

Reclassifying Hotel Room Exhaust

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Ventilation 5: Field Studies

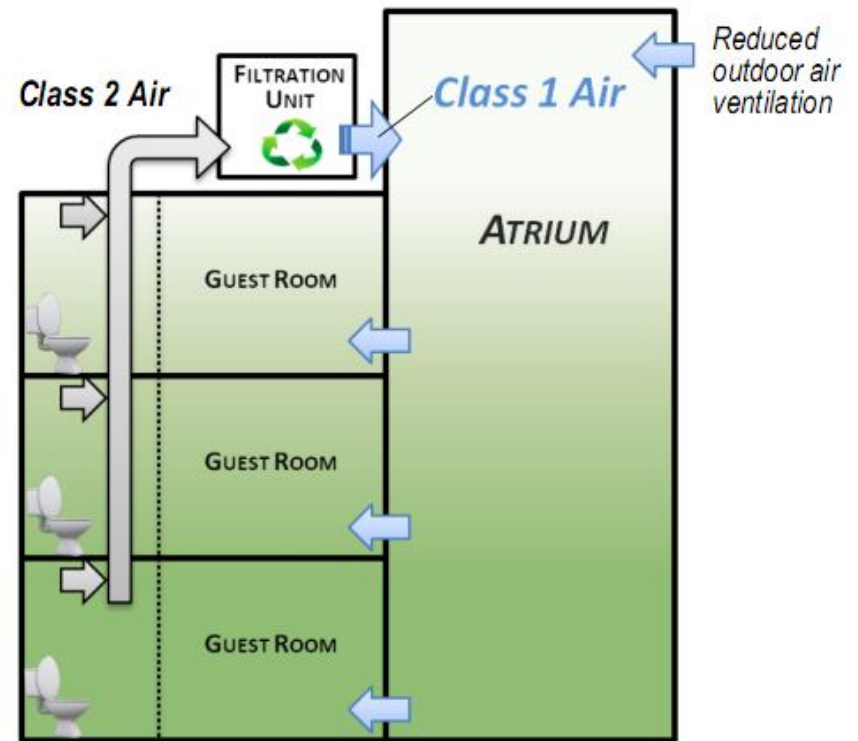
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Indoor Air 2011



Reclassification of Exhaust Air

- Hotel Guest Room Toilet Exhaust
 - Ventilation standards such as ASHRAE 62.1-2010 allows for the reclassification of exhaust air to a cleaner class provided the exhaust air passes through an air cleaning system.
 - Classification is subjective; Class 2 “...moderate contaminant concentration, mild sensory-irritation intensity, or mildly offensive odors.”
 - Hotels require relatively large exhaust airflow rate due to a toilet in each guest room. Conditioning the makeup air can be costly; especially in extreme climates.



Hotel Field Study

- Large (>1,000 rooms) hotel recycles toilet exhaust via gaseous and particulate filtration
- Recycled air is reintroduced into the building via interior atrium
- Environmental characterization was conducted to enable comparison of contaminants and concentrations to published guidelines by “cognizant authorities”
 - CA OEHHA REL
 - ATSDR MRL
 - OSHA PEL
 - EPA BASE
 - AIHA
- Hotel had >80% occupancy during testing

