# Mold and Other Indoor Air Quality Concerns



## Ohio

### Bureau of Workers' Compensation

Division of Safety & Hygiene Training Center

## Mold and Other Indoor Air Quality Concerns

<u>Tab</u>	<u>Topic</u>
1	Introduction to Mold
2	Mold Remediation
3	Indoor Air Quality Guidelines
4	Ventilation
5	Chemical Contaminants
6	Exercises
7	Resources

## Mold and Other Indoor Air Quality Concerns

### Objectives

#### You will learn:

- The potential sources of indoor air quality problems and potential health effects;
- Moisture and its effects on buildings;
- o Potential sources of moisture in a building;
- o Scientific findings on mold's health effects;
- Basic heating, ventilation, and air conditioning systems as they relate to IAQ;
- Practical hands-on applications of IAQ recognition, evaluation and control techniques.

#### After this course, you will be able to:

- Recognize what causes mold in a building;
- Explain the impact mold can have on the health of humans and buildings;
- o Apply techniques to maintain good indoor air quality;
- Summarize legislative strategies of different states to prevent/mitigate mold related issues;
- List potential sources of poor indoor air quality.

#### What are your objectives/expectations?

## Mold and Other Indoor Air Quality Concerns

### Agenda

<u>8:30 a.m. - noon</u>

- General Information
  - Emergency procedures
  - DSH services
  - o Objectives
  - Assessment method
- Introduction to Mold
  - Mold basics and costs
  - o Health effects
  - o Building related illnesses
  - o Legal Strategies
- Mold and Moisture Inspection
- Moisture and Mold Remediation
- <u>12 1 p.m.</u> - Lunch

### <u>1 – 4 p.m.</u>

- Indoor Air Quality Introduction
  - Laws and Standards
    - ASHRAE
    - OSHA technical manual
    - EPA
  - o LEED Criteria
- Ventilation and HVAC concerns
- Contaminants
  - <u>o</u> CO
  - o VOCs
  - o Particulate
  - o Formaldehyde
- <u>4 4:30 p.m.</u> Wrap-up
  - - Review content
    - Q & A
    - o Complete assessment sheets
    - o Complete evaluations sheet
    - o Dismiss

## BWC office locations

#### Ohio Center for Occupational Safety & Health (OCOSH)

13430 Yarmouth Drive Pickerington, OH 43147 1-800-OHIO BWC (Follow the prompts) (614) 995-8622 <u>Safety@bwc.state.oh.us</u>

#### Cambridge

61501 Southgate Road Cambridge, OH 43725 (740) 435-4210

#### Canton

400 Third St. S.E. Canton, OH 44701-4801 (330) 471-0937

#### Cleveland

615 W. Superior Ave. 6th Floor Cleveland, OH 44113 (216) 787-3060

#### Columbus

30 W. Spring St. 11th Floor Columbus, OH 43215 (614) 752-4538

#### Dayton

3401 Park Center Drive Dayton, OH 45414 (800-962-7768 (937) 264-5230

#### **Garfield Heights**

4800 E. 131<sup>st</sup> St.,Ste. A Garfield Heights, OH 44105 (216) 584-0115

#### Governor's Hill

8650 Governor's Hill Dr. 4th Floor Cincinnati, OH 45249 (513) 583-4403

#### Hamilton

One Renaissance Center 345 High St., 6th Floor Hamilton, OH 45011 (513) 785-4510

#### Lima

2025 E. Fourth St. Lima, OH 45804 (419) 227-4116

#### Logan

1225 W. Hunter St. Logan, OH 43138 (740) 385-9848

#### Mansfield

240 Tappan Drive N. Mansfield, OH 44906 (419) 529-4528

#### Portsmouth

1005 Fourth St. Portsmouth, OH 45662 (740) 353-3419

#### Toledo

1 Government Center 11th Floor Toledo, OH 43604 (419) 245-2474

#### Youngstown

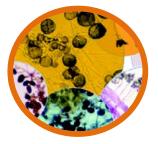
242 Federal Plaza W. Suite 200 Youngstown, OH 44503 (330) 797-5010

INTRODUCTION TO MOLD

### Ohio Bureau of Workers'

### Mold and Other Indoor Air Quality Concerns

The Ohio Division of Safety and Hygiene



(EPA photo courtesy of Chin Yang, Ph.D.)

#### Instructors

#### Tim Fiorilli, Industrial Hygienist Garfield Heights Service Office (216)-308-9378

 Jim Scholl, Industrial Hygienist Columbus Service Office (614)-562-5573

#### Agenda and class length

:00

- o General information
- o Introduction to mold
- Health effects
- Mold and moisture inspection
- Mold remediation
- Introduction to indoor air quality (IAQ)

Afternoon: 1:00 - 4:30

- Heating, ventilation, and air conditioning basics
- o Chemical contaminants

#### **Non-endorsement policy**

Mention of any commercial service or product in this presentation does not imply endorsement by the Ohio Division of Safety and Hygiene.

#### **Requirements for** successful completion

- o Students must complete the sign-in sheet.
- Students must be present in class 90% of the time that the class is in session.

#### Learning outcomes

#### You will learn:

- The potential sources of indoor air quality problems and potential health effects;
- o Moisture and its effect on buildings;
- o Potential sources of moisture in a building;
- o Basic heating, ventilation, and air
- conditioning (HVAC) systems as they relate to indoor air quality (IAQ).

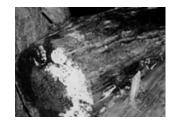
#### Learning outcomes

#### After this course, you will be able to:

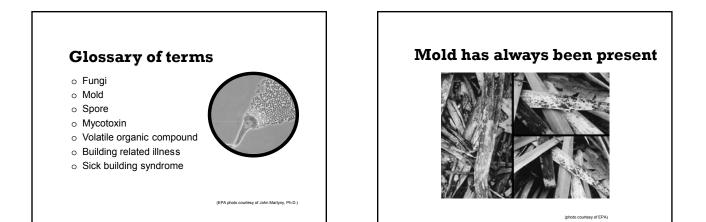
- Recognize what causes mold in a building;
- Explain the impact mold can have on the health of humans and buildings;
- Summarize legislative strategies to prevent and/or mitigate mold-related issues;
- o List potential sources of poor indoor air quality;
- o Apply techniques to maintain good IAQ.

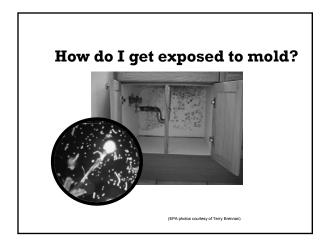
Section 1

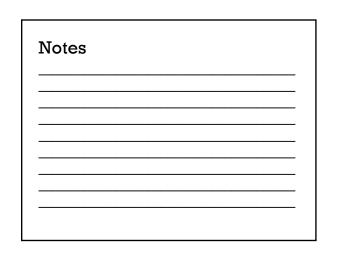
General information Legislative strategies Health effects What is mold and where is it found?



(photo courtesy of EPA)







#### What does mold need to grow?

- $_{\rm O}$  Spore source
- o Food (organic
- material) • Constant temperature (40-100 degrees fahrenheit)



 Water or humidity greater than 60%



### What can we control?



(photo courtesy of EPA)

## How do I tell if I have a mold problem?

- o Investigate, don't sample
- Use your eyes to look for mold growth
- Use your nose to locate the source of a suspicious odor
- Look for signs of excess moisture
- Worsening of allergy-like symptoms



(EPA photo courtesy of Terry Brennan)

#### What drives the clean-up cost?

- o The total area of the contamination.
- $\circ~$  The type of material supporting the
- mold growth (easily cleanable?)
- $\circ~$  Location (ductwork, behind walls)
- $\circ~$  Cost of setting up a containment area.

## Why are there no exposure limits for mold?

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.

#### Notes

#### What strategies have legislatures used to deal with this problem?

- o Create a task force
- o Develop mold remediation guidelines
- o License businesses engaged in mold assessment and remediation
- Provide for disclosure statements on insurance policies and real estate transactions
- o Provide protection for architects, contractors, and builders
- Prevent mold/water damage in schools
- o Provide consumer protection
- o Develop preventative maintenance programs

#### Indoor air quality 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 And 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 and commercial buildings
- 2003 IICRC S520 Stds. & Ref. Guide for Prof. Mold Rem.
- 2004 AIHA "Asses, Rem and Post-Rem Verification of Mold in Bldgs.

**Health Effects of Mold** 

#### Symptoms

Signs problems may exist include excessive reporting by building occupants of one or more of the symptoms listed below.

#### o Headache

- Lethargy
- o Tight chest
- Fatigue
- o Wheezing
- o Congestion
- o Dizziness
- o Burning eyes
- o Watery eyes
- o Sinus difficulty
- o Flu-like symptoms

#### How can mold affect your health?

- o Allergies
- o Infection
- o Irritation
- o Toxicity

#### Notes

#### 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% suffer from 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

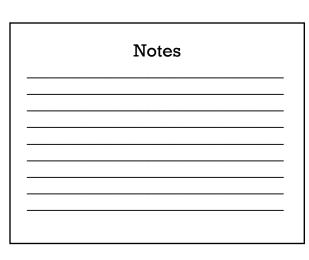
#### Irritation

- $\circ~$  From the volatile organic compounds (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

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



Section 2

#### Inspecting for Moisture and Mold

### Review: What does mold need to grow?

- Spore source
- Food (organic material)
- Constant temperature
- (40-100 degrees fahrenheit)
- Water or humidity greater than 60%



(EPA photo courtesy of Terry Brennan)

### Mold growth may not be obvious

This photo was taken in a bedroom closet

There was a hole in the insulation and it is cold outdoors, so what caused this problem?

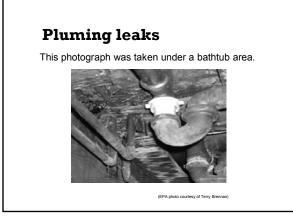


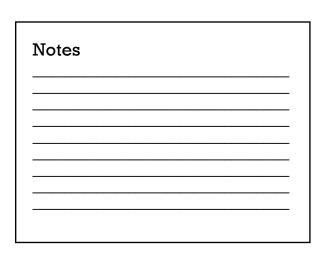
#### Water infiltration

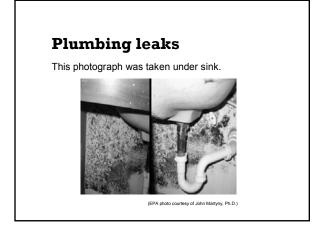
Water in the ground has seeped through the concrete walls of the basement, leaving white mineral deposits on the walls. The water evaporated, creating humidity.

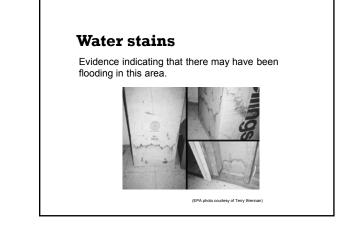


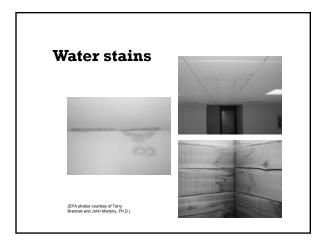
(EPA photo courtesy of John Martyny, Ph.D.)

