Recovery From Floods: Basic Principles and Practices for Mold Control
Dr. Lynne Sehulster, Centers for Disease Control, Atlanta
A Webber Training Teleclass

Recovery From Floods:
Basic Principles and Practices for Mold Control and Structural Remediation

Lynne Sehulster, PhD, M(ASCP)
Health Scientist
CDC Division of Healthcare Quality Promotion

Hosted by Jim Gauthier, MLT, CIC
Providence Care, Kingston, Ontario

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National Center for Emerging and Zoonotic Infectious Diseases

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The findings and conclusions in this presentation are those of the author and her information resources and do not necessarily represent any determination or policy of the Centers for Disease Control and Prevention (CDC).

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QUESTION: WHY ARE WE HERE?

Answer: Because of This

Recent Floods in the U.S.

- 1997 – Grand Forks, ND
- 1999 – North Carolina (Hurricane Floyd)
- 2005 – New Orleans, LA and Gulf Coast (Hurricanes Katrina, Rita)
- 2008 – Galveston, TX (Hurricane Ike)
- 2009 – Western and Eastern suburban Atlanta, GA
- 2010 – Iowa
- 2010 – Nashville, TN
- 2011 – anticipated flooding due to heavier than normal snowfall (near major river valleys)

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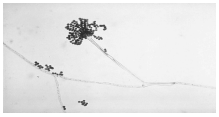
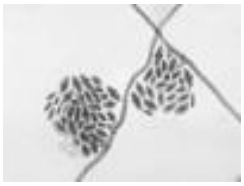
Some Facts About Mold

- ~ 100,000 species of fungi; only ~ 500 are pathogenic for man
- Multicellular organisms with filamentous structures, spores
- Ubiquitous in nature, visible growth
- Grow on any organic substance as long as oxygen and moisture are available
  - Wood, paper, carpet, foods, insulation, any building material containing cellulose, paint

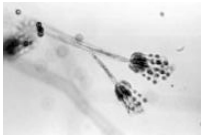
Molds in the Indoor Environment



***Aspergillus* sp.**



***Cladosporium* sp.**

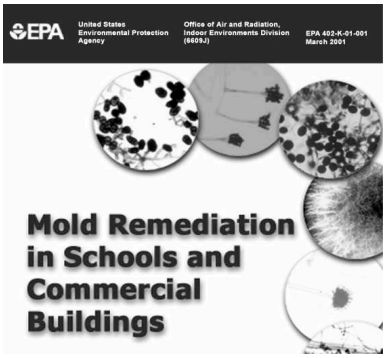


***Penicillium* sp.**

Photos' Source: CDC PHIL

Factors That Affect Mold Growth

- Two principal factors: MOISTURE and NUTRIENTS
- Presence of moisture inside the building envelope:
  - Uncontrolled humidity and inadequate ventilation
  - Roof leaks, landscaping, gutters that direct water into or under buildings
  - Temperature problems, excessive condensation
- Additional nutrient substrates:
  - Drywall, dust, wallpaper, upholstery
- Expect mold growth when building materials remain wet for > 48-72 hrs.



Mold Problems May Not Always Be Readily Evident

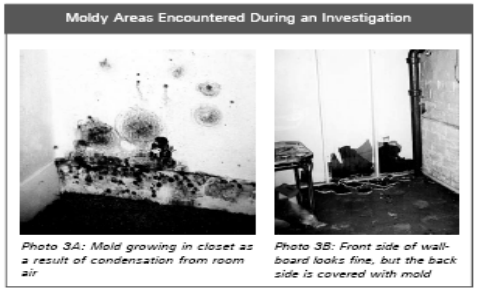


Photo source: EPA

Routine Mold Prevention Steps

- Identify and fix water leaks in roofs, plumbing as quickly as possible
- Maintain low indoor humidity, < 60% RH
  - Ideal indoor humidity range is 30 – 50%
- Perform regular maintenance on HVAC system
  - Ensure drip pans are clean and flowing properly
- Watch for condensation problem areas
  - Laundry, central sterile dept., kitchen, areas and/or pipes that are poorly insulated, boilers

Indirect Signs That Mold May be Present

- Many molds give off volatile organic compounds (VOCs)
- Particles counts and Rank-Order Analysis:
  - Fungal spores < 0.5 µm in diameter
  - Take a particle count of outdoor air (O)
  - Take a particle count in the room/area where you suspect the presence of mold (I)
  - Note the HVAC filtration % for the area (e.g., 90%)
  - Compare the indoor count (I) to what remains in outdoor air after filtration

