AIR QUALITY IN THE VALPARAISO AREA

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ABSTRACT

Volatile Organic Compounds (VOC's) and particulate matter (PM) have been serious air pollution concerns around the world, particularly where industries and high volume traffic are present. These pollutants have been shown to have a negative effect on most living organisms, which is why they are regulated in many countries. To determine the air quality in the Valparaiso area, an experimental plan was conducted to determine the amount and type of these pollutants in the air. One of the project goals was to measure and compare indoor vs outdoor pollution. Another was to observe and assess weather effects on outdoor air pollution. Various locations around Valparaiso University campus and in the surrounding geographical area were chosen to analyze VOCs and PM. VOC testing was conducted using a solid phase microextraction fiber (SPME) to passively collect air pollutants. For PM, a MIE pDR-1500 active personal particulate monitor was used to actively draw in air and measure the concentration of particulate matter. A filter paper was used in the personal particulate monitor to collect the actual particulates. The instrument was run with both no filter, to determine total PM, and an adapter to select for PM 2.5 microns or lower. The SPME fibers were analyzed using a gas chromatographer - mass spectrometer (GCMS) to help determine the volatile or semi-volatile compounds present in the air. The collected data shows many differences between indoor and outdoor air.

INTRODUCTION

Air pollution is a serious concern in the U.S. and worldwide. Although the US EPA regulates air pollution, indoor air is rarely monitored and only certain outdoor areas are monitored. There are industrial and non-industrial factors that create air pollution. Two important classes of pollutants are volatile organic compounds (VOC's) and particulate matter, more specifically particles less than 2.5 micrometers (PM 2.5). These tiny particles tend to be the most hazardous due to their small size and the ease at which they are inhaled into the lungs. We decided to test the air in the Northwest Indiana area, both indoors and outdoors, to determine the level of certain pollutants. We collected VOCs using a SPME fiber to passively collect compounds, and the MIE pDR-1500 active personal particulate monitor to actively draw in air to measure PM.

METHODS AND MATERIALS

Figure 1: Left picture is the particulate matter monitoring instrument and the right picture is the SPME holder and fiber options.

The MIE pDR-1500 active personal particulate monitor was used to measure the concentration of airborne particulate matter. The instrument was run with 1) no filter to determine total PM, and 2) an adapter to select for PM 2.5 microns or lower

VOCs testing was conducted using a solid-phase microextraction fiber (SPME) to passively collect air pollutants. The SPME fiber is then inserted directly into the gas-chromatography (GCMS) for desorption and analysis of organic compounds in the air.

