Remediation Overview: Regulations, Guidelines Approaches.... Where to begin?

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USA Weekend Cover Stories

MOLD: IS YOUR APARTMENT BUILDING INFECTED?

Memory loss, Dizziness, Asthma. Those are just some of the ailments renters are experiencing as they join the battle against this toxic, microscopic enemy.
National Expenditures for IAQ Problem Prevention or Mitigation
(LBNL – 58694, June 2005)

- $15.9 billion annual business (range $12-20 billion)
  - Air cleaning and improved filtration...........$1.5 billion
  - IAQ Consultant services......................$2.1 billion
  - Building Remediation.........................$3.4 billion
  - Duct Cleaning..................................$ 4 billion
  - Asbestos/lead abatement......................$ 4 billion
  - IAQ litigation/insurance......................$500 million
  - Radon Mitigation...............................$200 million
  - Certification/labeling.......................$100 million
  - Laboratory Services.........................$100 million
Goal of Mold Remediation

- To remove or clean mold-damaged materials using work practices that protect occupants by controlling the dispersion of mold from the work area and protect remediation workers from exposures to mold.

NYC Dept of Health 2008
Remediation guidance

- Progression or evolution encompasses some of the following factors:
  - Amount of mold
  - Specific types of organisms present
  - Location or distribution of mold
  - Types of materials affected
  - Extent of degradation
  - PPE consideration
  - Training/competency
  - Type of buildings and occupants

Photo by T Brennan, Camroden Assoc

Chapter 17 AIHA Green Book
New York City Department of Health (1993)

- Guidelines for Assessment and Remediation of Stachybotrys atra
- Four levels of contamination:
  - Level I: areas less than 2 ft\(^2\)
  - Level II: 2-30 ft\(^2\)
  - Level III: areas exceeding 30 ft\(^2\)
  - Level IV: for remediation of HVAC equipment

(Level III & IV: Require full containment with negative air pressure, isolation of heating, ventilation, air condition HVAC, and dermal & respiratory protection for workers)
Health Canada (1995)

- **Fungal Contamination in Buildings: A Guide to Recognition and Management**

- Three levels of remediation by extent of visible mold
  - **Level I:** less than 3.23 ft² (0.3 m²)
    - No containment; use of mask & gloves & trained personnel
  - **Level II:** 3.23-30 ft² (0.3-3.0 m²)
    - No containment; require half-face respirators & gloves
  - **Level III:** greater than 108 ft² (10 m²)
    - Full containment w/ high-efficiency particulate air (HEPA), filtered exhaust air, critical barriers, and airlocks
    - Visible mold 3 m²-10 m² (level II & III) not addressed
International Society of Indoor Air Quality and Climate (1996)

- Guideline TFI-1996 – Control of Moisture Problems Affecting Biological Indoor Air Quality
- Three levels of remediation:
  - **Level I**: less than 2.15 ft² (0.2 m²)
    - No specific recommendations
  - **Level II**: 2.1-32.3 ft² (0.2-3.0 m²)
    - Local containment w/ HEPA filtered exhaust air, bagging of refuse, and proper respiratory protection
  - **Level III**: greater than 32.3 ft² (3.0 m²)
    - Full containment w/ critical barriers, air locks, HVAC protection, full-face HEPA respirator, coveralls & eye protection
American Conference of Governmental Industrial Hygienists (1999)

- Recommended removal & containment precautions specified for toxigenic fungi be used as general rule “Virtually all fungi can cause allergy (in sensitized individuals) and many fungi produce toxins.”
- Three levels of visible fungal growth:
  - **Minimal growth:** requires source containment with N-95 respirators & gloves
  - **Moderate growth:** requires local containment with N-95 respirator, enclosures, negative air, full-body covering
  - **Extensive contamination:** full containment with critical barriers, negative air & trained personnel
  - **Dimensions not specified – professional judgment.**
NYCDOH (2000)

- NYCDOH updated its ’93 Guidelines by expanding the scope to include the growth of all indoor molds
- Criteria for extent of contamination revised:
  - **Level I**: areas smaller than 10 ft²
    - Areas vacated, dust suppression methods used, N-95 respirator
  - **Level II**: 10-30 ft²
    - Area covered with polyethylene, HEPA vacuumed, N-95 respirator
  - **Level III**: 30-100 ft²
    - Sealing HVAC system, negative pressure enclosure w/ HEPA filtered exhaust air, N-95 respirator recommended
  - **Level IV**: greater than 100 ft²
    - Oversight by H&S professional, full containment with critical barriers, full-face HEPA-filtered respirators
Mold Remediation in Schools and Commercial Buildings