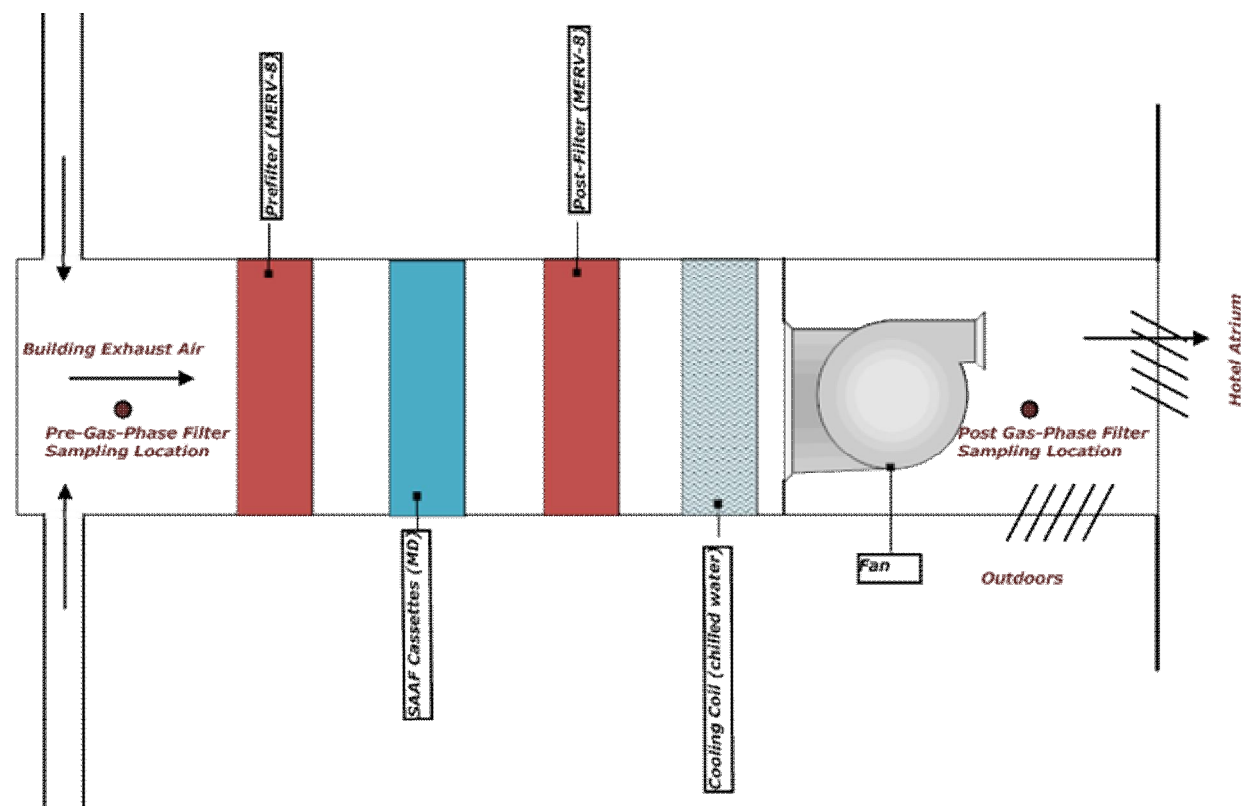


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Air Filtration System & Sampling Locations

- Particulate filtration consisted of 2 inch (51 mm) MERV 8 pre-gas-phase and post gas-phase filters
- Gas-phase filters consisted of deep (457 mm) V-bank cassettes filled with a blended loose fill media consisting of equal parts (by volume) of potassium permanganate impregnated (8%) alumina and virgin activated carbon
- Sampling was conducted prior to filter train, after filter train, and outdoors



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Methods

- Airborne Chemicals
 - VOCs (EPA method TO-15)
 - Aldehydes (EPA method TO-11A)
 - Ammonia (OSHA ID-188/ID-164)
 - Hydrogen Sulfide (CAS AQL 110)
- Bioaerosols
 - Fungi (non-viable and viable) using active impaction spore trap sampler and SAS sampler with Anderson style active plate impaction head
 - Bacteria (Coliforms with isolation of E.coli sp.) using SAS sampler with Anderson style active plate impaction head