Planning for Mold Remediation

- Designate a remediation manager
- Assess the extent of the damage and needed remediation; professional remediation contractor may be needed for medium – large recovery
- Determine the source of the water intrusion
  - If the source is a water leak, make the repair
- Determine what PPE and containment is appropriate

Begin the Mold Remediation

- First step: remove free-standing water
- Assess the extent of water damage
  - Visual inspection
  - Estimate interior damage (interwall spaces, between floors, etc.)
- Focus on materials containing cellulose
- Assess the HVAC system
  - Check for damp filters, dampness in the ductwork
- Useful tools: moisture meters, boroscopes

Personal Protective Equipment (PPE)

- Do not touch mold or moldy items with bare hands
- Minimize aerosol production if possible
- Consider PPE when disturbing mold due to clean water intrusion
- Threshold Limit Values (TLVs) for airborne conc. of molds have not been set
- Level of personal protection is generally based on the total surface area contaminated
- Professional judgment is important
- PPE is required (OSHA) when water source is sewage or contains chemical and/or biological pollutants

Personal Protective Equipment (PPE)

- Minimum:
  - Gloves, N-95 respirator, goggles/eye protection
- Limited:
  - Gloves, N-95 respirator or half-face respirator with HEPA filter, disposable overalls, goggles/eye protection
- Full:
  - Gloves, disposable full body clothing, head gear, foot coverings, full-face respirator with HEPA filter

Keep or Toss?

- Building materials, furniture, objects that were in standing water must be dried out within 48 – 72 hours
- If mold growth is visible and/or the material or item is still wet, it is prudent to toss or remove, especially if the material is a porous building material
- Moisture meter readings should be < 20%

Photo 9: Moisture meter measuring moisture content of plywood subfloor

Photo source: EPA

Remove or Disinfect?

- Goal of remediation is to remove the mold to prevent human exposure and damage to building materials
- Disinfection will kill mold, but not remove it
  - Dead mold can be allergenic, potentially toxic
- Bleach is not the only chemical option
  - Bleach may not be compatible with some surface materials; check label instructions
- EPA-registered biocides
  - Some states may require licensed, registered pesticide applicators
  - Do not use fungicides intended for outdoor applications for indoor mold remediation

Table 2: Guidelines for Remediating Building Materials with Mold Growth Caused by Clean Water*

Material or Furnishing Affected	Cleanup Methods†	Personal Protective Equipment	Containment
SMALL – Total Surface Area Affected Less Than 10 square feet (ft²)			
Books and papers	3	Minimum N-95 respirator, gloves, and goggles	None required
Carpet and backing	1, 3		
Concrete or cinder block	1, 3		
Hard surface, porous flooring (linoleum, ceramic tile, vinyl)	1, 2, 3		
Non-porous, hard surfaces (plastics, metals)	1, 2, 3		
Upholstered furniture & drapes	1, 3		
Wallboard (drywall and gypsum board)	3		
Wood surfaces	1, 2, 3		

Cleaning methods: 1) Wet vacuum; 2) Damp-wipe; 3) HEPA vacuum after materials have dried. Source: EPA

Table 2: Guidelines for Remediating Building Materials with Mold Growth Caused by Clean Water*

MEDIUM – Total Surface Area Affected Between 10 and 100 (ft²)			
Books and papers	3	Limited or Full Use professional judgment, consider potential for remediator exposure and size of contaminated area	Limited Use professional judgment, consider potential for remediator/occupant exposure and size of contaminated area
Carpet and backing	1, 3, 4		
Concrete or cinder block	1, 3		
Hard surface, porous flooring (linoleum, ceramic tile, vinyl)	1, 2, 3		
Non-porous, hard surfaces (plastics, metals)	1, 2, 3		
Upholstered furniture & drapes	1, 3, 4		
Wallboard (drywall and gypsum board)	3, 4		
Wood surfaces	1, 2, 3		

Cleaning methods: 1) Wet vacuum; 2) Damp-wipe; 3) HEPA vacuum after materials have dried; 4) Discard
Source: EPA

Table 2: Guidelines for Remediating Building Materials with Mold Growth Caused by Clean Water*

LARGE – Total Surface Area Affected Greater Than 100 (ft²) or Potential for Increased Occupant or Remediator Exposure During Remediation Estimated to be Significant			
Books and papers	3	Full Use professional judgment, consider potential for remediator exposure and size of contaminated area	Full Use professional judgment, consider potential for remediator/occupant exposure and size of contaminated area
Carpet and backing	1, 3, 4		
Concrete or cinder block	1, 3		
Hard surface, porous flooring (linoleum, ceramic tile, vinyl)	1, 2, 3, 4		
Non-porous, hard surfaces (plastics, metals)	1, 2, 3		
Upholstered furniture & drapes	1, 3, 4		
Wallboard (drywall and gypsum board)	3, 4		
Wood surfaces	1, 2, 3, 4		