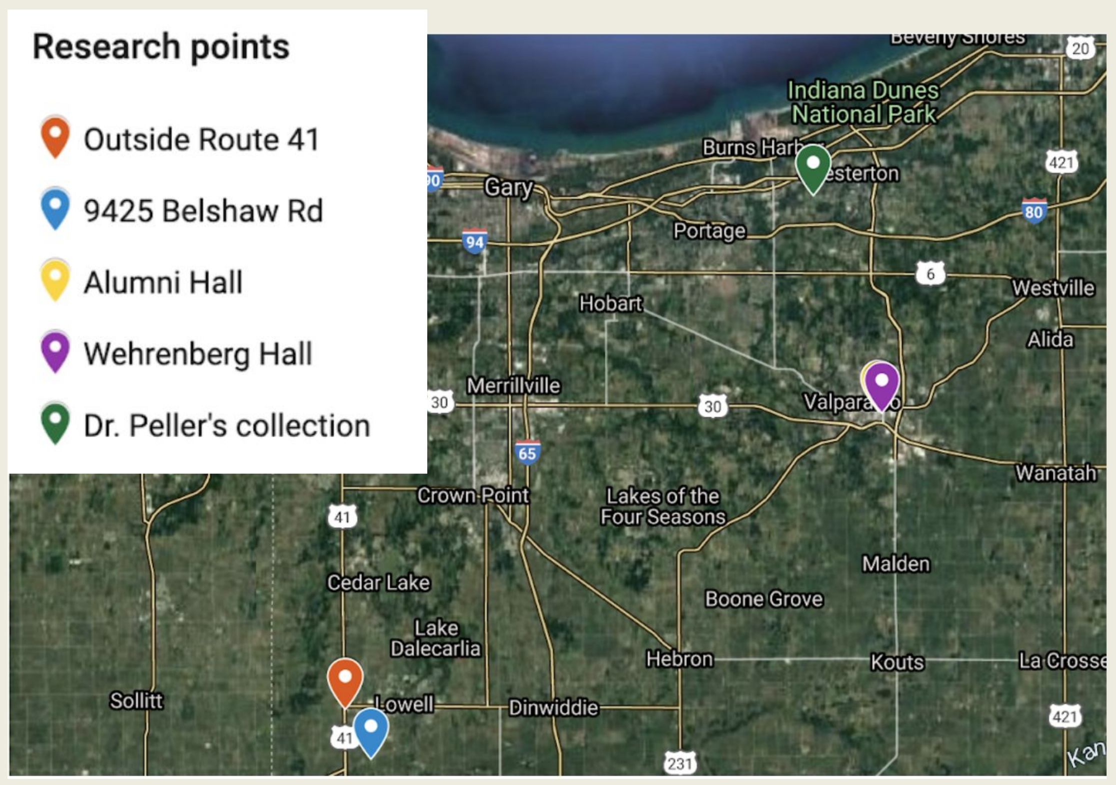


Figure 2. Map of locations where air quality monitoring took place. Mostly indoor air was monitored, due the the restrictions of the semester.

RESULTS - PM measurements

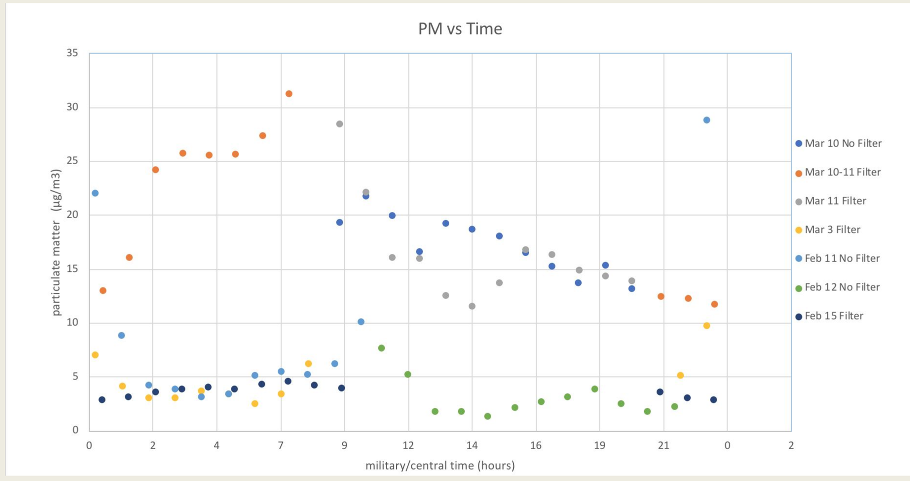


Figure 3: Particulate matter in ug/m^3 from indoor measurements at Alumni Hall

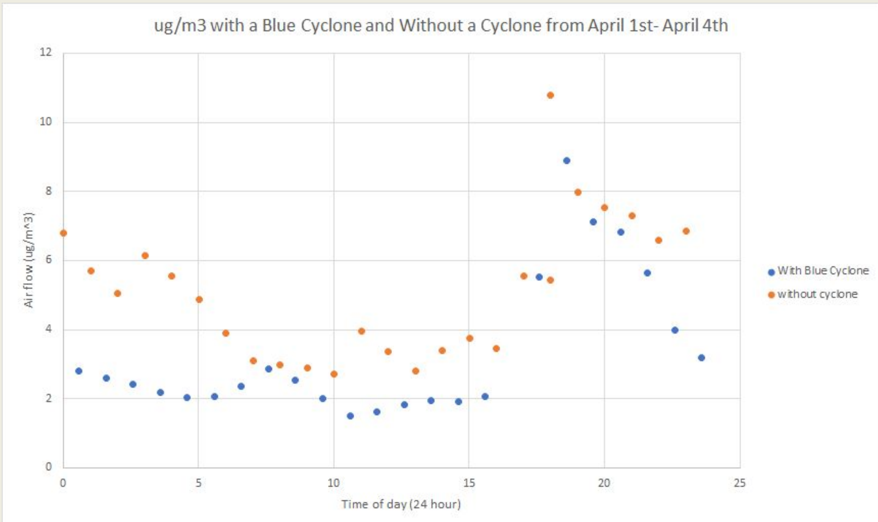


Figure 4: PM monitoring during April 1-4, 2020 at an inside location in Portage, IN.

