

Got Mold?

Student Manual

BWC Division of Safety & Hygiene
Ohio Center for Occupational Safety and Health

GOT MOLD?

INTRODUCTION	TAB 1
MOLD BASICS	TAB 2
HEALTH EFFECTS	TAB 3
LEGAL ISSUES AND REGULATIONS	TAB 4
MOISTURE AND MOLD INSPECTIONS	TAB 5
MOISTURE AND MOLD REMEDIATION	TAB 6
APPENDIX "A" Applicability of mold sampling results In Workers' Compensation claims	TAB 7
APPENDIX "B" A brief guide to mold, moisture and and your home - EPA	TAB 8
APPENDIX "C" AIHA remediation clearance sampling guidelines	TAB 9
APPENDIX "D" Resources	TAB 10

AGENDA

- 8:45 Mold Basics
 What is mold?
 Exposure to mold
 Visual Assessment
 Clean-Up
 Mold in the Media
- 9:30 Break
- 9:45 Health Effects
 Symptoms
 Stachybotrys Chartarum
- 10:15 Legal issues and Regulations
 Mold Regulations
 Workers' Compensation
 Standards?
- 10:30 Moisture and Mold Inspections
 Perimeter Visual Inspection
 Hidden Mold
- 11:45 Lunch
- 12:45 Moisture and Mold Inspections (Cont'd)
 Humidity and Mold
 Water Intrusion
 Filtration
- 2:15 Break
- 2:30 Moisture and Mold Remediation
 Guidelines for Remediation of Mold
 Sampling?
- 3:30 Interpretation of Results
 Proposed Guidelines
 Containment
 Clean up

COURSE OBJECTIVES

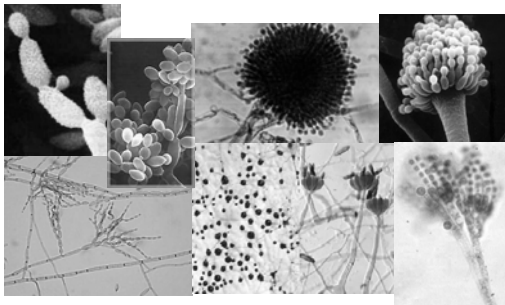
Students will understand more about mold and the health effects of exposure to mold. Information on assessing mold contamination, clean up and remediation will help students to know what steps must be done to limit health effects.

Got Mold?

Ohio Bureau of Workers'
Compensation
Division of Safety & Hygiene

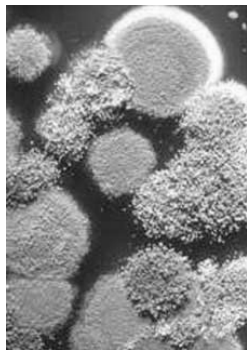


What is mold and where is it found?



The State of the Science

- Mold has always been present



How can you be exposed to mold?

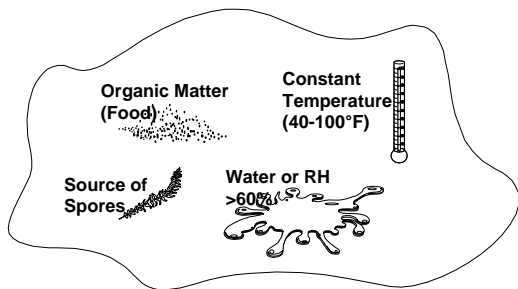
- Damaged or disturbed moldy material
- Inhaling spores



Is mold all the same?

- Aspergillus ?
- Cladosporium ?
- Fusarium ?
- Stachybotrys ?

How does mold grow?



You can only control one thing

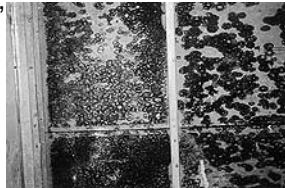
WATER!



Should I be concerned about mold in indoor environments?

Mold should not be permitted to grow and multiply indoors.

- When this happens, health problems can occur and building materials, goods and furnishings may be damaged.



How do I tell if I have a mold problem?

- Investigate, don't sample. Use your eyes to look for mold growth and by using your nose to locate the source of a suspicious odor, signs of excess moisture or the worsening of allergy-like symptoms

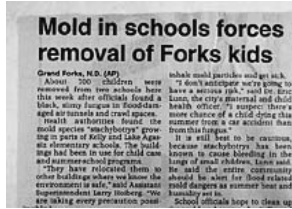
How can mold affect your health?

Health outcomes include:

- Allergies
- Infection
- Irritation
- Toxicity

Will my health or my child's health be affected, and should we see a physician?

- North Dakota flood, 9,000 homes affected.



How should mold be cleaned?

- Clean mold as soon as it appears



A Brief Synopsis of How We Got Here

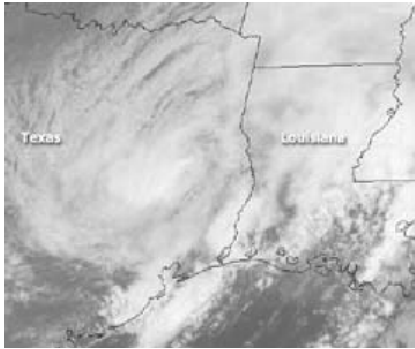
- Cleveland 1994
- Melinda Ballard 32 million
- Ed McMahon's dog
- Houston 2001
- Continues to be a large growth industry
- The media loves a good story

Melinda Ballard fought Farmers Insurance, and won?



- Many celebrities have dealt with mold problems
 - Ed McMahon
 - Erin Brockovich
 - Even the president's wife

Houston Flood 2001



Houston Flood



Health Effects

How can mold affect your health?

Cancer?

Dermatitis?

Development of Asthma?

Symptoms

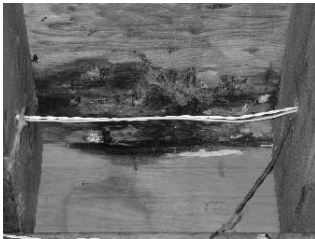
excessive reporting by building occupants of one or more of the following symptoms:

- headache
- lethargy
- tight chest
- fatigue
- wheezing
- congestion
- dizziness
- burning eyes
- watery eyes
- sinus difficulty
- flu-like symptoms

What is *Stachybotrys chartarum*?

- Black mold?
- Toxic mold?
- Killer mold?
- Death mold?
- Fatal fungus?
- \$ Mold is Gold? \$
- Cleveland 1994

How can you tell if *Stachybotrys chartarum* is present in your home?



Mold-Help.org

How can *Stachybotrys chartarum* affect your health?

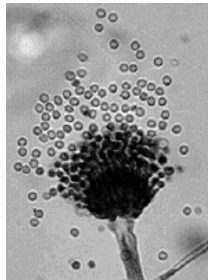
- There is inadequate evidence to support the conclusion that exposure to mycotoxins in the indoor environment is causally related to symptoms or illness among building occupants.
- There is inadequate evidence to support recommendations for greater urgency in cases where mycotoxin-producing fungi have been isolated.

AIHJ Sept/Oct 2001

Stachybotrys chartarum

- Does this take stachybotrys off the hook?
 - It does make mycotoxins
 - It can cause disease in animals
 - A transfer mechanism needs to be identified
 - It is less than 1% of indoor fungus
- Conclusion
 - Mycotoxins are real
 - Fungi should all be treated with respect

Review: How can you be exposed to mold?



Impact on human health

- Depends on:
 - Species involved
 - Metabolic products being produced by these species
 - Amount of exposure
 - Duration of individual exposure to mold parts or products
 - Specific susceptibility of those exposed
 - » Harriet Amman, Washington State DOH

Impact on human health

- Health effects generally fall into 4 categories:
 - Allergy
 - Infection
 - Irritation (mucus membrane & sensory)
 - Toxicity

Impact on human health

- Allergy
 - Molds are just one of several sources of allergens (mites, cockroaches, pet dander)
 - Most common response to mold exposure
 - Atopic individuals (genetically capable of producing an allergic response)
 - Respiratory exposure or skin contact
 - About 20% of population suffer from allergic rhinitis
 - About 10% allergically-induced asthma

Impact on human health

- Infection
 - Not common
 - In susceptible individuals (immune compromised from disease or drugs)
 - Aspergillus are known to be opportunistic pathogens
 - A fumigatus – aspergilloses, and allergic fungal sinusitis

Impact on human health

- Irritation
 - From the VOCs
 - Mucus membrane irritation from the pungent or unpleasant primary metabolic processes.
 - The moldy or musty odors are commonly produced from the secondary metabolites
 - Additionally, sensory response – trigeminal nerve responds to pungency not odor, by causing avoidance reactions

Impact on human health

- Toxicity
 - Secondary metabolites
 - Antibiotics
 - Mycotoxins (competitive advantage over bacteria)
 - Causation link has not been shown

Legal Issues and Regulations

Hot Topic in Tort and Construction Litigation

- Large verdicts
- Large number of mold claims
- Media attention



Why Litigation?

- Energy conservation – hinders escape of moisture
- Building materials with organic sources (paper)
- Improper building design (roofs/windows)
- HVAC systems
- Improper protection of building material during construction

Fed & State Regs

- NIOSH says there are:
 - No accepted standards for mold sampling in indoor environments or for analyzing and interpreting the data in terms of human health
 - Molds are everywhere – if you test you will find mold
 - It is not known what quantity is acceptable in indoor environments with respect to human health

No Standards Yet

- Why are there no standards?
 - Most studies have tended to be based on baseline environmental data, rather than human dose-response data
 - Individuals have different sensitivities to molds, so setting standards and guidelines for indoor mold exposure is difficult and impractical

Lawsuits Have Claimed

- Compromised immune systems
- Acute abdominal pain
- Central nervous system damage
- Memory loss
- Cancer

Current State of Mold Regulation

- States that have introduced legislation
Arizona California Connecticut
Idaho Illinois Indiana
Louisiana Maryland Massachusetts
Michigan Montana Nevada
New Jersey New York Oklahoma
Pennsylvania Rhode Island Tennessee
Texas

State Rules

- Mold Inspectors
 - Licensed – Arizona, Louisiana
 - Instate Address – Texas
- Oversee HVAC Industry for mold – Idaho
- Mold disclosure statement on real estate transactions – Montana (Not required)

State Rules (cont.)

- Study health effects of mold – Rhode Island
- Mold abatement guidelines for schools – Tennessee
- Abatement and Remediation licensing – Texas
- How insurance claims are handled - Texas

Toxic Mold Protection Act

- California – 2001
 - Develop PELs to molds in indoor environment
 - Assess the health threat posed by the presence of mold
 - Set standards for the assessment, identification, and remediation of mold
 - After limits are set, they are to be reviewed within a 5 year time period

Lack of funding has made this bill ineffective

Ohio Workers' Compensation Claims

How is BWC dealing with mold claims?

Questions?

Moisture and Mold Inspections

Ohio Bureau of Worker's
Compensation
Division of Safety & Hygiene

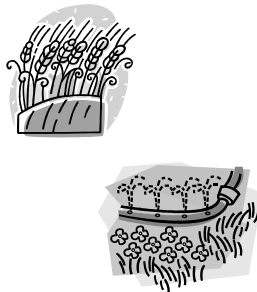
Mold Dynamics

- Hidden Mold
- Mold Distribution
- Mold Needs



Needs

- Temperature
- Light
- Food
- Moisture



Not All Bad!!! (If aged properly!!!)



Largest living organism found growing on roots

ASSOCIATED PRESS

Beneath the soil of the Malheur National Forest in eastern Oregon, a fungus that has been slowly weaving its way through the roots of trees for centuries has become the largest living organism ever found.

The *Armillaria ostoyae*, popularly known as the honey mushroom, started from a single spore too small to see without a microscope and has been spreading its black shoestring filaments called rhizomorphs through the forest for an estimated 2,400 years, killing trees as it grows. It now covers 2,200 acres.


"We ended up having on the landscape this humongous fungus," Tina Dreisbach, a botanist and mycologist at the U.S. Forest Service's Pacific Northwest Research Station in Corvallis, Ore., said yesterday.

In 1992, another *Armillaria ostoyae* was found in Washington state covering 1,500 acres near Mount Adams, making it the largest known organism at the time.

"We just decided to go out looking for one bigger than the last claim," said Gregory Filip, associate professor of integrated forest protection at Oregon State University and an expert in *Armillaria*.

The outline of the giant fungus, strikingly similar to a mushroom, stretches 3.5 miles across, and it extends an average of three feet into the ground. It covers an area as big as 1,665 football fields.

It was identified through DNA testing by comparing cultures of the fungus grown from 112 samples and determining that 61 were from the same organism, meaning a single fungus had grown bigger than anything anyone had ever described before.



Cladosporium
Locations: Paint, cloth, throughout forest floors.
Illnesses: Fungal infection, lung disease.

Common fungus that can be toxic proves costly for property insurers

Cladosporium
Locations: Paint, cloth, throughout forest floors.
Illnesses: Fungal infection, lung disease.

