

Review Criteria for Successful Mold Remediation

Summit's General Remediation Guidelines

The *three basic general requirements* for remediating water / moisture impacted buildings that have resulting fungal growth are:

- 1) All sources of water leaks and /or high relative humidity must be assessed and repaired / eliminated. Identification of the conditions that contribute to microbial growth is an important step in remediation. Proper remediation cannot be completed without a clear understanding of the events or building dynamics responsible for the mold growth.
- 2) Properly remove all mold while controlling the impacted area to prohibit the contamination of non-impacted areas during remediation. Use proper procedures and safety protocol.
- 3) After proper building drying and mold removal, review the project in detail and confirm that the work has been correctly completed. The evaluation should include appropriate testing and written documentation by an experienced certified professional. Revisit the area two to four weeks after remediation and it should show no signs of water damage or mold.

The details and specific tasks surrounding these three basic remediation steps can be substantial and vary by site based upon the nature of the moisture problem, amount and type of fungal growth present, the type of materials impacted by moisture and fungal growth, and potential occupant exposure.

Issues for Post Remediation Evaluations

Purpose

Names, Assessment, Clearance, Verification

Post Remediation Reviews

Various industry, professional and government organizations have discussed site evaluation procedures for post remediation clearance or validation. Due to the current level of litigation in the mold remediation business, some groups recommend extensive and costly sampling and review to document that all fungal impacted materials have been removed or cleaned and air quality sampling to show the air is not impacted with unusual concentrations of fungal material. In some cases, the post remediation evaluation costs are more than the remediation and repair costs. Other groups are proposing that visual inspections and lack of odors are adequate to document complete remediation.

Summit's post remediation generally follows those recommendations by (1) ACGIH, 1999. Bioaerosols: Assessment & Controls, American Conference of Governmental Industrial Hygienists, (2) AIHA, 1996. Field Guide for the Determination of Biological Contaminants in Environmental Samples, American Industrial Hygiene Association, and (3) IESO, 2002.

Standards of Practice for the Assessment of Indoor Environmental Quality, Volume I: Mold Sampling; Assessment of Mold Contamination, Indoor Environmental Standards Organization (April 2002). However, each project is unique and evaluations are subject to the actual problems being corrected. For lack of an accepted term, Summit will refer to the validation/closure inspection as post remediation observations, sampling, and evaluation (PROSE). The acronym happens to be the final task in the process—write the final report—to properly document the project completion. Many reports reviewed by Summit do not include all the information needed to confirm a site has been properly remediated. If a project budget/scope of work does not allow for complete evaluation, the report should state the limitations placed on the evaluation.

Relevant References

The following are some of the relevant reference that discusses post fungal remediation reviews. Note that whenever there is an amplification of fungi in a building, due to a water/moisture problem, there is also a likely amplification of bacteria. A fungal evaluation does not provide information on bacteria levels. In most cases, it is assumed by the microbial consultant/professional that the fungal remediation also helps to resolve the bacteria amplification.

EPA, 2001. Mold Remediation in Schools and Commercial Buildings

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

1. You must have completely fixed the water or moisture problem.
2. You should complete mold removal. Use professional judgment to determine if the cleanup is sufficient. Visible mold, mold-damaged materials, and moldy odors should not be present.
3. If you have sampled, the kinds and concentrations of mold and mold spores in the building should be similar to those found outside, once cleanup activities have been completed.
4. You should revisit the site(s) shortly after remediation, and it should show no signs of water damage or mold growth.
5. People should be able to occupy or reoccupy the space without health complaints or physical symptoms.
6. Ultimately, this is a judgment call; there is no easy answer.

ACGIH, 1999. Bioaerosols: Assessment and Control.

Judging Remediation Effectiveness

The success of a remediation effort is judged in part by the visible degree of contaminant removal that is achieved. Effectiveness may also be confirmed by sampling. The ultimate criterion for the adequacy of abatement efforts for treating biological contamination is the ability of people to occupy or reoccupy the space without health complaints or physical discomfort. Cessation of bioaerosol exposure should result in cessation of bioaerosol-

related symptoms. Likewise, mitigation of environmental conditions that led to problems of microbial contamination should result in the absence of microbial growth as long as the control measures continue to be effective. If this is not the case, the investigation did not correctly identify or sufficiently address the underlying causes of the problem.

