ASHRAE VIRTUAL WINTER CONFERENCE

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Seminar 6 – Fighting the Unseen Killers: Gas-Phase Air Cleaners

What is in My Gas Phase Filter and Why?

Paula Levasseur

Molecular Filtration Consulting and Design

LMF Services LLC

paula@lmfservicesllc.com

(503)-407-0407

LMF

Learning Objectives

- 1. Understand the basics of how gas-phase filters work.
- 2. Learn how current methods remove/clean air contaminants using various Gas-Phase Air Cleaners in residences, schools and office buildings.
- 3. Understand the gaseous contaminants that impact on human health and environment.
- 4. Provide information that assesses IAQ including non-human issues such as damage to equipment

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Agenda

- Principle Removal Methods
- Overview of Media Types
- What can my Media Remove
- Media Selection
  - How do I Choose?

Principle Removal Methods

- **Physical - Adsorption**
- **Chemical - Chemisorption**
- **Catalysis**

ADSORPTION

- Adsorption - The process by which one substance is attracted and held onto the surface of another.
  - It is a surface phenomena.
  - Capacity is independent of particle size
  - Adsorption rate is inversely proportional to particle size.
  - High temperatures, may cause desorption.
  - Humidity has an adverse effect on adsorption

Activated Carbons

- M W >50 and boiling points < 120 F
  - Toluene
  - Methyl ethyl ketone
  - Ozone
  - Methylene chloride
- Virgin Coconut shell carbon
  - Methyl methacrylate (nail salon)
  - Nerve gases and mustard gases

Depending upon the compound and its concentration in the air stream it can adsorb up to 33% of it's own weight

Stereo Scan Electron Micrograph Photos of Activated Carbons

Chemisorption

- Chemisorption - The result of chemical reactions on and in the surface of the adsorbent.
  - Fairly specific and depends upon chemical nature of media and the contaminant
  - Irreversible & essentially instantaneous
  - Oxidation - changes harmful gases to harmless solids
  - Higher temperatures will increase the reaction rate in chemisorption
  - Humidity is favorable toward the reaction

Chemisorbent Media

- Permanganate Impregnated Media
  - Alumina, zeolite
- Impregnated carbons
  - Acid impregnated (phosphoric acid)
  - Base impregnated (potassium hydroxide, Sodium Hydroxide)
- Specialty Impregnated
  - TEDA-KI
  - Sulfur

Permanganate Impregnated Media

- Broad based oxidizer
  - Sulfur dioxide
  - Formaldehyde
  - Hydrogen sulfide
  - Nitric oxide
- Cannot be regenerated
- Reaction Irreversible

Impregnated Carbons

- Fairly specific for a compound or chemical family
- Maintains adsorptive properties of activated carbon
- Reaction irreversible

Impregnated Carbons

Base Impregnated

- Sulfur dioxide
- Hydrogen sulfide
- Acetic acid
- Chlorine - high levels

Acid Impregnated

- Ammonia
- Amines

Specialty Impregnated Carbons

- Sulfur , KI_3
  - Mercury removal
- TEDA - KI (nuclear grade carbon)
  - Radioactive iodides

Catalysis

- Catalysis
  - Changing the rate of a chemical reaction, (usually increasing) where the catalyst is not consumed in the process
    - Carbon impregnated with various metals can aid in the reaction of a product difficult to adsorb.

Catalytic Carbons

- Impregnated with Metals to improve removal capability
  - ASZM-TEDA
    - Chemical warfare

Considerations

- Contaminant(s)
  - Known Contaminants
    - Media selection is relatively easy
  - Unknown or multiple
    - A blend of adsorbent and chemisorbent media is best
- Temperature
  - Recommended temp is normally under 120F.
    - Chemisorbent media not as affected by the higher temp whereas carbon efficiency will decrease.
- Humidity
  - Same as above

Conclusion

- Media selection requires knowledge of the application or the actual contaminant(s) present, along with environmental conditions.
- Proper media selection is only step one, the filter type plays a large roll in effectiveness.
- Media testing is available with ASHRAE Standard 145.1

Questions?

Paula Levasseur
Paula@lmfservicesllc.com