



Indoor Air Quality – Beyond Mold and Radon

Presented by Sarah Mack

InspectionWorld 2019

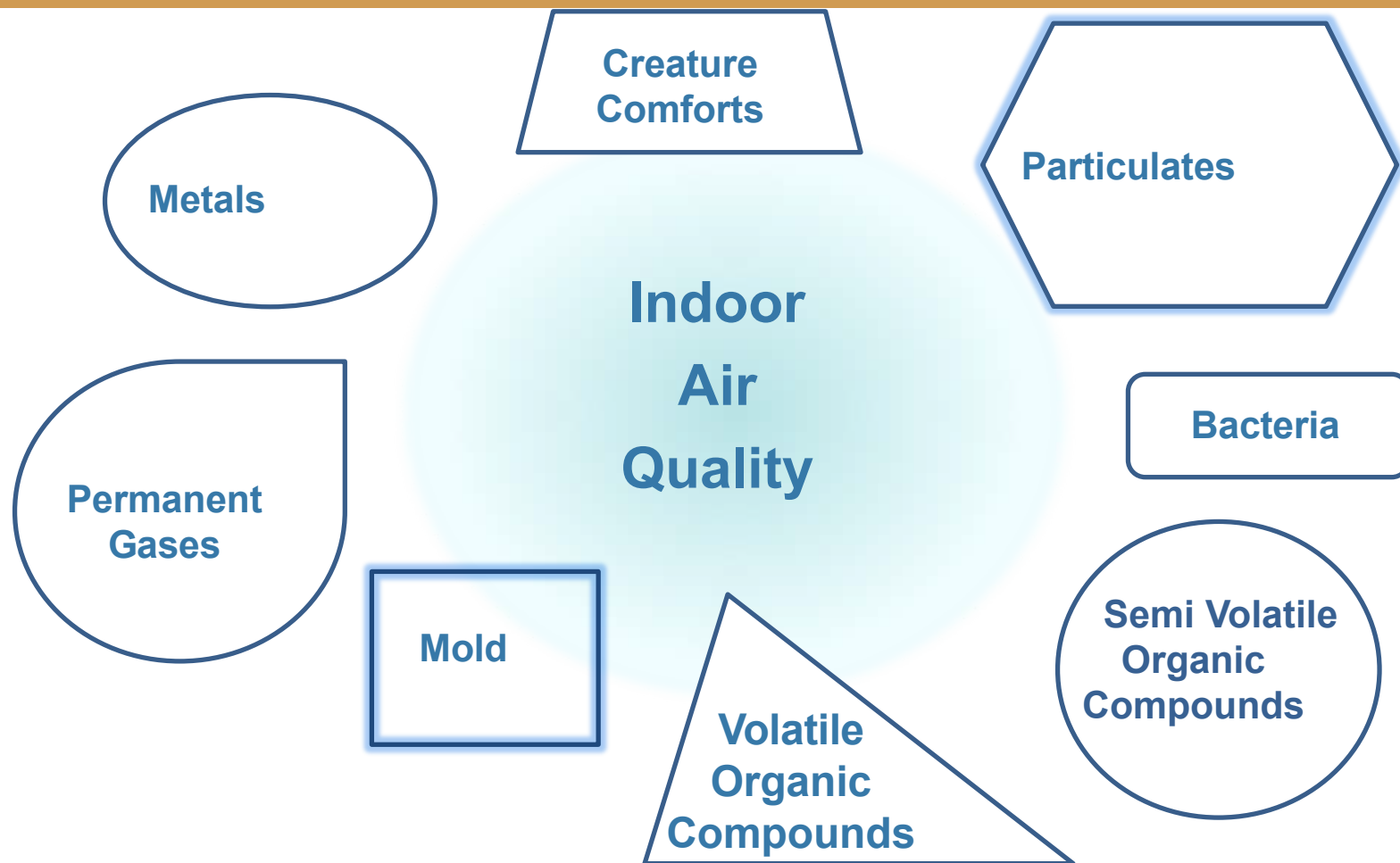
Goals

1. Expand understanding of Indoor Air Quality and what it can encompass.
2. Introduce testing options

Why IAQ?

