Medical Center Test Report

Note: It is the expressed wish of the Medical Center featured in this test report that their name not be published. Per their request, their name has been removed.

June 22, 2007

SENT VIA e-MAIL

Attention: Mr. , Project Manager

RE: PRELIMINARY REPORT - TVOC MONITORING AND DYNAMIC FILTER REVIEW, HEALTH RECORDS UNIT, MEDICAL CENTRE

Dear Mr. ,

Further to your request EHS Partnerships Ltd. (EHS^P) is conducting ongoing total volatile organic compound (TVOC) monitoring in the air intake located in the North Wing Mechanical Basement and servicing the Health Record Unit at the Medical Centre in . The air monitoring is being conducted as part of a trial evaluation of electrostatically charged filter media ("Dynamic Filters"). This report details our current data and provides a review of the operation and efficacy of the Dynamic Filters in controlling TVOCs.

SCOPE OF WORK

The assessment includes a program of air monitoring for TVOCs to assist in evaluating the efficiency and longevity of the Dynamic Filters that have been installed on the air handling unit. EHS^P is currently collecting a series of samples inside the "mixing chamber" upstream of the filters, and inside the air handling unit downstream of the filters. Background samples were collected prior to the installation of the filters, and a series of samples are being collected over several months to assess filter performance specific to TVOCs.

REGULATIONS & GUIDELINES

Alberta Workplace Health and Safety

Part 2 (Hazard Assessment, Elimination and Control) in the Alberta Occupational Health and Safety Code, October 2003 describes the requirements to assess and control hazards in the workplace. Section 9 of Part 2 requires that hazards be eliminated or controlled. If hazards cannot be eliminated the first requirement in the hierarchy is to use engineering controls. The use of ventilation can be an effective engineering control.

Part 26 (Ventilation Systems) in the Alberta Occupational Health and Safety Code, October 2003 details the requirements where a mechanical ventilation system is used to control worker exposure to contaminants in the workplace. The requirements are performance based with respect to chemical exposure and do not specify required ventilation rates. Part 26 describes the applicability of this section, and design and safety considerations to be met.

TVOC Indoor Air Quality (IAQ) Guidelines

Currently, there are no regulated limits for volatile organic compounds when considering typical indoor air quality levels. In most cases, establishing an acceptable limit is not appropriate due to the many confounding factors that typically exist. For office environments, both Health Canada and Alberta Infrastructure (AI) recommend keeping TVOC levels below 5 mg/m^3 in indoor air[1]. This is consistent with a typical indoor environment where the majority of the occupants do not express discomfort with the space. This discomfort may be in the form of odour or irritation, but is not indicative of irreversible health effects. For a typical mixture of hydrocarbons found in indoor air, the concentration at which one might experience adverse health effects is much higher, and typically greater than 25 mg/m^3 [2].

Health Effects

The ability of volatile organic chemicals to cause health effects varies greatly from those that are highly toxic, to those with no known health effect. As with other pollutants, the extent and nature of the health effect will depend on many factors including level of exposure and length of time exposed. Eye and respiratory tract irritation, headaches, dizziness, visual disorders, and memory impairment are among the immediate symptoms that some people have experienced soon after exposure to some organics[3].

FILTER SYSTEM DESCRIPTION[4]

Background

Particle filtration generally involves either passive filters or electrostatic precipitators (ESP's). Passive filters are essentially size selective sieves: the smaller the holes in the media, the more efficient the filter. Passive filters do nothing to influence particle charge and have no impact on gas phase contaminants. They do increase in efficiency and pressure drop as they load. The basic trade-off with passive filters is efficiency for pressure drop and expense.

ESP's work almost exclusively through electrostatic attraction: opposites attract. Particles are ionized by a corona created by a high DC voltage and then collected on oppositely charged plates. Although porous by comparison with passive filters, ESPs can be extremely effective at capturing even sub-micron particles. ESP's lose effectiveness as they load and have other operational issues in that they create ozone and the uncollected charged particles will tend to stick to grounded surfaces in the space.

According to the manufacturer, Environmental Dynamics Group, Dynamic Filters combine elements of both passive filters and ESP's. Generically, they are non-ionizing, polarized media air cleaners. They employ a high DC voltage (7,000 volts DC) applied to the center screen of the media pad. This creates an electrostatic field between the media and the grounded external screens. This field polarizes the fibers of the media pad and the particles that enter the air cleaner. The polarized particles stick to both the media and to each other.