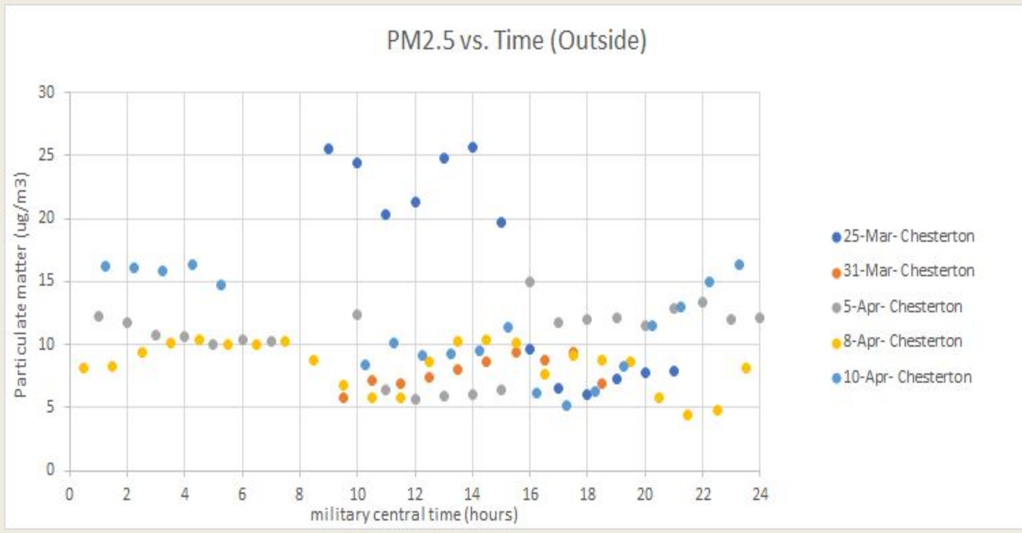


Figure 5: Particulate matter in ug/m^3 for PM 2.5 from outdoor monitoring. (All outdoor monitoring = Chesterton location).

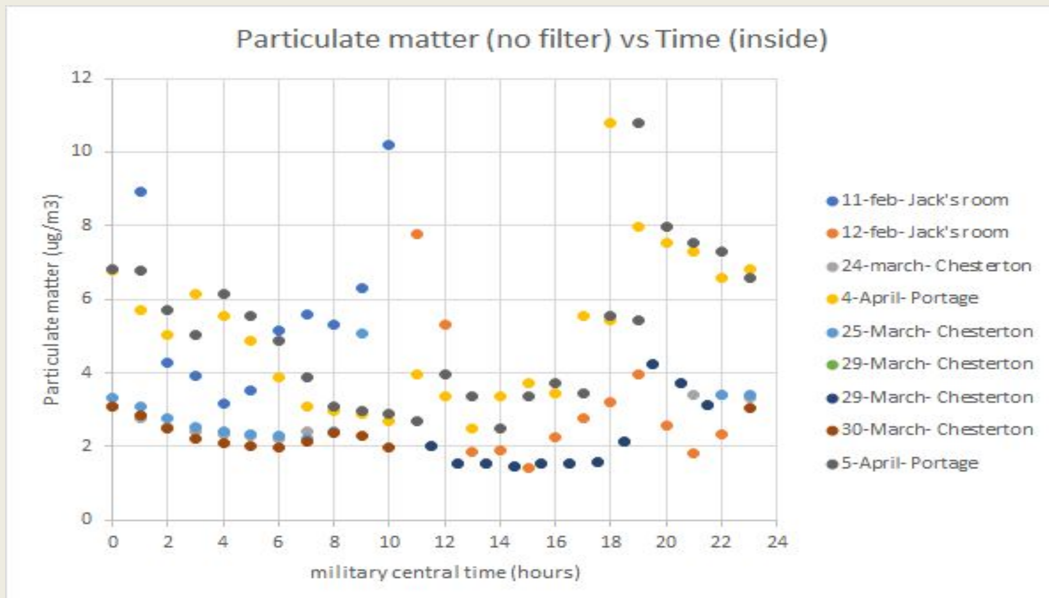


Figure 6: Particulate matter in ug/m^3 (no filter) from all indoor monitoring locations.

