

Indoor Air Technologies Inc

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## What is that black stuff? IAT FUNGAL INVESTIGATIONS

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Wood and dry-wall moisture contents above 18% support mold growth

Fungal spore sampling identifies an important component of fungal exposure

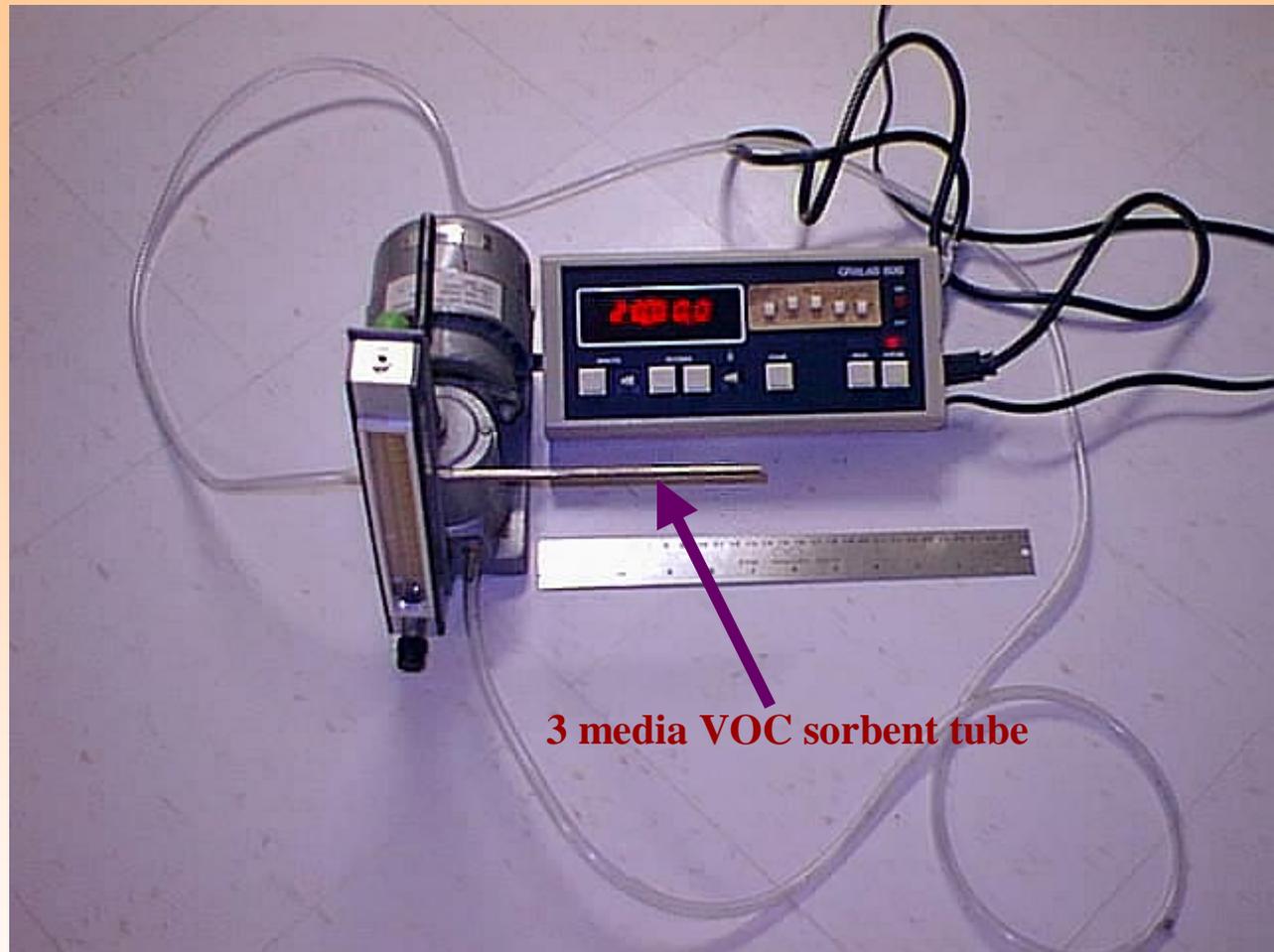


**Moisture meter**



**RCS spore sampler**

**Microbial VOC sampling is an important part of investigating mold exposure**



**Sampling pump with sorbent volatile organic compound sampling tube**

## Mold health effects

- allergens
- irritants
- mycotoxins
- pathogens



## POSSIBLE FUNGAL EXPOSURE HEALTH EFFECTS

**Allergic respiratory disease**  
(nasal congestion, runny nose, sneezing, conjunctivitis) or asthma (wheeze, chest tightness).

**Mycotoxic effects:** eg. *Stachbotrys chartarum* (black or black green, wet conditions) can affect heart tissue, the immune system. *P viridicatum* affects kidneys and nervous system.

**Atopic allergic/contact dermatitis.**

# Case History # 1

## Flooded Finished Basement

### Problems:

The open sump pit and the drains leading to it, in addition to the damp basement finishing, were also a source of microbial propagules and VOCs

