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Mold and Dampness in the Built Environment

White Paper

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Version 2 | March, 2018

Developed by the AIHA® Biosafety and Environmental Microbiology Committee and
Indoor Environmental Quality Committee
Adopted and Approved by AIHA Board of Directors: March 26, 2013
Date Reviewed: March 2018

The approximately 10,000 members of the American Industrial Hygiene Association (AIHA) serve in the occupational and environmental health and safety profession, practicing industrial hygiene in industry, government, labor, academic institutions, and independent organizations, primarily in the United States and Canada. The AIHA is a cognizant authority on all aspects of the profession. AIHA Technical Committees endeavor to ensure that reliable information is provided to all those concerned with the health and safety of people in the workplace and, in some cases, homes. AIHA members often play the unique role of working with other professionals, as risk managers and risk communicators, to solve problems and to protect the health and wellbeing of workers and the general public.

Since 1996, the AIHA has been a leader in the development of information and best practices on the management of mold and dampness problems in the build environment. This information has been relied upon by officials who develop and enforce public policy on indoor environmental quality (IEQ) for the non-industrial workplace, including schools. AIHA has also provided accessible information for individuals to enable more informed choices. It is appropriate to make clear the Association's positions with respect to reducing the risks associated with indoor microbial growth, and to define and explain the role of AIHA members in such endeavors, to all parties.

MOLD & HEALTH

Modest wetting and drying in buildings and in ventilation systems is normal and generally poses little risk for occupant health. Similarly, very brief episodes of wetting are not usually a problem provided that steps are taken to rapidly dry all materials.[1] "Dampness" is the presence of unwanted and excessive moisture in buildings.[2] This can lead to the growth of mold, fungi, environmental bacteria, and, in homes, house dust mites.

The term "mold" is a colloquial term for a group of filamentous fungi that are common on food or wet materials. Most of these are Ascomycetes that produce a lot of spores. The molds that grow on damp building materials are normally found in the soil and are adapted to grow on a wide variety of materials. Outdoors, molds live in the soil, on plants, and on dead or decaying matter. There are thousands of species of mold and they can be any color. Different mold species are adapted to different moisture conditions, ranging from just damp to very wet. Many times, mold can be detected by a musty odor.

Well conducted epidemiology studies in several countries have consistently shown that exposures from building/house dampness and mold have been associated with increased risks for respiratory symptoms, asthma, hypersensitivity pneumonitis, rhinosinusitis, bronchitis, and respiratory infections.[4,5] In studies conducted in the non-industrial workplace, individuals with asthma or hypersensitivity pneumonitis were found to be at risk for progression to more severe disease if the relationship between illness and exposure to the damp building was not recognized and exposures continued.[6]

Three recent, high quality, systematic reviews of the available evidence concluded that the implementation of interventions that combine elimination of moisture intrusion and leaks and removal of moldy items help to reduce mold exposure and respiratory symptoms and new onset asthma[4,5,7] This position has also been

taken by National Institute for Occupational Safety and Health (NIOSH) and many State governments[8], Health Canada[9,10] and internationally by the World Health Organization[11].

Based on this evidence, persistent dampness and mold damage in the non-industrial workplace, including schools and residential housing, requires prevention, management and effective remediation. If visible mold is present, it should be remediated, regardless of what species are present. Such actions are likely to reduce new onset asthma, lead to savings in health care costs, and improve public health.

Therefore

1. **While the design and location of a building have the greatest impact on the onset of serious mold damage, maintenance and effective management of mold and dampness requires an ongoing strategy involving occupants, building owners and managers, ventilation experts and occupational hygiene professionals.[1,2]**

Owners and occupants should take action to detect and correct leaks, condensation problems and floods as soon as they are discovered. The potential for building structural damage, microbial growth and increased adverse health effects can, and should, be reduced by limiting the buildup of indoor moisture. A formal mold/water prevention program with clear actions and responsibilities is required for an effective response to signs of moisture.[12,13] T he actions taken by all stakeholders, including designers, contractors, owners, and occupants of buildings, are critical to effective management of prolonged dampness in buildings. An effective prevention program is evidence of appropriate due diligence to protect both the health of occupants and visitors, and to preserve the building fabric. As new buildings are constructed, or older buildings are subject to major renovation, consistent effort is needed on the part of the architects and engineers involved in the design and construction of the structure, cladding, roof and HVAC system to make the building durable.[1,14]

