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CLEANING CONTENTS FROM MOLD-CONTAMINATED ENVIRONMENTS

Mold growth and associated contamination in buildings continues to garner public attention. While the insurance industry is struggling to define payment restrictions, the need for professional, competent mold remediation continues to grow. Fortunately, the remediation industry is advancing to meet the evolving needs related to mold.

Contractors and consultants who are knowledgeable about mold infestation in buildings understand that every mold clean-up project has two components. Much emphasis has been devoted to the remediation of visible mold from building components, including the removal of porous structural and finish materials that support mold growth. Considerably less attention has been given to methods of assessment and control for contents in mold-contaminated environments. However, an increasing awareness of the potential problems that are created when clothes and furnishings are not properly addressed as part of a mold remediation effort is forcing the industry to broaden its approach to mold cases.

Two Bad Examples

A short time ago, our laboratory received a lampshade from a woman who was in the middle of a mold remediation project. The fungal growth in her residence was severe enough that she had been advised to find an alternate living space until the remediation project was completed. Unfortunately, nobody warned her that taking contents from the house to her temporary apartment without proper cleaning could cause cross contamination. Her continuing health problems led to additional research and concern about exposure to the items taken from the contaminated house. The owner's fears were justified by our report. Although there was no visible mold growth on the shade, or even visible dust or dirt, the microvacuum sample revealed a high concentration of spores associated with water-damaged buildings, including *Stachybotrys*.

An even more contentious case involved a contractor who engaged in a mold remediation project without proper assessment or subsequent testing of the contents. Since the entire interior of the house was being remediated, all of the movable items were packed out of the house. Evaluation, cleaning, handling and documentation of the process was so poor that after the contents had been moved to a storage facility our organization was asked to evaluate their condition. A visual inspection and sampling of the "cleaned" materials confirmed the presence of excessive levels of spores and fungal fragments. The overwhelming majority of mold types still contaminating the contents were targeted for removal from the house: *Stachybotrys*, *Aspergillus*, *Chaetomium*, and the like. This information helped to push the contractor toward a five-figure settlement.

Guidelines Codify Field Experience

Although there is no mandatory national standard for dealing with mold, there is a standard of care that can be understood by focusing on the points where various guidance documents intersect. Currently, six

of the most important documents related to mold all confirm that mold-contaminated contents should be subject to specialized cleaning¹. The most extensive information on contents is found in documents published by the EPA and IICRC.

Most of the guidance documents favor the disposal of contents made of porous materials (*e.g.*, drapes, clothes, upholstered furniture) that have visible mold growth. Several recent studies confirm the difficulty of removing the spores and growth structures from fabrics and other porous materials after growth is visible².

Contents that are contaminated by deposition of spores from adjacent growth can be cleaned. The IICRC's S520 document refers to such contamination as Condition 2. The S520 notes that dust from impacted items does not reflect the "normal fungal ecology" in terms of amount or fungal types.

It Starts With Assessment and Categorization

Since proper handling of contents from a mold-impacted environment is based on the type of material and the type of contamination, an initial assessment and categorization is the first step of the cleaning process. Table 1 provides an example of an assessment chart that could be used to organize the contents from an affected area. Obviously, the key is to segregate items with actual mold growth from those impacted solely by spore deposition in order to minimize the possibility of further contamination.

Once the initial segregation is completed a determination can be made on how the content cleaning will proceed. Thinking through answers to key questions will assist in the development of an effective plan.

- What amount of contents is impacted?
- What is the overall condition of the structure?
- Are there security concerns at the site?
- What cleaning techniques will be used?
- Is there adequate space on-site to set up a decontamination work area?
- Will a substantial portion of the items be processed off-site (*e.g.*, laundry or dry cleaning)?
- Is a general pack-out part of the overall job?
- How long is the structural remediation expected to take?

Determining If Content Cleaning Was Successful

Perhaps the most vexing aspect of mold remediation projects in general, and content cleaning in particular, is determining an endpoint. What is clean enough? Does it depend on the situation and the occupants? The size of the project budget?

Most knowledgeable industry professionals believe that it is crucial to evaluate and document the cleaning effectiveness³. But without an accepted standard endorsed by a regulatory agency or national standards group, the suggestions for post-cleaning criteria range from the thoughtful to the ridiculous. Some evaluation methods that have been suggested or used include:

- Sensory verification – The owner conducts a visual and odor check.
- Canine sensory verification – A trained mold inspection dog is brought in to sniff the contents and react to any mold.
- Mycotoxin testing – Samples are collected and analyzed to determine if any residual poisonous chemicals are present.
- Viable spore testing – Samples are collected and analyzed by culturing, which identifies residual spores capable of growing on a specific nutrient agar.

- Total spore and fragment testing – Samples are collected by tape lift, microvacuum or air collection methods and fungal residue is identified under the microscope.

Regardless of which method is employed, a comparison criteria needs to be established at the beginning of the project. It is also critical to establish at the beginning the number of samples that will be collected and the timing of their collection.

At Wonder Makers Environmental we achieve content cleaning verification through a combination of visual inspection and total spore/fragment testing. Since visible growth on dust or contents signals improper cleaning, our first step in verifying content cleanliness is a white glove style visual inspection. We normally have the remediation contractor group cleaned items into batches. If a single item in a batch fails the visual inspection, the entire batch is recleaned. Once a batch of contents has passed the visual inspection, a representative number of samples are collected⁴. Since the actual number of spores in the dust on an object is influenced by both the concentration of spores in the air and the time it has taken for the dust to collect, our organization began reviewing microvacuum samples to determine the percentage of spores. By recording the data from such samples as a relative number rather than an absolute count of spores, we were able to correlate analytical results with field conditions and, ultimately, with customer satisfaction.