- **Buying new home**
- **Health**
- **Odor**
- **Mold**
- **Change in situation**
 - New baby
 - New product (e.g., furniture)
 - Renovation
 - Event (e.g., structural fire)

What is Indoor Air Quality?



What is Indoor Air Quality?

- **Chemicals**
 - Volatile Organic Compounds (VOCs)
 - Semi-Volatiles such as Pesticides and Herbicides
- **Mold**
 - Spores, Mycotoxins, MVOCs
- **Allergens**
 - Animals or pets, pet dander, cockroach, dust mites, pollen
- **Particulate/Dust**
 - Fibers (glass, cellulose, asbestos), biological (skin cells, pollen), mineral
 - Tobacco, structural, or wild fire

What is Indoor Air Quality?

- **Bacteria**
 - E.Coli, Staph., Legionella
- **Metals**
 - Lead, Mercury, Hexavalent Chromium
- **Permanent Gases**
 - CO, CO₂, Natural Gas, Radon
- **Comfort factors**
 - Temperature, Humidity, Odor

VOLATILE ORGANIC COMPOUNDS (VOCs)

VOCs – What is the Concern?

VOCs: chemicals that easily vaporize at room temperature

- **Many chemical categories**

- Hydrocarbons, aromatics, aldehydes, ketones, esters, furans, acids, amines, amides, halogenates, sulfurous
- Benzene, Acetone, Toluene, Xylenes, Ethane, Hexane, Diacetyl, Formaldehyde

- **Different sources**

- Products
- Activities
- Conditions

Most occupants are unaware of VOCs

VOCs from Building Materials

- **Flooring**
 - Formaldehyde, solvents
- **Vinyl Flooring**
 - Tetradecane
- **Cabinetry**
 - Formaldehyde, toluene, xylenes
- **Drywall**
 - Sulfur species
- **Paint**
 - Texanols, butyl cellusolve, HCs
- **Carpeting**
 - Caprolactam
- **PVC Cement**
 - Tetrahydrofuran, methylethylketone
- **Plastic Materials**
 - Phthalate esters
- **HVAC**
 - Freons™
- **Fiberglass**
 - Phenol/formaldehyde
- **Spray Foam Insulation**
 - Freons™, isobutane, butane, HCs
 - Pentafluoropropane
 - Trans 1,2-dichloroethene
- **Rigid Insulation Polystyrene**
 - Styrene
- **Adhesives**
 - Toluene, Xylenes

VOC Sampling Media

Canisters

Bags

Thermal Desorption Tubes



SEMI-VOLATILE ORGANIC COMPOUNDS (SVOCS)

SVOCs – What is the Concern?

SVOCs: chemicals vaporizing at higher than room temperature, limited suspension in breathing air (settle out quickly), route of exposure is primarily dermal

- **Pesticides and Herbicides**
- **Poly Aromatic Hydrocarbons (PAHs) and Poly Nuclear Aromatics (PNAs)**
 - **Asphalt, roofing materials, fuel oils**

SVOC Sampling Media

PUF Tubes
Surface Wipes
Bulk Materials



Volatility

Particle-Bound Organic Matter
Non-Volatile Organic Compounds

PAHs (~370-500)
Phthalates (~280-380)
Pesticides (~100-450)
Flame Retardants (~220-)

Semi-Volatile Organic Compounds

- BP 240-260 to 380-400 °C
- Primarily semisolid/solid state

Hexane (68)
Benzene (80)
Acetone (56)
MEK (80)
Limonene (176)