2. **It has long been recognized that, based on the application of existing methods to analyze air or dust samples, there are no quantitative, health-based microbial exposure guidelines or thresholds.[8,10] Sampling data that may be developed during an investigation must be comprehensive and communicated in a form useful to physicians and allied professionals, building occupants and decision-makers.[15,16]**

There are a number of audiences for the reports that are provided pursuant to a mold investigation. Regardless of the nature of the client (homeowner, insurance agent, large property company, government), reports must provide information that can (a) be translated into an action plan for repair and rehabilitation of the space, (b) provide a basis for protecting occupants and remediation workers health and, in certain situations (c) be useful for the personal physician and/or public health officials.

Investigators should provide clear and consistent field notes with sufficient detail to allow the field work and sampling data, if any, to be interpreted, verified, and repeated. The report should include, at a minimum, appropriate documentation of sample handling and reporting results. Ideal documentation should be thorough, detailed, readable, and focused. Additionally, it should present sufficient information to allow the work to be verified and repeated, and it should describe all quality assurance procedures.[17,18]

Good industrial hygiene practices dictate that clients verify that the consultant has suitable training and project experience, as well as appropriate and related references.[19] Almost all industrial hygienists (IHs) have college degrees in engineering or the natural sciences, such as biology, chemistry, biochemistry or microbiology. Additionally, 42% have master's degrees, and 12% have doctoral degrees. Industrial hygienists also have specialized training in ventilation engineering, environmental health, toxicology and microbiology. Unless this is waived by the client, investigators should be independent of the remediation contractor and testing laboratory associated with the project.[16,19,20]

Basic competencies that should be assessed by clients include knowledge and education in exposure characterization, microbiological assessment and remediation, general knowledge of the ecology of fungi and bacteria associated with damp or flooded buildings, building science and problem areas in Heating Ventilation and Air-Conditioning systems.[19,20] If samples are collected, laboratory analytical staff should have specific training and experience in the identification of environmental mold and bacteria, and be able to demonstrate successful participation in an external proficiency testing program.[2,21] Some States have certification requirements and other regulations regarding mold-related activities or remediation. A number of Canadian municipalities have regulations that cover mold damage in residences from illegal marijuana grow operations.

Recent guidelines from the American Academy of Allergy Asthma and Immunology focus on factors that promote allergen and contaminant production ('facilitating factors', in this case moisture) and reservoirs.[15] In this context, properly conducted building inspections, which depend on the training and experience of the investigator(s), are essential to physician evaluation. Physicians reviewing such reports should find clearly-described key elements and be able to judge the quality of a report. At a minimum, reports should include a statement of purpose and limitations, observations, results of any testing, conclusions, and recommendations. Such reports should not include any speculation or conclusions concerning medical causation.[2,16]

Since current analytical methods do not provide information on the health risks associated with mold exposures in the built environment[8,10], health assessment is primarily based on the nature and extent of the mold ***and*** water/moisture damage and the type of reservoirs present (e.g. carpets, soft furniture). In most studies and a recent meta-analysis on the subject, semi-quantitative estimates of the extent of visible mold/dampness has been identified as being the best predictor of long and short-term health outcomes.[5,9,22,23] The investigator's report needs to present this information in a clear fashion according to methods discussed in the AIHA publication Recognition, Evaluation and Control of Indoor Mold ("The Green Book").[2]

Air and/or settled dust sampling can be used to defend hypotheses about the nature of the contamination, 'hidden' sources of contamination, and whether or not the indoor air is similar to outdoor air.[16,24]

3. **Investigation and remediation of mold and moisture damage in buildings must be based on an informed inspection augmented by the judicious use of existing sampling methods, primarily for the purpose of detecting any hidden damage.[2,9] The protection of remediation workers and occupants during renovations is essential.[2,9] In case of occupants with more serious pre-existing respiratory conditions, relocation may be appropriate.[25,26]**

If mold is suspected, but not visibly detected after a thorough inspection, then microbial air sampling conducted in accordance with guidance documents can be useful.[2,3,24] This sampling may reveal evidence of indoor mold amplification or reservoirs, particularly of mold that is considered "hidden" behind walls and other building structures. If mold is being removed and there is a question about how far the colonization extends, then surface or bulk sampling, in combination with moisture measurements from affected building materials, may be useful. Sampling for airborne mold spores can indicate whether the mix of indoor molds is "typical" of the outdoor mix or, conversely, "atypical" or unusual at the time of sampling.