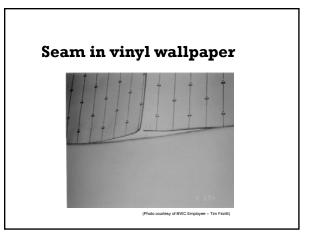


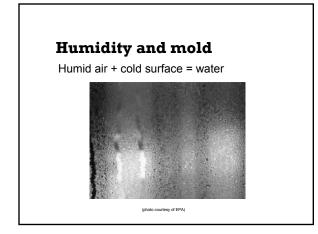


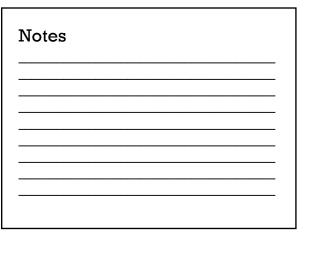












#### Humidity and spore release

#### Dry spores

- High periods between 10:00 am 3:00 pm
- o Release by desiccation

#### Slimy spores

- High periods between midnight 3:00 am
- Release by bursting

#### Humidity and spore release

Building engineers look for water pathways

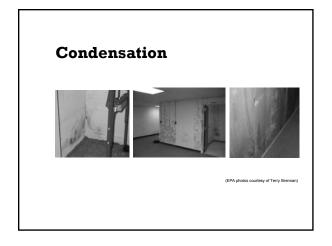
- If more water and dust is present usually equates to more mold growth
- Settled dust testing may be a good indicator
- Exposure pathway, may be settled dust
- Univents that are turned on and off can be good distributors of mold
- o Drywall can act like sponge

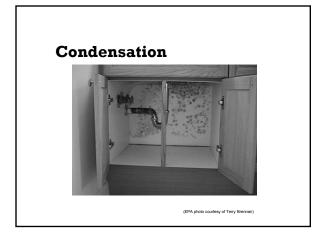
(Morey, Yang, Miller, Tiffnany; AIHCE-2000)

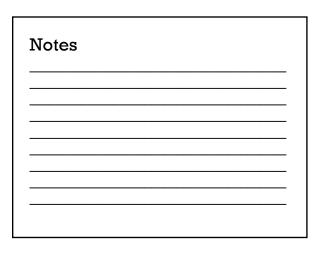
#### Free water in/on building

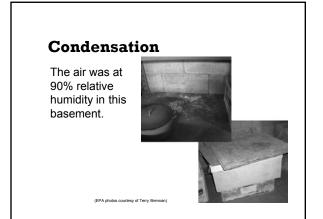
**material** (Aw = water activity)

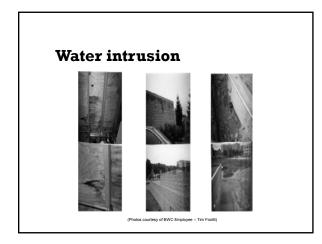
- Aw Low < .8 = Primary colonizers (first to grow in dust/dirt on wall/ceiling cavities, carpet, furniture) Aspergillus V., Penicillium & Wallemia fungi
- Aw Moderate .8-.9 = Secondary colonizers (common outdoors and infiltrate through air inlets & cloths) Cladosporium, Paecilomyces, Scopulariopsis & 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

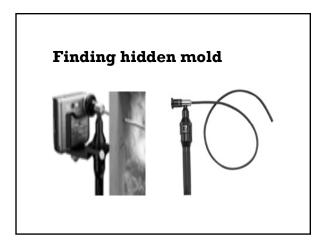


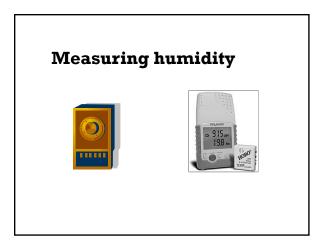


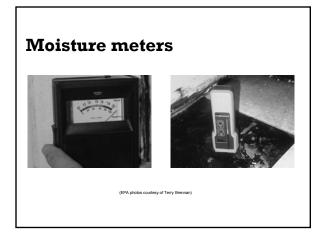


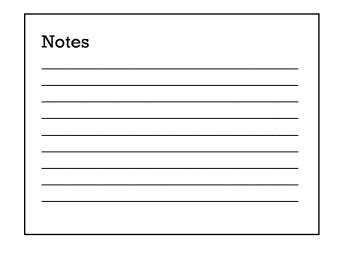












MOLD REMEDIATION

#### Remediation key steps EPR 402 K 01 001

- Assess size, source and damaged material (Leaks, HVAC, maintenance, condensation, humidity)
- o Select remediation manager
- Communicate with occupants (scope and timetable)
- Consult with health professionals as necessary

#### **Checklist for mold remediation** Plan remediation

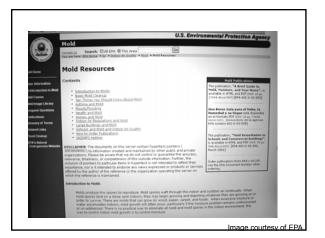
- Use professional judgment to customize guidelines
- Determine cleanup method for moldy items
- o Determine cleanup method by substrate
- o Determine proper PPE
- o Protect building occupants
- o Move susceptible occupants

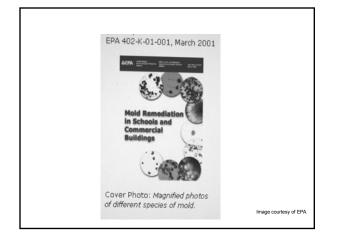
#### **Checklist for mold remediation**

#### Remediate

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

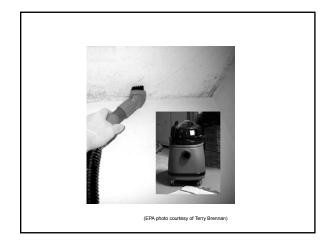
Also (IICRC pp. 46-47) (AREC)





Notes		
		-

Material Affected	Cleanup meth	od Do	wth (from clean water)
< 10 sq. ft. (3x3+)	Paper/Books/ Wal Concrete/ Carpet/ Wood, Plastic, Met	Furniture/ Drapes (1	1,3)
10 – 100 sq. ft. <mark>(10x10)</mark>	Paper/Books (3) Carpet/ Furniture/ Wood, Plastic, Met	Wallboard (3,4) Drapes (1,3,4)	Concrete (1,3)
> 100 sq. ft.	Paper/Books (3) Carpet/ Furniture/ I Wood, Plastic, Met Wood (1,2,3,4)	Wallboard (3,4) Drapes (1,3,4)	Concrete (1,3)
<ul> <li>Damp wipe with</li> <li>HEPA Vacuum</li> </ul>	Steam Clean / Comp n water or detergent / after material is the I with normal waste)	solution proughly dried	ea after removal



## IICRC reference of antimicrobial agents

Alcohols (eth/IPA)	60-90% solution	B,V,F
Quaternary ammonia	.4-1.6% solution	B*,V*,F
Phenolics	.4-5% solution	B,V,F,(T)
lodophors	75 ppm	B, V, F, S**, T**
Glutaraldehydes	2% solution	B, V, F, S**, T
Hypochorites	≥5000ppm free CI (1:10)	B, V, F, S**, T
Hydrogen peroxide	>3% solution	B, V, F, S**, T
B=Bactericidal V=Viruci		B, V, F, S <sup>**</sup> , T cidal T=Tuberculocidal

## IICRC reference of antimicrobial agents

Alcohols (eth/IPA)	non-irritating or staining	Inactivated by organic mater (IOM), flammable
Quaternary Ammonia	Inexpensive	IOM, limited efficacy
Phenolics	Inexpensive, residual	Toxic, irritant, corrosive
lodophors	Stable, residual	IOM, expensive
Glutaraldehydes	Resists OM, noncorrosive	Irritating, expensive
Hypochorites	Inexpensive	IOM, toxic, corrosive
Hydrogen Peroxide	Relatively stable	Corrosive, expensive

#### In conclusion,

the results from these experiments show that after removal of a water source that contributed to the initial growth of the fungi, over long periods under conditions similar to those inside human-occupied dwellings, colonies of *P. chrysogenum* can be culturable and colonies of *S. chartarum* can be culturable and toxic.

Journal of Occupational and Environmental Hygiene, 1:500-504, 2004 Copyright © 2004 JOEH, LLC ISSN: 1545-9624 print/1545-9632 online DOI: 10.1080/15459620490467945 Culturability and Toxicity of Sick Building Syndrome-Related Fungi Over Time Stephen C. Wilson, Curtis G. Carriker, Trevor L. Brasel, Enush Karunasena, David R. Douglas, Chunfa Wu, Larysa A. Andriychuk, Matthew R. Fogle, Jared M. Martin and David C. Straus

#### Notes

#### PPE

- $_{\rm O}$  Avoid inhaling
- Minimum N-95 respirator
- Avoid skin contact Minimum gloves
- Avoid eye contact
  - Minimum goggles



## EPA guidelines for remediating materials with mold growth (from clean water) Material affected Personal Protection Equipment < 10 sq. ft.</td> 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

Filter class	Efficiency	Test agent
N – 100	99.7%	NaCl
N - 95	95%	
R – 100	99.7%	DOP oil
R - 95	95%	
P – 100	99.7%	DOP oil
P-95	95%	

## Average spores/m3 during remediation

> 1,000,000	
> 10,000,000	
> 100,000,000	
> 300,000	
> 3,000,000	
> 30,000,000	
	> 10,000,000 > 100,000,000 > 300,000 > 3,000,000

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

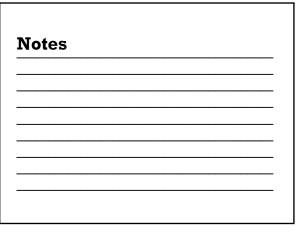


Table 5. Population-Specific Recommendations for Protection From Exposure to Mold in Buildings Flooded After Hurricanes Katrina and Rita,<sup>1</sup> by Specific Activity<sup>2</sup> and Risk Factor

		Exposure	Activity		
Risk Factor	Observing from outside the demolition area (disturbs no dust)	Inspecting or Assessing Damage (disturbs little dust or mold)	Recovering moldy personal belongings (Disturbs some dust or mold)	Sweeping, light cleaning, removing mold (disturbs much dust or mold)	Using power tools, cleaning demolishing (disturbs all dust and mold
None	No special precautions Needed	No special precautions needed	¢®⊯∕		Ę,
	People at I	High Risk for In	fection or Color	ization	
Profound immuno- suppresssion <sup>6</sup>	Avoid exposure	Avoid exposure	Avoid exposure	Avold exposure	Avoid exposure
Immunosuppression <sup>8</sup>	e	Ş:/	Avoid exposure	Avoid exposure	Aveid exposure
Obstructive or cavitary lung disease		Ĩ	814		Avoid exposure
Terr 10, 1997 - 19	People Who H	ave Diseases V	with Immune Ser	nsitization <sup>8</sup>	
Allergic rhinoconjunctivilis (exacerbated by moldy materials)			81		Aveid
Asthma (exacerbated by moldy materials)		0	Ş.	Avoid exposure	Avoid exposure
Hypersensitivity pneumonitis caused by moldy materials			E14	Avoid exposure	Avoid exposure
		People With Un	known Risk <sup>e</sup>		
Younger than 12 years <sup>10</sup>	Avoid	Avoid exposure	Avoid exposure	Avoid exposure	Avoid
				Avold exposure	Avoid exposure
Pregnant			L.J.		