Why all the fuss over a fungus that has been around for centuries? The answer lies in the fact that this common indoor fungus can cause a variety of health problems and damage to buildings.


The problem has become so widespread that insurers and property owners are taking notice. Many property insurance companies no longer include mold coverage in their policies, and it is being considered a preexisting condition in both commercial and residential policies.

Why all the fuss over a fungus that has been around for centuries? The answer lies in the fact that this common indoor fungus can cause a variety of health problems and damage to buildings.

The problem has become so widespread that insurers and property owners are taking notice. Many property insurance companies no longer include mold coverage in their policies, and it is being considered a preexisting condition in both commercial and residential policies.


Why all the fuss over a fungus that has been around for centuries? The answer lies in the fact that this common indoor fungus can cause a variety of health problems and damage to buildings.

The problem has become so widespread that insurers and property owners are taking notice. Many property insurance companies no longer include mold coverage in their policies, and it is being considered a preexisting condition in both commercial and residential policies.

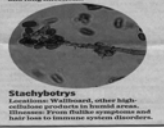


Alternaria
Locations: Carpet, cloth, window frames, household surfaces.
Illnesses: Asthma, meningitis.

While molds can produce allergenic responses in susceptible people, Alternaria is considered particularly common building mold and more active than many other fungi. However, there may be some mold here that is based on worst case scenarios. It could have done it if you think about it.



Aspergillus
Locations: Cloth (aspergillus niger), illnesses: Some types are toxic and allergenic and cause other, rare and lung infections.



Stachybotrys
Locations: Wallpaper, other high-moisture products in humid areas and illnesses: Even killing to rodents and has been to immune system disorders.

IAQ Milestones

- 1976 Legionnaires Outbreak
- 1987 NIOSH Guideline for IAQ Investigations
- 1989 ACGIH Bioaerosol Assessment & Control (2nd Ed. 1999)
- 1991 EPA Building Air Quality
- 1993 NYC Guidelines to Assessment & Rem. Stachy
- 1993 American IAQ Council Founded
- 1994 Pulmonary Hemosiderosis in Cleveland
- 1994 IAQ Association Founded
- 1995 EPA Tools for Schools (2nd Ed. 2000)
- 2000 NYC Guidelines/ Assessment & Rem. Fungi in IAQ
- 2001 EPA Mold Rem. In Schools & Commercial Bldgs.
- 2003 IICRC S520 Stds. & Ref. Guide for Prof. Mold Rem.
- 2004 AIHA "Asses, Rem & Post-Rem Verification of Mold in Bldgs."

Potential Hidden Mold



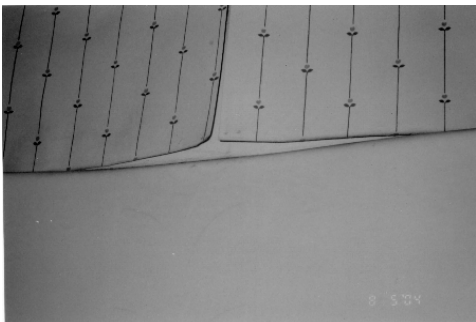
Potential Hidden Mold



Potential Hidden Mold



Potential Hidden Mold



Wood Decay

- Brown rot caused by cellulose digestion (basidiomycetes)
- White rot caused by lignin digestion (basidiomycetes)
- Soft rot caused by wet wood (bleached with black zone lines) (microfungi and ascomycetes)

Finding Hidden Mold



Humidity and Mold



Humidity and Spore Release

- Dry Spores
 - High periods between 10:00 am – 3:00 pm
 - Release by desiccation
- Slimy Spores
 - High periods between midnight – 3:00 am
 - Release by bursting

Humidity and Spore Release

Bldg Engineers look for water pathways

- If more water and dust is present usually equates to more mold growth
- Settled dust testing may be a good indicator
- Exposure pathway, may be settled dust
- Univents that are turned on and off can be good distributors of mold
- Drywall can act like sponge

(Morey, Yang, Miller, Tiffany; AIHCE-2000)

Fungal Categories

Leaf Surface
(*phylloplane*)

Alternaria
Cladosporium
Epicoccum

Outdoor growth on leaf surfaces. Presence in building through infiltration.

Soil Fungi

Aspergillus
Penicillium

Outdoor growth in soil. Outdoor infiltration and indoor sources.

Fungal Categories

Water requiring
(*hydrophilic*)

Aspergillus Fumigatus
Botrytis
Fusarium
Stachybotrys
Sporobolomyces
Ulocladium
Zygomycetes
Yeast

Outdoor growth on moist organic matter.
Outdoor infiltration and indoor sources.
Higher indoors = presence of excess water.

Fungal Categories

Toxogenic

Aspergillus Flavus
Aspergillus Fumigatus
Aspergillus Versicolor
Fusarium
Stachybotrys

Outdoor and indoor.
Outdoor infiltration and indoor sources.
Presence indoors may indicate concern for occupant health

Measuring Humidity





Water Intrusion



Water Intrusion



Water Intrusion

Water Activity

Drywall like a sponge

Moisture Meters

Condensation

Damp/Dirty filters/ coils

Water Intrusion



Free Water in/on bldg. Material

[Aw = Water Activity]

- **Aw Low < .8** =Primary colonizers (first to grow in dust/dirt on wall/ceiling cavities, carpet, furniture) **Aspergillus V., Penicillium & Wallemia** fungi
- **Aw Moderate .8-9** =Secondary colonizers (common outdoors and infiltrate through air inlets & cloths) **Cladosporium, Paecilomyces, Scopulariopsis & Aspergillus** fungi
- **Aw High >.9** =Tertiary colonizers (hydrophilic; grow on wet or recently wet bldg. materials; in cooling towers, humidifiers, cooling coils, and condensate pans) **Fusarium/Stachybotrys/ Acromonium/Ulocladium/Trichoderma/Chaetomium** fungi; **Pseudomonas/Bacillus/Streptomyces/ Actinomyces** G- bacteria

Water Intrusion

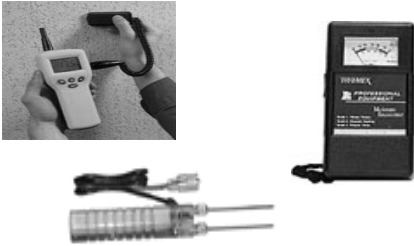


Water Intrusion



Moisture Meters

Carpet, Wood, Brick, Wallboard, Concrete



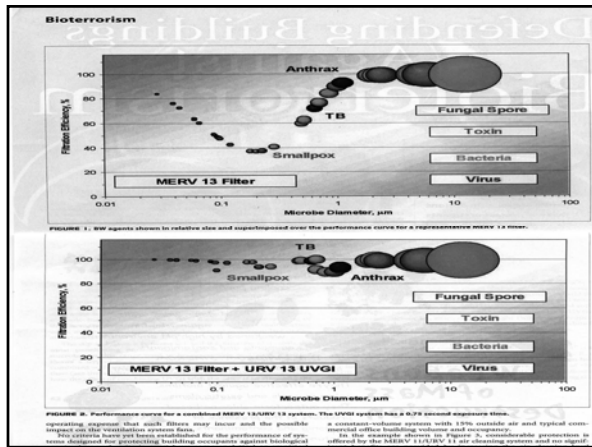
Filtration



ASHRAE 52.2 MERV

MERV	%Eff.	Final Resist	Controls	Type
1-4	<20	0.3 in. w.g.	Pollen/mites	Fiber / Disp Wash. /ES
5-8	20-70	0.6 in. w.g.	Dust/mist/spores	Pleated / ES
9-12	70-90	1.0 in. w.g.	Fume/Legionella	Box / Bag
13-16	90-99	1.4 in. w.g.	Tob.Sm./Bacteria	Box / ES

- Minimum Efficiency Reporting Value (MERV)
- Highly controlled laboratory testing, instead of dust spot
- Minimum efficiency instead of average
- Filter ability to remove particles of specific size



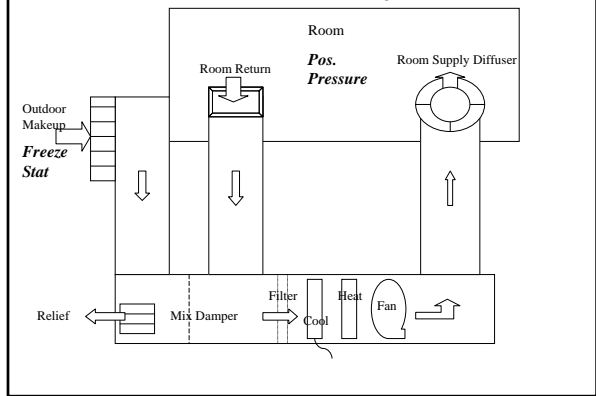
GERMS OF TERROR:

Disease	Origin	Prevention	Treatment
Anthrax	Bacillus anthracis bacterium	Vaccine available	antibiotic treatment before symptoms occur
Botulism	Clostridium botulinum bacterium	Vaccine currently not available	Antitoxins can halt progress
Plague	Yersinia pestis bacterium	Vaccine given until 1998	Antibiotics
Smallpox	Poxvirus	Mass inoculation stopped in 1972	Supportive therapy and Quarantine

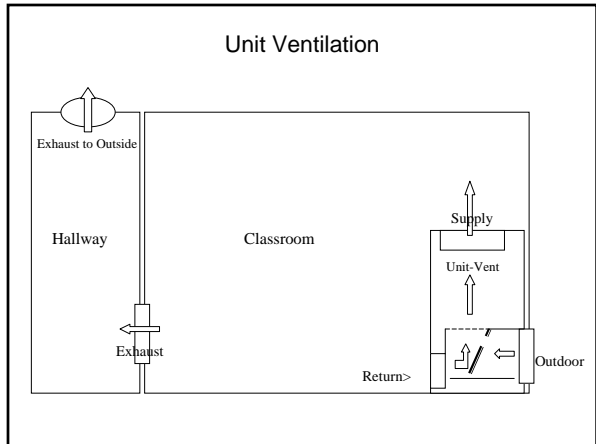
Filtration/ Infiltration



Basic Ventilation Design



Unit Ventilation



Moisture and Mold Remediation

Ohio Bureau of Workers'
Compensation
Division of Safety & Hygiene

Checklist for Mold Remediation

EPA 402-K-01-001 (p.27)

Investigate



- Assess size of moldy area (square feet)
- Consider hidden mold (wall cavity, air ducts, etc.)
- Clean up small mold problems
- Select remediation manager for medium to large mold problems
- Identify sources & type of water/ moisture sources
- Consult qualified professionals when necessary
- Consult with occupants throughout process

Checklist for Mold Remediation

(Continued)

Plan Remediation

- Use professional judgment to customize guidelines
- Plan to dry non-moldy materials
- Determine cleanup method for moldy items
- Determine proper personal protection equipment
- Protect building occupants

Checklist for Mold Remediation

(Continued)

Remediate

- Fix moisture problems (implement repair and maintenance)
- Dry non-moldy materials within 48 hours
- Clean and dry moldy materials
- Discard moldy porous items that can't be cleaned

Also (IICRC pp. 46-47) (AREC)

Sampling & Remediation

Occupant Health Investigation

- Clinical Investigation
 - No commercially available reliable diagnostic tests at this time
 - Assessment of symptomatic and asymptomatic occupants
 - Especially if occupant health problem remains unclear
- Epidemiologic Investigation
 - Recommended to clarify a building related problem
 - Baseline for comparison to remediation/ intervention
- Treatment
 - Almost always requires removal from environment
 - Treatments have not demonstrated long term relief

(IICRC S520 pp. 46-47)

EPA Guidelines for Remediating Materials with Mold Growth
(from Clean Water)

Material Affected *	Cleanup Method
< 10 sq. ft.	Paper/Books/ Wallboard (3) Concrete/ Carpet/ Furniture/ Drapes (1,3) Wood, Plastic, Metal (1,2,3)
10 – 100 sq. ft.	Paper/Books (3) Wallboard (3,4) Concrete (1,3) Carpet/ Furniture/ Drapes (1,3,4) Wood, Plastic, Metal (1,2,3)
> 100 sq. ft.	Paper/Books (3) Wallboard (3,4) Concrete (1,3) Carpet/ Furniture/ Drapes (1,3,4) Wood, Plastic, Metal (1,2,3) Wood (1,2,3,4)

1 – Wet Vacuum / Steam Clean / Complete Extraction
2 – Damp wipe with water or detergent solution
3 – HEPA Vacuum / after material is thoroughly dried
4 – Discard (sealed with normal waste) / HEPA Vacuum area after removal

EPA "Mold Remediation in Schools and Commercial Buildings," EPA 402-K-01-001, March 2001

EPA Guidelines for Remediating Materials with Mold Growth
(from Clean Water)

