

Moulds

*Workplace Guidelines for
Recognition, Assessment, and Control*

Occupational Health and Safety Council of Ontario

Moulds

More and more workplaces are involved in investigating or removing mould contamination from buildings. As a result, there's an increasing demand for information on moulds. This article explains

- what moulds are
- where they are found
- why they are of concern
- how they can be prevented
- what health effects they may cause
- how they can be identified
- how they can be safely removed.

Information also covers the obligations of employers and others under Ontario's *Occupational Health and Safety Act*.

What are moulds?

Moulds are microorganisms that produce thousands of tiny particles called spores as part of their reproductive cycle. Actively growing mould colonies are usually visible as colourful "woolly" or "slimy" growths. They can be virtually any colour—red, blue, brown, green, white, or black. When disturbed by air movement or contact, moulds release their spores into the air. Given the right environmental conditions, these spores can go on to form other mould colonies.

Mould becomes inactive or dormant if moisture is not present. Inactive mould is often dry and powdery or crusty and, like actively growing mould, can be readily disturbed by air movement or contact, causing mould particles and spores to become airborne. Mould can remain inactive for many years but will grow once moisture returns.

Where are moulds found?

Moulds can be found almost anywhere outdoors and indoors. There are over 100,000 species with at least 1,000 species commonly found in North America. Indoor moulds usually originate from outside sources such as soil, plants, and decaying matter. Moulds thrive in dark, moist environments and can grow at room temperature on various materials, including plastic, metals, insulation, wallpaper, particleboard, ceiling tiles, drywall, plywood, carpets, underpadding, and the interior surfaces of ventilation system equipment. This is not to say that moulds cannot grow in light, cool conditions—they can.

Workers can be potentially exposed to toxic spores when working on or in buildings with moisture problems. Moisture problems can be due to excessive humidity caused by lack of ventilation or by water damage from flooding, leaky plumbing, or leaks in the structure itself—that is, faulty roofs, windows, or walls.

Why are moulds of concern?

Numerous types of mould exist. In buildings with water damage or ongoing moisture problems, certain types of "water-loving" moulds may reproduce to higher than normal levels and potentially cause adverse health effects. *Stachybotrys chartarum* (also known as *Stachybotrys atra*) is of particular concern because it can be found in large colonies and can cause adverse health effects.

In addition to *Stachybotrys*, personnel working in water-damaged buildings may be exposed to other types of moulds such as *Fusarium*, *Aspergillus*, and *Penicillium*.

How can mould growth be prevented?

The most important point in mould control is moisture control. The following steps help control moisture.

- Where practical, divert water away from buildings. At ground level, this means sloping the soil away from the foundation. At roof level, it means installing and maintaining eavestroughs and downspouts to carry off water.
- Fix any plumbing or building leaks immediately. Clean up wet areas within 24-48 hours.
- Prevent moisture due to condensation by dehumidifying during warmer months. Keep humidity below 60 %. An air-conditioner provides dehumidification only while it's operating. A dehumidifier is needed when the air-conditioner is off.
- Vent moisture sources such as bathrooms and dryers to the outside.
- Keep heating, ventilation, and air-conditioning (HVAC) drip pans clean and in good repair.
- During construction projects, ensure that mould-susceptible materials are stored in a dry place and protected from moisture.
- In designing new or renovating existing facilities, choose water-resistant materials where moisture may be a problem. Follow installation techniques that minimize future water damage.

If the HVAC system is contaminated with mould, or suspected of being contaminated, it should be shut down and a professional remediator consulted. The New York City Department of Health provides control measures for HVAC units in *Guidelines on Assessment and Remediation of Indoor Environments*.

What health effects can moulds cause?

Mould can produce toxic substances known as mycotoxins. Some mycotoxins adhere to the mould spores while others can be found within the spore itself. Air movement and the handling of contaminated material can release spores containing mycotoxins into the atmosphere. Once released, spores must contact the skin or be inhaled before symptoms can develop.

- Exposure to toxic moulds may irritate skin, eyes, nose, and throat, resulting in symptoms such as difficulty in breathing, runny nose, and watery eyes.
- Other symptoms such as fatigue and headache have also been reported.
- Workers who are allergic to moulds could experience asthmatic attacks upon exposure.
- Workers exposed to *Stachybotrys* have additionally experienced burning in the nose, nosebleeds, severe coughing, and impairment of the immune system. *Stachybotrys* does not cause infection and is not spread from person to person.
- People with weakened immune systems are particularly susceptible to mould-related illness and should not be involved in removing mould or investigating areas that may be mould-contaminated.