Note: Everyone should avoid unnecessary exposure to mold, especially anyone at high risk for infection and anyone with a disease caused by immune sensitization to mold and mold constituents

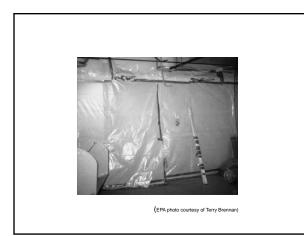
#### Containment

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



#### EPA guidelines for remediating materials with mold growth (from clean water)

Required
ed (Seal area with fire-retardant polyethylene sheeting, maintain negative pressure with HEPA, block supply & return air vents)
wo layers of fire-retardant poly with airlock chamber, maintain negative pressure with HEPA to outside, block supply & return air vents)
ļ



#### Should sampling be done?

- $_{\odot}$  Is there a clinical link?
- o Are the symptoms directly associated with mold?
- $\circ$  Is bacterial growth involved?
- Is there a persistently musty odor without visible mold?

(Any one of these may trigger sampling)

#### **Occupant health investigation**

- o Clinical investigation
  - No commercially available reliable diagnostic tests at this time
  - Assessment of symptomatic and asymptomatic occupants
  - Especially if occupant health problem remains unclear

#### Notes

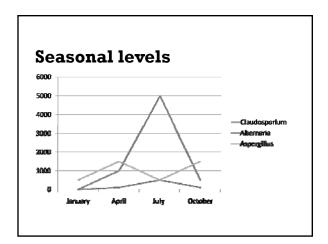
#### **Occupant health investigation**

- o Epidemiologic investigation
  - Recommended to clarify a building related problem
  - Baseline for caparison to remediation/ intervention

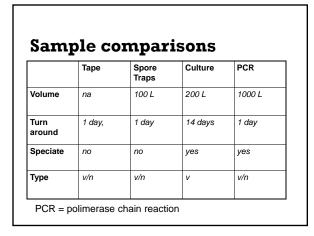
#### o Treatment

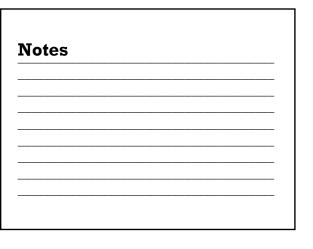
- Almost always requires removal from environment
- Treatments have not demonstrated long term relief (IICRC S520 pp. 46-47)





3 am	8 am	12 noon	4 pm	8 pm
<<< <fu< td=""><td>sarium&gt;&gt;&gt;&gt;&gt;</td><td><penicillium></penicillium></td><td><fusarium></fusarium></td><td><spegazzinia></spegazzinia></td></fu<>	sarium>>>>>	<penicillium></penicillium>	<fusarium></fusarium>	<spegazzinia></spegazzinia>
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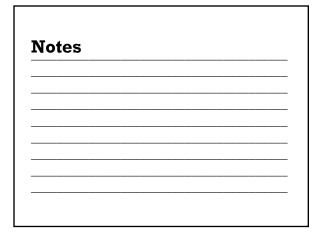
Туре	Normal	Possible contamination	Probable contamination
Air / residential	<5000 <500	5000-10,000 500-1000	>10,000 spores/m3 >1000 cfu/m3
Air / commercial	<2500 <250	2500-10,000 250-1000	>10,000 spores/m3 >1000 cfu/m3
Dust/bulk samples	<100,000 <10,000 <50.000	100,000-1,000,000 10,000-100,000 50,000-100,000	>1,000,000 sp/gram >100,000 cfu/gram >100.000 mvcelial frags/g
Swab samples	<10,000 <1500		>10,000 cfu/in2 >1500 cfu/cm2
Tape samples	No significant fungal material or biomass 1-5%	5-25%	25-100%

## Background in non-compliant buildings

- 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)

Normal C	FU/M3	Symp./threshold
	100,000	
	20,000	
Common outdoor level	10,000	
	5,000	
800 non-complaint homes	1,500	Active growth
	1,000	
		Possible cont.
Large % of non-complaint bldgs	s 500	Mixed species
	250	
150 non-complaint buildings	200	Single species
	150	
	50	
	low levels of \$	Stachy, Asp. V, Penicil, Crypto, Histo, Fuscarium

Normal	Spores/M3	Symp./Threshold
Santa Barbara (fall)	500,000	
	100,000	
St. Louis (fall)		
	50,000	High outdoor (Most mold
Santa Barbara (spring	1)	sensitive ind. will suffer)
	25,000	
St. Louis (spring)		Moderate outdoor (Many
	10,000	mold sensitive ind. will suffer)
		Moderate for remediation
Low outdoor	5,000	
	2,000	Clearance level
Albany (spring)	1,000	
Las Vegas	200	



### **EPA Relative Moldiness Index (ERMI©)**

#### A New Method for Screening Homes for Mold

Among the components of indoor air, molds present a growing concern for the public. For the detection and quantification of mold, mold specific quantitative PCR (MSQPCR) has been developed by EPA (Environmental Protection Agency) scientists and is now utilized in addition to spore trap analysis and culture methods. Acrotech P&K was the first commercial laboratory to use the new DNA based technology and currently offers MSQPCR for more than 45 different molds. Customized PCR panels provide maximum flexibility for mold detection. In addition, Aerotech P&K offers pre-selected panels that include fungal species found in water-damaged environments from air, dust, bulk, and swab samples. A new panel of 36 species is now available and is used to determine the EPA Relative Moldiness Index (ERMI) in dust samples. This is a significant and exciting new development as it applies MSQPCR technology in a meaningful and simple test for mold in homes.

#### TheEPARelative Moldiness Index (ERMI)

The EPA Relative Moldiness Index (ERMI) was developed as a screening tool to evaluate potential risk of indoor mold growth. Mold accumulates in homes over time and can be found in carpet dust and other accumulation sites. Using mold-specific quantitative PCR (MSQPCR), targeted mold species can be quantified biochemically. Mold species are divided into two groups. The first group (Group 1) of 26 species represents molds associated with water damage and the other group (Group 2) represents common indoor molds. The index is calculated by log-transforming all mold concentrations, then subtracting the sum of the second group from the sum of the first. The resulting ERMI is a whole number usually between -10 and 20 with a standard deviation of  $\pm$  3.

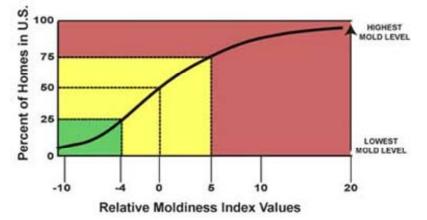
In order to most effectively use this new tool, the ERMI must be compared to a national database. Indices were determined using this method for 1,096 homes across the U.S. as part of the 2006 HUD American Healthy Home Survey. Individual indices, ranked from lowest to highest were used to create a national Relative Moldiness Index (RMI) Scale. This tool should be used as one element of an overall assessment or an indication that a more complete assessment is needed. As with all laboratory data, there are limitations that should be considered when using the index.

#### Sample Collection

A key component of the ERMI is the sampling of accumulated dust from the carpeting in the home. Residential carpet dust is a matrix that can be representative of persistent mold problems as spores accumulate over long periods of time. Carpet dust should be collected using equipment and supplies similar to the 2006 HUD Survey. Between 5 to 10mg of dust is needed for the analysis, which can be collected via dust cassettes such as the DustChek<sup>™</sup> or MiTest<sup>™</sup> using a vacuum cleaner or similar sampling device. A single, composite sample is collected from the common living area and primary bedroom of the home. Detailed sampling instructions are available upon request.

#### Interpretting the Results

The ERMI report includes the detection and concentrations of all 36 mold species along with the ERMI value itself. This provides a single number to rank the "moldiness" making it easy to compare the results to a national scale. Based on a national survey of 1,096 homes in the US as part of the 2006 HUD American Healthy Home Survey the following classification was adopted:



Low(lessthan-4) The ERMI result for this sample is in the low category. The low category represents the ERMI results for the lower quarter (25%) of all the homes tested in the HUD survey. The potential risk of significant indoor mold growth for this category is low.

**Moderate(-4to5)** The ERMI result for this sample is in the moderate category. The moderate category represents the ERMI results for the homes in the HUD survey between 25% and 75% of all the homes tested. There is a moderate risk of indoor mold growth for this category.

**High (greaterthan5)** The ERMI result for this sample is in the high category. The high category represents the ERMI results for the homes in the HUD survey higher than 75% of all the homes tested. This category represents the highest potential risk of significant indoor mold growth.

**TheERMIAdvantage** In addition to the simplicity of taking only one sample, the ERMI offers several advantages over traditional mold screening methods. Carpet dust acts as a reservoir for mold spores and is more representative of mold levels over time versus short-term air samples. The use of MSOPCR for this test allows for increased precision as it is based on a biochemical assay using calibrated instrumentation. Further research is being conducted and published that will link the ERMI assessing health risks for susceptible individuals. This information along with the national database will be invaluable in providing a standardized method for screening homes for mold.

Aerotech P&K offers all the sampling equipment and supplies needed to conduct an ERMI test. Sampling instructions are also available along with a customized ERMI report. Call 800-651-4802 or visit Aerotech P&K's <u>ERMI Website</u> for more information.

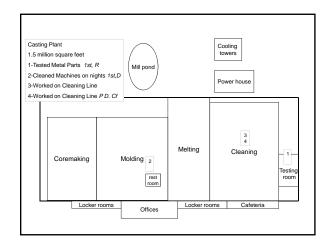
#### References

Haugland, R.A., Vesper, S.J., Wymer, L.J. Quantitative measurement of *Stachybotrys chartarum* conidia using real time detection of PCR products with the TaqMan<sup>™</sup> fluorogenic probe system. Mol. Cell. Probes, 1999, 13: 329-340.

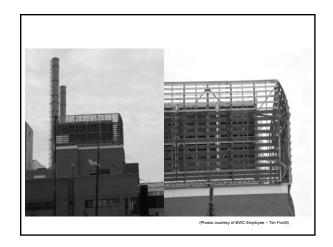
Meklin, T.M., Haugland, R.A., Reponen, T., Varma, M., Lummus, Z., Bernstein, D., Wymer L.J., Vesper, S.J. Quantitative PCR analysis of house dust can reveal abnormal mold conditions. Journal of Environmental Monitoring, 2004, 6: 615-620.

