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#### MICROBIOLOGICAL CONTAMINATION OF HVAC FILTERS.

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Heating, ventilating, and air-conditioning (HVAC) filters that were under investigation for filtration performance became contaminated with microbiological growth after the humidification system within the air-handling unit (AHU) malfunctioned. The HVAC system is a constant volume system operating 24 hours a day, 7 days a week that serves a biomedical research facility. The HVAC filters have a two-year recommended service life and were rated at 90% efficiency as per American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) 52.1 standard. These filters were also approved by the manufacturer for use in high humidity, turbulent airflow, and elevated operating temperature environments. The AHU humidification system malfunctioned causing some of the filters to become water-logged, restricting airflow. As a result, the filters became contaminated with a visible black microbiological growth within 24 hours of becoming saturated. Samples collected from the ventilation filters with sterile swabs were cultured. The predominant fungal species found on the contaminated filters were *Aureobasidium pullulans*, *Epicoccum nigrum*, *Penicillium*, *Cladosporium*, *Alternaria alternata*, and other yeasts. The bacterial species identified were *Staphylococcus*, *Rhodococcus*, *Micrococcus luteus*, and *Bacillus*. Filters with no visible contamination from the same filter bank were also tested and no detectible microbial growth was found. Within 48 hours of the humidification system malfunction, the system was repaired and normal airflow resumed through the filters. The black, gelatinous microbial contamination found on the filters was completely desiccated, leaving a slight black stain on the filtration material. It is recommended that contaminated filters be replaced, but due to the ongoing filtration study this was delayed. This incident documents the role humidification can play in microbial contamination. This incident also documents the unpredictable, spontaneous nature of contamination that can occur within AHUs with potential adverse impact on indoor air quality. This contamination can go unnoticed without routine inspection of the ventilation system.

253.

#### VOLATILE ORGANIC COMPOUND COMPARISON OF SEVERAL VENTILATION SYSTEMS.

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The ventilation system of a government facility consists of six commercial air-handling units (AHUs), three operating on 100% outside air intake and three using recycled mixed air

(15–20% outside air). All AHUs used 85% efficient Purolator Defiant Filters with Koch pre-filters. A strong odor emanating from used ventilation filters in one of the single-pass systems was noticed during annual routine maintenance. A study was undertaken to determine the cause of the odor and identify the source. To see if there was the potential for this problem to exist elsewhere, a second building of the same agency in another city was also investigated. The AHUs contained Columbus Industries average-efficiency, single-component bag filters with low-efficiency pre-filters. The study was conducted in both buildings over a period of several months in order to determine if the problem was time-related or location-specific. Air samples were collected in evacuated canisters for further analysis by gas chromatography-mass spectroscopy (GC-MS). Samples were collected in all AHUs upstream and downstream of the filter bank. Portions of new and used samples of the pre-filter and filter media were collected for GC-MS headspace analysis. The analysis of the air samples collected in the air intakes (outside air) from both buildings was very similar. The samples contained low concentrations (<10 ppb) of chloromethane, 1,3-butadiene, 3-chloropropene/allyl chloride, methylene chloride, and acrylonitrile. These same compounds were found in higher concentrations in the used filter headspace samples for both types of filter media of both buildings. It is concluded that the filter acts as a large vapor collection bed regardless of the filter media for these compounds that are found in outside air. This research and subsequent analysis may be useful in evaluating building indoor air quality and might lead to improved filter replacement schedules.

254.

#### EVALUATION OF INFECTION CONTROL TECHNIQUES DURING TOTAL RENOVATION OF IN-PATIENT SPACE FOR EXPANSION AND RETROFIT OF A TERTIARY CARE HOSPITAL IN HOUSTON, TEXAS.

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During a five-year expansion project and retrofit for an academic tertiary care hospital, a proactive planning process for construction and infection control techniques was utilized. The older building primarily scheduled for retrofit was known to have asbestos-containing materials (ACM) and was connected by working hospitals. A combination of friable and non-friable materials were documented. The potential presence of lead-based paint was also investigated. Other hospital areas were known to harbor spores of fungi potentially pathogenic to immuno-compromised patients.

Numerous infection control barriers were identified for use during pre-planning to contain airborne particulate based on the level of disturbance, location of the hospital areas, and ability to exhaust negative pressure contain-

ment work areas to the outside ambient environment. Development of anticipated project scope of work plans for abatement of ACM and other identified hazards was completed by an assembled team involving occupational health and safety, engineering, facilities, architects, contractors, and infection control.

A variety of evaluation techniques were utilized during construction to insure efficacy of the infection control barriers. These methods included: routine site observations and verification of effectiveness of negative pressure containment work areas, as well as a representative air-sampling strategy.

An industrial hygiene sampling protocol was designed involving initial and final work area monitoring as well as during various abatement and demolition work phases for three hospital wings during 2001–2002. Monitoring was performed for ultra-fine particulates, bioaerosols as culturable agents, and also nonculturable airborne fungal structures. Ultra-fine particulate levels were relatively variable. Microbial monitoring results also documented variability but showed a decrease in airborne fungal structures and bioaerosols relative to progression of the construction phase of work.

255.

#### THE LEVELS OF ELECTROMAGNETIC FIELD STRENGTH EMITTED FROM SEVERAL COMMERCIAL PHOTOCOPIERS.

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This study was designed to evaluate the levels of electromagnetic fields (EMFs) for extreme low frequency (ELF) and very low frequency (VLF) in accordance with the distance from photocopiers, manufactures, power consumption, and the amount of copy in the state of stand-by and running. The subjects were 15 commercial photocopiers produced by three manufacturers. Electromagnetic fields were not significantly increased according to the increase in the amount of copy. The levels of electromagnetic fields decreased as the distance from photocopiers increased. The levels of magnetic fields for ELF at 10 cm from photocopiers in the running mode were significantly different between manufacturer A and B. Magnetic fields for VLF at the same distance and mode in manufacturer A were significantly different with manufacturer B and C. The levels of EMFs at 10 cm exceeded the Korean exposure criterion had proved except these of manufacturer A. From the above results, when photocopiers were running, the levels of EMFs were significantly higher than those of EMFs in the state of stand-by. The levels of magnetic fields for ELF at 10 cm were significantly high and exceeded the Korean exposure criterion. Consequently, the preventive control of regulation should be appropriately applied to the workers engaged in copying work.

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