Material Affected *	Personal Protection Equipment
< 10 sq. ft.	Minimum (Gloves, Goggles, N-95 Respirator)
10 – 100 sq. ft.	Limited (add ½ mask & coveralls Full (add head gear, foot coverings, full face with HEPA)
> 100 sq. ft.	Full (Gloves, goggles, coveralls, head gear, foot coverings, full face with HEPA)

EPA "Mold Remediation in Schools and Commercial Buildings," EPA 402-K-01-001, March 2001

EPA Guidelines for Remediating Materials with Mold Growth
(from Clean Water)

Material Affected *	Containment
< 10 sq. ft.	None Required
10 – 100 sq. ft.	Limited (Seal area with fire-retardant polyethylene sheeting, maintain negative pressure with HEPA, block supply & return air vents)
> 100 sq. ft.	Full (two layers of fire-retardant poly with airlock chamber, maintain negative pressure with HEPA to outside, block supply & return air vents)

EPA "Mold Remediation in Schools and Commercial Buildings," EPA 402-K-01-001, March 2001

Sample Comparisons

	Tape	Spore Traps	Culture	PCR
Volume	na	100 L	200 L	1000 L
Turn Around	1 day	1 day	14 days	1 day
Speciate	no	no	yes	yes
Type	v/n	v/n	v	v/n

Fluorometric method = immediate field method
 PCR = polimerase chain reaction

Sampling Mediums



Biosampler 12.5 lpm 8-hours, preserves viability
 Viable and total Endotoxin Bacteria
 Less efficient collection of hydrophobic bacteria and fungal spores



Button Sampler 4 lpm on filter, limited viability
 Viable and total Endotoxin Bacteria
 Good collection uniformity low sensitivity to ambient conditions



Bio Stage Impactor 14.15/28.3 lpm on culture medium
 Viable and Bacteria
 Easy to use, organisms remain viable, cost effective, time proven
 Particle bounce, short sample times



Spore traps 15 lpm impaction on tacky glass
 Total pollen fibers
 Low particle bounce allow direct quantitative analysis
 Slide overload short sample times
 (Air-o-cell, Burkard, Allergenco, Cyclex-D, Laro)

Sampling Mediums



Bio Cassette 28.3 Lpm Impaction onto culture media
 Viable Bacteria
 No preparation, sterilization, disassembly, organisms remain intact
 and viable, low stress on particles
 Particle blow off/ bounce, short sample times



Surface Swab Wipe sample
 Viable and total / bacteria
 Easy to use, fast, non-destructive
 Sampling must be handled aseptically



Bio-Tape Lift Surface sample
 Fungal pollen fibers
 Non-destructive, predetermined sample area
 Possible secondary contamination of sample



Carpet Filtration using filter 10 lpm
 Fungi and fibers
 Easy to use Cost effective

Allergen Test Kits

- **Allergen Test Kits** Allergen **test** kits are designed to identify allergens in the carpet such as **dust mites**, cat dander, and cockroach allergens that may be the cause of asthma and allergies. Rating: *No user ratings* [rate this item] See: [All Home & Garden Allergy Buyers Club](#) **\$129.95Buy at Seller**
- **Home Dust Mite Test Kit (package of 4 tests)** If you are allergic to dustmites you will experience symptoms similar to pollen allergy and you may exhibit asthmatic symptoms if your reaction is severe. Rating: *No user ratings* [rate this item] See: [All Home & Garden Allergy Buyers Club](#) **\$99.95Buy at Seller**
- **MITE-T-FAST Dust Mite Test** MITE-T-FAST **Dust Mite** Detection Kit Detect Clinically Significant Levels Of **Dust Mite** Allergen **Dust mites** produce the most significant allergen in your home. Rating: *No user ratings* [rate this item] See: [All Air Purifiers NationalAllergy](#)

Interpretation of Results (Air)

- Pathogenic fungi - Aspergillus, Cryptococcus, Histoplasma
- Toxogenic fungi - Stachybotrys atra, Aspergillus, Fusarium
- Presence of 1 or more species greater than outdoor
- > 50 cfu/m3 of 1 or > species except Cladosporium, Alternaria ????????
- Different profile of species indoor than outdoor
- Mixture up to 150 cfu/m3 OK if similar to outdoor ????????
- Higher levels OK in summer if tree fungi like Cladosporium
- Elevated levels may reflect building problem but not disease
- Even low levels of Stachybotrys, Aspergillus Versicolor and various Penicillium beyond background a concern

Mold Indicators

Aspergillus vers., Wallemia can show damp (condensate problem)

Cladosporium, Alternaria are normal in buildings

Stachybotrys, Trichoderma, Chaetomium indicate wet problems

Ceiling tile formerly wet will have low water
Aspergillus versicolor, Wallemia

Penicillium indicates an inside moisture source

Common in outdoor air to find 20,000+ spores m3
(Such as Cladosporium)
(Common soil Penicillium, Aspergillus are < 1% in air)

National Allergy Bureau Data

- < 6500 Grains/m³ - Only individuals extremely sensitive to mold spores will suffer
- < 13,000 - Many individuals sensitive to mold spores will suffer
- < 50,000 - Most individuals with any sensitivity to mold spores will suffer
- > 50,000 - Almost all individuals with any sensitivity to mold spores will suffer. (can be severe)

Proposed Guidelines (AIHA Synergist Nov. 2001 pp.20-21)

Type	Normal	Possible Contamination	Probable Contamination
Air / Residential	<5000 <500	5000-10,000 500-1000	>10,000 spores/m ³ >1000 cfu/m ³
Air / Commercial	<2500 <250	2500-10,000 250-1000	>10,000 spores/m ³ >1000 cfu/m ³
Dust/Bulk Samples	<100,000 <10,000 <50,000	100,000-1,000,000 10,000-100,000 50,000-100,000	>1,000,000 sp/gram >100,000 cfu/gram >100,000 mycelial frags/g
Swab Samples	<10,000 <1500		>10,000 cfu/in ² >1500 cfu/cm ²
Tape Samples	No significant fungal material or biomass 1-5%	5-25%	25-100%

Some Consultants Use the Following

Type	Air CFU/m ³	Swab CFU/ in ²	Bulk CFU/gram
No growth/ Background	--	< 100	< 100
Low/ Normal	< 250	100 - 10,000	100 - 25,000
Moderate/ Borderline	250 - 1000	10,000 - 100,000	25,000 - 200,000
Active Growth/ Sporulation	1000 - 5000	100,000 - 1,000,000	200,000 - 1,000,000
Very Active Growth	> 5000	> 1,000,000	> 1,000,000

(EMSL Analytical Inc., 2004)

Background in Non-complaint Bldgs.

- Of 150 Commercial Buildings = 233 cfu/m³ when outdoor 1000
- Of 800 residential Buildings = 1200 cfu/m³ when outdoor 1500
- Large % of Buildings have air fungal levels > 500 cfu/m³
(a level often advocated for remediation)



Containment

To prevent contamination of other areas of the building
Prevent occupant and remediator exposure to mold



Limited Containment

- Between 10 and 100 square feet
- Single 6-mil layer
- Overlap flap entrance
- Taped to wall, floor, ceiling or on a stud frame
- All vent, door, chase, riser pathways must be sealed
- Remember common air plenums above drop ceilings
- Keep under negative pressure

Full Containment

- Greater than 100 square feet
- Double sheeting layer
- Decontamination layer or airlock
 - Large enough for changing in and out of work clothing

Move Occupants?

- Size of job
- Health of occupants
- Hazard of substrate
- Type of remediation
- Type of mold

Containment

- Maintain negative pressure
- Exhaust to the outside
- Proper containment will mean the sheeting will billow inward (as viewed from outside containment)
- Fluttering or billowing outward (as viewed from outside containment) indicates a compromised containment with leakage

Containment Area




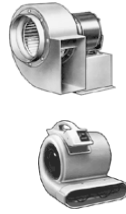
Photo 8: Full containment on large job

Air movers and Dryers

- Axial Air movers



- Centrifugal Air movers



Remediation Key Steps EPA 402 K 01 001

Assess Size, Source and damaged material
(Leaks, HVAC, Maintenance, Condensation, Humidity)

Select Remediation Manager

Communicate with occupants

Consult with health professionals as necessary

Plan remediation

In-house people (Containment and PPE)

Outside expertise

Remediate

Fix source of problem

Dry non-moldy materials within 48 hours

Clean & dry moldy materials (do not just kill or encapsulate)

Discard moldy materials that are not cleanable

Post remediation assessment

PPE

- Avoid Inhaling

– Minimum N-95 Respirator

- Avoid Skin Contact

– Minimum Gloves

- Avoid Eye Contact

– Minimum Goggles



Average Spores/m3 During Remediation

- Bathroom
 - 1 sq. ft. => 1,000,000
 - 10 sq. ft. => 10,000,000
 - 100 sq. ft. => 100,000,000
- Bedroom
 - 1 sq. ft. => 300,000
 - 10 sq. ft. => 3,000,000
 - 100 sq. ft. => 30,000,000

Suggested Minimum Respirators

Spores/m3	Protection Factor	Respirator
50,000	5	Filtering Facepiece
100,000	10	Half-face APR
200,000	50	Full-face APR
600,000	1,000	Full-face PAPR
>10,000,000	10,000	SCBA or Quant. Fit test

Clean-up by type

Discard and Replace –	Ceiling Tile, Insulation
Extract water (vacuum) – Dehumidify Accelerate drying (fans)	Carpet (24-48 hrs.), Concrete, Hard surface flooring
Dry in place (if not swelled) – Ventilate wall cavity	Wallboard
Damp wipe –	Hard surfaces

Porous Textiles, Uphostery, Paper

- Laundering – with detergents, sanitizers, Chlorine/Oxygen (sodium perborate) bleaches, Increase water temperature
- Dry Cleaning – Standard methods to physically remove contaminant, rather than microbial kill
- Upholstery/Area rugs – Per IICRC S300 “Standard And Reference Guide for Professional Upholstery Cleaning”
HEPA vacuum, rapid drying
- Paper documents – HEPA (downdraft) brushing, Air washing, rapid drying

IICRC Reference of Antimicrobial Agents

- | | | |
|----------------------|-------------------------|---|
| • Alcohols (eth/IPA) | 60-90% solution | B,V,F
<i>non-irritating or staining IOM, flammable</i> |
| • Quaternary Ammonia | .4-1.6% solution | B*,V*,F
<i>Inexpensive IOM, limited efficacy</i> |
| • Phenolics | .4-5% solution | B,V,F,(T)
<i>Inexpensive, residual Toxic,irritant, corrosive</i> |
| • Iodophors | 75 ppm | B, V, F, S**, T**
<i>Stable, residual IOM, expensive</i> |
| • Glutaraldehydes | 2% solution | B, V, F, S**, T
<i>Resists OM, noncorrosive, irritating, expensive</i> |
| • Hypochlorites | ≥5000ppm free Cl (1:10) | B, V, F, S**, T
<i>Inexpensive IOM, toxic, corrosive</i> |
| • Hydrogen Peroxide | >3% solution | B, V, F, S**, T
<i>Relatively Stable Corrosive, expensive</i> |
- B=Bactericidal V=Virucidal F=Fungicidal S=Sporicidal
T=Tuberculocidal
- IOM=Inactivated by organic matter * = Limited **=Long contact time

Know When Finished?