1 Indoor Air Quality Guideline, Alberta Infrastructure, Technical Services Branch, August 2003.

2 Total Volatile Organic Compounds (TVOC) in Indoor Air Quality Investigations, Report No. 19, European Commission, 1997.

3 http://www.epa.gov/iaq/voc.html

4 Request for the Evaluation of the Equivalency of Dynamic Air Cleaners to Merv 13 & 14 Passive Filters, Environmental Dynamics Group.

Filtration Mechanisms

Dynamic Air Cleaners have three primary mechanisms:

Passive Mechanisms: There is a media (although coarse), so there are all the mechanisms associated with passive filters. Like passive filters, Dynamic Filters increase in efficiency as they load. Unlike passive filters, Dynamics will load more evenly which may extend service life. This was found during laboratory evaluation, where it was observed that the electric filter fibers loaded almost uniformly around the whole fiber versus passive fibers that tend to load on the upstream side.

Electro-Static Attraction: The electro-static field polarizes the surface charge of the particles and the media, giving them negative and positive poles. The poles on the particles are then drawn to the oppositely charged poles on the media. Some particles (especially those under 0.4 micron) tend to already have a slight charge. Their charges will be enhanced and they will be collected on the oppositely charged media fibers. Further, the center screen has a positive charge and will attract the negative side of polarized particles and negative particles. So like ESP's, Dynamics rely on electro-static attraction and the ability to influence particle charge. Unlike ESP's, Dynamic Filters do not create charged particles or Ozone.

Agglomeration: This is a naturally occurring process whereby particles collide and stick together to form larger groupings. Dynamic Air Cleaners greatly speed up this process two ways: first, by polarizing the particles, they become, in essence, stickier to other polarized and charged particles, and second, the mobility and therefore the collision rate of the particles (especially those in the sub-micron range) is dramatically increased by the electrostatic field inside the air cleaner.

The mechanism by which the Dynamic Filters remove TVOCs has not been described in the product literature. It is suspected that it may be attributed to the removal of particles (ultrafine or otherwise) where TVOCs may be adsorbed, along with certain charge effects.

METHODOLOGY

Readings were collected continuously at 1 and 2 minute intervals using RAE Systems ppbRAE photo ionization detectors (PIDs). To combat instrument "drift" typical of PIDs, the equipment is calibrated and downloaded every few days. Detailed graphs of VOC levels throughout the sampling periods are then prepared. TVOC removal efficiencies have been calculated by subtracting downstream concentrations from upstream concentrations, and dividing by upstream concentrations. Efficiencies are reported on a percentage basis. Average concentrations are calculated as a mean of all data > 0 ppb. Negative results (due to instrument drift) and zero readings have been omitted.

RESULTS

Pre-filter TVOC levels are typically been in the range of 10 to 40 ppb. Post filter TVOC levels are typically in the range of 0 to 15 ppb. Graphs of the results for the period of June 1 to June 21 are provided in Figure 1. Results for March and April have been reported previously. May results were limited due to equipment malfunction, and have not been reported. Pre and Post average TVOC levels along with filter efficiencies are provided in Table 1.

