Mold in Commercial Buildings:

What you should know and look for

Presented by

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Course Agenda

- What is Mold
- What to look for
- How to respond to a mold problem
- Why is mold considered a public health problem
- Why do we worry about mold in buildings
- What workplace regulations exist

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Overview of Mold Contamination in Buildings

Mycology Review :Terms and Definitions

- ***Mycology*** **(from the Greek word *mykes* = mushroom) is the study of fungi.**
- ***Fungi*** **is a taxonomical (scientific) term. Fungi constitute there own kingdom (parallel to e.g. plants, animals, bacteria, protozoa). 69,000 described species but estimates of > 1.5 million species.**

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Overview of Mold Contamination in Buildings

Mycology Review : Terms and Definitions:

- ***Mold*** **describes fungi that typically grows on surfaces of building materials and food.**
- ***Mildew*** **typically describes plant parasitic fungi. (Plant diseases).**
- ***Wood destroying/decaying fungi*** **capable of growing inside wood causing decay or rot**
- ***Wood staining fungi*** **fungi that are able to penetrate deep into the wood causing discoloration.**

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Overview of Mold Contamination in Buildings

Mycology Review : Terms and Definitions:

- Conidia / Spores
- Conidiophores
- Hyphae
- Mycelium
- Yeast

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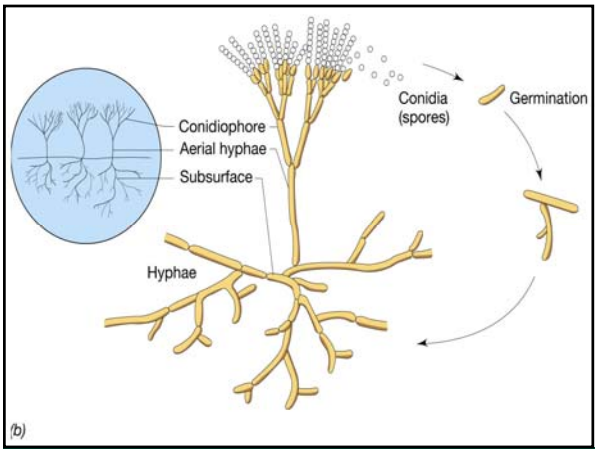

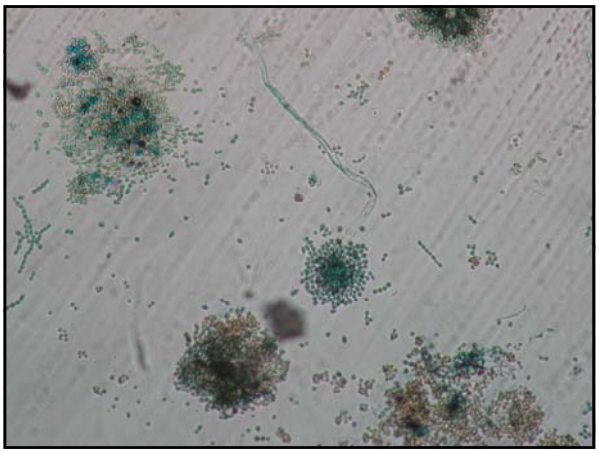

Overview of Mold Contamination in Buildings

Environmental conditions:

- Moist (water availability, water activity) Aw > 0.8
- pH 2-8
- Nutrition – organic material
- Temperature (1-35 ºC)(1-55 ºC)

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Overview of Mold Contamination in Buildings

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Overview of Mold Contamination in Buildings

- How Do Fungi Enter Buildings
  - Construction
  - Materials
  - Tracked-in Dirt
  - Air Infiltration

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Sampling for Mold

Normal background level for mold in air.

Indoor air median: 80 CFU/m^3
(ranging from: BDL to > 10,000 CFU/m^3).

Outdoor air median: 500 CFU/m^3
(ranging from: BDL to > 10,000 CFU/m^3).

(Applied and Environmental Microbiology 2002, 1743-1753)

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Sampling for Mold

Normal background level for mold in dust:

20,000 – 50,000 CFU/g dust
(EU report, 1994)

12,000 –65,000 CFU/g dust
(danish research project, 1999-2002)

Danish schools (children 6-10 years)
0.5-2 g dust/m^2 or 6,000 – 130,000 CFU/ m^2

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Overview of Mold Contamination in Buildings

Common Sources of Water Supporting Mold Growth in Buildings

- Condensation
- Water Intrusion, Diffusion
- High Humidity
- Water Damage
- Leaks (i.e. plumbing, roof, slab, gutters)
- Excessive Use of Water for Cleaning

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Overview of Mold Contamination in Buildings

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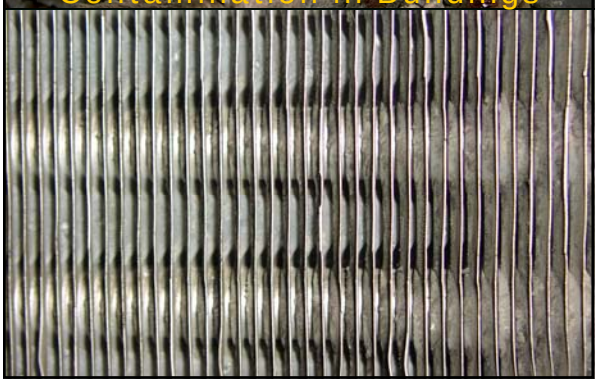

Overview of Mold Contamination in Buildings

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How is Fungal Growth Detected in Buildings ?