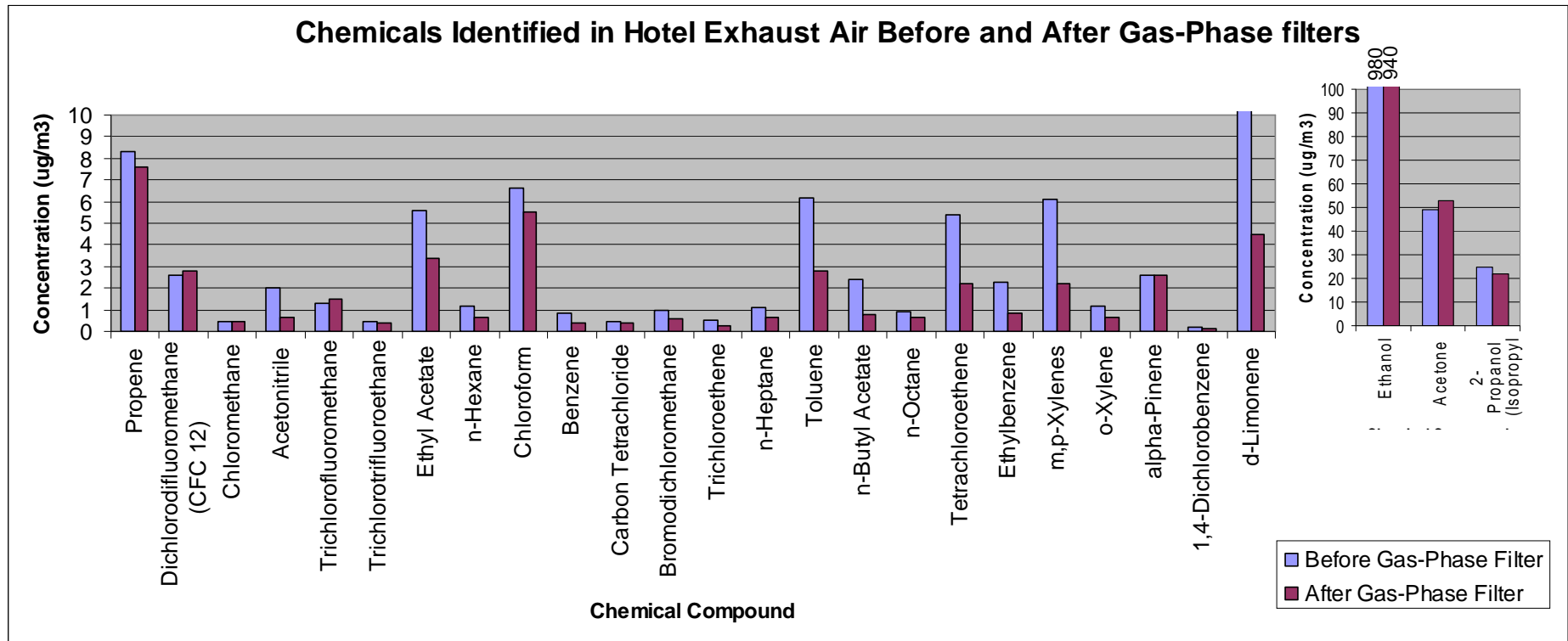


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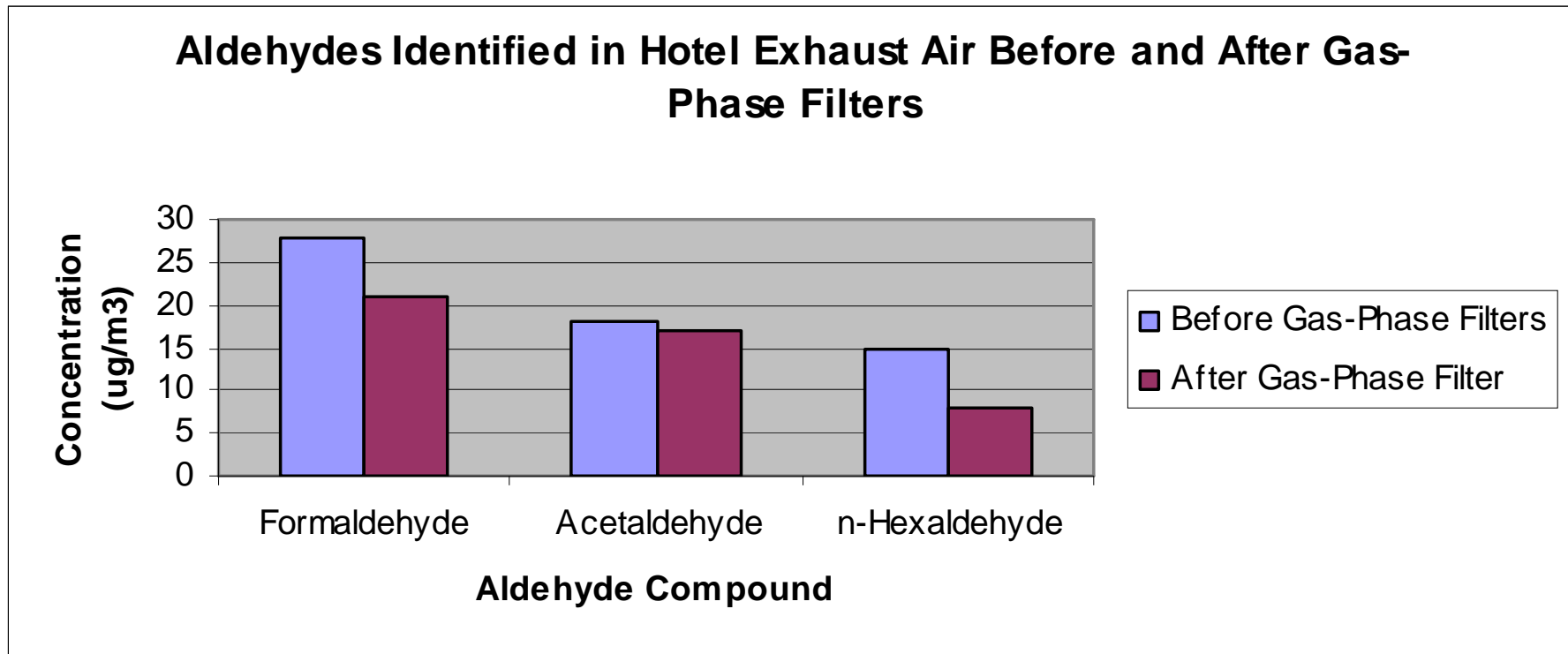
VOC Results