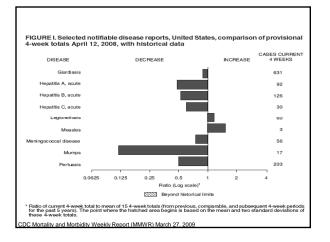
Vesper S. Developing the EPA Relative Moldiness Index © based on mold-specific quantitative PCR. The Synergist, April 2006: 39-43.

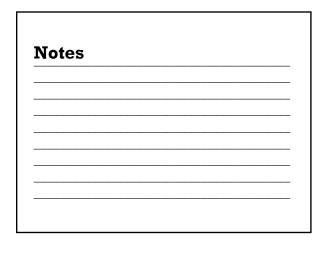


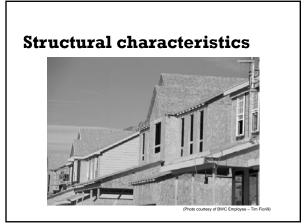












#### **Substitute materials**

- o Green board
- o 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.
- $_{\odot}$  Wall board thermal break
- o Vapor barriers (moisture retarders)

#### Green building coalition

www.clevelandgbc.org

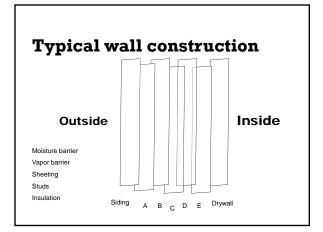
### Leadership in energy and environmental design

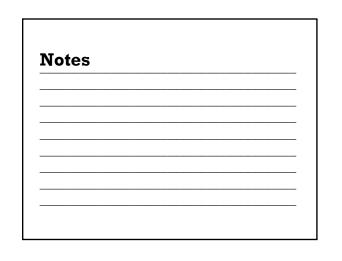
- o Rating system
- For new construction, commercial interiors, homes, existing buildings, core and shell, neighborhood development

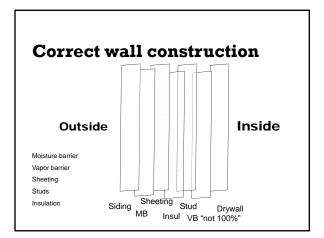
#### Green building coalition

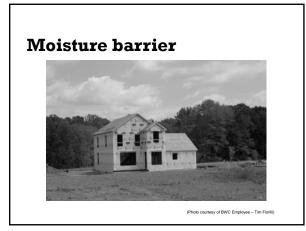
### Leadership in energy and environmental design

oAwards 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)



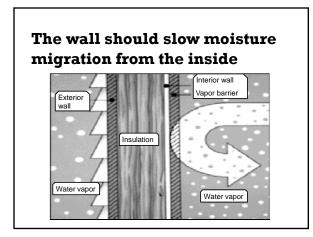


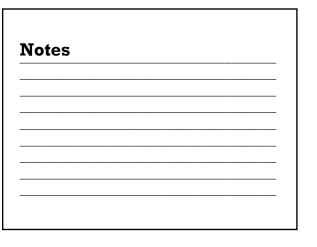






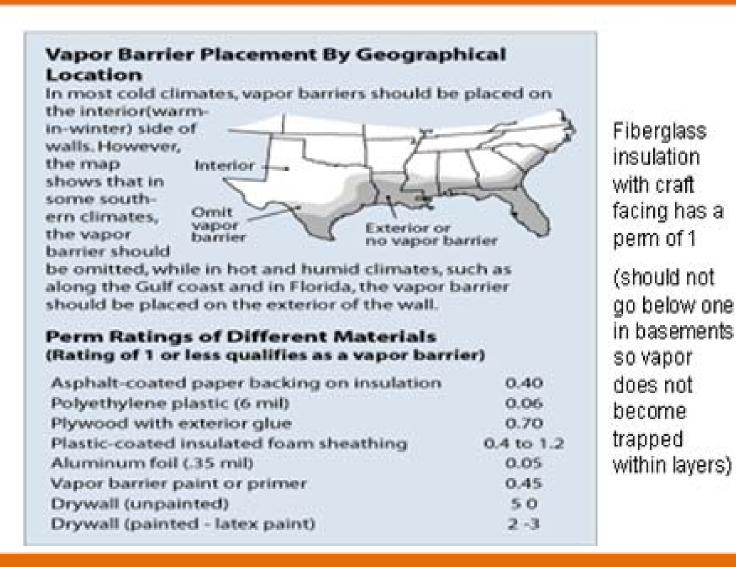






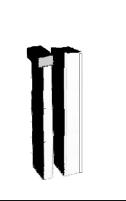


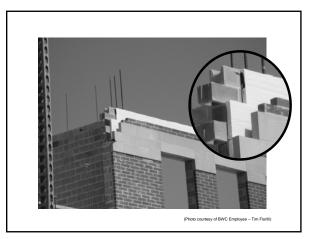
Ohio Burnau of Workers'



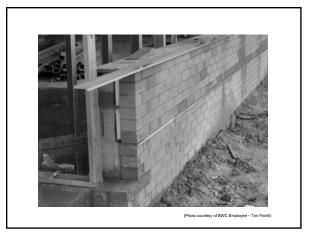
### Masonry

- Air space between brick and inside wall
- $_{\odot}$  Weep holes
- o Flashing at cap
- o Waterproofing

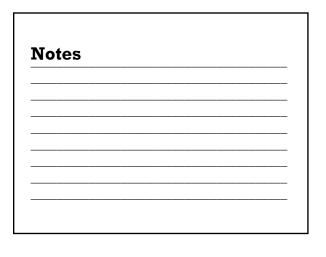












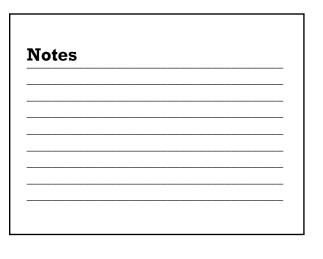






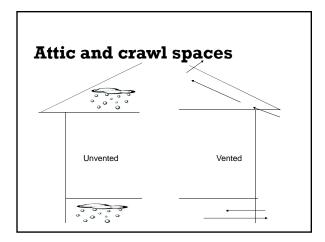






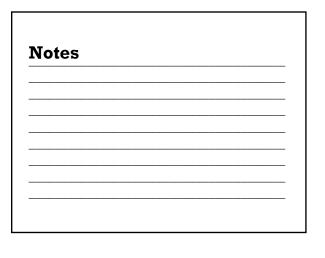


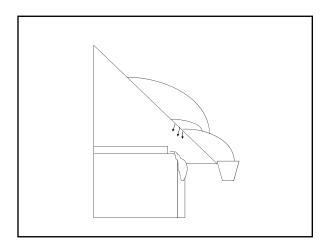








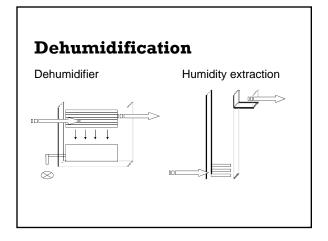


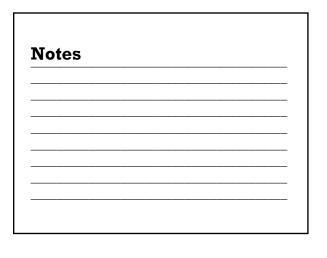












#### Major moisture movement

Infiltrate :

- o Wind, heat rise, stack effect
- o Must seal cracks with controlled infiltration Capillary
- Evidenced by efflorescence 3-4 ft. above ground "rising damp"
- Must lower water level at building or use a moisture barrier (don't just seal surface)

#### Major moisture movement

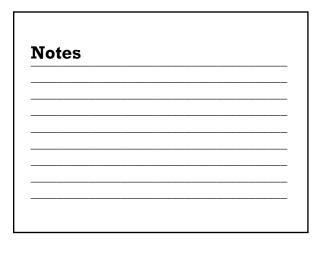
Vapor

- Moves through porous walls & condensates (cold climate-outward; hot climate-inward)
- Must lower temperature differential/add moisture barrier/lower humidity















#### Some additional Web sites

- http://www.cbs.state.or.us/osha/pdf/pubs/cdepot9-2003.pdf
- <u>http://gcrc.meds.cwru.edu/stachy/default.htm</u>
- http://www.arb.ca.gov/research/indoor/ab1173/report0205/rpt02 05.pdf
- http://eetd.lbl.gov/ied/viaq/viaq.html
- <u>http://www.oshforeveryone.org/wsib/spec\_haz/chemical/indoor\_air.html</u>
- <u>http://epa.gov/iaq/largebldgs/ibeam\_page.htm</u>
- http://www.cdc.gov/nceh/airpollution/mold/moldfacts.htm
- <u>http://www.acoem.org/guidelines/article.asp?ID=52</u>
- http://www.do-diligent.com/molds\_in\_the\_environment.htm
- IAQ guidelines for occupied buildings under construction.
- Sheet Metal & Air Conditioning Contractors National Association, Inc.
- BWC TD 883.17 .127 1995x

#### **Recent resources**

```
    Energy and Environmental Building Association
    Moisture control & bldg. guidelines in different climates
(EEBA.org)
```

#### o ASHRAE.org

- Humidity Control Design Guide for Buildings.
- Users manual for 62.1-2007
- Learning institute (2-3 hr. Course Modules)
- IAQ applications (Quarterly Magazine)

Photos not sourced were taken by BWC Employee - Tim Fiorilli

#### Notes

AIR QUALITY GUILDELINES

## **Standards and Codes**

Experience Industry vs. Schools/Offices

#### Standards or recommendations?

#### What "standards"?

OSHA	ASHRAE
ACGIH	OBBC
NIOSH	BOCA (Bldg. Officials Code Admin.)
EPA	HUD
ICC = International Code	Council (Mechanical Code)
LEED = Leadership in E	nergy and Environmental Design

**Risk rankings** 

## 21<sup>st</sup> Century Science & Technology magazine

To Control Malaria, We Need DDT!

"Neither case detection and treatment, nor use of insecticide-treated nets will result in dramatic reductions of malaria."

Presentation by Donald R. Roberts, Ph.D., Professor of Tropical Public Health at the Uniformed Services University of the Health Sciences in Bethesda, Maryland. His views do not represent the official position of the University, the Department of Defense, or the U.S. Government.

## 21<sup>st</sup> Century Science & Technology magazine

Rural malaria was a major public health problem prior to the mid-1940s, even in the United States. With the advent of DDT, the era of uncontrolled malaria ended, followed by decades of dramatic control or elimination of both urban and rural malaria. Unfortunately, those marvelous achievements were lost as countries complied with international pressures to abandon DDT and house spray programs.

(Full text from Fall 2002 issue 21st Century)

## \_\_\_\_\_

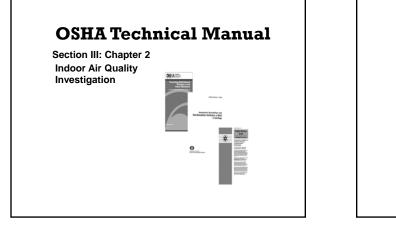
#### OSHA and ACGIH (PELs and TLVs)

Based on health effects to healthy adults of exposures for eight hour days over a working lifetime

Issue: relevance to office setting where focus may be 1) comfort or 2) desire for absence of unusual sensory stimuli?