- Visible Colonization
- Odors
- Surface Samples (Tools for Documentation)
- Air Samples (Tools for Detection)

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Overview of Mold Contamination in Buildings

Methods Used Today in Mold Remediations

Air-sampling:	Surface-sampling:
Living spores (CFU)	Microscopy
Total spores	Mycometer-test
MVOC´s	Rodac-plates
	Mycotoxins
	PCR (DNA)

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Overview of Mold Contamination in Buildings

Identification of Fungal Species

How many samples for identifying the fungal species present ?

Overview of Mold Contamination in Buildings

Consensus in Three Major US Public Health Organizations: Mold Growth Irrespectable of the Species Pose a Risk of Occupant Exposure and is Unacceptable.

- USEPA
- NYCDOH
- ACGIH
- AIHA

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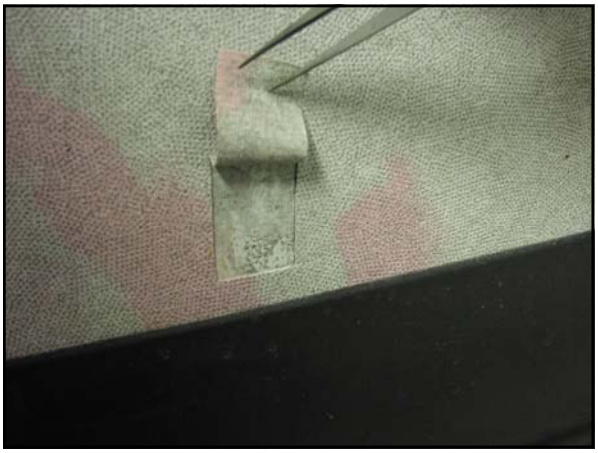

Objectives and Goals of a Mold Assessment

- **Due Diligence Assessment** : To survey and document the presence and location of mold within a building typically part of a building sale, lease or periodic building assessment.

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Objectives and Goals of a Mold Assessment

- **Post-Incident Assessment**: To survey and document the presence and location of mold contamination resulting from an episodic water intrusion incident such as a water pipe leak, roof leak, flooding or storm damage.

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Objectives and Goals of a Mold Assessment

- **Responding to Occupant Complaints**: To survey and document the presence and location of mold contamination in an occupied building in response to occupant complaints, often in response to complaints of odors, health problems, poorly defined illness, a perceived cluster of illness, or visible contamination.

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Objectives and Goals of a Mold Assessment

- **Delineating the Extent of Microbial Contamination**: To document the extent and severity of mold contamination within a building after the presence of mold growth has been confirmed by visual inspection or sample analyses. A delineation assessment is critical before a scope of work for remediation is developed. (ACGIH 12.1.4.2)

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Objectives and Goals of a Mold Assessment

- **Post-Remediation Assessment**: Document the efficacy of mold remediation. This assessment focuses primarily on areas previously found to have mold growth. A survey for residual contaminants on building surfaces.

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Delineating the Extent of Mold Contamination

Defining the Scope of Work

David Krause, MSPH, CIAQP

Delineating the Extent of Mold Contamination

- **Develop an Assessment Strategy**
- **Gather Critical Information concerning the location of mold contamination identified in earlier assessments.**
- **Analyze the building plans**
- **Establish (limit) the scope of assessment**
- **Define the Critical Questions: Critical questions in any delineation assessment revolve around which areas, materials and systems have microbial contamination (i.e. growth) and which do not.**

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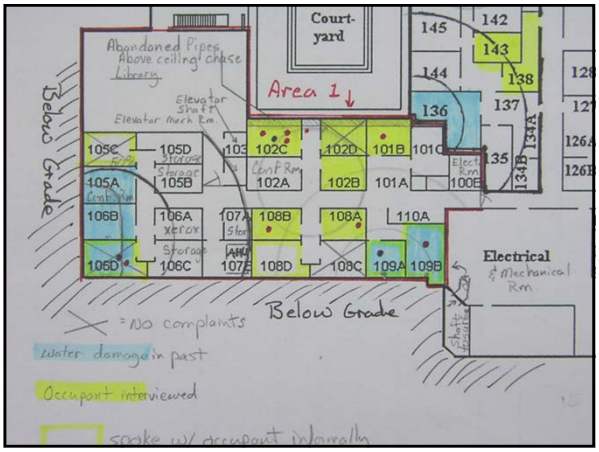