Cleaning methods: 1) Wet vacuum; 2) Damp-wipe; 3) HEPA vacuum after materials have dried; 4) Discard Source: EPA

Cleanup Method Details

- Method 1: Wet vacuum
  - Some mold spores may remain in porous materials, but this should not pose a problem if the material is thoroughly dried out
  - Steam cleaning is alternative for carpeting and upholstered furniture
- Method 2: Damp-wipe
  - Wipe hard surfaces with water or water + detergent; scrub to remove mold
  - Wood cleaner used on wood surfaces
- Method 3: HEPA vacuum
  - Use after materials have been thoroughly dried
  - Dispose vacuum bag contents in well-sealed plastic bags
- Method 4: Discard
  - Remove water-damaged materials in sealed plastic bags while in Containment (if present)
  - Discard as routine solid waste
  - HEPA vacuum the area after it is dried

Containment

- Limited:
  - Polyethylene sheeting ceiling to floor around affected area with slit entry and covering flap
  - Maintain negative pressure in the area with HEPA-filtered fan unit
  - Block supply and return air vents in the area
- Full:
  - Two layers of fire-retardant polyethylene sheeting with one airlock chamber
  - Maintain negative pressure in the area with HEPA-filtered fan exhausted to the outside
  - Block supply and return air vents in the area

Should You Do Environmental Sampling?

- In general – No
  - Visual assessment generally sufficient to guide remediation
- Sampling, if conducted, should have a defined purpose/objective
  - Air, water, surfaces, dust
- Air sampling is the one most frequently done
- No health-based standards exist
  - Readings will vary with the seasons, weather, type of building structure, type of sampling devices, methods

How Do You Know When The Job is Finished?

- The water source or moisture problem is completely fixed/removed
- Complete mold removal: visible mold, mold-damaged materials and odors should not be present
- If air sampling was done, readings indoors should reflect impact of filtration percentage relative to outdoor particulate readings.
- Mold growth should not re-occur
- Occupants should report no health complaints or physical symptoms
- It's a judgment call in the end

EPA Resources for Table 2

- Table 2 was developed from:
  - *Bioaerosols: Assessment and Control* (ACGIH, 1999)
  - *IICRC S500: Standard and Reference Guide for Professional Water Damage Restoration* (IICR, 1999)

Photo source: CDC - MMWR

For More Information

- EPA: Mold Remediation in Schools and Commercial Buildings: http://www.epa.gov/mold/pdfs/moldremediation.pdf
- NIOSH: Update – NIOSH Warns of Hazards of Flood Cleanup Work: http://www.cdc.gov/niosh/docs/94-123/
- CDC: MMWR – Mold Prevention Strategies and Possible Health Effects in the Aftermath of Hurricanes and Major Floods: http://www.cdc.gov/mmwr/PDF/rr/rr5508.pdf
- Institute of Inspection, Cleaning, and Restoration: IICRC S520 – Standard and Reference Guide for Professional Mold Remediation: http://iicrc.org

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First-line resource for remediation information:

EPA: Indoor Environments Division

Thank You!

For more information please contact Centers for Disease Control and Prevention
1600 Clifton Road NE, Atlanta, GA 30333
Telephone, 1-800-CDC-INFO (232-4636)/TTY: 1-888-232-6348
E-mail: cdcinfo@cdc.gov Web: www.cdc.gov

National Center for Emerging and Zoonotic Infectious Diseases

COMING SOON …

22 Mar. 11	*(Free Teleclass)* **Voices of CHICA – Part 1** Speaker: Community and Hospital Infection Control Association Board
06 Apr. 11	*(Free WHO Teleclass)* **Hand Hygiene Education and Monitoring: Returning to the WHO "My Five Moments" Concept** Speaker: Dr. Hugo Sax, University of Geneva Hospitals Sponsored by: WHO Patient Safety Challenge (www.who.int/gpsc/en)
07 Apr. 11	**The Outbreak Database – A Tool for Hospital Epidemiologists** Speaker: Prof. Ralf-Peter Vonberg, Hanover Medical School, Germany
12 Apr. 11	*(Free British Teleclass)* **Voices of the IPS** Speaker: Infection Prevention Society Board
13 Apr. 11	*(South Pacific Teleclass)* **Prevention of Surgical Site Infections** Speaker: Dr. Matthias Maliwald, KK Women's and Children's Hospital, Singapore
14 Apr. 11	**Healthcare-Associated Infection Prevention Bundles – Preventing The Preventable** Speaker: Dr. William Jarvis, Jason & Jarvis Associates

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