Stachybotrys chartarum

Stachybotrys chartarum (also known as *Stachybotrys atra*) is a black greenish mould that grows on materials with high cellulose content such as drywall, wood, paper, and ceiling tiles. Like some other moulds, this one produces chemicals called mycotoxins under certain environmental conditions. Health effects of breathing mycotoxins are not well understood.

- *Stachybotrys* appears as black slimy patches and grows well on water-soaked cellulose material such as wallpaper, ceiling tiles, drywall, and insulation containing paper.
- Not all black moulds are *Stachybotrys*, and not all types of *Stachybotrys* produce mycotoxins.
- While still alive, *Stachybotrys* is wet, slimy, and does not release many spores or mycotoxins. Exposure is more likely when it dries up and is disturbed. Then any spores and mycotoxins that may be present are released into the air.
- Airborne *Stachybotrys* spores are very small and easily inhaled into the lungs.
- There is no diagnostic test to determine whether a person is exposed to *Stachybotrys*.

Aflatoxin

Aflatoxin is a mycotoxin that can be produced by the moulds *Aspergillus flavus* and *Aspergillus parasiticus*. Ingesting aflatoxin can cause liver cancer. There is also some evidence that inhaling aflatoxin can cause lung cancer. Aflatoxin has been found in contaminated grains, peanuts, and other foodstuffs. It should be noted, however that *Aspergillus flavus* and *Aspergillus parasiticus* are not commonly found on building materials or indoors.

Are medical tests available to distinguish mould health problems?

Currently available routine tests can only identify allergies to fewer than ten of the hundreds of moulds that may grow indoors. Building occupants may have mould allergies that a doctor cannot accurately diagnose using existing allergy tests. When an allergy test does identify a person as being allergic to a mould, the test cannot determine where or when that person was most recently exposed to the mould causing the reaction.

Similarly, there is no blood, urine, or other medical test that can determine whether someone has been exposed to a mould toxin. Researchers and laboratories are working to develop such tests, but none have been shown to be accurate.

People encounter high levels of airborne mould spores in many places—for example, when gardening, mowing lawns, playing outdoor sports, hiking, camping, or simply living in their homes. Isolating the effects of these exposures from workplace exposures can be very difficult.

How are moulds identified?

Owners of buildings that may be mould-contaminated should conduct an assessment to determine whether the building is indeed contaminated. This assessment must include a visual building inspection and may include taking and analyzing samples. Interviews with occupants and building maintenance staff are also crucial to the overall assessment.

The person performing inspections or taking samples must be suitably protected and must be careful not to unduly disturb the mould. As a minimum, consider using an N95 respirator, gloves, and eye protection.

Mould on visible surfaces may be just the tip of the iceberg. Moulds thrive in dark, moist environments and may be hidden from view. A moisture meter can be a useful tool for measuring the moisture content of materials such as wood, brick, concrete, insulation, and carpet. If moisture is discovered, water-damaged areas must be thoroughly inspected. This may involve looking into wall cavities, behind drywall, under carpets, and above ceiling tiles. Based on a) the presence of visible mould, b) evidence of water damage, or c) symptoms that are consistent with allergic or toxic responses to mould, it may be justified to skip sampling and go straight to remediation (removal).

Sampling

Air sampling, surface sampling, bulk sampling (taking bits of carpet, drywall, etc.), and laboratory analysis are used to identify and document the type of mould present. Sampling for a mould is not generally recommended because the results can be inconclusive and misleading.

If sampling is desired, then a strategy should be developed, carried out, and the results interpreted by a competent professional person. Analysis of the sample should be done by an accredited laboratory participating in the American Industrial Hygiene Association's Environmental Microbiology Proficiency Analytical Testing Program.

How can moulds be safely removed?

All mould contamination must be removed. But an assessment should be conducted before remediation (removal) begins. The assessment must answer the following questions:

- What is the extent of the mould contamination?
- What types of materials are affected?
- What is the source of the moisture?