After years and hundreds of projects we have seen that fungal spore concentrations of one percent or less of the total sample constituents (absent target fungal types) are an indication of a normal fungal ecology. Fungal spore concentrations between one and three percent are an indication of an indoor environment contaminated with settled spores, dispersed directly or indirectly (Condition 2). Fungal spores recovered at three percent or more of the total sample constituents indicate an indoor environment contaminated with the presence of actual mold growth and associated spores (Condition 3). Recovery of target fungal spore types (including *Memnoniella*, *Stachybotrys*, *Trichoderma*, *Chaetomium*, and *Fusarium*) is further indication of fungal contamination. The total percentage of fungal spores recovered and the identification of target fungal spore types are two pieces of information used to determine if contents or surfaces have been impacted by mold sources in the environment, or whether they have been properly cleaned.

Solving the Contents Conundrum

Dealing with contents from a mold-contaminated building is complicated. As such, the work is fraught with technical and legal pitfalls. But traps can be avoided if remediation contractors follow these common-sense guidelines:

1. Appreciate the risk to the occupants, the remediation crew, and the environment posed by mold-contaminated contents.
2. Understand the growing consensus that the ultimate goal is for the contents of a mold-contaminated environment to have mold concentrations at levels consistent with, or less than, a normal environment.
3. Conduct a thorough assessment of contents, addressing fungal growth and spore deposition as well as the porosity of each item.
4. Implement appropriate cleaning practices and protective controls.
5. Select a defensible endpoint at the beginning of the project. This includes both the evaluation method (*i.e.*, type of inspection, number and location of samples, timing of sample collection, etc.) and the comparison criteria.

6. Utilize the percentage of spores criteria described in this article in the absence of other technically supported data as a pre-defined endpoint for determining if contents are clean following a mold remediation project.

Combining these guidelines with common sense and awareness that dealing with contaminated contents is an important aspect of each mold remediation project will protect the contractor and advance the industry as a whole.

TABLE 1 Assessment Chart for Contents from a Mold-Impacted Environment		
Type of Material	Level of Contamination and Suggested Cleaning Techniques	
	Spore Deposition (Condition 2)	Visible Growth (Condition 3)
Porous Fabric, paper, upholstered furniture, ceiling tiles, drywall board, etc.	Cleaning with a HEPA vacuum, hot water extraction with drying and HEPA vacuum, air washing, dry cleaning (perchloroethylene), laundering with bleach.	Disposal and replacement unless high value, then specialized restoration.
Semi-porous Raw wood studs, rafters, decking, unpainted cinder block, other masonry components, stucco, etc.	"HEPA sandwich" cleaning (vacuum, damp wipe, vacuum again), scraping, scrubbing, sanding, or abrasive blasting. May also include surface sealing after inspection.	Disposal and replacement if structural damage or significant rot; scraping, scrubbing, sanding, or abrasive blasting if surface contamination.
Non-Porous Metal, plastic, glass, sealed wood, etc.	HEPA vacuuming, wet wiping, washing, power washing, air washing, air blasting.	HEPA vacuuming, scrubbing, immersion washing, using ultrasonic bath, power washing, air washing, air blasting, steam cleaning.

Endnotes:

1. Health Canada, *Fungal Contamination in Public Buildings: A Guide to Recognition and Management*
 American Conference of Governmental Industrial Hygienists, *Bioaerosols: Assessment and Control*
 The Institute of Inspection Cleaning and Restoration Certification (IICRC), *S520 Standard and Reference Guide for Professional Mold Remediation*
 New York City Department of Health, *Guidelines on Assessment and Remediation of Fungi in Indoor Environments*
 American Industrial Hygiene Association, *Report of Microbial Growth Task Force*
 Environmental Protection Agency, *Mold Remediation in Schools and Commercial Buildings*
2. "An Investigation into Techniques for Cleaning Mold Contaminated Home Contents", *Journal of Occupational and Environmental Hygiene*, July 2004, p. 442-447
3. See documents cited in Endnote 1, especially Chapter 9 of the IICRC S520.

4. Determining what constitutes representative sampling of contents can be influenced by a variety of factors. If the term “representative” is used to describe a good cross section of items, then samples should be collected from at least one object in each major class of contents: clothing, upholstered furniture, finished or sealed furniture, electronics, food containers, draperies, and bedding. Professional judgment will be necessary to decide if further sub-categories for sampling are justified (e.g., samples of different clothing fabrics such as cotton, wool, leather, nylon).

If the term “representative” is used in a statistical sense, then the number of samples collected is influenced by:

- the overall number of items to be cleaned
- the potential variability of the cleaning process (i.e., What is the likelihood that some items could be well cleaned and others poorly cleaned?)
- the level of confidence desired that the sample results will reflect the actual conditions
- the level of precision desired from the results.

A mathematical formula can be used to determine the overall number of samples to be collected if the four variables are defined.

About the Author

Michael A. Pinto, CSP, CMP, is chief executive officer of Wonder Makers Environmental, Inc. Mr. Pinto is the author of over 140 published articles and several books including, Fungal Contamination: A Comprehensive Guide for Remediation. He completed his course work in environmental engineering and holds numerous other certifications in the environmental and safety areas. Michael can be reached at 269-382-4154 or map@wondermakers.com.