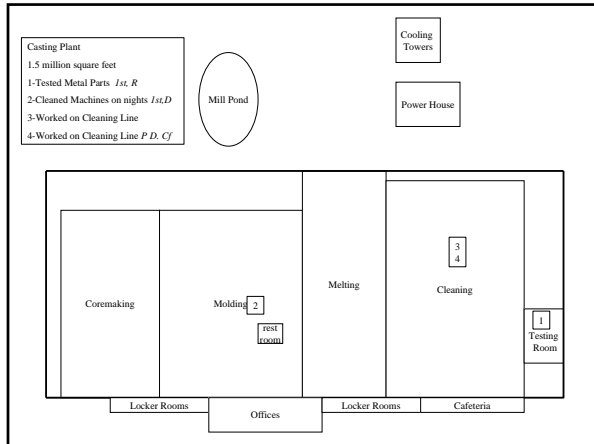
- The water problem is completely fixed
- Mold removed and no odor present
- Sample results similar to outdoors
- Follow-up evaluation (sustainability)
- Health complaints subside

Communicate

- Essential for successful remediation
 - Regular memos
 - Meetings
- Tell about
 - Size of project
 - Planned activities
 - Timetable

Bacterial Biocontaminants Legionella & Tuberculosis







Tuberculosis

Anticipation

- Hospitals
- Nursing Homes
- Public Health

Recognition

- Occupants are sources, not building structure

Tuberculosis

Evaluation

- Physician diagnosis of patient

Control

- OSHA / CDC has guidelines for prevention of spread of TB bacillus in affected industries

Building Structures & Additional Resources

Structural Characteristics



Substitute Materials

- Green board
- Low VOC Paints
- Pesticide not containing (allergic/ sensitizer/ carcinogen)
- Non-pesticide if has good adhesion, elasticity and vapor barrier, over a primer, will likely do the job.
- Wall board thermal break
- Vapor barriers

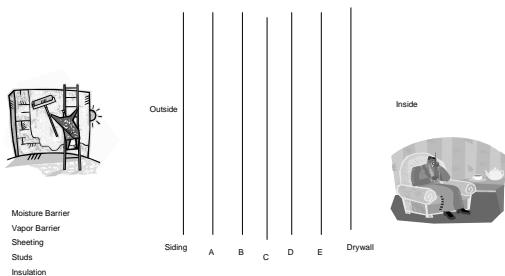
Green Building Coalition

- (www.clevelandgbc.org)

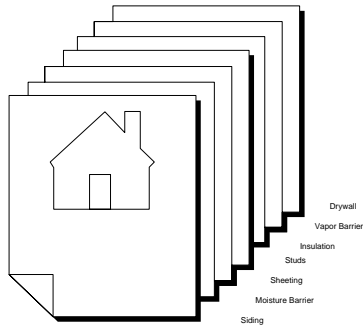
Leadership in Energy & Environmental Design

- Rating system
- For New Construction, Commercial Interiors, Homes, Existing Buildings, Core & Shell, Neighborhood Development
- Awards points for things such as minimum IAQ performance, Carbon dioxide monitoring, Ventilation effectiveness, Construction materials (Low-emitting), Indoor chemical and pollutant sources, Thermal Comfort per ASHRAE 55-1992 (Humidity)

Typical Wall Construction

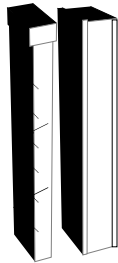


Correct Wall Construction

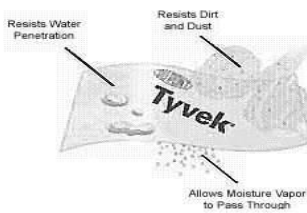


Masonry

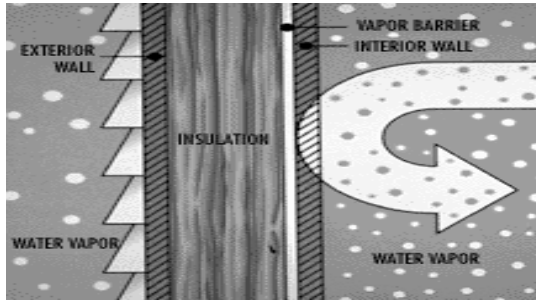
- Air Space between brick and inside wall
- Weep holes
- Flashing at cap
- Waterproofing



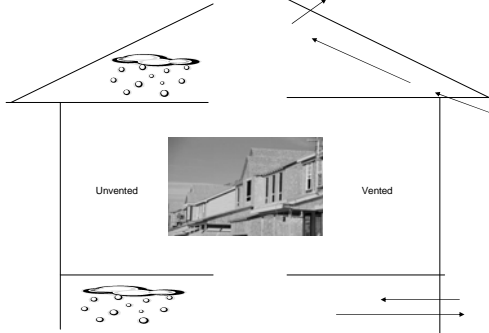
Moisture Barrier



The Wall Should Not Let Moisture Pass From the Inside



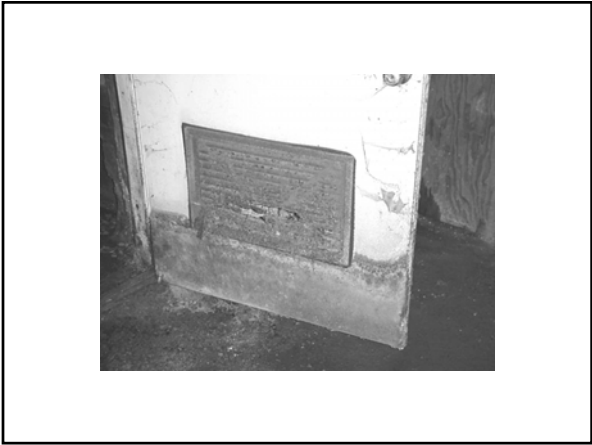
Attic & Crawl Spaces

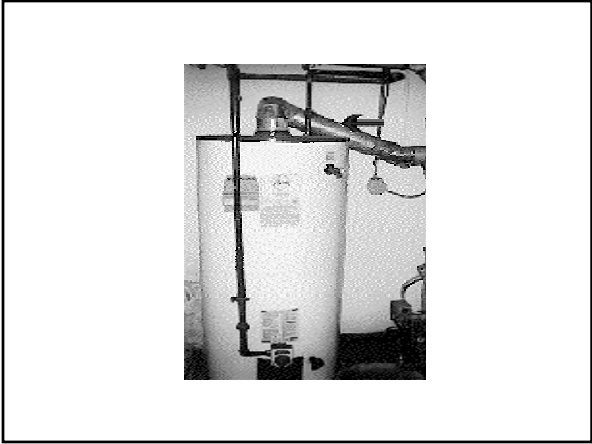


??? Is There a Mold Issue ???

- In addition to other issues, is mold also a concern?
- Signs of current, past or future growth?
- What is the source?
- What will prevent it in the future?















Certification Authorities

Institute of Inspection, Cleaning & Restoration (IICRC)
www.iicrc.org
Applied Microbial Remediation Tech
Water Restoration Tech
Applied Microbial Remediation Specialist

Indoor Air Quality Association (IAQA)
www.iaqa.org
Certified Mold Remediator (CMR)

American Indoor Air Quality Council (AmIAQ)
www.iaqcouncil.org
Certified Mold Remediation Supervisor (CMRS)

National Air Duct Cleaner Association (NADCA)
www.nadca.com
Ventilation System Mold Restorer (VSMR)
Air System Cleaning Specialist (ASCS)

EPA - Resources

U.S. Environmental Protection Agency (EPA), Indoor Environments Division (IED) An Office Building Occupant's Guide to IAQ www.epa.gov/iaq/pubs/occupgd.html	IAQ in Large Buildings / Commercial Buildings www.epa.gov/iaq/base/index.html
Biological Contaminants www.epa.gov/iaq/pubs/bio_1.html	IAQ in Schools www.epa.gov/iaq/schools/index.html
Building Air Quality Action Plan (for Commercial Buildings) www.epa.gov/iaq/base/actionpl.html	Mold Remediation in Schools and Commercial Buildings www.epa.gov/iaq/pubs/molds.html
Floods / Flooding www.epa.gov/iaq/pubs/flood.html	Mold Resources www.epa.gov/iaq/pubs/moldresources.htm
Indoor Air Quality (IAQ) Home Page www.epa.gov/iaq	U.S. EPA IAQ Information Clearinghouse Phone: (800) 438-4318 or (703) 356-4020 Fax: (703) 821-8236 Email: iaqinfo@aol.com

Asthma & Allergy - Resources

Asthma and Allergic Diseases:

American Academy of Allergy, Asthma & Immunology (AAAAI)
(800) 822-2762 www.aaaai.org
Physician referral directory, information on allergies and asthma

Asthma and Allergy Foundation of America (AAFA)
(800) 7-ASTHMA (800-727-8462) www.aafa.org
Information on allergies and asthma

American Lung Association (ALA)
(800) LUNG-USA (800-586-4872) www.lungusa.org
Information on allergies and asthma

Asthma and Allergy Network/Mothers of Asthmatics, Inc. (AAN-MA)
(800) 878-4403 or (703) 641-9595 www.aanma.org
Information on allergies and asthma

National Institute of Allergy and Infectious Diseases (NIAID)
(301) 496-5717 www.niaid.nih.gov
Information on allergies and asthma

National Jewish Medical and Research Center
(800) 222-LUNG (800-222-5864) www.njc.org
Information on allergies and asthma

Flooding - Resources

Floods/Flooding:

Federal Emergency Management Agency (FEMA)
(800) 480-2520 www.fema.gov/mit

Publications on floods, flood proofing, etc.

University of Minnesota, Department of Environmental Health & Safety
(612) 626-5804 www.dehs.umn.edu/remanagi.html

Managing water infiltration into buildings

University of Wisconsin-Extension, The Disaster Handbook
(608) 262-3980 www.uwex.edu/ces/news/handbook.html

Information on floods and other natural disasters

(A-B) Resources

American College of Occupational and Environmental Medicine (ACOEM)
(847) 818-1800 www.siouxland.com/acoem/ Referrals to physicians who have experience with environmental exposures

American Conference of Governmental Industrial Hygienists, Inc. (ACGIH)
(513) 742-2020 www.acgih.org Occupational and environmental health and safety information

American Industrial Hygiene Association (AIHA)
(703) 849-8888 www.aiha.org Information on industrial hygiene and indoor air quality issues including mold hazards and legal issues

American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE)
(800) 527-4723 www.ashrae.org Information on engineering issues and indoor air quality

Association of Occupational and Environmental Clinics (AOEC)
(202) 347-4976 www.aoec.org Referrals to clinics with physicians who have experience with environmental exposures, including exposures to mold, maintains a database of occupational and environmental cases

Association of Specialists in Cleaning and Restoration (ASCR)
(800) 272-7012 www.ascr.org Disaster recovery, water and fire damage, emergency tips, referrals to professionals

(C-F) Resources

Canada Mortgage and Housing Corporation (CMHC)

(613) 748-2003 [International] www.cmhc-schl.gc.ca/cmhc.html Several documents on mold-related topics available

Carpet and Rug Institute (CRI)

(800) 882-8846 www.carpet-rug.com Carpet maintenance, restoration guidelines for water-damaged carpet, other carpet-related issues.

Centers for Disease Control and Prevention (CDC)

(800) 311-3435 www.cdc.gov Information on health-related topics including asthma, molds in the environment, and occupational health

CDC's National Center for Environmental Health (NCEH)

(888) 232-6789 www.cdc.gov/nceh/asthma/factsheets/molds/default.htm "Questions and answers on *Stachybotrys chartarum* and other molds"

Energy and Environmental Building Association (952) 881-1098 www.eeba.org
Information on energy-efficient and environmentally responsible buildings, humidity/moisture control/vapor barriers

(G-M) Resources

Institute of Inspection, Cleaning and Restoration Certification (IICRC)

(360) 693-5675 www.iicrc.org Information on and standards for the inspection, cleaning, and restoration

International Sanitary Supply Association (ISSA) (800) 225-4772 www.issa.com
Education and training on cleaning and maintenance

International Society of Cleaning Technicians (ISCT) (800) WHY-ISCT (800-949-4728) www.isct.com
Information on cleaning such as stain removal guide for carpets

Material Safety Data Sheets (MSDSs) - Cornell University

<http://msds.pdc.cornell.edu/msdssrch.asp> MSDSs contain information on chemicals or compounds including topics such as health effects, first aid, and protective equipment for people who work with or handle these chemicals

MidAtlantic Environmental Hygiene Resource Center (MEHRC)

(215) 387-4096 www.mehrc.org Indoor environmental quality training on including topics such as mold remediation

(N) Resources

National Air Duct Cleaners Association (NADCA)

(202) 737-2926 www.nadca.com Duct cleaning information

National Antimicrobial Information Network (NAIN)

(800) 447-6349 <http://ace.orst.edu/info/nain/> Regulatory information, safety information, and product information on antimicrobials

National Association of the Remodeling Industry (NARI)

(847) 298-9200 www.nari.org Consumer information on remodeling, including help finding a professional remodeling contractor

National Institute of Building Sciences (NIBS)

(202) 289-7800 <http://nibs.org> Information on building regulations, science, and technology

National Institute for Occupational Safety and Health (NIOSH)

(800) 35-NIOSH (800-356-4674) www.cdc.gov/niosh Health and safety information with a workplace orientation

National Pesticide Telecommunications Network (NPTN)

(800) 856-7378 <http://ace.orst.edu/info/nptn/> Information on pesticides/antimicrobial chemicals, including safety and disposal information

**New York City Department of Health,
Bureau of Environmental & Occupational Disease Epidemiology**

(O-Z) Resources

Occupational Safety & Health Administration (OSHA)

(800) 321-OSHA (800-321-6742) www.osha.gov Information on worker safety, includes topics such as respirator use and safety in the workplace

Sheet Metal & Air Conditioning Contractors' National Association (SMACNA)

(703) 803-2980 www.smacna.org Technical information on topics such as air conditioning and air ducts

Smithsonian Center for Materials Research and Education (SCMRE)

(301) 238-3700 www.si.edu/scmre Guidelines for caring for and preserving furniture and wooden objects, paper-based materials; preservation studies

University of Michigan Herbarium

(734) 764-2407 www.herb.lsa.umich.edu Specimen-based information on fungi; information on fungal ecology

University of Tulsa Indoor Air Program

(918) 631-5246 www.utulsa.edu/iaqprogram Courses, classes, and continuing education on indoor air quality

Water Loss Institute, Association of Specialists in Cleaning and Restoration

(800) 272-7012 or (410) 729-9900 www.ascr.org/wli.asp
Information on water and sewage damage restoration

Mold forces children out from West Side house
A Cleveland family is looking for a new home after toxic black mold was discovered in the basement of their rental home on the city's West Side.
Check, Baleigh and his three girlfriends, the three youngest of the five children, had to leave their home last October. Since then, they have been staying at a temporary apartment while the house is being cleaned.
The city has ordered the landlord, Brown and Lisa Decker of Hartsville, in Stark County, to have the mold removed by Dec. 11, using a professional contractor.
Lisa Decker said yesterday that she would have a contractor brought in to clean the mold.
She said her infant son, David, has been suffering from diarrhea a couple times since he's been in the mold during a recent doctor appointment. A nurse asked whether any mold could be in the house.
She said her infant son, David, has been suffering from diarrhea a couple times since he's been in the mold during a recent doctor appointment. A nurse asked whether any mold could be in the house.