Initial finding (October)

- 1,638 CFU/m<sup>3</sup> including 675 toxigenic *P. viridicatum* - affects kidneys, *P. brevicompactum* - is teratogenic, mutagenic, immuno-suppressive)

(outdoor air had 613 CFU/m<sup>3</sup> with 0 toxigenic).

## Flooded Finished Basement cont'd

### Problems:

The open sump pit and the drains leading to it, in addition to the damp basement finishing, were a source of microbial propagules and VOCs

March: Basement stripped and disinfected

- 63 CFU/m<sup>3</sup> including 31 toxic spores  
(outdoor air had 0 CFU/m<sup>3</sup>)

May: Basement sump sealed and vented

- 144 CFU/m with 0 toxic spores  
(outdoor air had 169 CFU/m<sup>3</sup>  
including 25 pathogenic (*A. fumigatus*)  
and 64 toxigenic (*A. versicolor*) spores)

## Case History # 2

### New Energy Efficient Model House

First floor

62 CFU/m<sup>3</sup> Penicillium sp.

Second floor

25 CFU/m<sup>3</sup> Alternaria, NSI

Basement crawl space

> 10,631 CFU/m<sup>3</sup>

Basement cold room

> 7,656 CFU/m<sup>3</sup> Penicillium species, Aspergillus

Ventilation air after HRV (with humidity wheel)

1,294 CFU/m<sup>3</sup> - Penicillium species

(Outdoor air, March, 19 CFU/m<sup>3</sup>)

