New Tools Bring Success to Mold Projects: Fogging Agents and Microfiber Cloths

By
Michael A. Pinto, CSP, CMP, CFO
Wonder Makers Environmental

As a professional who has been involved in the mold remediation industry ever since it emerged from the shadows of the more general concept of an indoor air quality problem, I find it fascinating to see how much the science and practice of fungal control continues to change. While many restoration and cleaning contractors have the mistaken idea that the "mold hysteria" has peaked, the reality is that the industry is in a continuing development stage. Anyone who thinks that there is nothing new in the mold field should sit in on one of the weekly teleconference discussions among the professionals who are working on the fourth edition of the IICRC's S520 Standard for Professional Mold Remediation. The debate and discussion is just as vigorous and enlightening as it was when I served on the committee to produce the inaugural edition of the document in 2001 and 2002.

One of the most important concepts that have been clarified as the mold control industry has matured is the emphasis on finishing projects. Today there is a much stronger understanding of the terms post-remediation *evaluation* and post-remediation *verification.* The term *evaluation* refers to in-house quality control steps taken by the contractor and the term *verification* is used for third-party review of projects once the contractor is finished. While every mold remediation project should have some form of post-remediation *evaluation*, there are a number of states that now require third-party *verification* of the effectiveness of the work.

Adapting Methods to Meet Stricter Requirements

Whether it is the contractors who are trying to hold themselves to better standards of remediation effectiveness or an outside entity on behalf of the building owner, there is clearly a push for mold remediation work to produce an exceptionally clean environment. This impetus toward cleaner environments is impacting each of the primary parts of the mold remediation effort, cleaning inside a Condition 3^1 isolated work area, and cleaning adjacent Condition 2^1 parts of the structure.

In order to meet ever more stringent standards, mold remediation contractors have migrated technology developed for other industries toward their own uses. While some technology transfers sound good but fail miserably in the real world, two that have shown to be exceptionally useful are disposable microfiber cloths and specialty fogging solutions. Interestingly, these two adjustments work hand in hand as fogging helps to remove small particles from the air and the microfiber cloths remove the **particles** from surfaces.

Negative Pressure, Air Scrubbing, and Air Fogging

Most mold remediation projects that involve the removal of visible fungal contamination are conducted inside an isolated work area. In order to prevent some of the airborne contamination that is a necessary byproduct of the physical removal from migrating to adjacent spaces, the standard of care encourages contractors to create negative pressure inside the work area. A situation is set up where slightly more air is being removed from the work area than is allowed to enter. This is typically done with one or more air filtration devices (AFD) equipped with HEPA filters. The AFDs are exhausted outside the work area and the restriction on the makeup air entering the remediation zone creates a slight negative pressure which minimizes the migration of spores and other small particles into the un-impacted rooms.

Negative pressure is a critical engineering control used during a controlled removal and initial cleaning of the sources of fungal contamination. However, many contractors have found that maintaining negative pressure for the final cleaning and testing is not the most beneficial approach because of two specific complications. By design, negative pressure brings in the air from outside the work area. There are a great many projects where adjacent spaces are not included in the work scope, even if they are considered to be Condition 2. Therefore, using negative pressure at the end of the project often results in pulling air into the work area that is dirtier than the contractor has achieved inside. In addition, negative air setups often result in air flow patterns which result in dead spaces as well as the inefficient capture of small particles.

These realities have led to many restoration contractors switching from negative pressure at the end of the mold remediation project (after the demolition and initial cleaning are completed) to air scrubbing. This term refers to a work area where an air filtration device is allowed to operate inside the work zone without exhausting the isolation barriers outside. The setup does not produce negative pressure but does allow the air in the work area to cycle through the filtration mechanisms multiple times in an effort to reduce the particulate levels.