Family takes home back 'after mold'

Mysterious illness traced to Hong Kong hotel guest
"Speculation can go from it being a pigeon sitting on a window sill... in a neighbor's under the eave."
Health Department
Dr. David Bernstein, WHO's
If the illness was spread by an animal, it would be a first.

Officials seal basement to deal with poisonous mold
The health department sealed off the basement of a house on the city's West Side Tuesday to deal with poisonous mold.
The house, located on the city's West Side, was sealed off Tuesday afternoon by health department workers. The house is owned by a family that has been living in the house since the mold was discovered.
The health department said the mold was found in the basement of the house. The mold was found in the basement of the house. The mold was found in the basement of the house.

WALDEN
AURORA, OHIO
4,200 Sq. Ft. Condominium
Located in
LANDINGS OF WALDEN
Original Market Value
Estimated \$450,000
TOXIGENIC CONTAMINATION
Stachybotrys and other toxic molds and fungi. Requires Level IV remediation in compliance with OSHA 1910.134, 1910.1200, and other applicable environmental Federal Standards. Specifics upon request to qualified buyers only. Call (216) 496-6631 Reference www.toxicmold.org

Applicability of Mold Sampling Results in Workers' Compensation Claims

**Don Bentley, PE, CIH
Industrial Hygiene Technical Advisor
Bureau of Workers' Compensation
Division of Safety and Hygiene**

Mold is present everywhere and during every season. Sampling for mold/fungi will usually always produce positive results because mold is present in the air and on objects of your home or office, indoors or outdoors. With regard to problems resulting from mold in the workplace, it is not the **presence** of mold that indicates a problem; it is the **exposure** to a large quantity of mold. When mold is identified as a problem in the workplace, mold will usually be visible and will be accompanied by a musty odor. Mold contamination can always be traced to certain events such as a flooded area or an ongoing wet or damp area.

Workers' Compensation Claims

I was asked to attend a hearing during the first week of December. In this claim, the claimant alleged that elevated exposure to mold in his workplace was producing allergic responses. The claim was denied because he did not have a medical diagnosis of a condition and a statement that the condition was the result of exposure from the workplace. However, the claimant, if he would have had a proper medical diagnosis, was ready to argue that exposure to mold in the workplace was the contributing factor to his disease. The claimant had bulk samples of dust in his work area collected and analyzed for mold. The results of the sampling were reported as total colony forming units (CFU). I have further explained my thoughts on this claim in Attachment A.

In another claim, involving a teacher in the Circleville Schools (claim 01-410533), the claim was allowed for fungal allergy. In this case, the District Hearing Officer writes, "The District Hearing Officer also relies on EMSL Analytic, Inc. report which revealed 24 CFU's per gram of Cladosporium." Cladosporium is one of over 100,000 species of fungi and molds. "This report was based on moldy tiles taken from the claimant's classroom. The claimant testified that she took a sample of the ceiling tiles that had been removed from her classroom and sent it to the above lab for testing."

I contend that the flooding over Christmas break provides more helpful information in allowing this claim than does the results of the bulk sampling. Additionally, the fact that health effects to the individual in this area started shortly after the event is helpful once again in a doctor's diagnosis that the condition is the result of the event. However, if only the results of the bulk sampling were to be used to validate the claim, I would have to say the results are very conclusive that the dust from the ceiling tile was not "moldy". These results would compare very favorably with levels of mold in every home and office setting. I have expanded on this claim in Attachment B.

BWC's Division of Safety and Hygiene Position on Mold

The Bureau of Workers' Compensation, Division of Safety and Hygiene (DSH) does not sample for mold in the workplace. The reason DSH does not sample for mold is no exposure limits exist to help interpret the results and it is quite expensive to perform proper sampling. Information from the New York City Department of Health, EPA, and peer-reviewed Journal Articles, all agree that sampling should not normally be performed, is unnecessary, and is expensive to perform properly. The American Conference of Governmental Industrial Hygienists (ACGIH), book "Bioaerosols, Assessment and Control" also does not recommend sampling, but does provide the steps that must be taken to properly sample a work environment. We have a copy of the book in our Resource Center.

In most cases mold contamination is obvious. If mold is present in the workplace, it needs to be removed as quickly as possible. Additionally, steps must be taken to stop the source of water that produced the environment for mold growth. The presence of a large amount of water, i.e. the room was flooded, the carpet was wet, etc. or an ongoing source of wetness such as improper maintenance of the cooling coils in a heating, ventilating and air-conditioning (HVAC) unit, is usually necessary to produce an event.

Published Articles on Mold

I have included information from two sources to provide backup documentation. The first attachment is from the Technical Exchange, in The Synergist, November 2001. The article "Assessment and Sampling Approaches for Indoor Microbiological Assessments" includes a table that must be read with care (check the units for all numbers). In the table, information is given on normal background levels of fungal spores (mold). This information shows that for bulk samples, normal background levels are as high as 10,000 CFU/gram. This number is many, many times greater than the individual sampling that was performed in either of these claims. There are basically two types of sampling identified in this table. The first two rows deal with air sampling of residential and commercial buildings. The reporting of air sample results will typically be spores per cubic meter of air or colony forming units per cubic meter. The last 4 rows describe different sampling means to obtain a sample material in the building. The rows cover dust sampling, bulk sampling, swab sampling and tape samples. Analysis of bulk material (dust or bulk) is typically reported as spores per gram or CFU per gram. Analysis of swab samples is reported as CFU per square centimeter and tape samples in percent concentration of fungal material. All six sampling types have very specific procedures on how sampling should be performed. The ACGIH book "Bioaerosols, Assessment and Control" outlines the procedures that should be used. The procedures, when done properly are expensive and require a large number of samples to be taken. Additionally, indoor and outdoor samples are needed for air samples to identify if there is "amplification" or a source of contamination indoors. The article also states that the level in non-problem buildings showed fungal spore concentrations in dust to be much lower (103 to 105 CFU/gram), and that dust is never "spore-free".

A peer-reviewed article, “Resolution of Sick Building Syndrome in a High-Security Facility”, in Applied Occupational and Environmental Hygiene identifies the levels of airborne fungal concentrations in a building that had visible microbial contamination in the HVAC system. In this case, the airborne concentrations ranged from 85 to 6,157 CFU/cubic meter in the building. The 3 sites that were identified as problem areas were found to have 6,175; 4,778; and 221 CFU per cubic meter. After remediation had taken place and the condition was much improved, the airborne concentrations were found to range from 14 to 500 CFU/ cubic meter. Please note these are air samples and cannot be compared to the claimants bulk samples. Bulk sampling is done because it is very inexpensive, but is also very unreliable.

Additionally, Dave Johnson, Editor & Publisher of Industrial Safety and Hygiene News (ISHN) in November 2001, said: “Experts agree that some people with acute sensitivities are at high risk from certain molds. But they also point out that we’ve lived with mold since the stone age and actual cases of related health problems are unique or rare, according to the Centers for Disease Control.” www.ishn.com

Finally, the New York City Department of Health has issued “Guidelines on Assessment and Remediation of Fungi in Indoor Environments.” This document has become accepted by the health and safety community as one of the best documents available on the issue of fungi and mold. In this document it once again states that sampling is usually not necessary. Additionally, no health standards currently exist, so interpretation of results is difficult.

In summary, mold is ubiquitous and so finding the presence of mold in any workplace would be expected. Air or bulk sampling of mold contamination needs to be performed with extreme care and following procedures as outlined in the ACGIH book, “Bioaerosols, Assessment and Control.” Not following the procedures can lead to contamination of collected samples or insufficient data to interpret the results. No health standards currently exist which makes interpretation of the results very difficult. The American Industrial Hygiene Association (AIHA) guideline provides the only information I could find. These numbers come from many mold remediation circumstances similar to the remediation sampling described in the Resolution of Sick Building Syndrome in High-Security Facility article.

I hope you find the above information and the attached articles helpful. If you would like to discuss this further, please let me know. Thank you for your time.

Attachments:

- A) Discussion of claim: 00-609357 Staff Hearing on December 5, 2001
- B) Discussion of claim: 01-410533 District Hearing on October 17, 2001
- 1) Clark, Geoffrey A.; “Assessment and Sampling Approaches for Indoor Microbiological Assessments”, The Synergist, American Industrial Hygiene Association, November 2001, pg 20-21.

- 2) BWC Division of Safety and Hygiene Information Sheet – Mold, June 2001.
- 3) Hiipakka, David W.; “Resolution of Sick Building Syndrome in a High-Security Facility”, Applied Occupational and Environmental Hygiene, Vol. 15:(8), 2000, pp 635-643.
- 4) D’Andrea, Christopher, Editor “Guidelines on Assessment and Remediation of Fungi in Indoor Environments” New York City Department of Health, November 2000.

Attachment A:

Workers’ Compensation Claim: 00-609357 Staff Hearing on December 5, 2001.

I conducted a visual survey of the basement levels (B2 and B1) of the William Green Building on October 5, 2001. I submitted a report on October 15, 2001, identifying no visible mold in the claimants work area and only isolated situations where the potential existed for mold growth in other sections of the basement level. Building management accompanied me on the survey and addressed problems very quickly. At the time of the hearing, all recommendations made in my report had been implemented. I was not informed of any events that could lead to gross contamination of mold in the basement level. The only flooding that was mentioned on the survey date, was in the print shop area where limited material is present to enhance the growth of mold. The print shop has a tile floor. If standing water were cleaned up quickly, the tile floor would not enhance the growth of mold as carpeting can. The drywall in the area of the leak was removed, which also removed the cellulose material on the drywall that would be a potential for mold growth. The area was visually inspected and was in good condition.

When mold is not visually observed, or an odor does not exist, mold sampling will not produce results that indicate gross contamination. In this case, a bulk sample of dust was taken and submitted to an analytical laboratory. This sample showed very little mold present. Additionally all results of bulk material should be in the form of CFU/gram or spores per gram. The claimant’s lab results were in the form of Total CFU. This number is meaningless for comparative purposes. The Division of Safety and Hygiene did not take samples. When sampling is performed, bulk sampling of material is typically done because it is inexpensive. However, a bulk sample is not a good indicator of the mold contamination in an area.

The best indicator of exposure to mold in this workplace would be the presence of gross contamination of mold or a musty odor. These were not present in this situation. If samples were taken, air samples in the department of concern, air samples in adjacent hallways and rooms, air samples in the HVAC unit and outside air samples would help determine if an extensive amount of mold exists. The results of the air sampling would identify if the mold found in the building were similar to the mold found outdoors or if the number of colony forming units (CFU) were higher inside than outside. If the number of CFU inside the building were much higher than outdoors then **amplification**

would be occurring. Amplification involves mold from outdoors finding a source of wetness indoors where the mold reproduces and creates a problem indoors.

When bulk samples are taken to find mold, those samples are typically taken by removing a section of an obviously moldy area and sending that sample to a lab for analysis. The results of the bulk sample sent to the lab by the claimant are conclusive that they did not take a sample of a “moldy” area.

As a result of my walk-through survey, I can say that in this case, there was no visible mold present in the claimants work area. Additionally, there was minimal mold found in the bulk sampling that was performed, and there have been no documented events, i.e. flooding, or continuous wet areas, which can produce a mold event. Thus, in my opinion, supported by the documentation that is attached to this information sheet, there is no occupational exposure occurring that would be the contributing factor to the individuals medical condition.

Attachment B:

Workers’ Compensation Claim: 01-410533 District Hearing on October 17, 2001.

I am not familiar with this case beyond what I read in the Record of Proceedings by Jaimee Touris, District Hearing Officer, mailed on 10/23/2001. In this claim, the claimant was diagnosed with fungal allergy with the events occurring in the workplace contributing to the disease.