#### Problems:

- Improperly ventilated crawl space,

-Damp cold room,

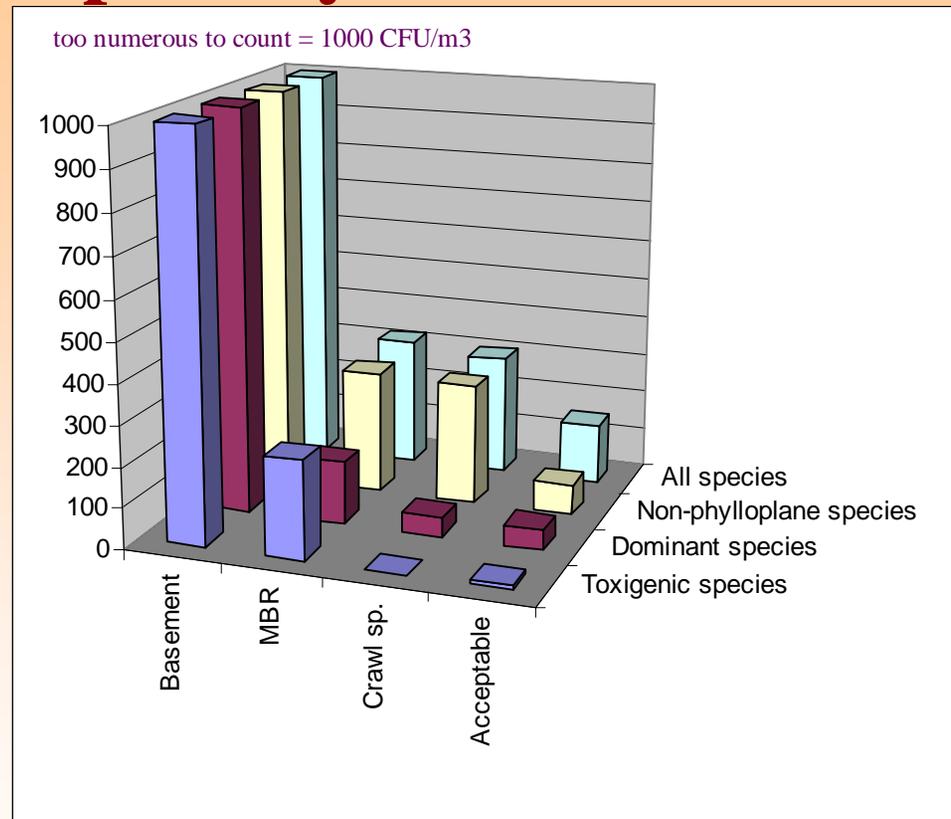
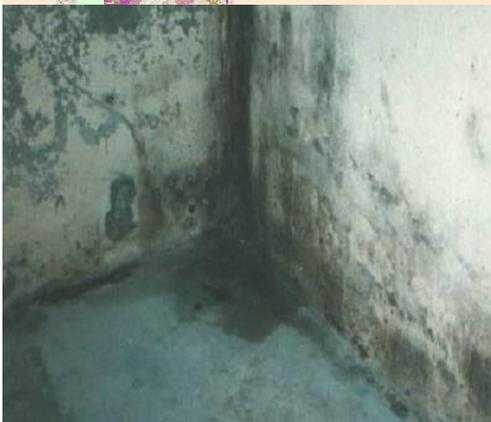
-Mold source in HRV

# Case History # 3

## House with Mold Throughout, especially in the Basement

### Problems:

- wet finished basement
- damp wall and many plants in MBR



### Toxigenic fungi

*Penicilium viridicatum* (soil smell; kidney disease)

TNTC in basement, 70 CFU/m<sup>3</sup> in MBR

*Stachybotrys chartarum* (lung disease, flu-like symptoms)

20 CFU/m<sup>3</sup> in MBR

## Case History # 4

### House with Mold Throughout

#### **Problem:**

**-Insufficient ventilation for the house occupancy load**

Ice damming had been suspected by occupants as cause of mold growth.