Once the assessment has been conducted, a plan of action must be developed. For medium or large-scale remediation, a person should be appointed as manager. This person should be competent in assessing and remediating microbial contamination and exercise decision-making authority.

The plan should include

- steps to correct the moisture problem
- special control measures (which may include containment or isolation) to prevent worker exposure and the spread of moulds from the remediation zone to adjacent areas
- measures to relocate occupants during remediation if necessary.

Any decision to relocate workers should take into account the degree of contamination, the extent and types of health effects exhibited by workers, and the potential health risks associated with work activities during remediation. Special consideration must be given to workers who are sensitive to moulds or have weakened immune systems and other health-related concerns. Workers should be encouraged to check with their physicians if they are unsure of their medical status.

The Environmental Protection Agency (EPA), American Industrial Hygiene Association, Health Canada, the IRSST (Institut de recherche en sante et en securite du travail du Quebec), and the New York City Department of Health have all produced documents on assessing, removing, and managing fungal contamination. The chart on pages 6-7 summarizes the EPA's strategies for responding to water damage within 24-48 hours. Although these guidelines are designed to prevent the growth of mould, the chart also provides general advice on remediation, depending on the material involved and the extent of contamination. This information is intended only as a summary of basic procedures and is not intended, nor should it be used, as a detailed guide to mould remediation.

Biocides

In the past, biocides such as bleach were recommended to eliminate moulds. However, biocides have not proven to be any more effective than ordinary detergent and water in reducing moulds. Any use of biocides should be directed by a competent professional experienced in mould remediation.

Obligations under the *Occupational Health and Safety Act*

Although the *Occupational Health and Safety Act* does not specifically address moulds, an employer must take every precaution reasonable in the circumstances for the protection of a worker. Work practices set out in the documents below provide reasonable standards.

Employers have a duty to instruct workers in the safe removal and handling of mould-contaminated material. Workers in turn have a duty to follow these instructions. Building owners must ensure that trade contractors follow proper remediation procedures, such as those in the following publications.

- **Mould Remediation in Schools and Commercial Buildings:** *United States Environmental Protection Agency. Office of Air and radiation, Indoor Environments Division.* March 2001
- <http://www.epa.gov/iaq/molds/toc.html>
- **Fungal Contamination of Public Buildings: A Guide to Recognition and Management,** *Health Canada.* June 1995
- http://www.hc-sc.gc.ca/ehp/ehd/catalogue/bch_pubs/fungal.pdf

- **Guidelines on Assessment and Remediation of Indoor Environments.** *New York City Department of Health, Bureau of Environmental & Occupational Disease Epidemiology. January 2002* <http://www.ci.nyc.ny.us/html/doh/html/epi/moldrpt1.html>
- **Guide for the Prevention of Microbial Growth in Ventilation Systems.** *IRSST (Institut de recherche en sante et en securite du travail du Quebec) October 1994.* http://www.irsst.qc.ca/htmen/catalogue/3_0_10.htm
- **Microbial Growth Task Force.** *American Industrial Hygiene Association. May 2001.* <http://www.aiha.org/Committees/documents/webmicrobial.pdf>
- **Guidelines for the Investigation, Assessment and Remediation of Mould in the Workplace.** *Manitoba Labour. March 2000.* <http://www.gov.mb.ca/labour/safety/Mould.pdf>