Addresses “Hidden Mold” – concealed from view

Three levels of containment:

- **Level I:** less than 10 ft²
  - No containment required; requires N-95 respirator

- **Level II:** 10-100 ft²
  - Poly sheeting around area, HEPA filtered exhaust air, blocked HVAC openings, N-95 respirator, coveralls, eye protection

- **Level III:** greater than 100 ft²
  - Full containment w/ critical barriers & airlocks, full-face HEPA filtered respirator, coveralls & eye protection
American Industrial Hygiene Association (2001)

- Report of the Microbial Growth Task Force
- Considered issues that affect selection of containment:
  - Possibility of hidden mold, density of growth, presence of reservoirs of settled spores
- Combine professional judgment w/ guidance on worker protection from NYCDOH 2000 & ACGIH 1999

- **Guide for Housing Authorities in Indian Countries**
  - Summary or common problems & general cleanup procedures
  - Homeowners & renters capable of handling moldy areas less than 10 ft²
  - Use of N95 respirator, eye protection, long gloves & disposable clothes encouraged

- Untrained workers using appropriate PPE considered competent to remediate areas with minimal growth
U.S. Occupational Safety & Health Administration (2003)

- Brief Guide to Mold in the Workplace
- Emphasizes need for professional judgment & flexibility when applying guidelines
  - **Level I:** small isolated areas – 10 ft² or less
    - N-95 respirators, gloves, and eye protection recommended
  - **Level II:** 10-30 ft²
    - Dust suppression methods, HEPA vacuuming & plastic containment barrier
  - **Level III:** 30-100 ft²
    - Consultation & oversight from IH or H&S professionals; trained remediation consultants; sealing of ventilation ducts/grills & containment
  - **Level IV:** greater than 100 ft²
    - Extensive precautions: use of full-face HEPA respirator, negative pressure containment w/ airlocks & decontamination room

- Guidelines based on universal precautions & controlled conditions (professional judgment)
- **Level I:** areas less than 1 m² (10 ft²)
  - N-95 respirator, disposable coveralls, gloves & boots
- **Level II:** 1-10 m² (10-100 ft²)
  - Negative pressure isolation & H&S professional
- **Level III:** greater than 10 m² (100 ft²)
  - Full-face air purifying respirator (APR) with P100 filters, decontamination area for negative pressure enclosure
Institute of Inspection, Cleaning and Restoration, IICRC (2003)

- **Standard and Reference Guide S520 for Professional Mold Remediation**
- General guidance defines mold contamination ranging from normal fungal ecology to active growth (no action levels or procedures based on area)
- **Professional judgment** required based primarily on:
  - Extent and ecology of mold growth
  - Location of mold growth
  - Sensitivity of the occupant population

- Competent Professional
  - Minimum qualifications and competencies
  - Assessment, planning, oversight of remediation
- Includes more detail on:
  - Worker protection
  - Building occupants (types)
NYC DOH Guidelines 2008

- ‘Environmental sampling is not usually necessary to proceed with remediation of visually identified mold growth or water-damaged materials.’
- ‘In all situations, the underlying moisture problem must be corrected to prevent recurring mold growth.’
- Stress immediate drying and managing water-damaged materials
NYC DOH Guidelines 2008

- For bldg owners/mgrs, env contractors/consultants; includes summary fact sheet for quick reference
- Includes hidden mold (crawlspace, attics, behind wallboard)
- **Level I:** areas less than 1 m² (10 ft²); (trained bldg staff)
  - N-95 respirator, gloves, eye protection
- **Level II:** 1-10 m² (10-100 ft²); (trained bldg staff)
  - Seal ductwork; cover floor and pathways w/ plastic sheeting
- **Level III:** greater than 10 m² (100 ft²); (Trained professionals)
  - Min’m of ½ faced respirators w/ P-100 filters; fill body cover, gloves, eyes; , negative pressure enclosure and isolation suggested
Hidden Mold; need to remediate?