Table 1: Indoor Averages of PM measurements.

Date	Time of Day	Blue Cyclone Average ug/mg3	No Cyclone Average ug/mg3
March 3	PM-AM	4.76	
February 11	PM-AM		8.95
February 12	AM-PM		3.1
February 15	PM-AM	3.79	
March 24/25	PM-AM	2.75	
March 29	AM-PM	2.22	
March 29/30	PM-AM		2.37
April 3-April 4	PM-PM		6.18
April 1-April 2	PM-PM	3.3	
February 20	AM-PM		4.94
February 25	AM-PM	3.95	
February 27	PM-AM		4.16

Table 2: Outdoor Averages from PM monitoring.

Date	Time of Day	Blue Cyclone Average ug/mg^3	No Cyclone Average ug/mg^3
March 10	AM-PM		17.38
March 10-March 11	PM-AM	20.56	
March 11	AM-PM	16.45	
March 25	AM-PM	15.91	
March 31/20	AM-PM	7.84	
April 5- April 6	AM-AM	10.52	
April 8-April 9	PM-PM	8.36	
April 10-11	AM-AM	11.77	

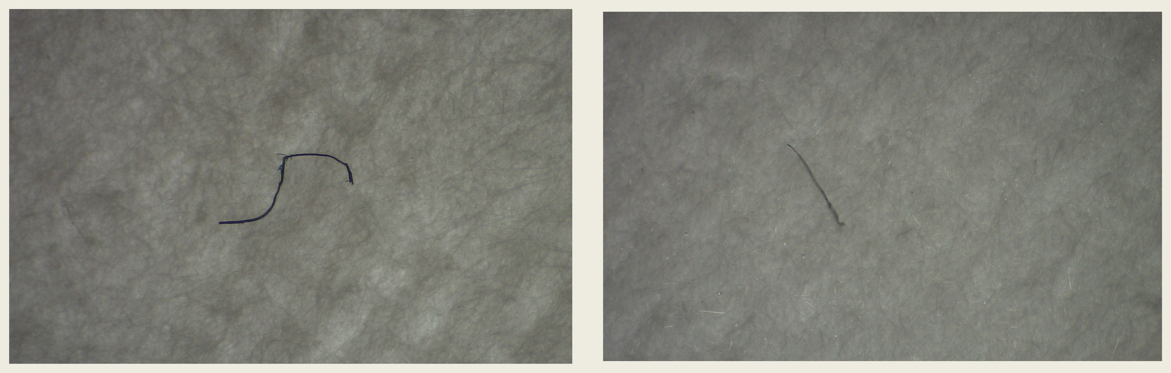
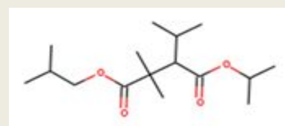
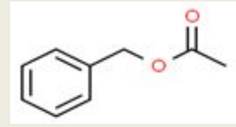


Figure 7: Microfibers collected indoors by the PM monitor with no filter.

RESULTS - Volatile Organic Compounds

Table 3: Classification of the identified indoor volatile organic compounds.

Classification	Chemical name	Structure
Plasticizer	Pentanoic acid 2,2,4 trimethyl-3 carboxy isopropyl, isobutyl ester	
Candle	Decanal or other HC	
Fragrance and cosmetic	Acetic acid, phenylmethyl ester	
Cleaning agent	2-propanol, 1-(2-butoxy-1-methylethoxy)	

Most commonly found VOCs from SPME monitoring (indoor)	
Cyclohexene	(3/6)
Nonanal	(4/6)
Decanal	(3/6)
Propanoic Acid, 2-methyl-3-hydroxy-2,2,4-trimethylpentyl ester	(3/6)

Some of the detected compounds are from natural sources, while others, such as certain cleaners, personal care products and plasticizers (compounds released from plastic materials, are not natural. At certain levels, these can be hazardous.

CONCLUSIONS

The levels of particulate matter indoors were consistently lower than the amount of PM observed outside. Both the indoor and outdoor PM varied over time. During the middle of the day, higher amounts of particulate matter were measured. At night, the amount of particulate matter both indoors and outdoors was lower. After examining some of the indoor filters under a microscope, several microfibers were found, likely from articles of clothing or blankets. Indoor VOCs are readily detected. The compounds released from plastic materials and candles were the most commonly detected.