Following building restoration, the kinds and concentrations of biological agents in air samples should be similar to what is found locally in outdoor air. 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 (Strom et al, 1990, Nevalainen and Flannigan, 1993, AIHA, 1996). In general, removal of semi-porous (e.g., enamel-painted wallboard or wood) may not be necessary if washing with a detergent solution returns the material to its original condition (as determined visually). Even then, moisture must be rigorously controlled to prevent future growth. If not further cleaning may be necessary until no difference is detectable. In some situations, it may be difficult to achieve these levels even with thorough and costly remediation (Ansari and Morey, 1996, Morey, 1996). Investigation may decide to treat a portion of a contaminated area to determine if the remediation process will be satisfactory before proceeding to treat a larger area.

Institute of Medicine, 2004. Damp Indoor Spaces and Health.

Evaluate Whether the Space Has Been Successfully Remediated

Whenever a remediation activity is undertaken—especially when it requires containment that results in evacuation of portions of all of a building—a determination must be made that the job has been completed and that the space is suitable for reoccupation. Such determinations are necessary subjective because there are no generally accepted health-based standards for acceptable concentrations of fungal spores, hyphae, or metabolites in the air or on surfaces (ACGIH, 1999; AIHA, 2001; Rao et al., 1996).

There is substantial variation in recommended clearance criteria between the guidance documents. The NYCDOH 2000, U.S. EPA, and AIHA guidance documents discussed above agree that the work site should be dry, clean, and free of visible mold growth. However, the NYDCOH guideline also requires air monitoring for areas that had more than 100ft² of contamination. The U.S. EPA document specifically says that air samples are not required but may be useful in some circumstances. Finally, the AIHA task force guideline suggests two principal quality-assurance indicators for successful remediation: documentation that the moisture problems have been solved and physical inspection of contaminated areas to ensure that the contaminants have been removed. Air sampling and surface sampling are left as options, but the task force suggests that surface sampling for cleanliness may be more useful than biologic surface sampling. THE ISIAQ guideline states that materials should be dry and surfaces cleaned until only background concentrations of mold and bacteria remain, but it does not specify how that is to be determined. The Health Canada guideline does not specifically discuss clearance but does mention that things should be left clean. And the ACGIH guideline recommends that remediated areas be clean and leaves sampling of biologic as an option. There is no specific interpretation for biologic

sampling in the remediation section, but there are extensive discussions on making and interpreting biologic samples in general.

Although all the guidance documents agree that moisture problems should be fixed and materials in the building should be dry, no methods for establishing whether materials are dry are offered. Remediation failures due to regrowth of mold frequently occur, and this is of particular concern and needs to be addressed in future research. Regrowth often occurs because a faulty moisture dynamic was not mended or because a damaged area was reassembled before materials were completely dry; for example, the surface of porous materials, such as wood and concrete, may be dry while the interior remains damp.

“Clean” in the context of a clearance inspection means that the remediated area is free of residual microbial contamination. However, it is possible to ascertain that only if all potentially contaminated visible and hidden spaces have been inspected. All spaces would have to be subjected to close inspection for dust, debris, fungal contamination, and dampness. Only in this unusual case could thorough examinations and measurements be easily made. The greater the chance of hidden dampness or contamination, the more difficult it is to determine whether a remediation can be defined as successful by this criterion.

Even when visible contamination has been removed, air, or surface measurements might detect mold or bacteria because fungal and other microbial is ubiquitous. Their presence alone thus does not indicate a contamination problem, so it is difficult to set quantitative standards for evaluating when and whether a space is clean.

There is no agreement on requirements for, methods of, of interpretation of microbiologic sampling for clearance purposes. One could undertake a sampling campaign after the completion of remediation identical with that before the remediation and document whether there was a decrease in microbial contamination as a result of the remediation. Such a decrease in concentrations and microbial diversity to those of a reference building has been reported in some studies. However, sampling may present an incomplete picture.

A small number of studies report decreases in symptoms experienced by occupants after remediation of moisture damage. Studies in Finnish schools (Savilahti et al 2000 and Meklin et al. 2002) both used questionnaires before and after renovation in combination with fungal sampling. In the Meklin et al. study, a comparison was made with a control building. A third study (Jarvis and Morey, 2001) looked at new building in a hot, humid climate. Biologic sampling and questionnaires were used before and after remediation. The study found that the occurrence of illness was reduced after remediation was completed.