The District Hearing Officer found in this case that “the claimant’s classroom flooded over Christmas break. In February, after being back at school for approximately one month the claimant began experiencing rash-like symptoms on her arms which eventually spread.” The flooding of the classroom is exactly the type of event that produces a mold event that may produce an affect on personnel. I propose that if an event occurs and both parties agree that an event such as this has occurred, then the environment is ripe for producing affects to the claimant as claimed.

However, the next paragraph in the order says that the “District Hearing Officer also relies on EMSL Analytic, Inc. report which revealed 24 CFU’s per gram of Cladosporium.” This was once again the inexpensive bulk sampling that does not follow protocols for this type of sampling as discussed in the book by the American Conference of Governmental Industrial Hygienists (ACGIH), “Bioaerosols, Assessment and Control.” Comparing the results of the bulk sampling with the Table from Attachment 1, it is obvious that the sample that was submitted was not producing the effects that the claimant was experiencing.

In this case, based on the limited amount of information presented in the Record of Proceedings, I believe that the claimant has a claim and should be compensated. However, the bulk sample should not have been taken and the results should not be relied

upon to make a decision. Comparing the 24 CFU/g of Cladosporium with the table that states that anything less than 10,000 CFU/g of fungal spores would be considered background levels, does not help her case.

Additionally, one sample should not be used to disprove a claim when an event such as flooding has occurred. If sampling is to be performed and used in evaluation of claims, the sampling must follow procedures as outlined by the ACGIH and include both air sampling and bulk sampling.



**A BRIEF GUIDE TO
MOLD,
MOISTURE,
AND
YOUR HOME**

**This Guide provides
information and guidance
for homeowners and
renters on how to clean
up residential mold
problems and how to
prevent mold growth.**

*U.S. Environmental Protection Agency
Office of Air and Radiation
Indoor Environments Division
1200 Pennsylvania Avenue
Mailcode: 6609J
Washington, DC 20460
www.epa.gov/iaq*

A BRIEF GUIDE TO MOLD, MOISTURE, AND YOUR HOME

Contents	Page
Mold Basics	
Why is mold growing in my home?	2
Can mold cause health problems?	2
How do I get rid of mold?	3
Mold Cleanup	
Who should do the cleanup?	4
Mold Cleanup Guidelines	6
What to Wear When Cleaning Moldy Areas	8
How Do I Know When the Remediation or Cleanup is Finished?	9
Moisture and Mold Prevention and Control Tips	10
Actions that will help to reduce humidity	11
Actions that will help prevent condensation	12
Testing or sampling for mold	13
Hidden Mold	14
Cleanup and Biocides	15
Additional Resources	16



MOLD BASICS

- The key to mold control is moisture control.
- If mold is a problem in your home, you should clean up the mold promptly *and* fix the water problem.
- It is important to dry water-damaged areas and items within 24-48 hours to prevent mold growth.

W

hy is mold growing in my home?

Molds are part of the natural environment. Outdoors, molds play a part in nature by breaking down dead organic matter such as fallen leaves and dead trees, but indoors, mold growth should be avoided. Molds reproduce by means of tiny spores; the spores are invisible to the naked eye and float through outdoor and indoor air. Mold may begin growing indoors when mold spores land on surfaces that are wet. There are many types of mold, and none of them will grow without water or moisture.



Mold growing outdoors on firewood. Molds come in many colors; both white and black molds are shown here.

Can mold cause health problems?

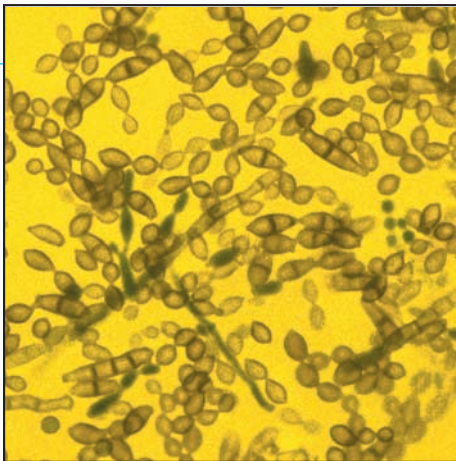
Molds are usually not a problem indoors, unless mold spores land on a wet or damp spot and begin growing. Molds have the potential to cause health problems. Molds produce allergens (substances that can cause allergic reactions), irritants, and in some cases, potentially toxic substances (mycotoxins).

Inhaling or touching mold or mold spores may cause allergic reactions in sensitive individuals. Allergic responses include hay fever-type symptoms, such as sneezing, runny nose, red eyes, and skin rash (dermatitis). Allergic reactions to mold are common. They can be immediate or delayed. Molds can also cause asthma attacks in people with asthma who are allergic to mold. In addition, mold exposure can irritate the eyes, skin, nose, throat, and lungs of both mold-

allergic and non-allergic people. Symptoms other than the allergic and irritant types are not commonly reported as a result of inhaling mold.

Research on mold and health effects is ongoing. This brochure provides a brief overview; it does not describe all potential health effects related to mold exposure. For more detailed information consult a health professional. You may also wish to consult your state or local health department.

How do I get rid of mold? It is impossible to get rid of all mold and mold spores indoors; some mold spores will be found floating through the air and in house dust. The mold spores will not grow if moisture is not present. Indoor mold growth can and should be prevented or controlled by controlling moisture indoors. If there is mold growth in your home, you must clean up the mold **and** fix the water problem. If you clean up the mold, but don't fix the water problem, then, most likely, the mold problem will come back.



Molds can gradually destroy the things they grow on. You can prevent damage to your home and furnishings, save money, and avoid potential health problems by controlling moisture and eliminating mold growth.

Magnified mold spores.

MOLD

CLEANUP



Leaky window – mold is beginning to rot the wooden frame and windowsill.

If you already have a mold problem – **ACT QUICKLY.** Mold damages what it grows on. The longer it grows, the more damage it can cause.

Who should do the cleanup? Who should do the cleanup depends on a number of factors. One consideration is the size of the mold problem. If the moldy area is less than about 10 square feet (less than roughly a 3 ft. by 3 ft. patch), in most cases, you can handle the job yourself, following the guidelines below. However:

- If there has been a lot of water damage, and/or mold growth covers more than 10 square feet, consult the U.S. Environmental Protection Agency (EPA) guide: *Mold Remediation in Schools and Commercial Buildings*. Although focused on schools and commercial

buildings, this document is applicable to other building types. It is available free by calling the EPA Indoor Air Quality Information Clearinghouse at (800) 438-4318, or on the Internet at: www.epa.gov/mold.

- If you choose to hire a contractor (or other professional service provider) to do the cleanup, make sure the contractor has experience cleaning up mold. Check references and ask the contractor to follow the recommendations in EPA's *Mold Remediation in Schools and Commercial Buildings*, the guidelines of the American Conference of Governmental Industrial Hygienists (ACGIH), or other guidelines from professional or government organizations.
- If you suspect that the heating/ventilation/air conditioning (HVAC) system may be contaminated with mold (it is part of an identified moisture problem, for instance, or there is mold near the intake to the system), consult EPA's guide *Should You Have the Air Ducts in Your Home Cleaned?* before taking further action. Do not run the HVAC system if you know or suspect that it is contaminated with mold - it could spread mold throughout the building. Visit www.epa.gov/iaq/pubs/airduct.html, or call (800) 438-4318 for a free copy.
- If the water and/or mold damage was caused by sewage or other contaminated water, then call in a professional who has experience cleaning and fixing buildings damaged by contaminated water.
- If you have health concerns, consult a health professional before starting cleanup.

MOLD CLEANUP GUIDELINES

BATHROOM TIP

Places that are often or always damp can be hard to maintain completely free of mold. If there's some mold in the shower or elsewhere in the bathroom that seems to reappear, increasing the ventilation (running a fan or opening a window) and cleaning more frequently will usually prevent mold from recurring, or at least keep the mold to a minimum.



Tips and techniques The tips and techniques presented in this section will help you clean up your mold problem. Professional cleaners or remediators may use methods not covered in this publication. Please note that mold may cause staining and cosmetic damage. It may not be possible to clean an item so that its original appearance is restored.

- Fix plumbing leaks and other water problems as soon as possible. Dry all items completely.
- Scrub mold off hard surfaces with detergent and water, and dry completely.

Mold growing on the underside of a plastic lawnchair in an area where rainwater drips through and deposits organic material.



Mold growing on a piece of ceiling tile.



- Absorbent or porous materials, such as ceiling tiles and carpet, may have to be thrown away if they become moldy. Mold can grow on or fill in the empty spaces and crevices of porous materials, so the mold may be difficult or impossible to remove completely.
- Avoid exposing yourself or others to mold (see discussions: **What to Wear When Cleaning Moldy Areas** and **Hidden Mold**.)
- Do not paint or caulk moldy surfaces. Clean up the mold and dry the surfaces before painting. Paint applied over moldy surfaces is likely to peel.
- If you are unsure about how to clean an item, or if the item is expensive or of sentimental value, you may wish to consult a specialist. Specialists in furniture repair, restoration, painting, art restoration and conservation, carpet and rug cleaning, water damage, and fire or water restoration are commonly listed in phone books. Be sure to ask for and check references. Look for specialists who are affiliated with professional organizations.

WHAT TO WEAR WHEN

CLEANING MOLDY AREAS



Mold growing on a suitcase stored in a humid basement.

It is important
to take
precautions to
**LIMIT
YOUR
EXPOSURE**
to mold and
mold spores.

- **Avoid breathing in mold or mold spores.** In order to limit your exposure to airborne mold, you may want to wear an N-95 respirator, available at many hardware stores and from companies that advertise on the Internet. (They cost about \$12 to \$25.) Some N-95 respirators resemble a paper dust mask with a nozzle on the front, others are made primarily of plastic or rubber and have removable cartridges that trap most of the mold spores from entering. In order to be effective, the respirator or mask must fit properly, so carefully follow the instructions supplied with the respirator. Please note that the Occupational Safety and Health Administration (OSHA) requires that respirators fit properly (fit testing) when used in an occupational setting; consult OSHA for more information (800-321-OSHA or osha.gov/).

■ **Wear gloves.** Long gloves that extend to the middle of the forearm are recommended. When working with water and a mild detergent, ordinary household rubber gloves may be used. If you are using a disinfectant, a biocide such as chlorine bleach, or a strong cleaning solution, you should select gloves made from natural rubber, neoprene, nitrile, polyurethane, or PVC (see **Cleanup and Biocides**). Avoid touching mold or moldy items with your bare hands.

■ **Wear goggles.** Goggles that do not have ventilation holes are recommended. Avoid getting mold or mold spores in your eyes.



Cleaning while wearing N-95 respirator, gloves, and goggles.

How do I know when the remediation or cleanup is finished?

You must have completely fixed the water or moisture problem before the cleanup or remediation can be considered finished.

- You should have completed mold removal. Visible mold and moldy odors should not be present. Please note that mold may cause staining and cosmetic damage.
- You should have revisited the site(s) shortly after cleanup and it should show no signs of water damage or mold growth.
- People should have been able to occupy or re-occupy the area without health complaints or physical symptoms.
- Ultimately, this is a judgment call; there is no easy answer. If you have concerns or questions call the EPA Indoor Air Quality Information Clearinghouse at (800) 438-4318.

MOISTURE AND MOLD PREVENTION AND CONTROL TIPS

MOISTURE Control is the Key to Mold Control



Mold growing on the surface of a unit ventilator.

- When water leaks or spills occur indoors - **ACT QUICKLY.** If wet or damp materials or areas are dried 24-48 hours after a leak or spill happens, in most cases mold will not grow.

- Clean and repair roof gutters regularly.
- Make sure the ground slopes away from the building foundation, so that water does not enter or collect around the foundation.
- Keep air conditioning drip pans clean and the drain lines unobstructed and flowing properly.



Condensation on the inside of a windowpane.

- Keep indoor humidity low. If possible, keep indoor humidity below 60 percent (ideally between 30 and 50 percent) relative humidity. Relative humidity can be measured with a moisture or humidity meter, a small, inexpensive (\$10-\$50) instrument available at many hardware stores.

- If you see condensation or moisture collecting on windows, walls or pipes - ACT QUICKLY to dry the wet surface and reduce the moisture/water source. Condensation can be a sign of high humidity.

Actions that will help to reduce humidity:

- 💧 Vent appliances that produce moisture, such as clothes dryers, stoves, and kerosene heaters to the outside where possible. (Combustion appliances such as stoves and kerosene heaters produce water vapor and will increase the humidity unless vented to the outside.)
- 💧 Use air conditioners and/or de-humidifiers when needed.
- 💧 Run the bathroom fan or open the window when showering. Use exhaust fans or open windows whenever cooking, running the dishwasher or dishwashing, etc.

Actions that will help prevent condensation:

- ◆ Reduce the humidity (see preceding page).
- ◆ Increase ventilation or air movement by opening doors and/or windows, when practical. Use fans as needed.
- ◆ Cover cold surfaces, such as cold water pipes, with insulation.
- ◆ Increase air temperature.

