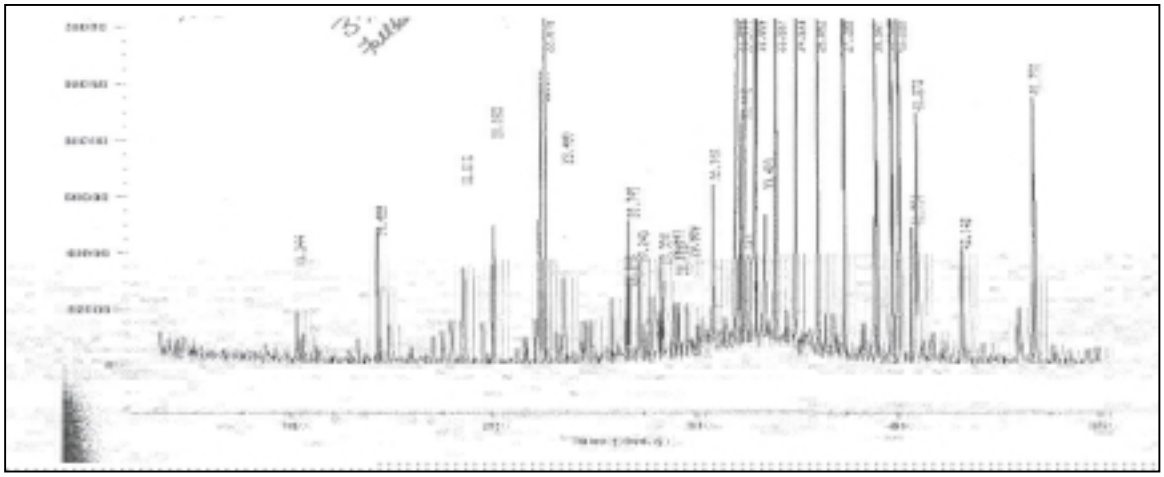


Figure 128. Results of Analysis of Wipe Sample from
Roof of Building Near Runway 27L.

Unique to these two chromatograms is the pattern of very large peaks found in the region between 30 and 40 minutes.

For comparison purposes, a chromatogram of diesel fuel and a chromatogram of a standard of NIST Urban Dust was also obtained under similar conditions. By comparing the results of these two analyses it is obvious that neither of these two sources can explain

the additional compounds found in the wipe samples that were obtained from the various locations in this study.

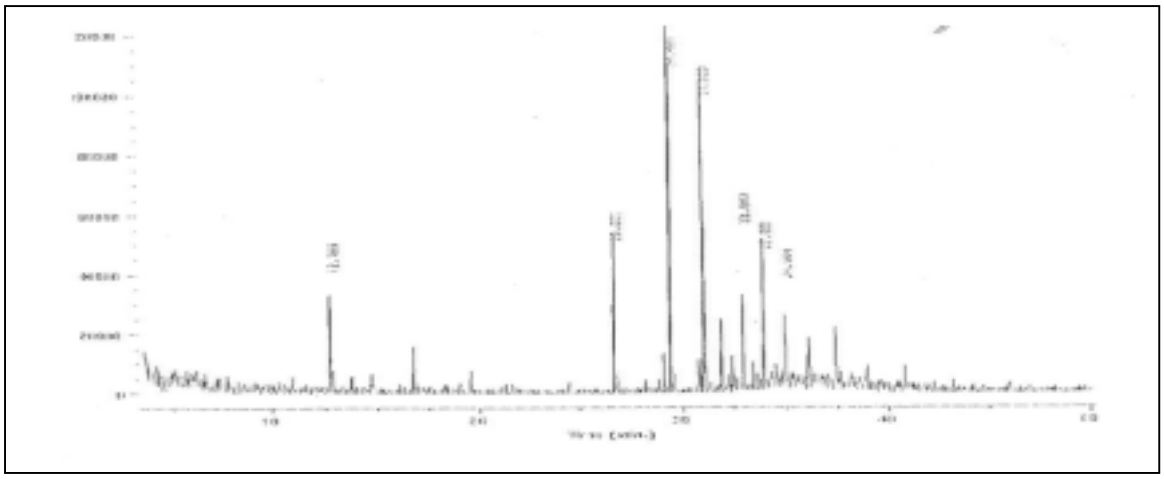


Figure 129. Results of Analysis of NIST Urban Dust.