## OSHA Occupational Safety and Health Administration

- o IAQ standard on hold
- o Nothing new
- Record-keeping is emphasized
- o Addressed in OSHA technical manual
- Public Emp. = Under PERRP



#### NIOSH

National Institute for Occupational Safety and Health

- o Research arm for OSHA
- HHE\* provide unique, valuable info on building related illnesses
- $\circ$  Provides useful specific guidance -- e.g., on CO<sub>2</sub> levels even though recommendations only

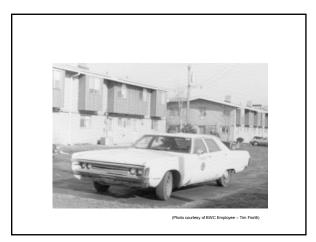
\*Health Hazard Evaluations

## EPA

#### **Environmental Protection Agency**

- National Ambient Air Quality Standards (six contaminants)
- Set in order to protect the public 24 hours a day
- Issue: relevance for office IAQ problems?



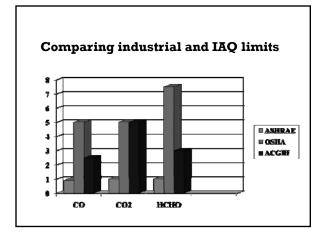


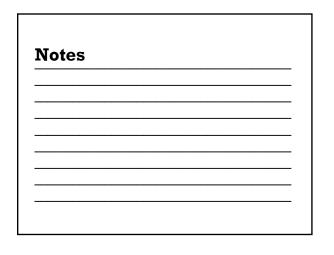
#### **IAQ** milestones 1976 Legionnaires Outbreak 1987 NIOSH Guideline for IAQ Investigations 1989 ACGIH Bioaerosol Assessment & Control (rev. 1999) 1991 EPA Building Air Quality 1993 NYC Guidelines to Ass. & Rem. Stachy 1993 American IAQ Council Founded

- Pulmonary Hemosiderosis in Cleveland
- 1994 1994 IAQ Association Founded
- 1995 EPA Tools for Schools (rev. 2000)
- NYC Guidelines to Ass. & Rem. Fungi in IAQ 2000 EPA Mold Rem. In Schools & Com. Bldgs. 2001
- 2003 IICRC S520 Stds & Ref Guide for Prof. Mold Rem.
- 2004 ASHRAE Std. 55-2004
- 2007 ASHRAE Std. 62.1-2007 (www.ashrae.org)

#### National Ambient Air Quality Standard

Contaminant	Long term concentration /averaging	Short term concentration averaging
Sulfur Dioxide	80ug/m3 (0.03ppm) / 1 year	365 ug/m3 / 24 hours
Particulate (PM 10) (PM 2.5)	50 ug/m3 / 1 year 15 ug/m3 / 1 year	150 ug/m3 / 24 hours 65 ug/m3 / 24 hours
Carbon Monoxide		35 ppm / 1 hour 9 ppm / 8 hours
Ozone		0.12 ppm / 1 hour 0.08 ppm / 8 hour
Nitrogen Dioxide	100ug/m3 (0.053ppm)/ 1 year	
Lead	1.5 ug/m3 / 3 months	





## ASHRAE

American Society of Heating, Refrigerating, and Air-Conditioning Engineers

Developed specifically for the indoors

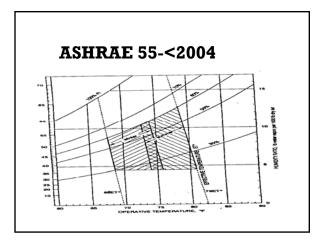
- Thermal comfort guidelines (55-2004) See <u>BAQ</u>, p. 137-38
- Ventilation standard (62.1-2007) See <u>BAQ</u>, p. 137

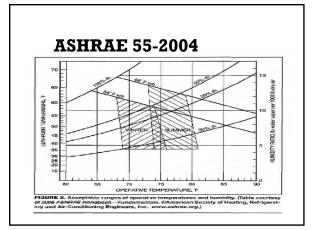
## ASHRAE 55-2004

"Thermal Environmental Conditions for Human Occupancy"

o Temperature range:

- 67 79 F in winter (1.0 Clo)
- 74 83 F in summer (0.5 Clo)
- Relative humidity range:
  - Maintain at or below humidity ratio of 0.012
  - [Ranges from 85%(67deg.) 55%(80 deg.)]
  - No lower limit stated
- o Maximum air speed of 40 fpm



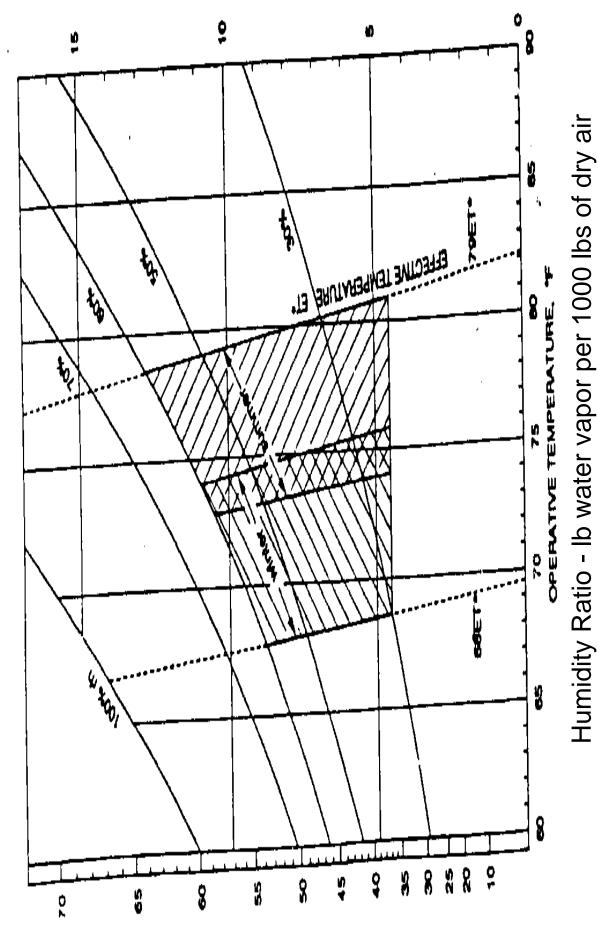


#### **OSHA** Technical Manual (OTM)

#### Section III: Health Hazards

CHAPTER 1. POLYMER MATRIX MATERIALS: ADVANCED COMPOSITES CHAPTER 2. INDOOR AIR QUALITY INVESTIGATION CHAPTER 3. VENTILATION INVESTIGATION CHAPTER 4. HEAT STRESS CHAPTER 5. NOISE AND HEARING CONSERVATION CHAPTER 6. LASER HAZARDS CHAPTER 7. LEGIONNAIRE'S DISEASE

ASHRAE 55 -< 2004



39

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ASHRAE 55 - 2004

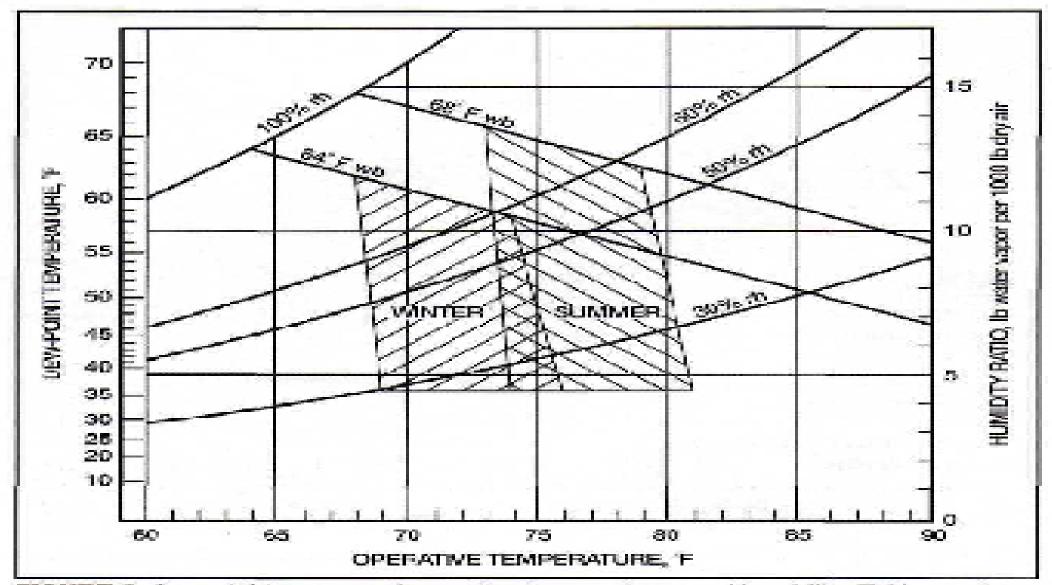


FIGURE 2. Acceptable ranges of operative temperatures and humidity. (Table courtesy of 2005 ASMRAE Handbook – Fundamentals. ©American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., www.ashrae.org.)

#### V. RECOMMENDATIONS FOR THE EMPLOYER.

 The following are general recommendations which, where relevant, should be standard procedure. If followed, they will help prevent or alleviate many indoor air-quality problems.

#### A. ENGINEERING RECOMMENDATIONS.

- 3. Air Treatment is the removal of air contaminants and/or the control of room temperature and humidity. Recommendations for air treatment include:
  - The use of filtration, electronic cleaners, chemical treatment with activated charcoal or other sorbents;
  - Humidity control in the range of 20%-60%;
  - Temperature control in the range of 68-76 F.

# Outdoor temperature/Indoor relative humidity recommendation maximums

+20º F.	35%
+10º F.	30%
0° F.	25%
-10º F.	20%
-20º F.	15%

Source: Anne Field, Extension Specialist, Emeritus, with reference from the Association for Home Appliance Manufacturers (<u>www.aham.org</u>)

#### ASHRAE 62.1 - 2007

"Ventilation for Acceptable Indoor Air Quality"

CFM refers to outside air supplied per occupant

## ASHRAE 62.1-2007

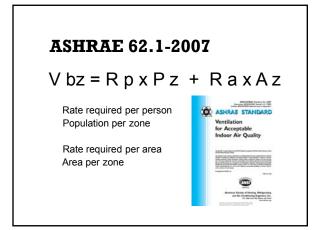
"Ventilation for Acceptable Indoor Air Quality"

Defines acceptable indoor air quality as: "air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (**80% or more**) of the people exposed do not express dissatisfaction."