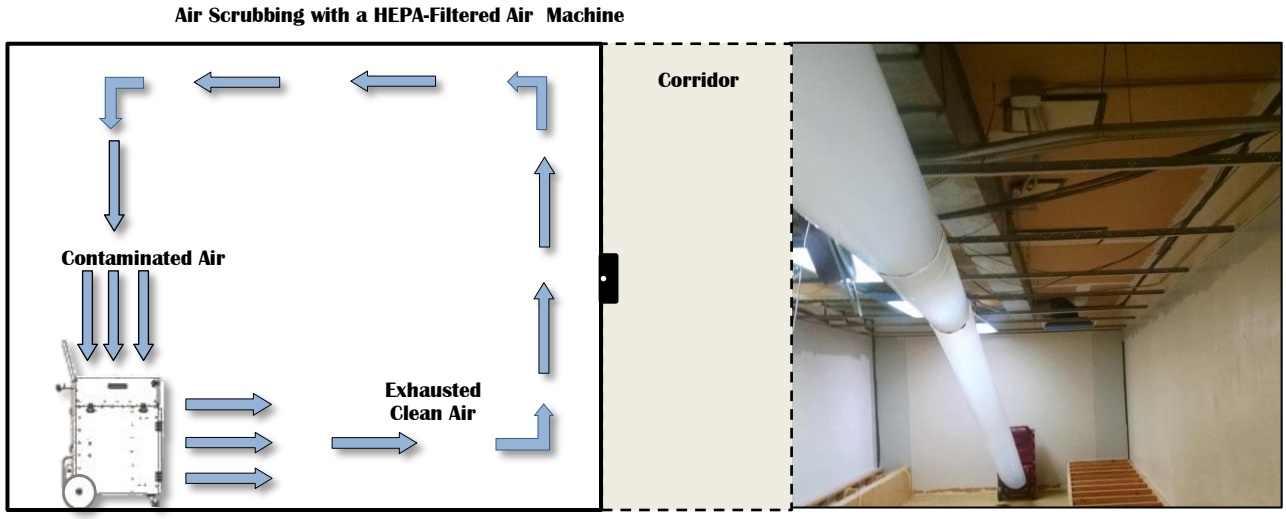


Diagram illustrating the concept of air scrubbing while the photo shows an air scrubber working inside a contained area with a diffuser hose attached to the exhaust. The plastic "lay flat" has been perforated to allow the air to diffuse throughout the room.

Fogging For Particle Control

A method to enhance air scrubbing is to incorporate fogging. By adding micro droplets of liquid to the air it forces the smallest dust particles to coalesce into larger bits. Also, by increasing particle size (and weight) the airborne material is more likely to either settle out or move toward the air scrubber. There is an extensive history of fogging for particle control in both outdoor and indoor activities. Some of the more common uses of water sprays, mists, or fog for dust control include:

- explosion control
- water spray trucks during highway construction
- sprayers on the building during the demolition (see photo below)
- smokestack wet scrubbers
- manufacturing dust control
- paint booth overspray control
- asbestos lockdown
- deodorizing after fire damage (see photo below)

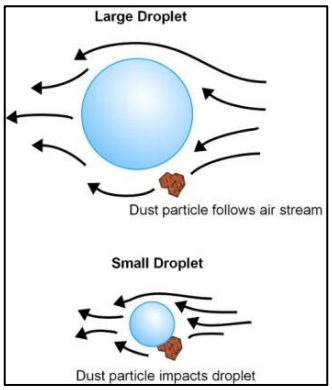
Keys to Effective Fogging

As with dust in general, there is quite a science to fogging. Indeed, scientists have identified four different characteristics of the fogging process that determine its effectiveness in controlling airborne particles:

1. droplet size
2. droplet charge
3. droplet dispersion
4. droplet "cling"

When using fogging to assist with particle control, the first concern is to get the droplets of the material being fogged the proper size. While large droplets will collide and combine with bigger dust particles in the air (larger than 10 microns), forcing them to settle quickly are not as effective with smaller particles. The small, light, particles move with the air and actually bypass

the larger droplets as illustrated in the following diagram. In a general sense, droplet size needs to be similar, or smaller, than the particles that are being removed from the air.