Mold growing on a wooden headboard in a room with high humidity.



Renters: Report all plumbing leaks and moisture problems immediately to your building owner, manager, or superintendent. In cases where persistent water problems are not addressed, you may want to contact local, state, or federal health or housing authorities.



Rust is an indicator that condensation occurs on this drainpipe. The pipe should be insulated to prevent condensation.

Testing or sampling for mold Is sampling for mold needed? **In most cases, if visible mold growth is present, sampling is unnecessary.** Since no EPA or other federal limits have been set for mold or mold spores, sampling cannot be used to check a building's compliance with federal mold standards. Surface sampling may be useful to determine if an

area has been adequately cleaned or remediated. Sampling for mold should be conducted by professionals who have specific experience in designing mold sampling protocols, sampling methods, and interpreting results. Sample analysis should follow analytical methods recommended by the American Industrial Hygiene Association (AIHA), the American Conference of Governmental Industrial Hygienists (ACGIH), or other professional organizations.

HIDDEN MOLD



Mold growing on the back side of wallpaper.

Suspicion of hidden mold You may suspect hidden mold if a building smells moldy, but you cannot see the source, or if you know there has been water damage and residents are reporting health problems. Mold may be hidden in places such as the back side of dry wall, wallpaper, or paneling, the top side of ceiling tiles, the underside of carpets and pads, etc. Other possible locations of hidden mold include areas inside walls around pipes (with leaking or condensing pipes), the surface of walls behind furniture (where condensation forms), inside ductwork, and in roof materials above ceiling tiles (due to roof leaks or insufficient insulation).

Investigating hidden mold problems Investigating hidden mold problems may be difficult and will require caution when the investigation involves disturbing potential sites of mold growth. For example, removal of wallpaper can lead to a massive release of spores if there is mold growing on the underside of the paper. If you believe that you may have a hidden mold problem, consider hiring an experienced professional.

Cleanup and Biocides Biocides are substances that can destroy living organisms. The use of a chemical or biocide that kills organisms such as mold (chlorine bleach, for example) is not recommended as a routine practice during mold cleanup. There may be instances, however, when professional judgment may indicate its use (for example, when immune-compromised individuals are present). In most cases, it is not possible or desirable to sterilize an area; a background level of mold spores will remain - these spores will not grow if the moisture problem has been resolved. If you choose to use disinfectants or biocides, always ventilate the area and exhaust the air to the outdoors. Never mix chlorine bleach solution with other cleaning solutions or detergents that contain ammonia because toxic fumes could be produced.

Please note: Dead mold may still cause allergic reactions in some people, so it is not enough to simply kill the mold, it must also be removed.

Water stain on a basement wall — locate and fix the source of the water promptly.



ADDITIONAL RESOURCES

For more information on mold related issues including mold cleanup and moisture control/condensation/humidity issues, you can call the EPA Indoor Air Quality Information Clearinghouse at

(800) 438-4318.

Or visit:

www.epa.gov/mold



Mold growing on fallen leaves.

This document is available on the Environmental Protection Agency, Indoor Environments Division website at: www.epa.gov/mold

NOTES

Acknowledgements

EPA would like to thank Paul Ellringer, PE, CIH, for providing the photo on page 14.

Please note that this document presents recommendations. EPA does not regulate mold or mold spores in indoor air.



Assessment and Sampling Approaches for Indoor Microbiological Assessments

by Geoffrey A. Clark

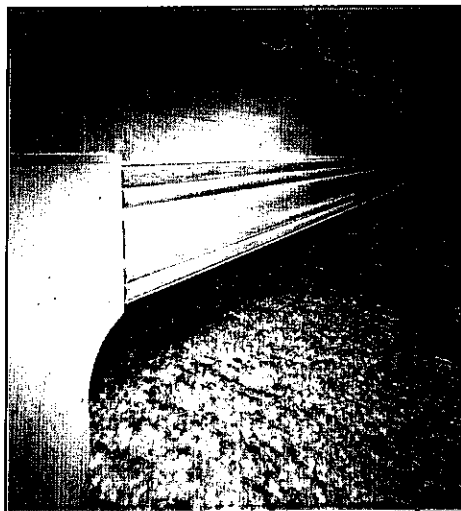
Editor's note: This article is based on the presentations at the AIHce 2001 forum bearing the same title as above.

Microbiological contamination has become a major part of the indoor air quality assessment. There is no standard protocol or approach for indoor microbiological assessment and sampling, whether air, surface, bulk or dust. In addition, microbiological contamination may include bacteria, fungi and their byproducts, such as endotoxins, mycotoxins and glucan.

Michael Crandall, M.S. Crandall Group Inc., said it is very important to evaluate the effects of both bacteria and fungi when assessing health effects in water-damaged buildings. However, of the two, culturable bacteria data can be difficult to interpret. Direct measurement of endotoxin, which is an integral part of the bacterial cell wall, makes evaluation of the influence of these organisms on human health much easier.

Worker exposure to endotoxin levels high enough to cause respiratory system and pulmonary symptoms has been shown in a number of industrial occupations including cotton processing, animal handling and farming, grain handling and use of metalworking fluids. Some threshold levels have already been demonstrated, such as 1,000 to 2,000 endotoxin units per cubic meter (EU/m³) for a decrease in forced expiratory volume and 5,000 to 10,000 EU/m³ (1 EU = 0.1 ng of endotoxin) for fever. In contrast, 90 to 1,800 EU/m³ has been considered a "no effect" range. Outdoor measurements of endotoxin range between 0.04 and 4 EU/m³.

Endotoxin in air can be measured using a 37 mm 0.45 µm endotoxin-free polycarbonate filter, and the volume collected should be approximately 1000 liters of air. The samples are analyzed using a LAL assay (a number of laboratories now offer this service). Crandall found that the con-



centration of airborne endotoxin in "problem" buildings is elevated in comparison to nonproblem buildings or outdoors; however, the levels were less than the reported "no effect" range. He cautioned that studies showing a relationship between chronic lower-level exposure to endotoxin and health symptoms are lacking and that numbers from occupational environments, with healthy workers, may not apply to commercial or residential buildings.

Since carpet is a potential reservoir, amplifier and disseminator of fungal spores in buildings, Mark Hodgson, Clayton Group Services Inc., suggested that carpet dust samples may be a more reliable assessment of overall building condition than air samples, which have the potential to provide false negative results. His data set included information from studies conducted across many regions of the United States on a range of residential, commercial and institutional complainant and control buildings with a range of different moisture problems, including major disaster events.

Hodgson proposed 100,000 colony-forming units per gram (CFU/g) as a possible numerical limit. Nonproblem buildings showed fungal spore concentrations in dust ranging from 103 to 108 CFU/g (the median was about 200,000 CFU/g). In contrast, the level in nonproblem buildings was much lower (103 to 105 CFU/g). He also pointed out that dust is never "spore-free" and that certain fungal taxa are normally present in carpeting. The use of settled dust sampling provides a useful tool in aiding assessment of the microbial

condition of a building as well as providing information on the need to replace or clean damaged carpeting materials.

John Tiffany, Tiffany-Bader Environmental Inc., presented information on the use of spore trap air samples for screening and final clearance sampling on microbial abatement projects. Environmental consultants should use three parameters when clearing a fungal remediation project—visual assessment, air sampling results and surface sampling results. Spore trap sampling has an advantage over culturable sampling in that it will reveal both viable and nonviable spores, is less expensive and has a quicker turnaround time. However, in Tiffany's experience, not all the "positive" spore trap data agree with the culturable results (and vice versa); spore trap sampling is a useful tool but should not be used as a sole source for determining final clearance.

Brad Prezant, Prezant & Associates Inc., advised that contents, including furnishings and carpeting, of water-damaged buildings can become wet and serve as substrates for mold growth. Additionally, migration of spores into occupied areas from mold hidden in wall cavities occurs in such buildings. Such content items, if porous, can accumulate spores and release them at a later time, creating potential occupant exposures. Both porous and nonporous content items can be cleaned and evaluated for residual contamination. Successful cleaning techniques have included dry-cleaning (for clothing, bedding and linens), HEPA vacuuming (for all surfaces, including carpeting and upholstered furniture) and wet-wiping (for nonporous surfaces). A combination of wet-wiping and HEPA vacuuming is one of the most widely used techniques.

As far as developing exposure limits for fungal spores is concerned, Geoffrey Clark, Pacific Environmental Consulting Inc., said there are pros and cons for doing so. To determine the potential for worker or occupant exposure to hazardous materials, occupational hygienists have traditionally used published or regulated exposure limits. Examples used throughout North America include the ACGIH TLVs®, OSHA OELs and various limits mandated by local workers' compensation boards. However, fungal spore exposure determination is problematic due to the number of potential species (more than 100,000 at present), the variability of measurements

TECHNICAL EXCHANGE

and differences in the sensitivity of individuals.

To date, worker exposure to fungal spores has been measured in a variety of industrial environments including grain terminals, refuse incinerators and whole-glass recycling facilities, in concentrations exceeding 300,000 spores/m³. Water-damaged residences have also shown ele-

vated spore counts, ranging from less than 1,000 spores/m³ to more than 200,000 spores/m³, before any remediation. Abatement workers are exposed to even higher concentrations—in the millions of spores/m³.

Over the past few years, hygienists have collectively gathered a significant amount of exposure information from air, dust and

surface samples during both investigative studies and abatement projects. Using numbers adapted from a variety of sources, including peer-reviewed publications, courses and seminars presented by other consultants and individual investigations, Clark presented the set of proposed numerical guidelines for fungal spores as shown in Table 1.

Table 1 – Proposed Guidelines for Fungal Spores

Type	Normal Background *	Possible Contamination Source	Probable Contamination Source
Air Samples from Residential Buildings	< 5,000 spores/m ³ < 500 cfu/m ³	5,000–10,000 spores/m ³ 500–1,000 cfu/m ³	> 10,000 spores/m ³ > 1,000 cfu/m ³
Air Samples from Commercial Buildings	< 2,500 spores/m ³ < 250 cfu/m ³	2,500–10,000 spores/m ³ 250–1,000 cfu/m ³	> 10,000 spores/m ³ > 1,000 cfu/m ³
Dust Samples	< 100,000 spores/g < 10,000 cfu/g < 50,000 mycelial frags/g	100,000–1,000,000 spores/g > 10,000–100,000 cfu/g 50,000–100,000 mycelial frags/g	1,000,000 spores/g > 100,000 cfu/g > 100,000 mycelial frags/g
Bulk Samples	< 100,000 spores/g < 10,000 cfu/g < 50,000 mycelial frags/g	100,000–1,000,000 spores/g 10,000–100,000 cfu/g 50,000–100,000 mycelial frags/g	> 1,000,000 spores/g > 100,000 cfu/g > 100,000 mycelial frags/g
Swab Samples	< 10,000 cfu/in ² < 1,500 cfu/cm ²		> 10,000 cfu/in ² > 1,500 cfu/cm ²
Tape Samples	NSFM or NSFB ** 1–5%	5–25%	25–100%

* Types and relative proportions of fungal spores should be similar to outdoors.

** NSFM = no significant fungal material; NSFB = no significant fungal biomass

These guidelines were developed for the purpose of addressing concerns regarding fungal assessments and abatement and would not necessarily apply to health effects. In addition, they should not be used as the only means of decisionmaking in the remediation of fungal contamination.

Clark is with PE Services, Houston.

Technical Exchange is a feature offering a forum to discuss real-life experiences in technical areas. These experiences are informational and are not peer reviewed; however, submissions are reviewed for technical accuracy. They are intended to help IHs share information for the benefit of all industrial hygiene professionals.

Readers are encouraged to submit summaries of case studies, new technology, problem-solving and other experiences they may encounter through the course of their work. Send submissions to Terry Hoskins, The Synergist, 2700 Prosperity Ave., #250, Fairfax, VA 22031; fax (703) 207-3561; thoskins@aiha.org. Submissions will be edited for space and clarity.