#### ASHRAE

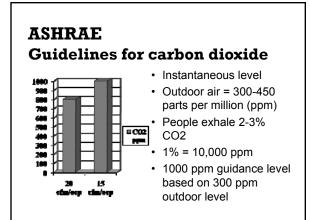
American Society of Heating, Refrigerating, and Air-Conditioning Engineers <u>Fresh air per occupant</u>

Standard:	Non-smoking area:	Smoking area:
62-1973	25 CFM	50 CFM
62-1981	5 CFM	20 CFM
62-1989/99/01	15-20 CFM	60 CFM
62-2004 & 07	Vbz = RpPz+RaAz	6.2.9 no #
CFM refers to C	UTSIDE air supplied pe	er person



## ASHRAE Outdoor Air Requirements (62.1-2007)

Location	Cfm/person
Office space	17
Conference rooms	6
Classrooms	13-15
Libraries	15



## IAQ indicators table (room#)

TIME	# PEOPLE IN ROOM	ROOM CO2 LEVEL	TEMP.	R.H.	VENTI - LATION	CO2 ON VENTI- LATOR	DOOR	WINDOW
9:30	0	800	70	29	ON	800	OPEN	CLOSED
10:30	26	2100	71	27	ON	2000	OPEN	CLOSED
12:00	1	1500	71	28	ON	1400	OPEN	CLOSED
1:30	27	2200	70	30	ON	2000	CLOSED	CLOSED
2:30	25	800	71	28	ON	500	CLOSED	CLOSED

SPECIFIC AGENTS (CO, DUST, FORMALDEHYDE, VOC'S, OZONE)
 COMMENTS (Return blocked; Musty odor; Stained tiles; Plants; Pets)

## MERV (ASHRAE 52.2)

(Minimum Efficiency Reporting Value)

- Highly controlled laboratory testing not dust spot
- o Minimum efficiency instead of average
- Filters ability to remove particles of a specific size

## US Department of Housing & Urban Development (HUD)

#### Source emission standard

- Product standard limiting formaldehyde exposures from pressed wood products in mobile & manufactured homes
- $\circ$  <0.2 PPM plywood
- o <0.3 PPM particleboard
- Goal: indoor HCHO exposures <0.4 PPM, but TLV is now 0.3 PPM!

## **Ohio Model Building Codes**

Ohio Basic Building Code (OBBC) Uses BOCA's Nat'l Mechanical Code (Article 16, "Ventilation Air")

**Article 16** [Ohio Admin. Code 4101:2-4-01] "Ventilation Air (Mechanical)"

## IAQ Tools for Schools Action Kit

12

- o IAQ Coordinator's Guide
- o IAQ Coordinator's Forms
- o IAQ Backgrounder
- o IAQ Problem Solving Wheel
- IAQ Checklists
  - Teachers
  - Administrative Staff
  - Health OfficerBuilding Maintenance
  - Food Services
  - Renovation and Repair
  - Video (Taking Action & Vent. Basics)

## Mold Remediation in Schools and Commercial Buildings

- o EPA Doc. 402-K-01-001 March 2001
- Invest./Eval./Remediation of moisture/mold
- $\circ~$  Introduction to molds
- o Resources and references
- I-BEAM = CD on IAQ Bldg. and Educ. Assess. Model
- Interactive program of IAQ/energy and Bldg. Economics
- o Establish/Train/Diagnose/Document IAQ issues

## **Additional resources**

American Lung Association	800-LUNG-USA
ACGIH	513-742-2020
ASHRAE	800-527-4723
Assoc. of Occ. and Env. Clinics	202-347-4976
Bldg. Air Quality Alliance	888-704-2577
Carpet and Rug Institute	800-882-8846
Division of Safety and Hygiene	800-OHIOBWC

EPA IAQ Information Clearinghouse	800-438-4318
Tool for School Pub.# 055-000-00563	202-512-1800
National Air Duct Cleaning Association	202-737-2926
National Air Filtration Association	202-628-5328
National Pesticide Network	800-858-7378
Ohio Dept. of Health Env. Health Div.	614-466-3543
OSHA (Clev / Col / Tol)	800-321-6742
Radon Information Hotline	800-767-7236

## Standards on the Web

- ansi.org -Am asce.org
- -Amer. Society of Civil Eng. ashrae.org
  - -Am. Society of Heating Refrig & Air-conditioning Eng. -Am. Soc. For Testing and Materials

er. Nat. Standards Institute

-Building Officials & Code Administrators International -US Dept. of Energy Bldg. Stds & Guidelines Program

-Nat. Conf. Of States on Bldg. Codes and Stds, Inc.

-National Institute of Standards and Technologies

- EPA Tools for Schools site -International Conference of Building Officials -National Evaluation Services, Inc.

-The National Fire Protection Association

-National Institute of Building Sciences

- astm.org bocai.org
- energycodes.org
- · epa.gov/iaq/schools
- icbo.org
  nateval.org
- ncsbcs.org
- nfpa.org
- nibs.org
- nist.gov nssn.org osha.gov
- -National Resource for Global Standards -Occupational Safety and Health Administration

VENTILATION

## **HVAC** systems

- Terminology, principles and properties of air relevant to IAQ.
- Primary HVAC system functions and their impact on IAQ.
- Major HVAC system components and configurations used to perform these functions.

## Dry air

Approximate composition (by volume)

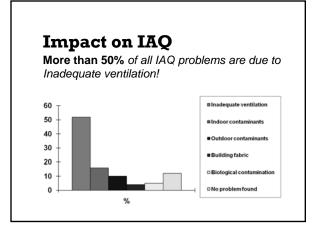
78.0 %	Nitrogen
20.9 %	Oxygen
1.0 %	Argon
0.1 %	other gases

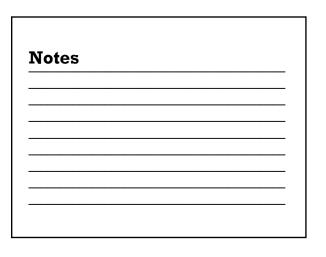
## Wet air composition

Approximate composition

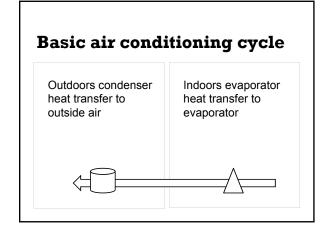
78.0 %	Nitrogen
20.9 %	Oxygen
1 - 2 %	water vapor
1%	Argon
0.1 %	other gases

The Basics	
Heating Ventilation Air Conditioning	<ul> <li>Heating</li> <li>Cooling</li> <li>Ventilation</li> <li>Filtration</li> <li>Dehumidification</li> <li>Humidification</li> <li>Distribution</li> </ul>





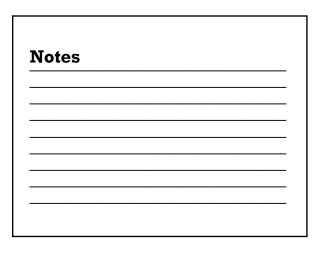


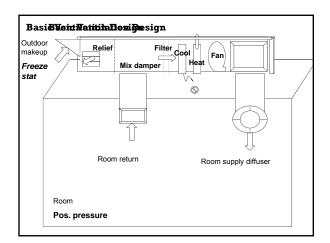




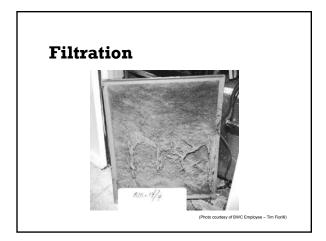






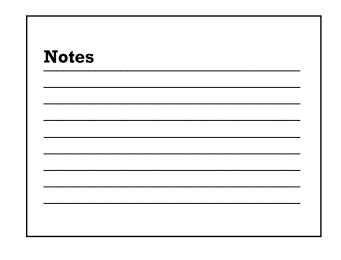


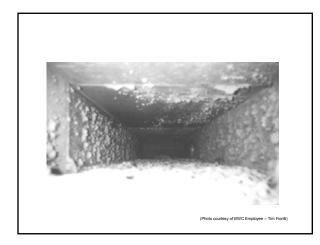




Common items and their respective particle sizes:	
Postage stamp, 1 inch high	25,400 microns
Eye of a needle	1,230 microns
Beach sand	100 to 2000 microns
Pollens	10 to 1000 microns
Human hair	40 to 300 microns
Coal dust	1 to 100 microns
Mold spores	10 to 30 microns
Oil smoke	0.03 to 1 micron
Tobacco smoke	0.01 to 1 microns
Typical atmospheric dust	0.001 to 30 microns

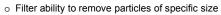






## ASHRAE 52.2 MERV

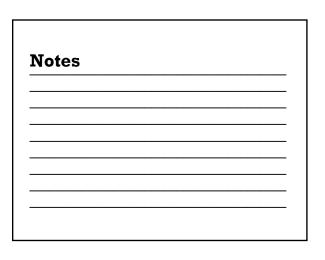
	MERV	<u>%Eff.</u>	Final resist	Controls	Туре	
	1-4	<20	0.3 in. w.g.	Pollen/mites	Fiber / Disp Wash. /ES	
	5-8	20-70	0.6 in. w.g.	Dust/mist/spores P	leated / ES	
	9-12	70-90	1.0 in. w.g.	Fume/Legionella	Box / Bag	
	13-16	90-99	1.4 in. w.g.	Tob.Sm./Bacteria	Box / ES	
<ul> <li>Minimum Efficiency Reporting Value (MERV)</li> <li>Highly controlled laboratory testing, instead of dust spot</li> <li>Minimum efficiency instead of average</li> </ul>						





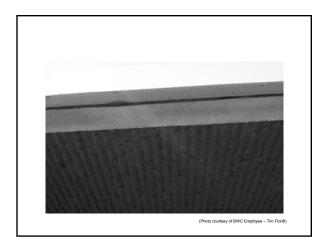
ration							
MERV 13 with Ultraviolet germicidal lamp							
		90 to 99 % efficient					
Efficient to:							
gal spores (largest)							
toxins bacteria							
				virus (smallest)			
ţ							





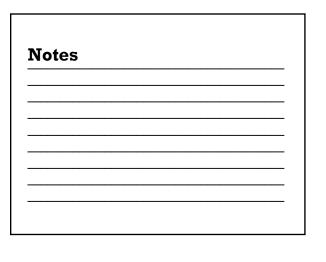




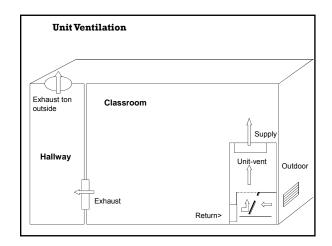






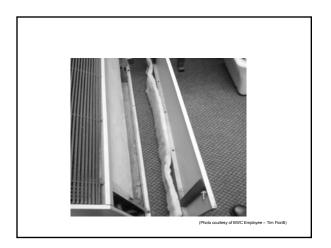


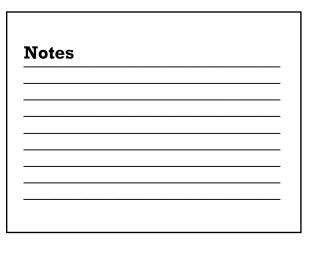




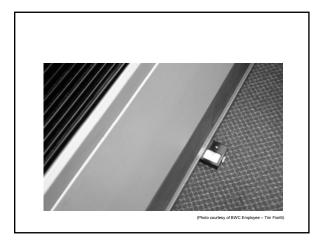














## **Continuous flow system**

- o Constant volume of air
- $_{\odot}$  Variable temperature of air
- $\circ$  Effective for uniform load
- $\circ$  Simple
- $_{\circ}$  Inexpensive