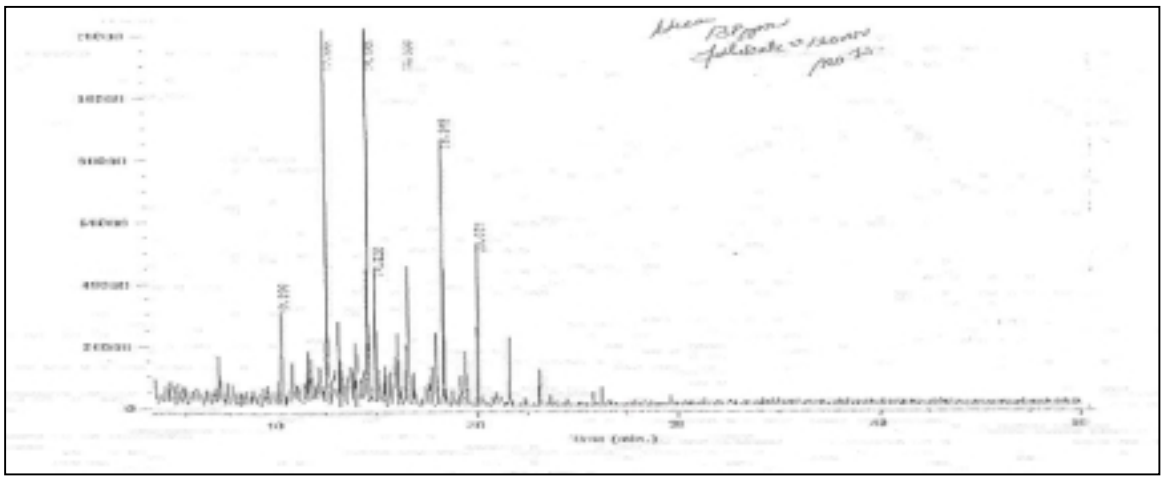


Figure 130. Results of Analysis of Diesel Fuel.

The deposits that were sampled do not appear to be the result of unburned diesel fuel. The compounds that were found have molecular weights that are much heavier than the compounds found in diesel fuel. While there appear to be some components of NIST Urban Dust that may be present in the wipe samples, there are many more compounds that do not correlate with the sample of NIST Urban Dust. Much more work needs to be done in this area in order to determine the compounds that are present in these deposits and the origins of these compounds, if possible. The work presented here is only very preliminary and is meant only to suggest that further investigation be undertaken.

Conclusion

This study serves to demonstrate that a great deal of information can be obtained concerning the emission of various types of organic and particulate air pollution from O'Hare International Airport. The thoughtful placement of sampling equipment and the detailed analysis that was accomplished in this study lead to a wealth of knowledge about the specific compounds that are being emitted. This study was by no means exhaustive but only served as a snapshot of the emissions occurring during the days that were sampled. A more thorough investigation would be expected to shed even more light on the magnitude of the emissions and the sources for these emissions.

Recommendations for further investigation would include:

- an investigation of the pollutant concentrations at various heights. In this study all samples were taken at approximately 5 feet from ground level
- a more thorough investigation of the deposits that have been detected by the population living in communities around the airport particularly those residing near approaches to the airport
- an investigation of pollutant concentrations at various times during the day with sample durations being more on the order of grab samples and less emphasis on composite sampling
- an investigation of pollutant concentrations throughout the year to determine if there are seasonal effects
- a thorough investigation of jet engine emissions in order to determine what types of compounds are being emitted in order to provide a better list of target compounds for the ambient sample analysis
- an investigation of other activities at the airport to determine what other sources are present and what types of compounds are being emitted by these activities.