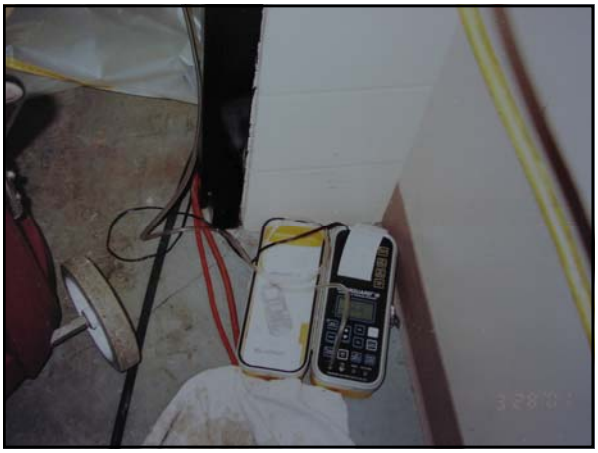

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Post-Remediation Assessment

The Process of Measuring and Verifying Remediation Efficacy

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Reliable Guidance Documents on Mold and its Remediation

Abstract

•A review of criteria and methods recommended for successfully performing and evaluating a mold remediation from the NYC DOH, ACGIH, US EPA, AIHA, OSHA & IICRC reveals several consistent recommendations.

•However all leave a great deal of discretion to professional judgment and offer few specific recommendations for planning, oversight or post-cleaning assessment criteria.

•This section attempts to incorporate the available guidance criteria for project oversight managers into a Planning and Oversight Process that describes developing remediation specifications, establishing post-cleaning assessment criteria and documenting successful remediation of the mold damage and moisture sources.

Guidelines on Assessment and Remediation of Fungi in Indoor Environments

New York City Department of Health *Revised Guidelines on the Assessment and Remediation of Fungi in Indoor Environments* (November 2000)

- The underlying cause of water accumulation must be rectified
- Routine inspections should be conducted to confirm the effectiveness of remediation work
- All materials to be reused should be dry and visibly free from mold
- When the extent of mold-affected building material exceeds 30 ft², or 10 ft² of contamination within an HVAC system, a health and safety professional with experience performing microbial investigations should be consulted prior to remediation activities to provide project oversight
- After remediation of an HVAC system, air monitoring should be conducted prior to re- occupancy with the HVAC system operating

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ACGIH Bioaerosols Committee

Bioaerosols: Assessment and Control (1999)

- Mitigation of the environmental conditions (e.g., water intrusion or high relative humidity) that led to the microbial growth
- Evaluating the degree of visible debris removal
- Post-cleaning air samples of spores and indicator material (e.g. glucan or ergosterol) in the containment zone are qualitatively and quantitatively similar to ambient outdoor air
- Post-cleaning samples of surfaces indicate that only background concentrations and types of fungi are present on porous surfaces
- Concentrations of biological agents in surface samples should be similar to what is found in well-maintained buildings or on construction and finishing building materials.
- The ultimate criterion for the adequacy of abatement efforts to treat biological contamination is the ability of people to re-occupy the area without health complaints or physical discomfort

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Guidance from the US EPA on

Mold Remediation in Schools and Commercial Buildings

(EPA 402-K-01-001) March 2001

- The water or moisture problem is completely fixed
- All visible mold, mold-damaged materials, and moldy odors have been removed
- Once clean-up activities are completed, indoor air samples should be similar to outdoor air samples
- People should be able to re-occupy the area without health complaints or physical symptoms
- Inspection of the area shortly after remediation should not indicate any re-occurrence of water damage or mold re-growth

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AIHA
Report of Microbial Growth Task Force (May 2001)

- The precipitating water or moisture sources have been identified and eliminated
- All (potentially) affected areas have (at least) been (visually) inspected for mold
- Appropriate containment was used throughout the remediation
- Cleaning was performed according to the specifications
- Mold removal (and abatement of mold-damaged materials) was performed according to the approved remediation plan
- The remediated areas were checked for any undetected mold/water damage that may have been revealed during the demolition/cleaning process and it was properly remediated
- The amount of surface dust does not indicate a need for re-cleaning
- The remediated area surfaces were HEPA-vacuumed

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OSHA Safety & Health Information Bulletin 03-10-10:

A Brief Guide to Mold in the Workplace (October 2003)

- How Do You Know When You Have Finished Remediation/Cleanup?

- You must have identified and completely corrected the source of the water or moisture problem.
- Mold removal should be complete. Visible mold, mold-damaged materials, and moldy odors should no longer be present.
- Sampling, if conducted, should show that the level and types of mold and mold spores inside the building are similar to those found outside.
- You should revisit the site(s) after remediation, and it should show no signs of moldy or musty odors, water damage, or mold growth.

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