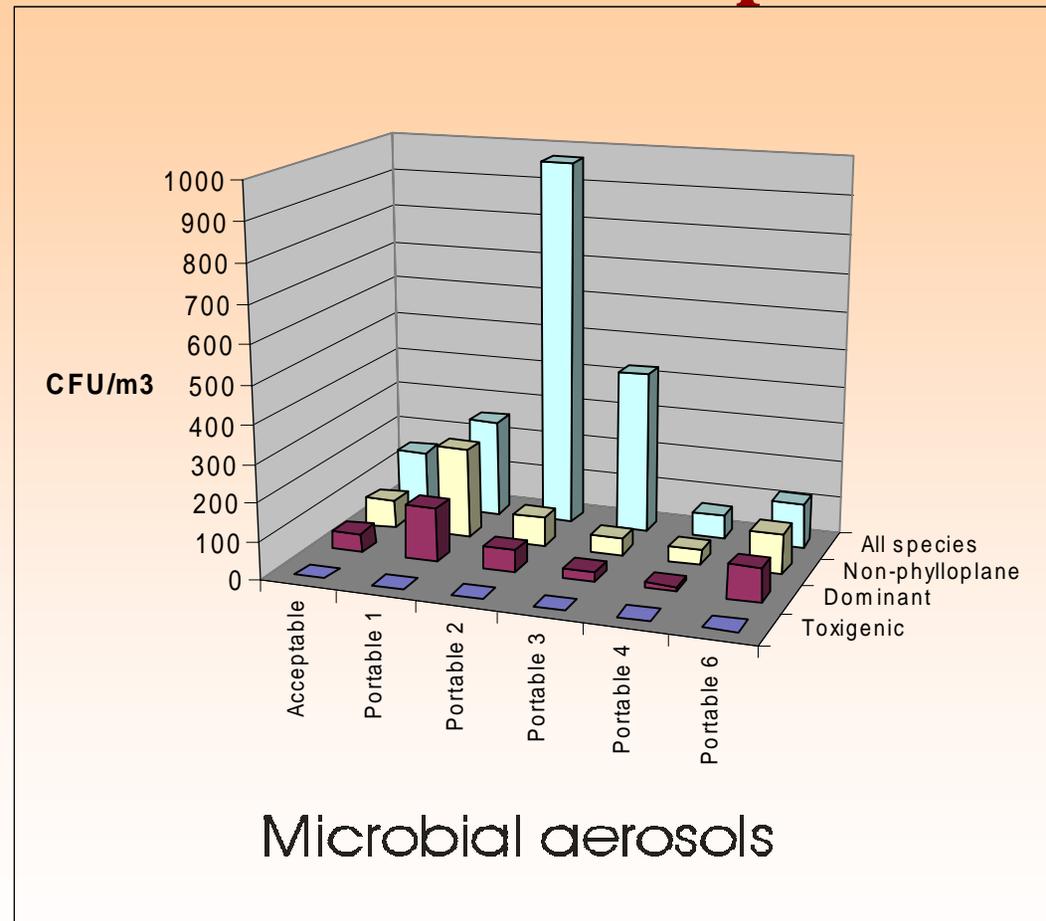
Found that the house ventilation rate was 1/3 of the minimum rate required under the building code (carbon dioxide was > 2000 ppm when it should be less than 1000 ppm)