The following post remediation information was taken from IICRC Standard and Reference Guide for Professional Mold Remediation S520, Institute of Inspection, Cleaning and Restoration Certification Standard, 2003.

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Post Remediation Verification

Following post-remediation evaluation by the remediator, including application of internal quality control procedures, verification of a return to Condition 1 status may need to be determined by sampling and testing, and, if so it is highly recommended that an independent IEP conduct or oversee that process. It is recommended that the criteria and process used in the post remediation verification be documented. Verification activities may include, but are not limited to: visual inspection, olfactory evaluation, sampling and testing, laser particle counting and moisture measurements.

Final Documentation

After post remediation evaluation, and post evaluation verification, it is recommended that the remediator take appropriate action to close the job files and complete the appropriate paper work.

Indoor Environmental Professional

The role of IEP is to perform an assessment of the fungal ecology of property, systems and contents at the job site, create a sampling strategy, sample the indoor environment, interpret laboratory data and determine Condition 1, 2, and 3 status for the purpose of establishing a scope of work (preremediation assessment) and/or when necessary to verify the return to normal fungal ecology.

S520 is not intended to establish procedures or criteria for assessing mold contamination in an indoor environment. These issues are most appropriately addressed by professional organizations that represent Indoor Environmental Professionals or "IEPs." Since these professional organizations have not agreed upon threshold exposure limits or levels of visible mold growth that constitute a concern for occupant and worker safety, the IICRC S520 Mold Remediation Standard Committee decided not to establish action levels based upon the quality of size of the area of visible mold growth.

Summit's Fungi Data Interpretation Guidelines

There are no specific standards or regulations governing surface or airborne microbiological contamination in indoor environmental air. Establishing a standard has been difficult due to the ubiquity of fungi, the natural fluctuation in the background concentrations of microorganisms, limited reliable health affects data, considerable variation in individual response to exposures, and the overall lack of scientific experience in interrelating bioaerosol laboratory data. Given the state of the science, the laboratory data should be considered as a rough approximation of the type and quantity of fungi and bacteria actually present at the time of sampling. Most residential and small commercial mold remediation

projects do not have the budget to collect and analyze multiple data sets to increase sampling reliability.

Bioaerosol samples collected from indoor suspect areas need to be compared to similar samples collected from non-suspect areas indoors and background concentrations outside. Summit also reviews outdoor results from past studies in nearby areas to help assess data reasonableness. Environmental conditions which may influence sampling results should be adequately documented (adjacent property use, weather, operation of drying fans or negative air, general dustiness of the environment, activity in the area, windows opened or closed, source of makeup air for contained areas under negative pressure, HVAC system operation, etc.).

Summit Environmental, Inc. evaluates microbial sampling results against numerous criteria and utilizes the data as efficiently as possible for making important project decisions. We consider it important to not over represent the importance of the often limited sampling data. All the various project issues and conditions should be considered during data evaluation. Samples from separate sites must be comparable in all relevant details including collected at approximately the same time, similar collection method and similar volumes of air, analyzed by the same laboratory method, and if possible, by the same laboratory personnel. If Summit has conducted the field sampling, we will be much more familiar with the project conditions than if Summit is reviewing the results presented in a report by another investigator.

Some of Summit's microbial data evaluation considerations / criteria include:

- were the samples properly collected and were the locations appropriate?
- is the data reasonable given past and current site conditions?
- was excess sample debris reported by the laboratory which may bias the results?
- how do total non-viable concentrations compare between sample locations?
- how do total viable concentration compare between the sample locations?
- are the non-viable and viable microbials / agents identified in the affected area also found in the background / control area?
- are genera or species of the more toxic microbials present in the indoor environment at concentrations greater than the laboratory detection limit?
Greater than the laboratory quantification limit?
- are the dominant genera or species in the samples similar between locations?
- if the data indicate different microbial populations present at the sample locations, is the inside or affected location lower than the background / control location, indicating no problem identified even though the locations differ?
- how do the sample concentrations (total and genera) compare to the various current suggested guidelines for health impact concerns?