- Emerging consensus is hidden mold should be effectively cleaned or removed
- AIHA, Health Canada, NYCDOH, CMHC, US EPA, FEMA have all referenced growth in wall cavities as potential health problem and recommend inclusion in remediation plans
- Final decision to remediate hidden mold may be based on proximity to occupied areas and occupancies of high risk (viability and taxa not pivotal to decision)
• *Damp Indoor Spaces and Health* (2004)
• Focus on moisture
• Compared 7 published mold guidelines: “Guidance for containment and worker protection lack clarity within and between documents”; often subjective
• Because of lack of dose-response relationship, approach depends more on the “magnitude” of contamination”

*Wide range of occupant susceptibility*
Mold/Moisture Damage & Health

Key visual characteristics:
• Size of damage
• Location of damage
• Duration of damage
• Damaged material type


Guidance to date based primarily on extent of visible mold growth
*(experience and judgment emphasized)*
Shifting Focus

- Health Canada’s *Fungal Contamination in Public Buildings: Health Effects and Investigation Methods* (2004) expanded the definition of “remediation” to include *the elimination of the building defect (moisture problem)* that allowed mold growth to occur.
WHO guidelines for indoor air quality: dampness and mould (2009)

- Dampness/microbial growth may result in greater numbers of spores, cell fragments, allergens, mycotoxins, endotoxins, β-glucans and volatile organic compounds in indoor air.

- **Persistent dampness and microbial growth on interior surfaces and in building structures should be avoided** or minimized, as they may lead to adverse health effects.

AIHA 2008: Recognition, Evaluation, and Control of Indoor Mold

- Comprehensive guidelines written by practitioners, govt personnel, and scientists
- Attention paid to moisture and mold damaged areas on remediation efforts
- General mold remediation guidelines follow Canadian Construction guidance
- Attention to type of buildings and occupancy
- Professional judgment emphasized
The definition of moisture damage used here follows that presented by the ISIAQ Task Force IX, 2002:

**Damage caused by unwanted moisture (air humidity / dampness / liquid water / ice) in building structures or on the surfaces of building materials**
# Cleanup Based on MOISTURE Damage

**Table 16.1 Cleanup Matrix Based on Severity of Moisture Damage/Dampness in Room or Zone**

<table>
<thead>
<tr>
<th>Response Actions</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fix moisture problem and dry building immediately. Problem typically can be resolved by building operator (including homeowner) or building maintenance personnel.</td>
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<td>Visible signs of moisture damage on non-biodegradable materials should be removed/cleaned using mild detergent solution.</td>
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<td>Damaged biodegradable materials, especially those left wet for a prolonged period (&gt; 48–72 hr) should be professionally cleaned or discarded.</td>
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Examples of Low/High Severity Designation

LOW

- Minor slow water intrusion or spillage of water (e.g., small leaks in water lines, water seeping through building envelope, periodic moisture accumulation from convection/diffusion)
- No hidden damage suspected;
- Damage on resistant building material
- No odors
- Localized damage

*Photo courtesy of R Shaughnessy, Univ of Tulsa*
Water Damage Plaster Ceiling

Photo courtesy of R Shaughnessy, Univ of Tulsa
Paint Flaking

Photos courtesy of R Shaughnessy, Univ of Tulsa
Shower Patching

Photo courtesy of Carl Grimes, Healthy Habitats, Inc
Cracked Baseboard
Water Marks Ducting

Photo courtesy of Carl Grimes, Healthy Habitats, Inc
Damage from Water Intrusion from Shower on Opposite Side of Wall

Photos courtesy of R Shaughnessy, Univ of Tulsa
Water seepage and efflorescence

Photo by R Shaughnessy
Examples of Low/High Severity Designation

**HIGH**

- Massive powerful water leakage
- Possibility of hidden damage (e.g., closed cavity space with possible air leakage to indoor spaces)
- Damage on susceptible building material
- Odorous materials (MVOCs)
- Building-wide problem

Flooding from Hurricane Ike Saturday, Sept. 13, 2008. (AP Photo/Richard Alan Hannon, pool)
Large area of Ceiling Discoloration

Photo courtesy of Carl Grimes, Healthy Habitats, Inc
Interstitial Wall Base Track

Photo courtesy of Carl Grimes, Healthy Habitats, Inc
EIFS Rot

Photo courtesy of Carl Grimes, Healthy Habitats, Inc.
Baseboard Damage

Photo courtesy of Carl Grimes, Health Habitats, Inc
Greenboard: resistant to growth?
(normal paper covered gypsum w/ silicone spray on coating)
Floor Expansion