# Case History # 5

## Portables with mold problems

### Problems:

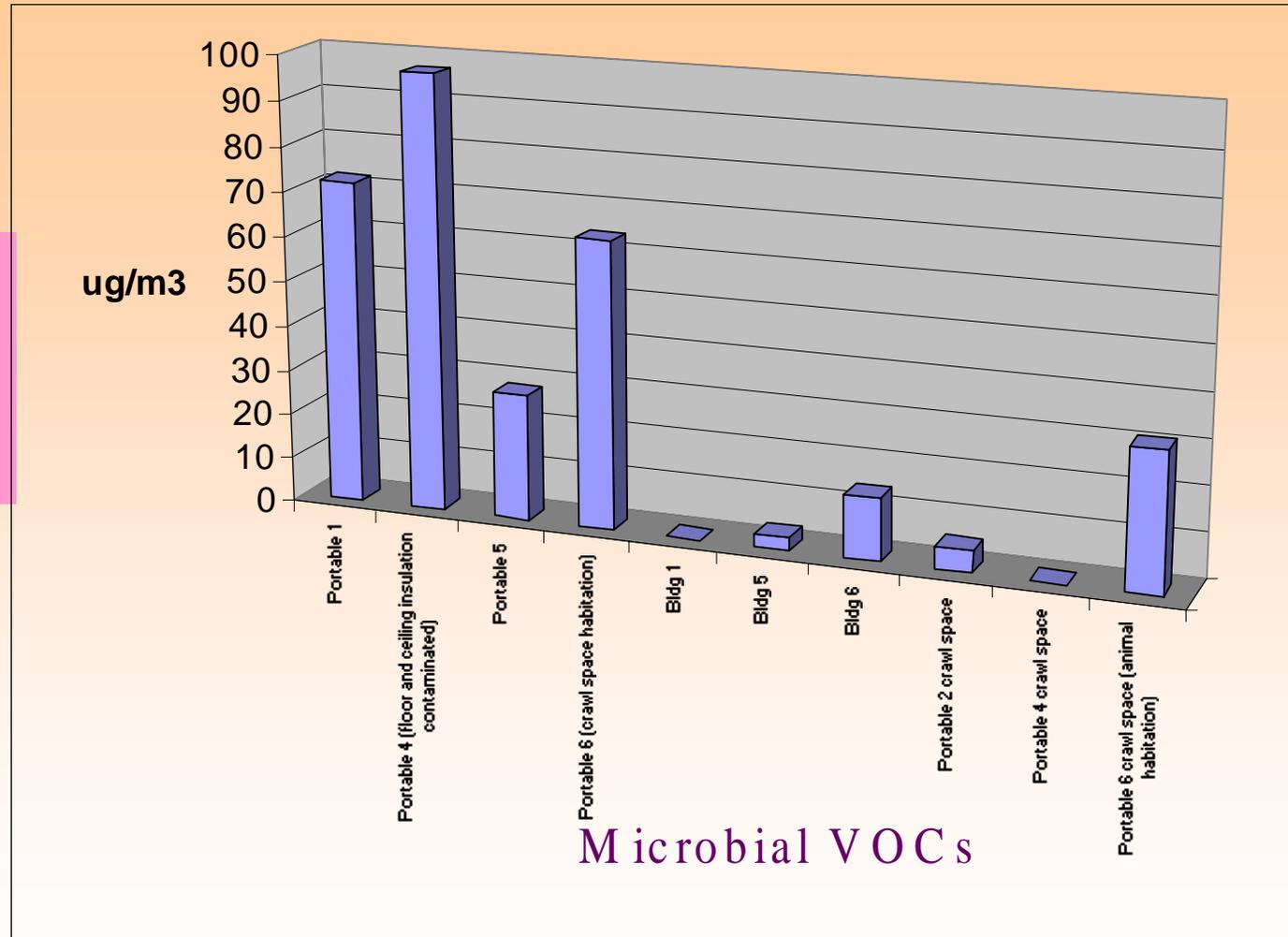
- Improper use of poly to support floor insulation,
- animals nesting in the insulation under the trailers,
- unvented roof insulation
- insufficient ventilation