Volatile Organic Compounds

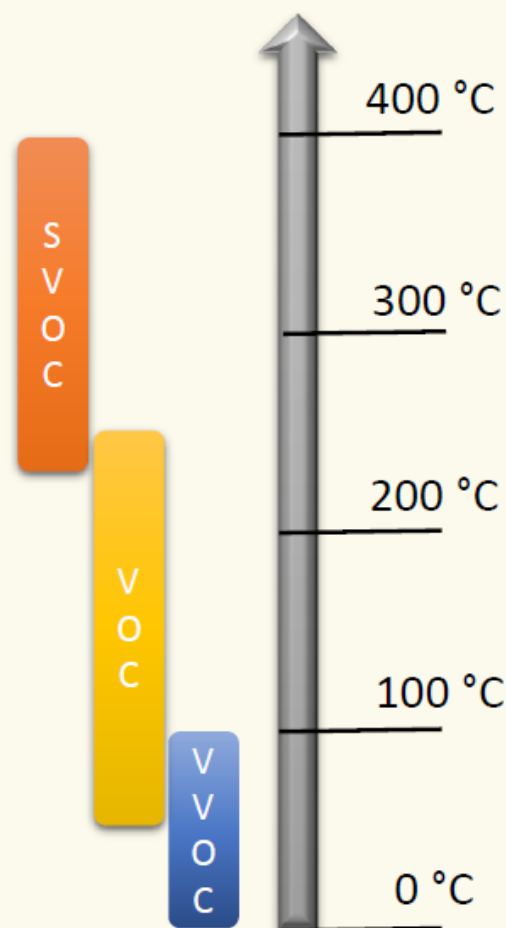
- BP 50-100 to 240-260 °C
- Both gas and liquid/solid state

Methane (-151)
Ethane (-89)
CFCs (~ -40 to 50)

Very Volatile Organic Compounds

- BP < 50 to 100 °C
- Permanent gases

Formaldehyde (-19°C)



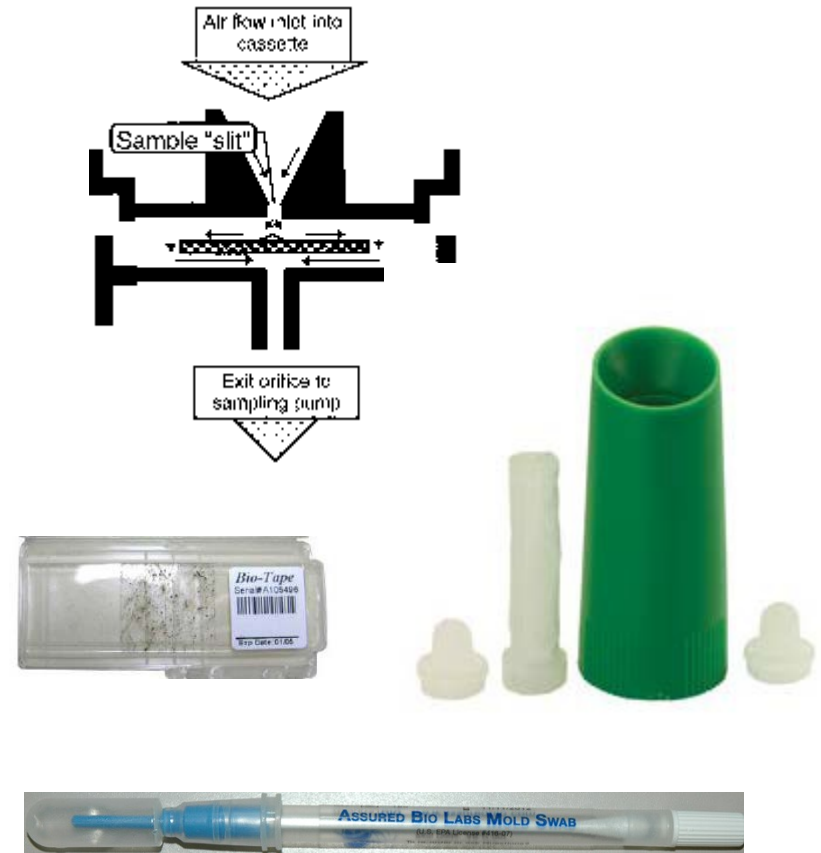
MOLDS

Mold – What is the Concern?