- 75 compounds targeted in method
- Only 27 compounds had concentrations higher than the limits of detection
- Post gas-phase concentrations were lower than what was found in non-problem office building air (BASE study) with the exception of eight compounds; four of which were not targeted in the BASE study. The other four compounds (Ethanol, Chloroform, alpha-Pinene, and Acetone) were either not listed as a COC or below recommended concentrations levels per the cognizant authority listings.
- Gas-Phase filtration reduced the overall concentration of the chemical compounds by an average of 31%



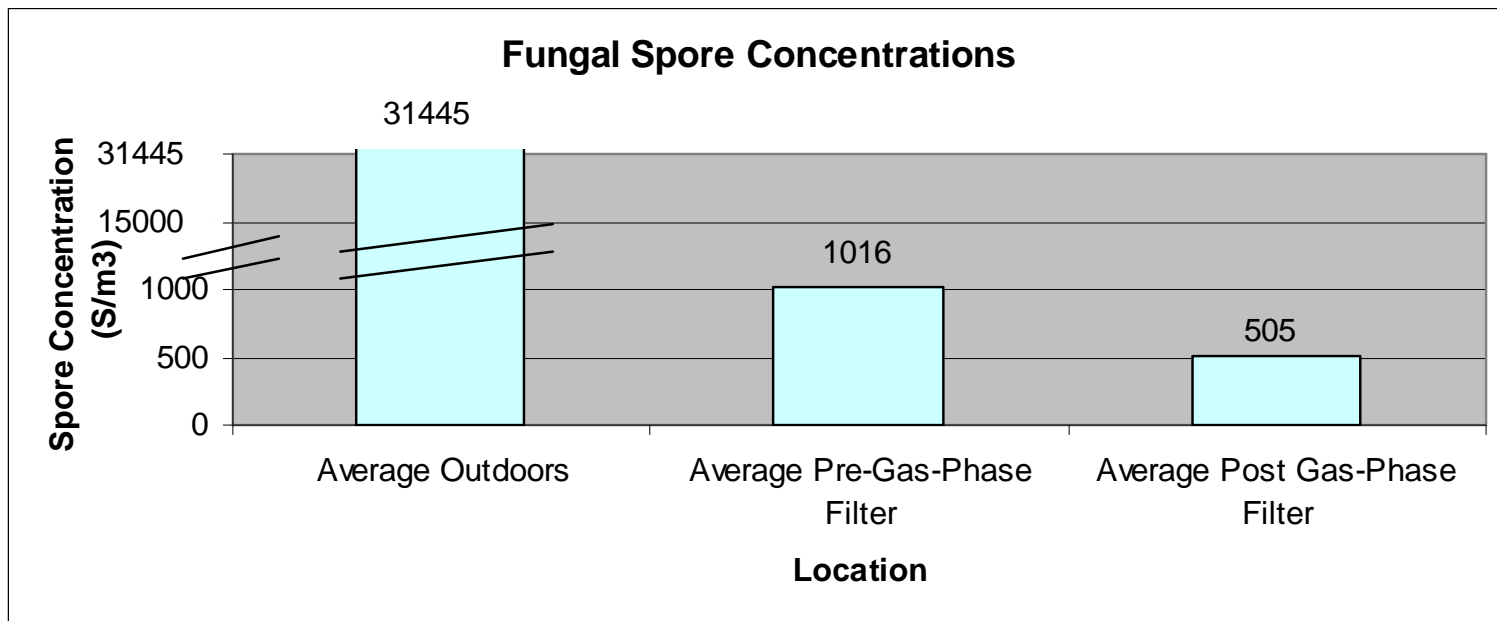
Aldehyde Results

- Eight Aldehydes targeted in method
- Only three had concentrations greater than the limits of detection