# Case History # 5 cont'd

## Portables with mold problems

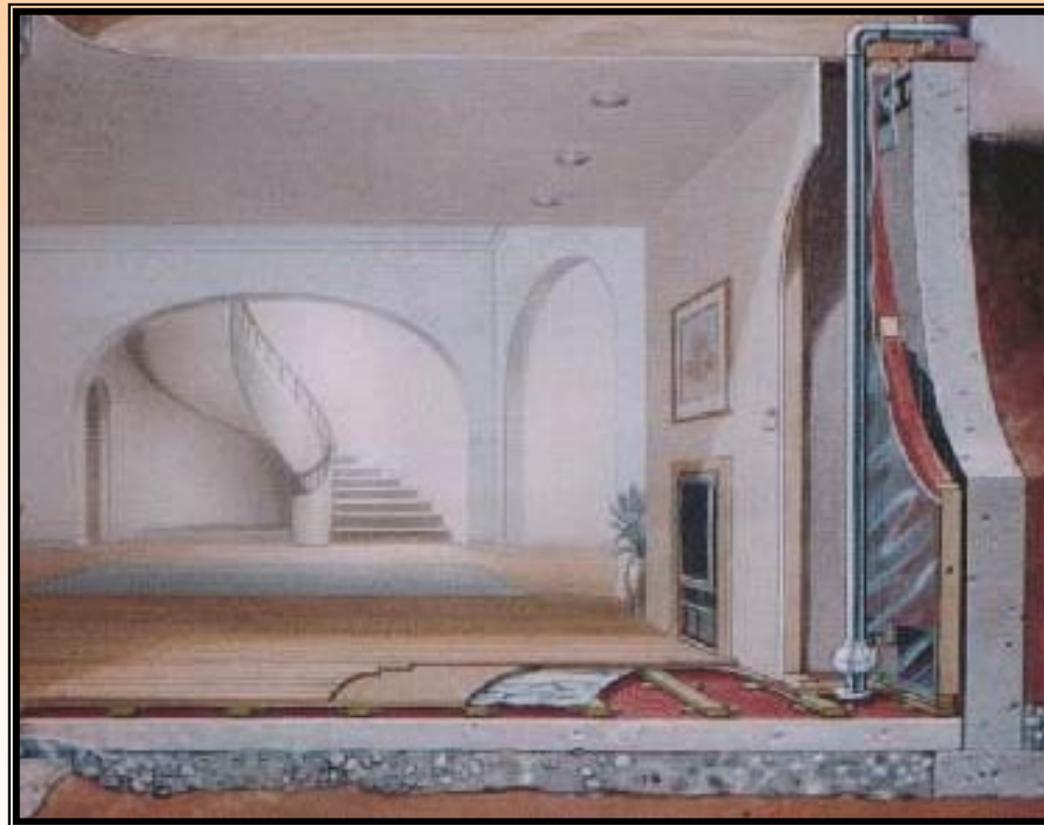
Microbial VOCs were growing on the poly and in animal debris



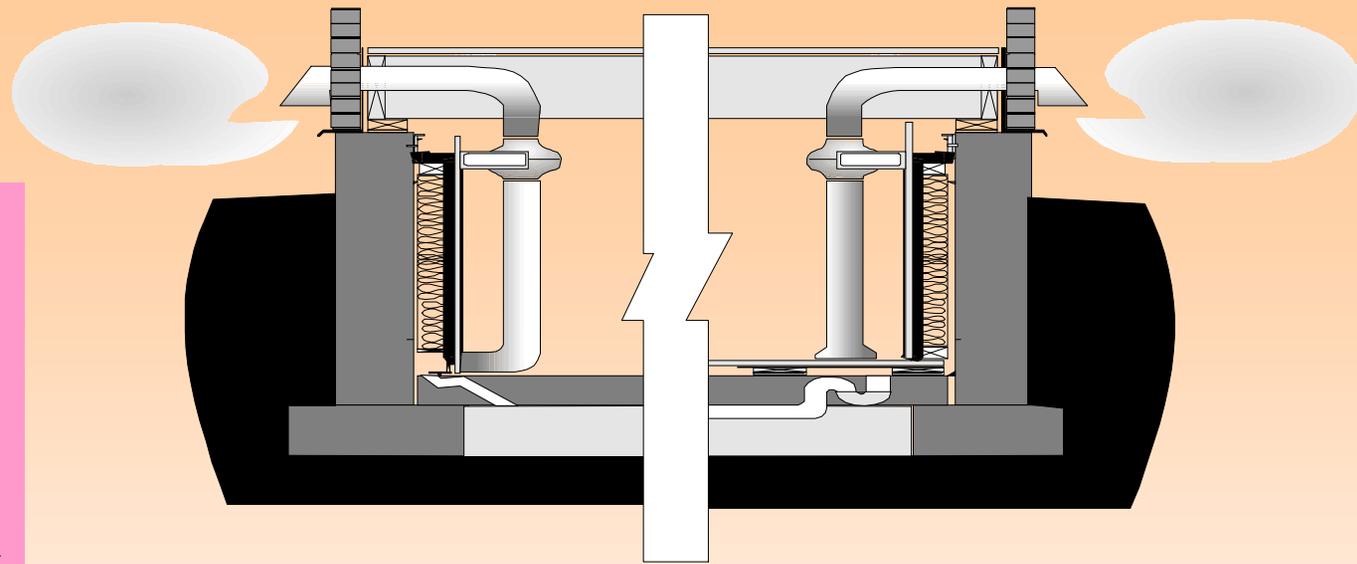
The ECHO System prevents soil and envelope gas entry by depressurization - not by air circulation.