Generally, restoration contractors and cleaning companies utilize thermal foggers or ultralow volume (ULV) foggers (as shown in the photo) to produce a dust-cleansing fog that has droplets of the proper size. The ULV foggers use special air-atomizing nozzles that can be adjusted to produce a wet fog with larger droplets or a very dry fog with tiny droplets to agglomerate and remove airborne dust particles. With such devices the dry fog setting tends to produce droplets in the 1 to 10 micron size; which is even effective for removing the very small dust particles from the air.

Although many factors impact the ability for droplets to disperse, the primary determinant as to how well fog droplets spread into an area is whether uniform droplet sizes are created. Ultralow volume foggers are fairly good at creating droplets in a relatively small size range. However, sprayers or foggers that utilize tips employing ionized or ultrasonic technology can create droplets in an even smaller size range which allows them to disperse farther into room air. Several manufacturers have brought this sort of technology to the restoration industry[2].

Overcoming Molecular Electrical Forces

Many dust particles have an electrical charge associated with them which is a result of their composition or the fact that they picked up an "induced charge" by passing near a charged surface. Indoors, this induced charge of dust particles most typically comes from an electronic appliance such as television or computer. Since some small particles can have a negative charge and others can have a positive charge, creating fog droplets that have both negative and positive electrical charges helps to cleanse the air as the dust particles and water droplets follow the maxim that "opposites attract."

The term, "droplet cling," refers both to the solubility of the drops as well as its electrostatic charge. Generally, chemicals known as surfactants are added to water to improve the ability of the foggers to create smaller droplets and result in droplets that are more easily soluble. Choosing different additive materials can also result in small droplets that have a particular electrostatic charge depending on the chemical makeup of the surfactants that are added. These

molecular electrical forces (officially referred to as van der Waals forces, named after Dutch scientist Johannes Diderik van der Waals) also come into play when trying to remove small dust and mold particles from surfaces. Surprisingly, the attractive forces of the smallest particles are proportionally so great that even cleaning with industrial style HEPA-filtered vacuums may not be enough to remove them. Realizing that such materials may be left behind after extensive vacuuming efforts only to be picked up by a tape sample and set off a new round of cleaning has led many organizations to switch to a final cleaning step with microfiber cloths rather than HEPA vacuums.

Microfiber Cleaning Is Efficient but Not All Microfiber Cloths Are the Same

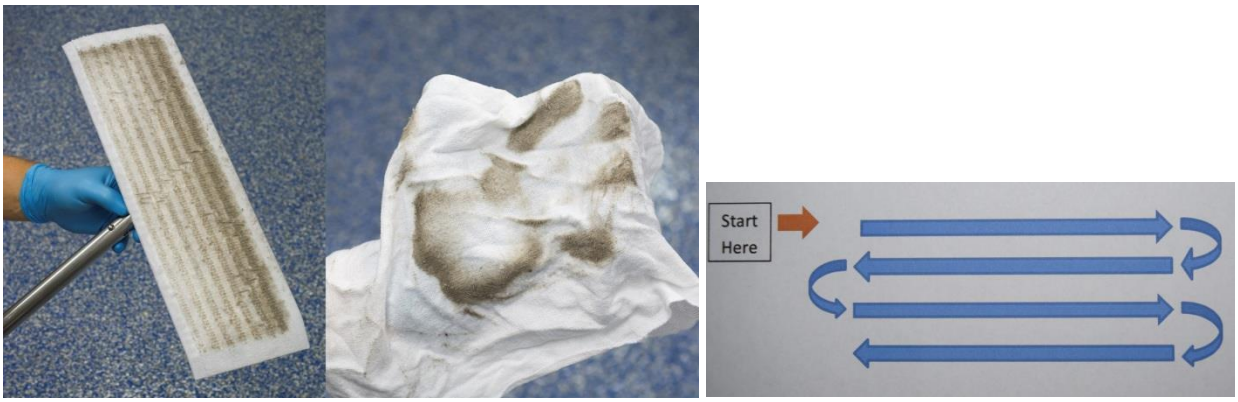
Just like smaller water droplets do a better job of collecting smaller particles, the same can be said for fibers in a cleaning cloth. The smaller the fiber size the more effective a cloth is at capturing and removing small particles. Cotton and nylon, the two materials most prevalent in standard cleaning cloths, have fiber diameters that generally range from 10 to 50 microns[3]. In contrast, lower grade microfiber cloths have fibers with diameters of 1 to 5 microns; with the best ones having fiber sizes in the 0.3 micron range. The small fiber size means that many more strands are present per square inch. The small fibers actually use the van der Waals molecular electrical properties to their advantage. They are so small that they can interact with the tiny particles and switch the attractive force of the particle from the surface to the fiber. This impressive (or confusing) sounding science explains why microfiber cloths are so efficient at removing small particles.