- Formaldehyde levels were greater than BASE by $5 \mu\text{g}/\text{m}^3$ (4 ppb) and lower than CDC ASTR 2009 minimum risk levels for intermittent exposures ($38 \mu\text{g}/\text{m}^3$; 30 ppb)
- Gas-Phase filtration reduced the overall concentration of the Aldehyde compounds by an average of 47%



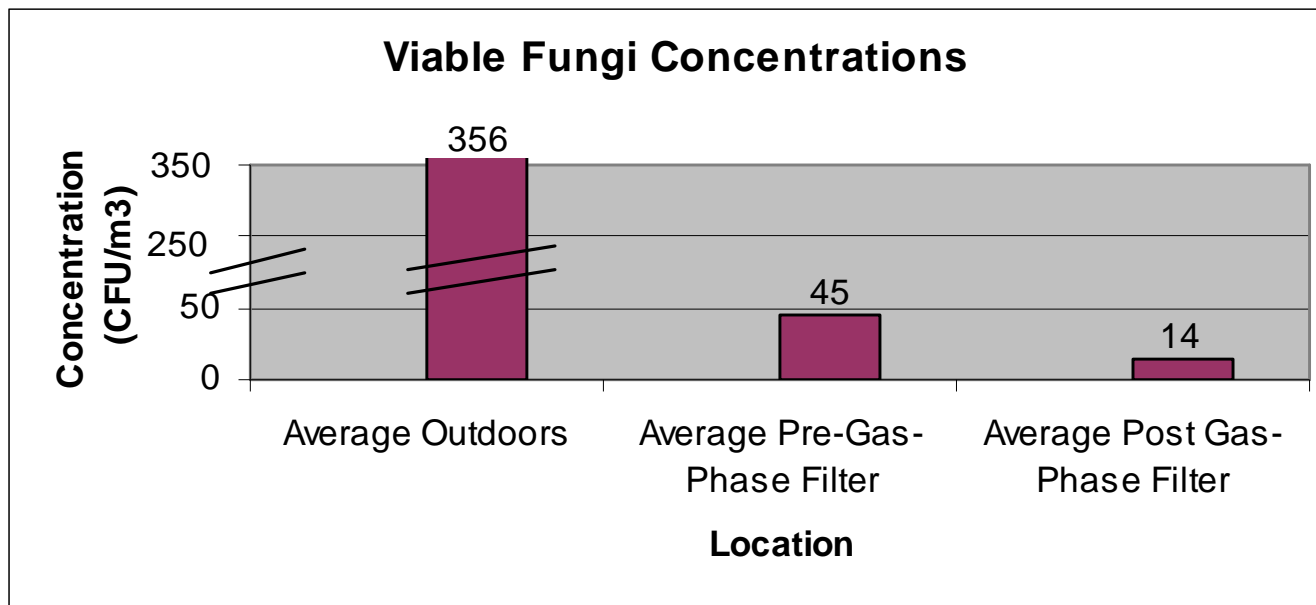
Bioaerosol Results

- Non-viable fungi (spore trap sampling)
- Exhaust air spore concentrations (pre and post gas-phase filter) were significantly lower than outdoors
- Dominant fungal types were similar between outdoor samples and pre/post gas-phase filter samples (dominant spore types - *Cladosporium*, *Penicillium/Aspergillus*, basidiospores, and ascospores) which is considered normal and typical of non-problem buildings