Photo courtesy of Carl Grimes, HealthyHabitats, Inc
Floor Expansion

Photo by W. Turner, HL Turner Group
Moisture absorbed by gypsum; 24 hours after exposure

Mold growth 96 hours after exposure

Photo by R Baker, BBJ Chem
If Mold Contamination is Present......
### Table 16.3 Mold Cleanup Matrix Based on Severity of Mold Colonization in Room or Zone

<table>
<thead>
<tr>
<th>Severity of Mold Colonization</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response Actions</td>
<td></td>
</tr>
<tr>
<td>Actions can be carried out by</td>
<td></td>
</tr>
<tr>
<td>appropriately trained building personnel.</td>
<td></td>
</tr>
<tr>
<td>N95 minimum respirator</td>
<td></td>
</tr>
<tr>
<td>Eye protection</td>
<td></td>
</tr>
<tr>
<td>Gloves protection (suitable to work being performed); disposable overall/boots may be considered based on situation</td>
<td></td>
</tr>
<tr>
<td>Turn off HVAC system (place plastic sheeting on diffusers &amp; return air openings)</td>
<td></td>
</tr>
<tr>
<td>HEPA vac nonporous items, followed with cleaning detergent/disinfectant solution. If further remediation is needed, remove cleaned items from the space; if fixed items, seal all polyethylene sheeting to protect during subsequent work.</td>
<td></td>
</tr>
<tr>
<td>Remove porous visually moldy materials (e.g., ceiling tile); remove gypsum wallboard a minimum of 30 cm beyond demarcation line of visible growth.</td>
<td></td>
</tr>
<tr>
<td>For moldy items being removed, consider placing drop cloth under the material; dust suppression methods should be considered.</td>
<td></td>
</tr>
<tr>
<td>Bag all waste into 6 mil minimum disposable bags for removal; wet wipe/HEPA vac the plastic bag and then double bag for final removal.</td>
<td></td>
</tr>
<tr>
<td>After bulk removal of material, damp wipe exposed surfaces in the room; consider HEPA vacuuming of surfaces when necessary.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response Actions</td>
<td></td>
</tr>
<tr>
<td>Industrial hygienist (IH) or indoor environmental professional (IEP) experienced in mold remediation should be consulted to provide oversight during remediation activities.</td>
<td></td>
</tr>
<tr>
<td>Competent supervisor to be present during all work; should be capable of inspecting work area for defective containments.</td>
<td></td>
</tr>
<tr>
<td>Full-body dust impervious coverall; eye protection; N95 respirator minimum, with full face HEPA air-purifying respirator (APR) recommended.</td>
<td></td>
</tr>
<tr>
<td>Isolate the work area w/polyethylene sheeting, taped and supported as needed; provide for containment roof as needed; use polyethylene sheeting for floor covering.</td>
<td></td>
</tr>
<tr>
<td>Induce a minimum negative pressure within the enclosure of 5 pascal (0.22 inches water column) by drawing air from enclosure using (a) exhaust fan directing air from within enclosure to outdoors (away from people) or (b) HEPA air filtration device (negative air machine), exhausting air to outside of enclosure preferably to outdoors if possible.</td>
<td></td>
</tr>
<tr>
<td>Consider use of a single chamber airlock at entry to containment area; ensure airlock is under negative pressure with respect to occupied areas of building, and under positive pressure with respect to containment work area.</td>
<td></td>
</tr>
<tr>
<td>IH or IEP experienced in mold remediation must be consulted to provide oversight and inspection prior to and during remediation activities. The IH or IEP must determine the exact containment methodology based on the following recommendations.</td>
<td></td>
</tr>
<tr>
<td>Workers shall wear impervious gloves and full-body dust-impervious coveralls, with attached hoods, tightly secured with tapes at the ankles and wrists; boot covers that can be cleaned with a HEPA vac; isolate work area using temporary containment measures (taping/polyethylene sheeting; cover all walls with one layer of polyethylene sheeting, taped in place).</td>
<td></td>
</tr>
<tr>
<td>Provide negative pressure within enclosure with HEPA negative air machines; minimum negative pressure of 5 pascal (0.22 inches of water column); design of minimum of 4 air changes per hour within the enclosure area (as described in Reference 4, p. 26, item 6).</td>
<td></td>
</tr>
<tr>
<td>Provide a three-chamber decontamination unit to include clean change room and dirty change room; workers to don all clothing/PPE in clean change room; when exiting, workers must exit thru dirt change room and remove all coveralls, etc., prior to leaving contained area.</td>
<td></td>
</tr>
<tr>
<td>Double bag and seal wastes generated during mold remediation and remove these wastes through the decontamination unit (for more detail refer to Reference 4, p. 26, item 10).</td>
<td></td>
</tr>
</tbody>
</table>