Of course, this efficiency comes with its own set of drawbacks. The quality of microfiber cloths vary greatly depending on the manufacturer and the intended use. Many restoration contractors who are using such cloths for mold have found that it is better to purchase the ones designed for healthcare use as those products tend to have smaller fiber size. Regardless of the quality of the microfiber cloths, they are best used for final cleaning where no visible debris is present. If microfiber cloths are used for cleaning gross debris, they quickly become overwhelmed and end up just moving contamination from one location to another.

Probably the biggest drawback of microfiber cloths is the fact that they are not "normal" cleaning rags. Janitorial and restoration contractors are used to laundering their cleaning cloths so that they can be reused. However, few contractors are aware that laundering microfiber cloths involves very specific steps and materials. Because of their small size the microfibers actually attract soap residue and fabric softener to the point that "clean" cloths no longer have any room to pick up small particles. Too hot of a water temperature or the use of bleach will also damage the fibers to the point where their ability to attract dust is worse than a standard cotton rag.

The Advance of Single Use Microfiber Cloths and Backing Pads

The difficulties of maintaining microfiber cloths in a condition that allows their cleaning properties to be useful is one of the main reasons that the big move in the cleaning industry today is toward single use microfiber cloths. Manufacturing efficiencies helped push this forward as the cost of procuring microfiber cloths has come down dramatically over the last 10 years. This allowed critical industries like healthcare to start taking advantage of the cleaning efficiency and labor reductions which come from single use microfiber cloths for cleaning of microorganisms. Such products[4]are now easily available to the restoration industry and have quickly developed a proven track record.



Photos shows the difference in collection efficiency when a microfiber cloth is used with a backing pad that turns it into a mop.

In addition to using the cloth on a frame, there is a trick to using them correctly. The most efficient pick of particles is possible when the leading edge of the mop stays in front (no back and forth mopping), the mop is used in an S wipe mopping pattern, and there is a 20% overlap on each pass of the mop head.

A Case Study Shows How It All Works

Even the best contractors sometimes have difficulty adjusting practices that have worked for years. For many mold remediation contractors, the tried and true process of cleaning using the "HEPA sandwich" (HEPA vacuum, damp wipe, HEPA vacuum) is a work practice almost set in stone. But, as post-remediation clearance criteria get more stringent, contractors need to look at expanding their "toolbox" of work techniques. This is especially true for the final cleaning steps.

A great example of seeing the need to improve their performance and stepping up to some of the work practices discussed above recently occurred with a well-respected restoration contractor. The project in a healthcare facility with mold contamination above the ceiling tile from a history of roof leaks was anything but ordinary. Limited evening and weekend hours, extremely aggressive post-remediation criteria for the work areas, and lots of equipment to protect and work around were some of the most challenging aspects of the project.

Because of the "high stakes" related to the remediation efforts, several smaller projects were conducted to determine the effectiveness of various setup approaches and work practices before

a large project was undertaken. One of the early projects involved the isolation of a single room work area. However, to minimize potential cross-contamination to the other sections of the building, that mold project was designed with the construction of a temporary tunnel from the work area entrance to the exit door. While the isolation techniques, engineering controls (negative pressure created by the use of AFDs), and work practices were successful in protecting adjacent areas of the building, the contractor had difficulty passing clearance testing in the tunnel that led from the work area to the exterior door.