It removes leakage water by drainage and evaporation.

## ECHO System basement finishing



Depressurized walls and sub-floors solve the finished basement mold problem

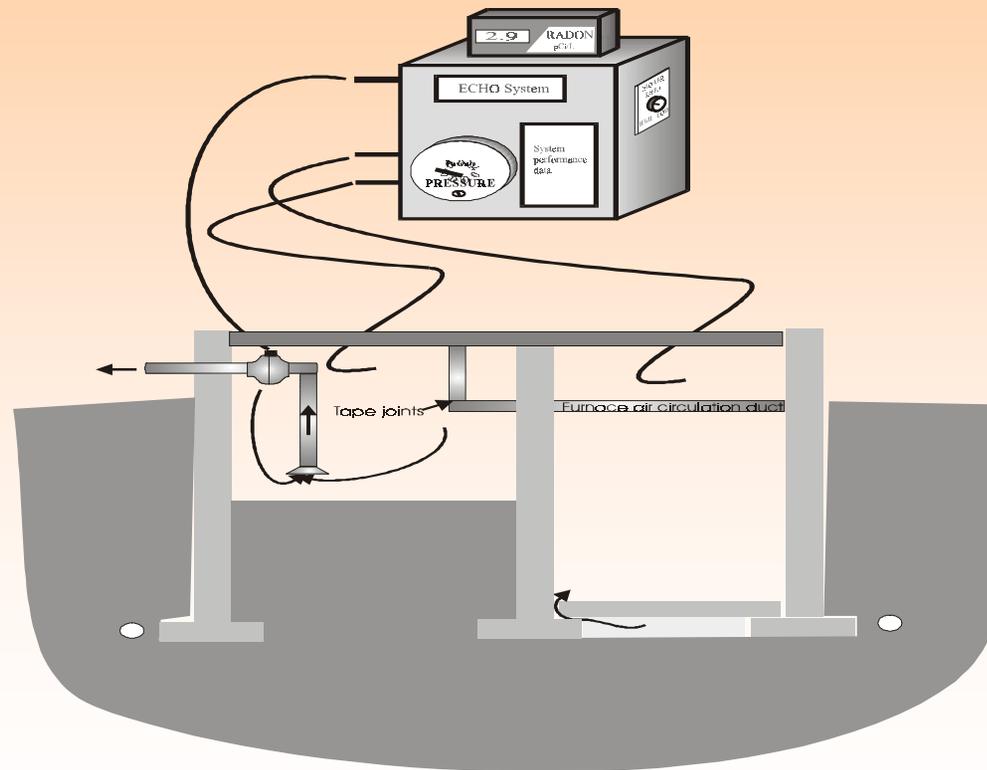


**Drained &  
depressurized  
wall & sub-slab**

**Drained &  
depressurized  
wall & Sub-floor**

Exhaust ventilation dehumidifies and warms the space with house air, while it depressurizes it.

Crawl spaces can be strong sources of mold emissions into the living space.



Cracks such as this had been filled with a “Water Proofing” grout but continued to bleed whenever it rained. This basement was subsequently finished with an ECHO System, with cracks left to leak.