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* See criteria shown in Table 16.4 to make preliminary estimates of the severity of mold contamination within a building.

* High-efficiency particulate air (HEPA) filtration system.

* HEPA filters are high-efficiency particulate air filters that can capture particles as small as 0.1 micrometers and larger.

* HEPA filters are typically used in laboratories and clean rooms to maintain a high level of air purity.
## Criteria to Assess Severity of Mold Contamination Based on Location, Extent & Material

<table>
<thead>
<tr>
<th>LOW SEVERITY</th>
<th>MEDIUM SEVERITY</th>
<th>HIGH SEVERITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderately close, less extensive, resistant</td>
<td>Close, moderately extensive, resistant</td>
<td>Close, extensive, susceptible</td>
</tr>
<tr>
<td>Distant, moderately extensive, resistant</td>
<td>Close, less extensive, susceptible</td>
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<td></td>
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</tbody>
</table>
LOCATION

3 Categories for mold damage observations are formed primarily based on proximity to occupants:

- **Distant locations** (hallways, closets, storage rooms, garages, basements, crawlspaces).
- **Moderately close** to occupants (bathrooms and kitchens) where people normally spend less than an hour/day.
- **Close proximity** to occupants (classrooms, offices, bedrooms) where people spend the most time.
3 Categories are formed based on estimated size of damage (in m^2); size designations are not meant to be exact determinants, but rather approximations based on professional judgment:

- Less extensive (<1 m^2).
- Moderately extensive (1-10 m^2).
- Extensive (>10 m^2).
MATERIAL Type

2 Categories of Materials

- **Susceptible** (poor at resisting moisture and provides nutrients for microbes; subject to structural damage or failure)
  - Wood
  - Gypsum board
  - Amorphous cellulose products
  - Fiberboard

- **Resistant** (low in nutrients/inert)
  - Concrete
  - Brick
  - Metal surfaces
  - Terracotta and ceramic tiles

Photo courtesy of Richard Shaughnessy, University of Tulsa
Case Examples of Low, Medium & High Severity Categories

LOW SEVERITY CASE

Distant, less extensive, susceptible material

Photo courtesy of Richard Shaughnessy, University of Tulsa
MEDIUM SEVERITY CASE

Close, less extensive, susceptible material

Photo courtesy of Richard Shaughnessy, University of Tulsa
Case Examples of Low, Medium & High Severity Categories

HIGH SEVERITY CASE

Close, extensive, susceptible material
Mould Industry Standards & Guidelines

- Since publication of AIHA Mould Book (2008)
  - NYC DOH Guidelines (updated 2008)
  - EACO Mould Abatement Guidelines (updated 2010)
  - OSHA – A Brief Guide to Mold in the Workplace (March, 2010)
  - NY State Toxic Mold Task Force (2010)
  - ACOEM Mold Position Statement (March, 2011)
Mould Industry Standards & Guidelines

- Since publication of AIHA Mould Book (2008) (cont’d)
  - UFGS – Mold Remediation Specification (May, 2011)
  - CDC – Dampness and Mold in Buildings (May, 2011)
  - AIHA – Revised Facts of Mold for Consumers and Professionals (2011)
  - NIOSH – Preventing Occupational Respiratory Diseases from Exposures caused by Dampness in Office Buildings, Schools and other Non-Industrial Buildings (March, 2011)
Mould Industry Standards & Guidelines

Coming up soon......

- LEED 2012
  - Ballot delayed until Jun 2013
  - No specific requirements for mold at this time
Roles & Communication

- Address Outrage
- Not Just Risk
- Empathetic
- Listen
- Err on Side of Caution
- Adjust for building type
Single-family owner-occupied home
Professional Judgment to be Exercised:
-Making “informed” decision based on all information-