After reviewing the sampling data, several ideas were discussed. Since the entire building had not yet been remediated, it was possible that some of the spores were being brought into the cleaner work area from adjacent interior areas. As such, the amount of negative pressure in the tunnel was reduced with some of the AFDs used in an air scrubbing mode.

It was noticed that the sampling data showed most of the problem coming from the smaller, lighter spore types. This information led to the suspicion that spores were clinging to plastic and being dislodged during the sampling sequence. In order to provide more effective removal of the small particulates, the contractor was provided information on new products being offered to the restoration industry, including fogging and microfiber products.

The fogging was a low-cost addition because the contractor already had a ULV device that they used for odor control. Fogging the work area was completed after an additional visual inspection confirmed that there were no small sources of materials trapped in crevices of the plastic or other hidden spaces. Rather than vacuuming for the final cleaning, the contractor substituted the use of microfiber pads on a mop head. The crew volunteered comments about how much faster this process was compared to vacuuming. They were surprised at how much additional debris they collected with the combination of fogging and microfiber mopping. Most importantly, this slight revision of the engineering controls and modification of the cleaning regimen led to the next set of samples passing with "flying colors."

Control and Elimination of Small Particles Is Critical For Many Projects

Whether it is mold, soot, infectious agents, allergens, irritants, or asthmagens[5]; cleaning and restoration contractors are being asked to address them on a regular basis to protect the health and safety of building occupants. These days, contractors facing such challenges should consider adjusting the traditional HEPA sandwich cleaning technique and convert it to the "HEPA pizza." In this approach to particulate removal, the contractor starts with a "crust" of a thorough HEPA vacuuming which is then topped with wet wiping, fogging, and microfiber mopping. What they may find is that in many situations a "pizza" is actually easier to make than a "sandwich"; as long as they are using the right toppings.

Endnotes

1. The terms Condition 2 and Condition 3 come from the IICRC S520 Standard for Professional Mold Remediation. They refer to an area of the building that is negatively impacted by

visible fungal growth (Condition 3) or spaces contaminated by settled spores which were dispersed from the active fungal growth (Condition 2). These impacted areas are in contrast to structures, or parts of structures, which are designated as Condition 1 -- spaces having a "normal fungal ecology."

2. One product that has incorporated many of these features is known as Particulate Conqueror. More information can be found at: https://www.fastmoldremoval.com/product/bad-axe-particulate-conqueror/

3. Microns are 1 millionth of a meter. To help put things in perspective, consider that a typical human hair is 70 to 100 microns in diameter, a red blood cell is about 25 microns I diameter and bacteria generally range from 1 to 5 microns in size.

4. For an example of such products see the website for Contec Premira products: http://www.contechealthcare.com/files/documents/WIP021_PremiraProducts.pdf

5. Asthmagens is a term that is being used for materials which may not be allergens yet seem to trigger an increased level of asthma attacks.

About the author

Michael A. Pinto is chief executive officer of Wonder Makers Environmental, Inc., a manufacturing and environmental consulting firm that specializes in identification and control of asbestos, lead, IAQ, mold, industrial hygiene, and chemical problems. Mr. Pinto is the author of over 200 published articles and several books including, *Fungal Contamination: A Comprehensive Guide for Remediation* and *Forensic Restoration: Procedures to Protect Operators and Occupants*. He completed doctoral course work in environmental engineering and holds numerous certifications in the environmental and safety areas, including Certified Safety Professional, Certified Mold Professional, and Certified Forensic Operator. In addition to being a frequent speaker at industry events, Michael has been honored with such prestigious awards as the Golden Quill, Martin L. King Award, the Phoenix Award for Innovative Restoration from the Restoration Industry Association, and the President's Award from the Environmental Information Association. He serves on the board of the BIO PTO and as the chairperson of the Environmental Council for the Restoration Industry Association (RIA). Michael can be reached at 269-382-4154 or map@wondermakers.com.