Any mold sampling that does occur must be performed by qualified and experienced investigators familiar with current guidelines and, if applicable, local regulations.

Samples should not be taken without a clear purpose (i.e., testing a hypothesis) and a sufficient number of samples must be taken to reliably assess the existing conditions. Laboratories vary in experience and proficiency; using an AIHA-LAP, LLC EMLAP-accredited lab or ISO 17025 equivalent is recommended.[3]

4. **It is not unusual for buildings to have a number of concurrent problems that affect IEQ or the perception of IEQ. Water and moisture damage can result in the release of gasses from some building materials. (8) Investigations of apparent or suspected mold-related health complaints must consider all possibilities. While mold damage comprises a large percentage of problem situations, studies of occupant complaints find that a high percentage have an outdoor air make up below the American Society for Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) standard, inappropriate and inadequate temperature and humidity levels, inadequate control of contaminants from outdoor air (including ozone, traffic pollutants, etc.), contaminants arising from equipment or activities within the building or house (including cooking activities), and poor air distribution.**[22,27,28]

IHs and other IEQ practitioners should approach mold, water intrusion, and IEQ investigations with the same mindset they use when they approach all investigations. The process includes three of the five key industrial hygiene elements: anticipation, recognition, and evaluation. While the IH can reasonably anticipate that there will be mold exposures associated with water intrusion, mold may or may not be the primary cause of any health effect(s) that may be experienced by the occupants. The IH should ensure that, while investigating mold-related complaints, whether apparent or reported, active consideration of other possibilities affecting IEQ in the space is an essential part of the investigation.[29]

In addition to mold-related exposures, contaminants that are both directly and indirectly associated with water-related damages may also be affecting the occupants. These contaminants may include, but are not limited to:

- particulate and gas/vapor contaminants associated with improper combustion ventilation or improperly operating utilities, such as carbon monoxide, nitrogen and sulfur compounds, soot and other fine particles, fuel and other volatile organic compounds (VOCs), etc.;
- VOCs from construction product degradation and/or off gassing, such as formaldehyde and other aldehydes, phenolics, and amines;

- organisms that proliferate under damp conditions or when maintenance is substandard, such as bacteria, amoeba, dust mites, cockroaches, and rodents; and,
- animal and chemical-based allergens already present and/or exacerbated by the water damage.

Many potential contaminants may be present along with mold damage that can affect health or the safety of investigators, remediation workers, and occupants. For example, failure to recognize the presence of asbestos, radon, or lead-based paint could lead to their disturbance during investigative or remedial activities, unnecessarily creating a new hazard. Finally, there is a need to recognize the potential hazards associated with remedial alternatives that may lead to the introduction of pesticides, ozone, chlorine dioxide, and other chemicals that could exacerbate existing health conditions or lead to new health issues.

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NOTE: Good industrial hygiene practices ensure that individual performing mold investigations and remediation are properly trained in the occupational and environmental hazards in buildings for all hazards.

Qualified persons should be utilized for the design and management of mold assessments, directing others performing initial mold assessments, writing protocols for mold remediation, and conducting post-remediation inspections. This may include Certified Industrial Hygienists (CIH) and/or Registered Occupational Hygienists (ROH) with the specific education, training, and experience in microbial contamination. A CIH is the leading professional accreditation for experts to investigate mold and dampness problems in buildings, particularly in the non-industrial workplace. There are other individuals who have undergone considerable training and education and may be appropriately qualified. However, any individual with the expertise necessary to be involved in the recognition, evaluation or control of mold should normally possess a certification awarded by a nationally recognized accreditation body.