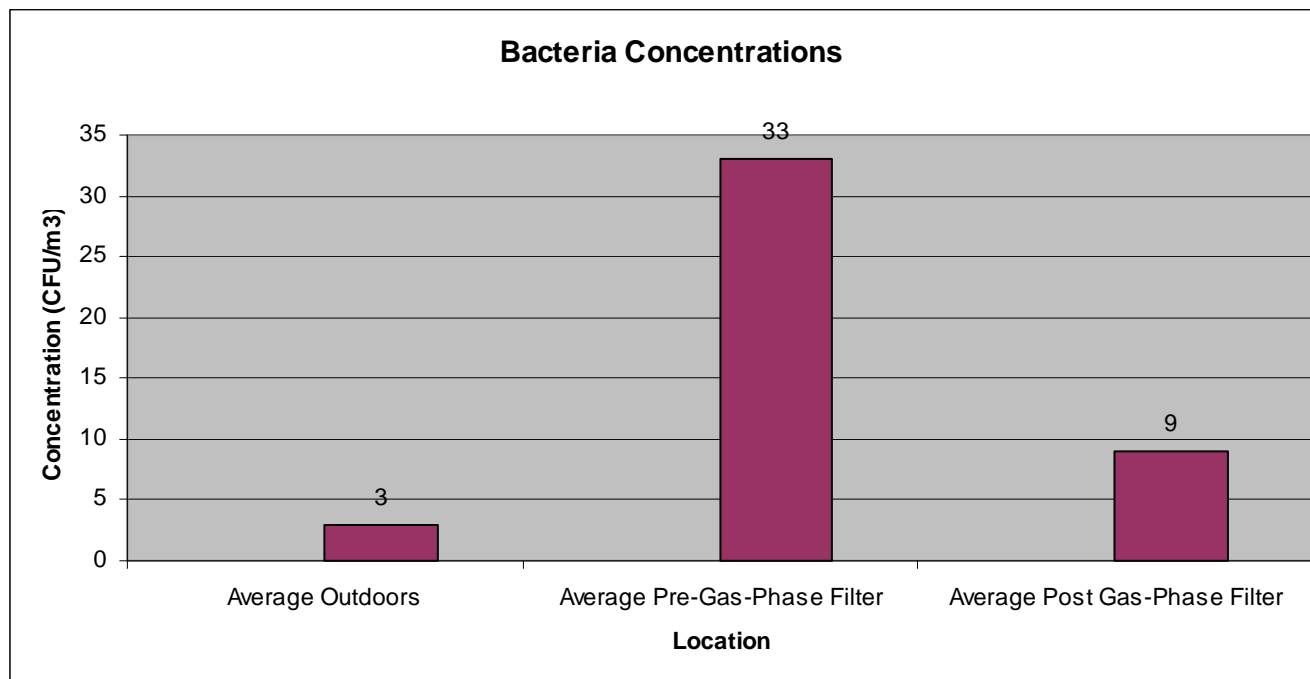
Bioaerosol Results (2)

- Viable fungi (impactor style culturable sampling)
- Exhaust air total viable fungi concentrations (pre and post gas-phase filter) were significantly lower than outdoors
- Dominant fungi were similar between outdoor samples and pre/post gas-phase filter samples (dominant fungi- Cladosporium) which is normal and typical of non-problem buildings



Bioaerosol Results (3)

- Bacteria (impactor style culturable sampling)
- Post gas phase filter total coliform bacteria concentration was higher than outdoors but lower than non-problem office building environments (U.S EPA BASE Study)
- Escherichia coli (E. coli) was not present in any of the samples collected



H₂S, NH₃, Temperature & Relative Humidity Results

- H₂S & NH₃ concentrations were below the limits of detection (i.e. non-detect)
 - H₂S - <4.3 µg/m³ (3 ppb)
 - NH₃ - <89 µg/m³ (130 ppb)

Conclusions

- Contaminants identified by industry as of concern for occupant comfort and health were found to be generally within the levels recommended by cognizant authorities and/or below levels found in non-problem office buildings.
- Recycling conditioned air via air filtration (cleaning) system with particulate and gaseous filtration media is a viable option for reducing energy consumption with little or no impact on the indoor air quality of the building.
- Hotels in urban areas likely have significant times of the year when outdoor air is a significant source of indoor contamination (e.g. smog).
- Energy savings and building carbon footprints can be significantly reduced by implementing building exhaust reclassification, where appropriate, contributing to the goal of zero-net energy buildings



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