## **Constant flow system**

- o Thermostat controls delivery temperature
- A constant air volume is delivered to each space (when the system is running)
- $_{\odot}$  System is designed to cycle on-and-off
- o Less efficient

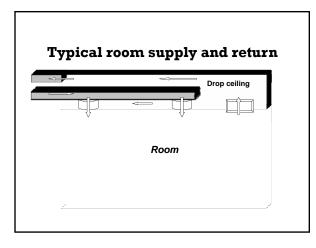
## \_\_\_\_

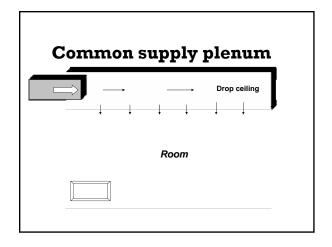
## **VAV** system

- o Variable Volume of Air
- o Constant Temperature of Air
- $_{\rm O}$  Control at each location
- $_{\odot}$  Effective for Variable Loads

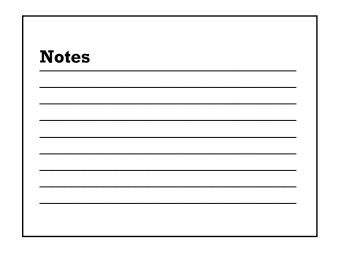
## Variable air volume

- $_{\odot}\,$  Thermostat controls damper
- Air volume to each space varies based on tempering requirements
- $\circ\,$  System is designed to run constantly
- Delivery temperature is constant
- $_{\odot}$  More efficient













CHEMICAL CONTAMINANTS

## **Control hierarchy**

- $_{\odot}$  Engineering controls
- $_{\odot}$  Administrative controls
- Personal Protective Equipment (PPE)

**Indoor Chemical Contaminants** 



"All substances are poisons! There is none which is not a poison. The right dose differentiates a poison and a remedy."

Paracelsus

## **Major IAQ contaminants**

- o Carbon monoxide
- o Formaldehyde
- VOCs (volatile organic compounds)
- $\circ$  Particulates

## **AREC** evaluation model

0	Anticipation	-	Sources
---	--------------	---	---------

- Recognition Symptoms, signs
- o Evaluation Testing
- **Control** Prevention

## Carbon monoxide (CO)

#### Anticipation (sources)

- o Cracked heat exchangers
- Combustion engines
- o Poorly located air intakes
- Gas burners, gas ovens, wood stoves, or kerosene heaters
- o Even from weapons firing!

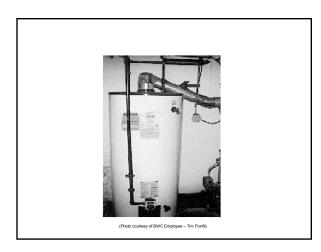
## AREC

## Carbon monoxide (CO)

#### Recognition

- Possibly complaints of headache
- Extreme: collapse
- **The problem** prevents blood from carrying normal oxygen level -- and puts those with heart problems at special risk



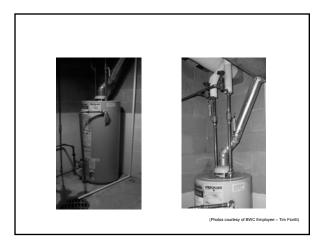


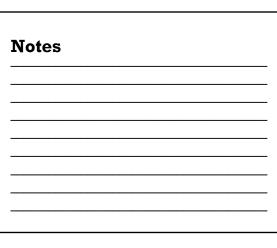
## Carbon monoxide (CO)

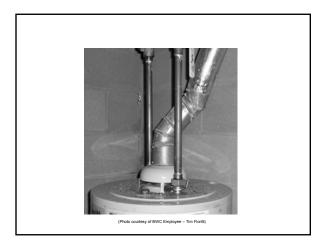
Evaluation Note - you cannot smell, taste or see it

Use direct-reading instruments • Passive, electronic and draw samplers TLV(ACGIH): 25 PPM PEL (OSHA): 50 PPM LEED (USGBC): 9 PPM / 2 > Outdoor











## Carbon monoxide (CO)

#### Control

- o Preventive maintenance
- e.g., forklift tune-ups
- Proper ventilation design/layout
   Structure and location

## Carbon monoxide (CO)

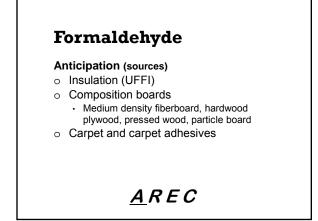
#### Control (continued)

- Appropriate policies/rules
  - Where and when motor vehicles can idle

#### o Equipment choice

 Airtight wood stoves, reduced fuel consumption kero heaters

A R E <u>C</u>



## Formaldehyde

Anticipation (sources continued)

- o Fabrics
- o Gas burners, gas ovens
- o Embalming fluids
- o Many other sources

## <u>A</u>REC



## Formaldehyde

#### Recognition

- Burning eyes (0.1 to 0.3 PPM)
- Respiratory tract irritation (2 or 3 PPM)
- o Dermal sensitization

## Formaldehyde

#### Evaluation

- Odor threshold below 1 PPM
- Direct reading instruments, and long-term sampling
- TLV: C-0.3 PPM PEL: 0.75 PPM
- LEED (USGBC): 50 PPB

AR<u>E</u>C

## Formaldehyde

#### Control

• Product choice or application method

AREC

- o Scheduling of work (exposure)
- o Proper isolation design
- o Local exhaust ventilation
- $\circ$  Dilution ventilation
- $\circ \ \ \, \text{Building commissioning procedures}$







#### Volative organic compounds

#### Classes:

- Aliphatic hydrocarbons
   e.g., n-hexane, kerosene
- Aromatic hydrocarbons
   Benzene, xylene, toluene

## **VOC** -- classes (continued)

- Halogenated hydrocarbonsPerchloroehylene, methylene chloride, diazinon
- Oxygenated hydrocarbons
   Aldehydes, alcohols, and ketones

## Volatility

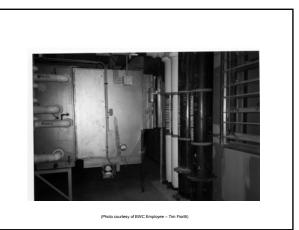
The tendency of a material to pass into the vapor state at a given temperature; that is, the tendency to evaporate into the surrounding space.

## **VOC**s

#### Anticipation

- o Maintenance products
- $\circ$  Building materials
- Combustion processes (including tobacco smoking)
- o Industrial / laboratory chemicals
- o Many potential sources





# **VOC**s

#### Recognition

Examples:

- $_{\odot}$  Mucous membrane irritation
- $_{\odot}$  Ocular (eye) irritation
- o Skin irritation

A<u>R</u>EC

## **VOC**s

#### Evaluation

- Direct reading, and
- o Long-term sampling

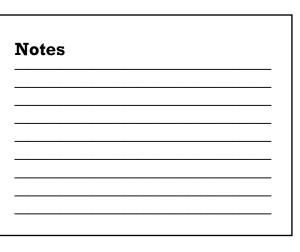
## Examples:

- $\circ~$  N-hexane: TLV: 50 PPM PEL 500 PPM
- $\circ~$  Methyl alcohol: TLV and PEL 200 ~ PPM ~

 $\circ~$  LEED (USGBC): TVOC – 500 ug/m3 ~

**AR**<u>**E**</u>**C** 4-PCH – 6.5 ug/m3





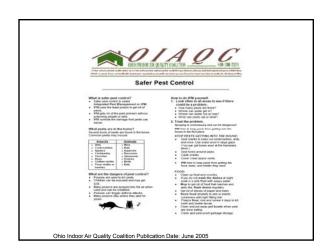
## **VOC**s

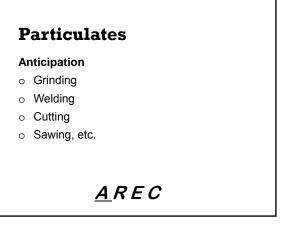
#### Control

- Product choice or application method
- o Scheduling of work (exposure)
- o Proper isolation design
- o Local exhaust ventilation
- o Dilution ventilation
- o PPE

A R E <u>C</u>







# 



OTAQU exists to promote healthy indeer air in Ohio and to promote optimum public health through education, advocacy, technical support and agency collaboration, OTAQU is a group of state and local health departments, organizations and public and private partners focused on improving indeer air quality for all citizens of Ohio.

# Safer Pest Control

## What is safer pest control?

- Safer pest control is called Integrated Pest Management or IPM.
- IPM uses the least poison to get rid of pests.
- IPM gets rid of the pest problem without poisoning people or pets.
- IPM controls the damage that pests can cause.

## What pests are in the home?

Several kinds of pests are found in the home. Common pests may include:

Insects	Animals
o Ants	o Mice
<ul> <li>Cockroaches</li> </ul>	o Rats
o Spiders	o Squirrels
<ul> <li>Centipedes</li> </ul>	o Raccoons
<ul> <li>Termites</li> </ul>	<ul> <li>Opossums</li> </ul>
o Bees	o Snakes
<ul> <li>Clothes moths</li> </ul>	o Birds
<ul> <li>Flour moths or</li> </ul>	o Bats
beetles	

## What are the dangers of pest control?

- Poisons are used to kill pests.
- Children can be exposed and may get sick.
- Many poisons are sprayed into the air when used and can be breathed.
- Poisons can trigger asthma attacks.
- Many poisons stay where they land for years.



## How to do IPM yourself.

- Look often in all areas to see if there could be a problem.
  - How many pests are there?
  - Where can pests get in?
  - Where can pests live or hide?
  - What can pests eat or drink?
- 2. Treat the problem.

#### Spraying is unnecessary and can be dangerous!

#### IPM tries to keep pests from getting into the house in the first place

#### STOP PESTS GETTING INTO THE HOUSE:

- Seal cracks to keep out cockroaches, ants, and mice. Use brass wool in large gaps. (You can get brass wool at the hardware store.)
- Seal holes around pipes.
- Caulk cracks.
- Cover crawl space vents.
- IPM tries to keep pests from getting the food, water, and shelter they need.

#### FOOD:

- Clean up food and crumbs.
- If you do not wash the dishes at night soak in a sink filled with soapy water.
- Mop to get rid of food that roaches and ants like; flush drains regularly.
- · Get rid of stacks of paper and trash.
- Store food properly in jars or plastic containers with tight fitting lids.
- Freeze flour, rice and cereal 4 days to kill moth and beetle larvae.
- Clean and put away pet bowls when pets are done eating.
- Clean and pest-proof garbage storage.