- **Potential health effects**
 - Allergic reactions, asthma, respiratory complaints
- **Damage to materials inside building**
- **No practical way to eliminate all mold/mold spores in indoor environment**
- **Moisture control is key**
- **No official limits for mold or mold spores**

Mold Spore Sampling

- **Air samplers**
 - Collect onto plate or filter
 - Active (requires sampling pump)
 - Air-O-Cell, Anderson impaction
- **Settling plate**
 - Collection by gravitational settling
- **Tape lift**
 - Small surface area
- **Dust**
 - Settled dust
 - Vacuum collection
- **Bulk material**
 - Typically visibly moldy material
 - Species identification



ALLERGENS

Allergens – What is the Concern

- **~50 million North Americans affected by allergic conditions**
- **Immune system overreaction to certain substances**
 - Symptoms: hay fever, asthma, eye irritation, respiratory irritation (wheezing, sneezing, coughing), eczema, hives, allergic shock
- **Allergens: dust, ragweed, pollen, mold, pet dander, rodent, cockroach, dust mites, certain foods, etc.**

Allergen Sampling

- **Dust**

- Settled dust
- Vacuum collection

- **Bulk material**

- Concern items (carpet, furniture fabric, etc.)



PARTICULATES BACTERIA METALS

Particulates – What is the Concern

Microscopic solid or liquid matter

- Fine $< 2.5 \mu\text{m}$
- Respirable Coarse $2.5 - 10 \mu\text{m}$
- Coarse (Dust) $> 10 \mu\text{m}$
- **Health symptoms**
 - Allergies, asthma, respiratory conditions, cardiovascular conditions, cancer
- **Indicate home conditions and activities**

Particulate Sampling

- **Surface**

- Tape Lift
- Bulk
- Wipe



Tape Lift

- **Air**

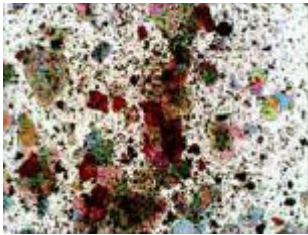
- Impaction (e.g., Air-O-Cell®)
- Particle Counters
- Size-Selection



Impact Sampler

Particulate Source Analysis (by Microscopy)

- **Occupancy**



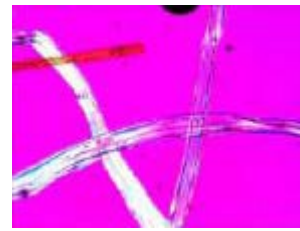
Cosmetics



Skin Cells



Insects

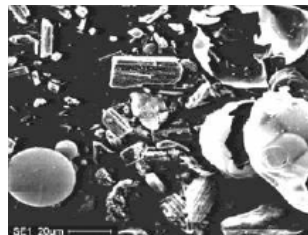


Clothing/Paper

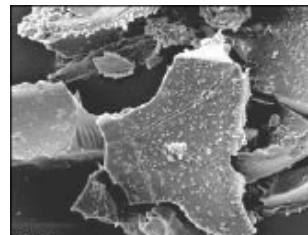
- **Building Shedding**



Fiberglass



Patching Cpd



Corrosion/Rust

PERMANENT GASES

Radon Testing

- **Action Level: 4 pCi/L**
 - No known safe level
- **Charcoal canisters, alpha track, electret ion chamber, continuous monitors, charcoal liquid scintillation**
- **Passive**
 - Short term: 2-90 days
 - Long term: > 90 days
- **Active**
 - Continuous monitors



Other PG Testing



COMFORT FACTORS

Temperature

Humidity

Odor

Indoor Air Quality Assessments

- **Detects the non-observable**
 - HVAC, chemical, mold and allergen issues
- **Provides home buyers more information on the home**
 - Home buyers want quality homes that are safe
- **Significant business opportunity for Home Inspectors**

Questions

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