Figure 1: Pre and Post Filter TVOC Levels

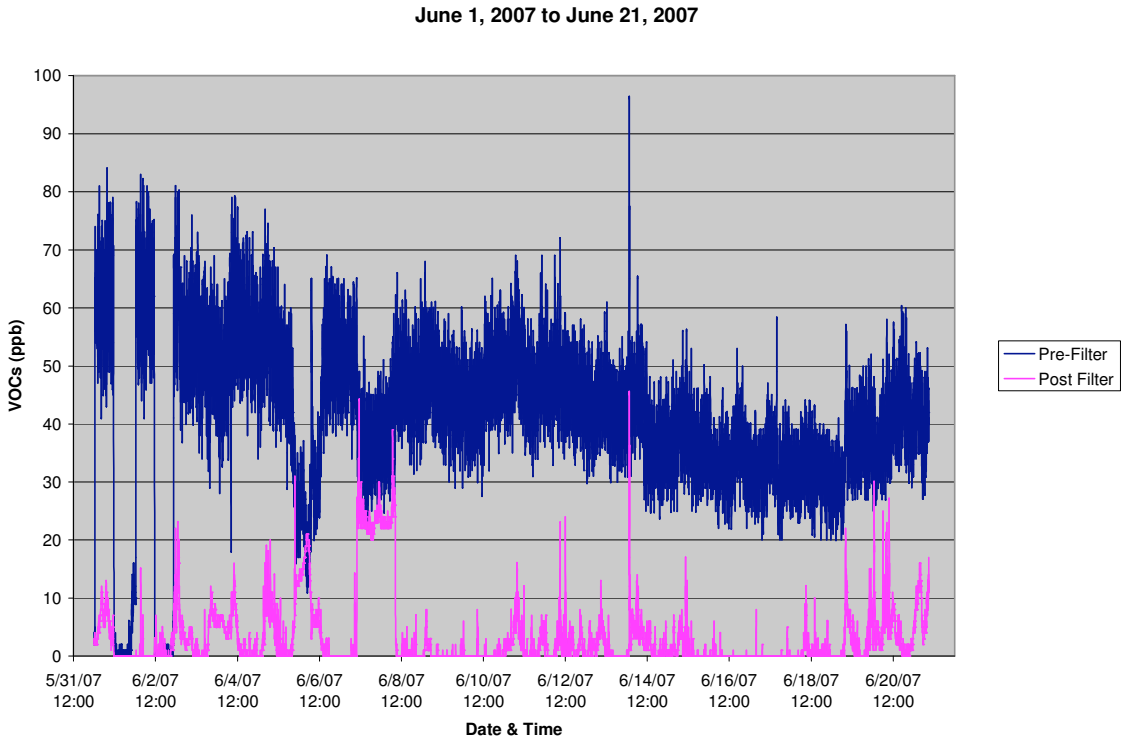

Table 1: Pre and Post Filter Average TVOC Levels and Estimated Removal Efficiencies

Date Range	Pre Filter Average		Post Filter Average		TVOC Removal Efficiency
	ppb	mg/m^3	ppb	mg/m^3	
March – April	24.1	0.01	8.5	0.004	77 %
June 1 – 21	41.1	0.02	3.2	0.001	91%

Notes:

ppb – parts per billion by volume, instrument calibrated with isobutylene
mg/m^3 – milligrams per cubic meter of air, converted and adjusted to TVOC methane equivalents

DISCUSSION AND CONCLUSIONS

Measured TVOC levels are considered very low, and typical of IAQ in a facility with limited or no reported complaints. To date, over sixty thousand data points have been collected since monitoring for TVOCs began on March 9th, and none have exceeded (or approached) the AI/ Health Canada guideline level of 5 mg/m^3, and all have been much less than 1 mg/m^3.

TVOC removal efficiencies at the low levels measured appear to provide in excess of 77% efficiency. It is expected that the removal efficiency will decline at greater TVOC concentrations, for example on June 14th the pre-filter TVOC level of 96 ppb was reduced to 45 ppb, a 53 % removal efficiency. The expected design TVOC removal efficiency for the Dynamic Filters was not available, and therefore a comparison of design or reported removal efficiency vs. measured efficiency could not be conducted.

The Dynamic Filters appear to be effective at controlling low level TVOC concentrations. Should a point source or other contaminant source with high TVOC concentration impact the air intake, the ability of the Dynamic Filter system to control these levels is unknown.

The evaluation for the Health Records was conducted considering this area as an "office" type environment. If this system will be considered for hospital or other healthcare areas where nosocomial infection risks exist, further evaluation of particulate filtration efficiency and pathogen removal should be conducted. Germicidal treatment or additional filtration may be required to address infection prevention.

STATEMENT OF LIMITATIONS

This report is for the exclusive use of the and their authorized agents. Third party use of this report, or any reliance or decisions made on the information herein, is at the sole risk of the third party. EHS^{P} has no obligation, contractual or otherwise, to any third persons using or relying upon this report for any reason and therefore accepts no responsibility for damage suffered by any third party as a result of actions taken or decisions made on the basis of information or conclusions of this report.

CLOSURE

If you have any questions, require clarification, or would like to discuss this report, please feel free to contact the undersigned at (403) 243-0700 or at pmackinnon@ehsp.ca. Thank you for the opportunity to be of service.

Sincerely,

EHS PARTNERSHIPS LTD.

Paul MacKinnon, M.Sc., CIH
Partner