## **Particulates**

#### Evaluation

- o Long-term methods primarily
- Direct reading (increased use)
- o Direct observation of gross contamination
- LEED (USGBC): PM10 50 ug/m3

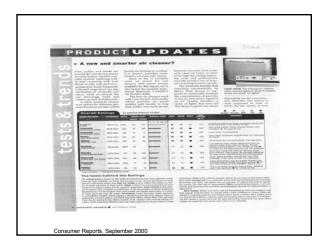
## AR<u>E</u>C

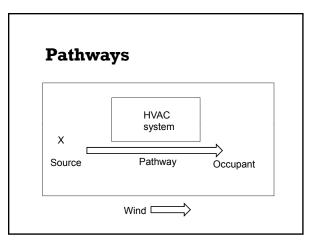
## **Particulates**

#### Control

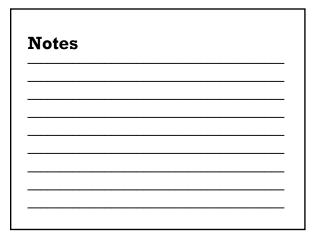
- Local exhaust ventilation
- o Dilution ventilation
- Material or process selection
- Work area isolation
- o PPE









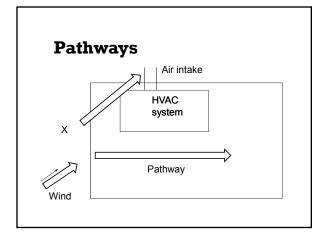


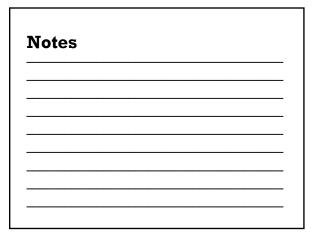








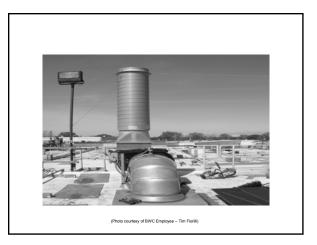












## Additional information

Asbestos: See <u>BAQ</u>, Appendix D, pp. 147-50

Radon: See BAQ, Appendix E, pp. 151-52

Glossary/acronyms: See BAQ, pp. 153-56

EXERCISES

# **Awareness Survey**

- 1. Which of the following are reasons for concern about indoor air today?
  - a. people spend most of their time indoors
  - b. the use of natural ventilation has decreased
  - c. many buildings and furnishings are produced from synthetic chemicals
  - d. all of the above
- 2. Which is most likely to be a potential source of formaldehyde?
  - a. particleboard subflooring
  - b. roofing felt
  - c. paint
  - d. solid hardwood floors
- 3. Volatile organic compounds (AKA VOCs) are most likely to be released from which of the following sources?
  - a. asbestos insulation
  - b. an area with newly installed carpet
  - c. a recently poured concrete basement floor
  - d. old, dirty carpet
- 4. If a house has a volume of 15,000 ft<sup>3</sup> and air is replaced at a rate of 500 ft<sup>3</sup> per <u>minute</u>, how many air changes per hour (expressed as "ach") are occurring?
  - a. 0.5 ach
  - b. 1.0 ach
  - c. 2.0 ach
  - d. 0.25 ach
- 5. Which term correctly identifies the occurrence of eye, nose, and throat irritation experienced by a person who walks into a new home?
  - a. acute effect
  - b. chronic effect
  - c. homeitis effect
  - d. delayed effect
- 6. Which of the following determines whether or not health effects will result from exposure to indoor contaminants?
  - a. physical properties of the contaminant
  - b. age and body size
  - c. humidity level
  - d. all of the above
- 7. Internal nose hairs are useless evolutionary structures.
  - a. true
  - b. false

- 8. Which of the following is most likely to be associated with dry air?
  - a. fatigue
  - b. chest pain
  - c. irritation of the eyes, nose, and throat
  - d. profuse sweating
- 9. Which of the following contaminants could result from the use of a heat exchanger or evaporative cooler? (Note: mark all that apply.)
  - a. carbon monoxide
  - b. hydrogen sulfide
  - c. nitrogen dioxide
  - d. microorganisms
- 10. Which of the following statements about ASHRAE's Standard 62-1989 (Indoor Air Quality Procedure) is correct?
  - a. Acceptable indoor air quality is defined as air that does not have known harmful cotaminants and 80 percent or more of the people exposed do not express dissatisfaction.
  - b. Acceptable indoor air quality must be achieved by meeting acceptable concentrations of indoor air contaminants.
  - c. The Standard recommends using a safety factor of1/100 as a preliminary guideline for contaminants that are not specifically listed.
  - d. The Standard is designed to provide protection to the entire population, including those who are especially sensitive to chemical exposures.
- 11. Which of the following are characteristics of variable air volume (VAV) systems?
  - a. variable temperature
  - b. variable volume
  - c. control from one temperature sensor for each location
  - d. provide both hot and cold air

12. What are reasons ventilation standards/guidelines may be inadequate to protect indoor air quality in the U.S.?

- a. houses have been constructed at different times under different code or standard requirements
- b. some HVAC systems may be poorly maintained and not operated correctly
- c. although adequate openable window space may be available, it may not be used
- d. all of the above

- 13. Which of the following statements about survey forms is not correct?
  - a. survey forms should collect data in a consistent manner
  - b. form design is not difficult
  - c. the confidentiality of collected information must be preserved
  - d. survey forms can include questionnaires with both yes/no and open-ended questions
- 14. Which of the following is not important when obtaining data on health effects?
  - a. smoking history
  - b. occupational history
  - c. caffeine intake
  - d. all are important
- 15. Which of the following explains why it is difficult to evaluate measurement results? (Mark all that apply.)
  - a. there are many different types of houses/structures
  - b. the variability in human response to contaminants
  - c. the lack of consensus on standards and guidelines
  - d. the similarity of symptoms resulting from exposure to indoor air contaminants and stress
- 16. A given volume of humid air weighs \_\_\_\_\_\_ than the same volume of dry air
  - a. more
  - b. less
- 17. Which can hold the greatest quantity of water vapor?
  - a. air at 100° F
  - b. air at 98.6° F
  - c. air at 55° F
  - d. air at  $30^{\circ}$  F
- 18. ASHRAE Standard 62-1989 recommends that \_\_\_\_ CFM of outside air per personbe supplied to <u>non-</u> <u>smoking</u> occupied <u>office</u> environments
  - a. 5
  - b. 10
  - c. 15
  - d. 20
  - e. 25

19. Energy-efficient buildings are the primary cause of IAQ problems today.

- a. true
- b. false
- 20. Air sampling is a necessary step in performing a legitimate IAQ investigation.
  - a. true
  - b. false

### **Case Study One**

For 15 years a company has used the same rust-inhibiting solution in which manufactured parts are dipped. For quality control reasons a decision was made to spray on the rust-inhibitor and this requires another chemical to be substituted for the one used long-term. In response to information on the new chemical's MSDS, employees are instructed to wear disposable latex gloves; this is the first time any have done so. Shortly thereafter, several employees start to complain of skin irritation on their hands.

Meanwhile, office workers begin to complain of a smell which they had never before noticed. One day a person even becomes nauseous at work; that had never happened. The office employees complain to their supervisor, who says she couldn't possibly bring up the problem now to the plant manager while the more serious production floor issues are going on -- and anyway, once those problems get fixed the office problem will, too.

- Use the AREC (anticipation, recognition, evaluation, control)model.
- What potentially incorrect assumptions are being made in this scenario?
- Based on what has been covered in this course, as well as your own insights/experience, what recommendations would you make to this company?

### **Case Study Two**

Personnel in a fourth floor hospital laboratory start complaining of strong diesel-like odors occurring periodically in their work area. No one can remember this having happened before. The hospital has just had a major addition completed, which includes a (re-located) loading dock. The maintenance personnel have heard many complaints in the past from lab personnel about other air quality problems, and relations are strained between the lab's director and the maintenance section head.

- Use the AREC model.
- How would you investigate this situation?
- What are some likely causes?
- What steps might correct the lab's problem?

### **Case Study Three**

You are the owner of a cash-poor printing firm located in the basement of a building which was flooded with several inches of water. The office's carpet -- laid over floor tile -- was cleaned by a company which assured you that their steam clean process would make it almost like new. It is now a month later and again there are odors (both musty and organic solvent-like) in the office as well as the print department. Several office and print workers complain of stuffy noses and eye irritations. The carpet cleaners say another \$150 cleaning should take care of the problem.

- Use the AREC model.
- What are your various options and what do you do?
- Is the carpet the only possible culprit?

### **Case Study Four**

You are the owner of an up-and-coming nail salon that is located with several other tenants in a 30-year-old office building located in an area with lots of empty rental spaces. You also own another business which has been in the building for five years. In addition, for two years you have acted as the Florida-residing, absentee landlord's representative to the other tenants. Ever since your nail salon opened you have been barraged with odor complaints from three tenants -- including a dentist, whose patients periodically complain of strong odors, and from personnel in the office of a small construction firm. The landlord has heard rumors of at least two tenants threatening to move out.

The dentist calls in the Division of Safety & Hygiene; their investigator, granted access by you, finds 2,000 ppm carbon dioxide in all areas of the building but no solvent levels in your nail shop in excess of what OSHA allows. Also, she finds no evidence of a fresh air supply in the building's HVAC system. She recommends that an HVAC maintenance vendor be called in to see what options are available. She does mention that a local exhaust system at all five of the salon nail benches might be appropriate to control the smells. You are afraid to think how much that might cost. The landlord and you are relieved that no OSHA chemical exposure violations were found.

Meanwhile, the HVAC vendor brings in a company rep who says he can sell, for only \$1,200, an ozone generator which will, by producing small amounts of ozone, essentially neutralize all the solvent vapors created by your nail technicians. Its cost turns out to be about 20 to 30 percent of what you'd be charged for a local exhaust capture system. He has product literature which backs his claims. The State's industrial hygienist must be restrained when she hears of this device.

- Use the AREC model.
- What do you do?
- And what's with that hygienist, anyway?

RESOURCES



### **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
<b>Mold Basics</b> Why is mold growing in my home? Can mold cause health problems? How do I get rid of mold?	2 2 3
Mold Cleanup Who should do the cleanup?	4
Mold Cleanup Guidelines	6
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## 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.

Why is mold growing in my home? Molds are part of the



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

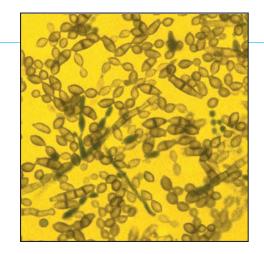
natural environment. Outdoors, molds play a part in nature by breaking down dead organic matter such as fallen leaves and dead trees, but indoors, mold growth should be avoided. Molds reproduce by means of tiny spores; the spores are invisible to the naked eye and float through outdoor and indoor air. 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.

**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 moldallergic 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.



Magnified mold spores.

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.

## LEANUP



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 Hygenists (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.



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



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.

Mold growing on the surface of a unit ventilator.

- 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 preceeding 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



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

local, state, or federal health or housing authorities.

**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



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



#### Acknowledgements

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