Additional Resources for Mold

Web Sites

General Information

Aerias: <http://www.aerias.org>

Aerotech Labs – InfoBase: <http://www.aerotechlabs.com/Aero>

American Industrial Hygiene Association (AIHA)—Mold Resources:
<http://www.aiha.org/GovernmentAffairs-PR/html/prmoldsources.htm>

Building Science Corporation: <http://www.buildingscience.com/>

California Indoor Air Quality Program: <http://www.cal-iaq.org/iaqsheet.htm#Mold>

Canadian Center for Occupational Health and Safety:
http://www.ccohs.ca/oshanswers/biol_hazards/iaq_mold.html

Centers for Disease Control and Prevention, Mold: <http://www.cdc.gov/nceh/airpollution/mold/>

Education Safety Association of Ontario – IAQ: <http://www.esao.on.ca/scriptcontent/index.cfm>

Environmental Microbiology Laboratory, Inc.: <http://www.emlab.com>

Environmental Protection Agency (EPA), U.S.:
Sources of Indoor Air Pollution - Biological Pollutants <http://www.epa.gov/iaq/biologic.html>
Indoor Air Quality Building Education and Assessment Model (I-BEAM) Software
http://www.epa.gov/iaq/largebldgs/ibeam_page.htm

Federal Emergency Management Agency (FEMA): <http://www.fema.gov/>

Fungi.ca: <http://www.fungi.ca/moulds.htm>

Georgetown University:
Mold Medicine & Mold Science: Its Practical Applications for Patient Care, Remediation & Claims May
13-14, 2002, Georgetown University Convention Center, Washington, D.C.
<http://phys4.harvard.edu/~wilson/soundscience/mold/mold.html>

Health Departments, State and Local: http://www.apha.org/public_health/state.htm

National Association of Realtors "Field Guide to Mold and Health Issues:"
<http://www.realtors.org/libweb.nsf/pages/fg711>

New York Committee for Occupational Safety and Health: <http://www.nycosh.org/moldfacts.html>
<http://www.nycosh.org/linktopics/indoorair.html>

Occupational Health and Safety Administration (OSHA):
<http://www.osha-slc.gov/SLTC/indoorairquality/>
<http://www.osha.gov/dts/shib/shib101003.html>

Texas Dept. of Health, Links to Web Sites about Mold Growth in Buildings:
<http://www.tdh.state.tx.us/beh/IAQ/MoldLinks.htm>

University of Minnesota: <http://www.dehs.umn.edu/iaq/>

Antimicrobials

Antimicrobial Pesticides, U.S. EPA: <http://www.epa.gov/oppad001/>

Construction and Renovation

American Society of Heating, Refrigerating and Air-Conditioning Engineers: <http://www.ashrae.org>

National Air Duct Cleaners Association: <http://www.nadca.com>

"General Specifications for the Cleaning of Commercial Heating, Ventilating and Air Conditioning Systems:" <http://www.nadca.com/standards/standards.asp>

Fungal Biology

Airborne Pathogen Database, Penn State University:
<http://www.bio.psu.edu/groups/apdbase/fungus.html>

Introduction to Fungal Biology, University of Sydney, School of Biological Sciences:
<http://bugs.bio.usyd.edu.au/Mycology/contents.shtml>

Moulds: Isolation, Cultivation, Identification, University of Toronto, Dept. of Botany:
<http://www.botany.utoronto.ca/ResearchLabs/MallochLab/Malloch/Moulds/Moulds.html>

Guidelines

American College of Occupational and Environmental Medicine (ACOEM):
<http://www.acoem.org/guidelines/article.asp?ID=52>

Health Canada:
"Fungal Contamination in Public Buildings: A Guide to Recognition and Management" http://www.hc-sc.gc.ca/hecs-sesc/air_quality/pdf/fungal.pdf

New York City Department of Health: <http://www.ci.nyc.ny.us/html/doh/html/epi/moldrpt1.html>

Insurance

Environmental Risk Resources Association: <http://www.erraonline.org/default.htm>

"Mold and Minnesota homeowner insurance": Statement of Minnesota Commerce Commissioner Jim Bernstein: <http://www.commerce.state.mn.us/pages/NewsReleases/Releases2002/News020719.htm>

Laboratories

AIHA Accredited Labs: <http://www.aiha.org/LaboratoryServices/html/lists.htm>

Aerotech Labs: <http://www.aerotechlabs.com/Aero/>

Environmental Microbiology Laboratory, Inc.: <http://www.emlab.com>

Forensic Analytical: <http://www.forensica.com>

Legal

See Georgetown University on first page of resource list.

Poole & Shaffery, LLP: <http://www.pooleshaffery.com>

Legislation

United States, Toxic Mold Safety and Protection Act: http://www.house.gov/conyers/Mold_Bill.pdf

California's Toxic Mold Protection Act of 2001:

http://www.leginfo.ca.gov/cgi-bin/postquery?bill_number=sb_732&sess=PREV&house=B&author=ortiz

<http://www.cal-iaq.org/SB732update.htm>

Medical

American Academy of Allergy Asthma and Immunology: <http://www.aaaai.org>

American Lung Association: <http://www.lungusa.org/air/envindoorap.html>

DoctorFungus: <http://www.doctorfungus.com>

Mayo Clinic: <http://www.mayoclinic.com>

MedlinePlus: <http://www.nlm.nih.gov/medlineplus/molds.html>

Institute of Medicine, National Academy of Sciences (<http://www.iom.edu/>):

"Clearing the Air: Asthma and Indoor Air Exposures"

<http://books.nap.edu/books/0309064961/html/index.html>

Damp Indoor Spaces and Health

<http://www.nap.edu/catalog/11011.html>

National Institute of Allergy and Infectious Diseases, National Institutes of Health

<http://www.niaid.nih.gov/default.htm>

Miscellaneous

California Department of Health Services:

"Bioaerosols and Green-Waste Composting in California"

<http://www.dhs.cahwnet.gov/org/ps/deodc/ehib/EHIB2/topics/compostbioaerosols.doc>

"Stachybotrys chartarum: The Toxic Indoor Mold." See also links at this page:

<http://www.apsnet.org/online/feature/stachybotrys/>

Remediation

"Fact Sheet: Flood Cleanup - Avoiding Indoor Air Quality Problems:"

<http://www.epa.gov/iaq/pubs/flood.html>

"Mold Remediation in Schools and Commercial Buildings:"

http://www.epa.gov/iaq/molds/mold_remediation.html

Residential

"A Brief Guide to Mold, Moisture, and Your Home:" <http://www.epa.gov/iaq/molds/images/moldguide.pdf>

Duct Cleaning:

"Should You Have the Air Ducts in Your Home Cleaned?" <http://www.epa.gov/iaq/pubs/airduct.html>

Environmental Health Watch Home Moisture Audit:

http://www.ehw.org/Healthy_House/HH_Moist_Audit.htm

Fighting Mold? The Homeowners' Guide:

http://www.cmhc-schl.gc.ca/en/burema/gesein/abhose/abhose_ce08.cfm

Sampling Equipment

Aerotech Laboratories, Inc.: <http://www.aerotechlabs.com>

SKC, Inc. Bioaerosol and Biological Samplers: <http://www.skcinc.com/bioaerosol.asp>

Wood Products

Forest Products Laboratory, U.S. Department of Agriculture:

<http://www.fpl.fs.fed.us/documnts/FPLGTR/fplgtr113/fplgtr113.htm>

Western Wood Products Association: http://www.wwpa.org/index_lumberandmold.htm

Books, Reports, and Pamphlets

Bioaerosols: Assessment and Control, Janet Macher, editor, ACGIH, 1999.

AIHA Biosafety Committee, *Environmental Mold: State of the Science, State of the Art*, AIHA Press, 2003.

IICRC Standard and Reference Guide for Professional Mold Remediation S520, 1st ed., Institute of Inspection, Cleaning and Restoration Certification, 2003.

IICRC Standard and Reference Guide for Professional Water Damage Restoration, 2nd ed., Institute of Inspection, Cleaning and Restoration Certification, 1999.

Indoor Environmental Standards Organization, *Standards of Practice for the Assessment of Indoor Environmental Quality, vol. 1: Mold Sampling; Assessment of Mold Contamination*, IESO, 2002.

American Industrial Hygiene Association, *Report of the Microbial Growth Task Force*, AIHA Press, 2001.

American Industrial Hygiene Association, *The Facts About Mold*, AIHA, 2003.

Articles

Armstrong, Sarah and Jane Liaw, "The Fundamentals of Fungi," *ASHRAE Journal*, November 2002, 18-22.

"Controversy Surrounding Environmental Mold Exposure—Current Scientific Knowledge and Future Directions for Investigational Studies," *OEM Report*, December 2002, 89-96.

Copley, Michael F., "Can the Inspection Leg of the Construction Industry Help Prevent Mold in the Future?," *Code News*, May/June 2003, 29-31.

Fung, Frederick, "Health Effects of Indoor Fungal Bioaerosol Exposure," *Applied Occupational and Environmental Hygiene*, 18:535-544, July 2003.

- Fung, Frederick, "Health Effects of Indoor Fungal Exposure," *IAQ Applications*, Winter 2004, 13-14.
- Glaser, G., "Doctors Rethinking Treatments for Sick Sinuses," *New York Times*, December 17, 2002.
- Lstiburek, Joseph, "Investigating & Diagnosing Moisture Problems," *ASHRAE Journal*, December 2002, 36-41.
- Mahoney, Daniel P. and Jerome E. Spear, "Mold Risk Assessment & Remediation," *Professional Safety*, August 2003, 20-26.
- Miller, Vincent, "Understanding Mycotoxin Testing and Interpretation," *Occupational Hazards*, May 2003, 49-52.
- Norred, William P., "Agriculturally Important Fungal Toxins," *Chemical Health & Safety*, July/August 2000, 22-25.
- Page, Elena H. and Douglas B. Trout, "The Role of *Stachybotrys* Mycotoxins in Building-Related Illness," *AIHA Journal*, 62:644-648, 2001.
- Pinto, Michael A., "A Reasoned Approach to Mold Contamination," *Professional Safety*, March 2004, 46-48.
- Van Loo, Jason M., et al., "Growth of Mold on Fiberglass Insulation Building Materials—A Review of the Literature," *Journal of Occupational and Environmental Hygiene*, 1:349-354, June 2004.
- Wilson, S.C., et al., "An Investigation into Techniques for Cleaning Mold-Contaminated Home Contents," *Journal of Occupational and Environmental Hygiene*, 1:442-447, July 2004.

Magazines

ASHRAE IAQ Applications, ASHRAE (www.ashrae.org).

Many of the above materials are available through the BWC Division of Safety & Hygiene Libraries. Call 800-644-6292 or e-mail library@bwc.state.oh.us.

Saving You Time and Research

Requests for copies of OSHA standards, information on starting a safety committee, a video on accident investigation techniques -- these are some of the thousands of inquiries BWC's Division of Safety & Hygiene (DSH) libraries receive each year.

DSH has two libraries to serve you:

- The central library in the William Green Building in downtown Columbus;
- The resource center and video library located at the Ohio Center for Occupational Safety and Health (OCOSH) in Pickerington.

Both libraries are open 8 a.m. to 4:45 p.m., Monday through Friday. Your need for information does not require a visit to the library. You can phone, fax, or e-mail your requests and receive a quick response.

The central library provides free information services on the topics of occupational safety and health, workers' compensation and rehabilitation.

The OCOSH resource center provides similar services for those who visit OCOSH for meetings and training center classes.

The video library offers an extensive collection of videotapes to supplement your organization's safety and health training program. It is a convenient and popular source for Ohio employers to borrow quality occupational safety- and health-related training aids.

Visit our Web site at **www.ohiobwc.com**.

Central Library
30 W. Spring St., Third Floor
Columbus OH 43215-2256
1-800-OHIOBWC
(614) 466-7388
(614) 644-9634 (fax)
library@bwc.state.oh.us

OCOSH Resource Center
13430 Yarmouth Drive
Pickerington OH 43147
1-800-OHIOBWC
Resource center (614) 728-6464
Video library (614) 644-0018

Resources Available from the Division of Safety & Hygiene (DSH) Libraries

(800) 644-6292 (614) 466-7388

library@bwc.state.oh.us

www.ohiobwc.com

Safety training:

- Safety talks, outlines and scripts - DSH Safety leader's discussion guide, Training Center's One-hour safety presentations, reference books, web resources
- Videos – hundreds of safety and health topics
- Books and articles on training techniques

Machine and equipment safety:

- Safety standards (ANSI, NFPA, CGA)
- Books and articles on power presses, material handling equipment, lockout/tagout, etc.

Sample written programs:

- DSH program profiles and sample written programs
- Reference books
- Internet resources

Illness and injury statistics:

- Statistics from the U.S. Bureau of Labor Statistics
- National Safety Council's *Injury Facts*
- National Institute of Occupational Safety & Health (NIOSH) studies

Hazard communication and chemical safety:

- Chemical safety information
- Material safety data sheets (MSDSs)
- Sample written programs
- Videos
- Internet resources

Safety standards

- American National Standards Institute (ANSI) standards (including standards for construction, machinery and equipment, personal protective equipment)
- National Fire Protection Association (NFPA) fire codes (including the Life Safety Code and the National Electrical Code)
- Compressed Gas Association (CGA) standards

Other topics of interest (books, articles, magazines, videos and standards):

- Confined spaces
- Electrical safety
- Job safety analysis
- New employee orientation
- Powered industrial trucks
- Respiratory protection
- Safety culture
- Scaffolds

Directories and lists of vendors of safety equipment

Occupational Safety & Health Administration (OSHA) regulations

Manual of Uniform Traffic Control Devices (MUTCD)

Recommendations of useful Internet sites

BWC publications