**Mold growth was found in the corners of this basement when the insulation was removed.**

**The basement was subsequently finished with an ECHO System.**



## Summary

### Fungal exposure health effects

- allergies, asthma
- flu-like symptoms, headaches, hypersensitivity pneumonitis, heart and kidney disease...
- contact dermatitis

### Sources of moisture/mold

- Soil in contact with foundation
- Sump pits
- Indoor humidity (winter)
- Ambient humidity (summer)
- Unvented insulation
- Animal habitation

### Amplification site

Basement finishing, carpets, crawl spaces, cold rooms  
Slime, weeping tile  
dry wall in corners, closets  
Basement finishing, carpets  
Vapour barrier  
Crawl spaces, attics

## Appendix

### Some Toxigenic Fungi which have been found in Indoor Air

#### *Aspergillus fumigatus*

Mycotoxin producing pathogen. Can cause infections in wounds and may attack cardio-vascular, brain and lungs. Can cause asthma, rhinitis, extrinsic alveolitis (farmers' lung), aspergillosis and aspergilloma with pneumonia-like symptoms. MVOCs include: aromadendrene, camphene, a-copaene, a-farnesene, trans b-farnesene, 2,4,5-trimethyl-phenol-like, 2-methyl-5-isopropyl-pyrazin. Found in bird and bat feces, mouldy hay, wood chips, leaf litter, compost, wet insulation.

#### *Aspergillus versicolor*

Mycotoxin producing moderate xerophile. Causes eye, nose and throat mucosal irritation. Metabolites produced include sterigmatocystin which is toxic and carcinogenic. Musty, earthy odour. MVOCs include, depending upon substrate: isoprene, 3-methyl furan, 2-methyl 1-propanol, 3-methyl 2-pentanone, 1,3-octadiene, octadiene isomer, 3-hexanone, 2-hexanone, 4-methyl-3-hexanone, mycrene, octatriene isomer, camphene, B-pinene, limonene, b-phellanderone, 3-octanone, 2-octen-1-ol, 1-octen-3-ol, a-terpinolene, 5-ethyl-4-methyl-3-heptanone, C<sub>15</sub>H<sub>22</sub> terpene, 7C<sub>15</sub> terpenes. Found on damp wood, wallboard, condensation under vinyl wall coverings, and other organic substrates.



## Appendix, cont'd

### Some Toxigenic Fungi

#### *Penicillium auranteogrisium* (*P. cyclopium*, *P. polonicum*, *P. viridicatum*)

Grows from 0 to 35° C. Possible agent in Balkan endemic nephropathy (disease or an abnormality of the kidney. Unpleasant smell suggestive of soil. Produces terpenoid VOCs, 2-ethyl-1-hexanol, 2-ethylhexanal. Found on materials and fabrics undergoing degradation. Eg. Wallboard

#### *Penicillium brevicompactum*

A moderate xerophile, it produces brevianimide A and mycophenolic acid mycotoxins. The former toxin is known to be teratogenic. The latter is anti-bacterial, anti-viral, anti-fungal, mutagenic, immunosuppressive and antimutagenic. MVOCs include: 2-heptanone, 1-octen-3-ol, 2-octen-1-ol. It is a primary colonizer, growing on moist chip board, wallboard & other organic substances.



## Appendix, cont'd

### Some Toxigenic Fungi

#### *Stachybotrys chartarum* (*S. Atra*)

Black sooty hydrophilic fungus. Grows from 2-40° C only on wet substrate. Causes flu like symptoms, pulmonary haemorrhage/ hemosiderosis in infants and lung diseases in adults. Contact dermatitis. Non viable spores remain toxigenic and allergenic. Found on heavily wetted cellulose such as wall board, in floor drain traps, dead plant material, soil, textiles.

#### *Trichoderma viride* (*harzianum*)

Hydrophilic soft rot fungus. Grows between 6-32° C. Widespread soil fungi. Destroys cellulose in wood. Distinct coconut smell. Produces a ketone (6-pentyl- $\alpha$ -pyrone), chrysophanol. In damp houses found on paper, wood, tapestry, unglazed ceramics. Allergy is rare. Inhalation of VOCs or conidiae may cause *S. Chartarum-like* symptoms