Mould Remediation Chart

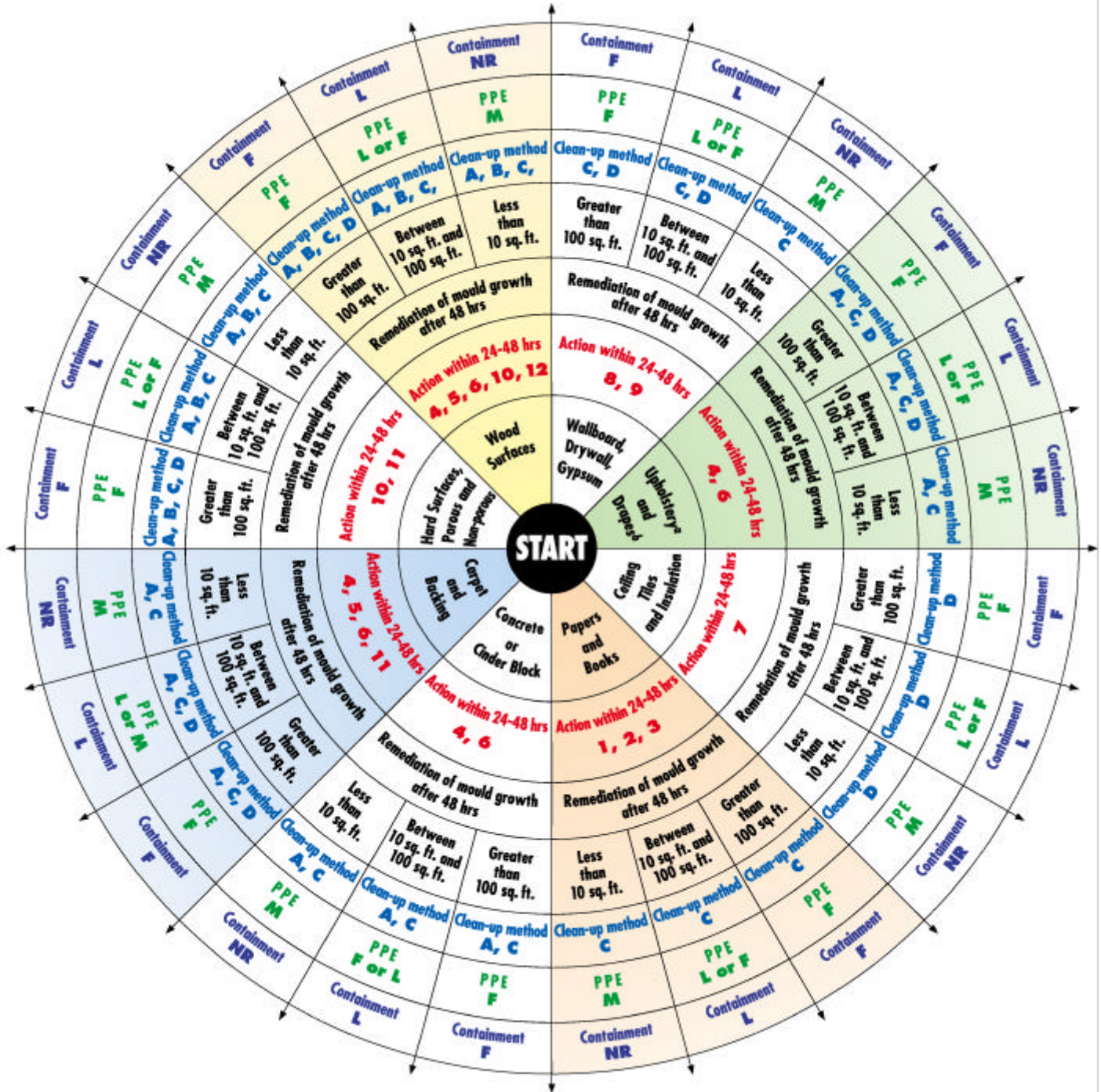
The chart on the next two pages summarizes mould control procedures recommended by the Environmental Protection Agency in the United States.

For various kinds of material, the chart indicates how mould growth can be prevented within 24-48 hours of water damage and also provides general advice on remediation. This information is intended only as a summary of basic procedures and is not intended, nor should it be used, as a detailed guide to mould remediation.

Although the chart may look complicated, it becomes clear and useful when taken one step, or one ring, at a time.

1. Start at the centre.
2. In the first ring, identify the material you are concerned about.
3. In the next ring, find out what actions to take within the first 24-48 hours of CLEAN water damage. Actions are numbered 1, 2, 3, 4, and so on. Each is spelled out under the Action within 24-48 hrs column on the next page.
4. Proceed to the next ring if mould growth is apparent and more than 48 hours have elapsed since water damage. Determine whether the contaminated area is less than 10 square feet, between 10 and 100 square feet, or greater than 100 square feet.,
5. Proceed to the next ring and follow the clean-up method indicated for the size of the contaminated area. Methods are lettered A, B, C, and D. Each is spelled out under the Clean-up Methods column on the next page.
6. In the next ring, determine the level of personal protective equipment required. This is indicated by M, L, or F under the PPE column on the next page.
7. Finally, in the outermost ring, determine whether containment is necessary and, if so, whether it must be L (limited) or F (full). These requirements are explained in the Containment column on the next page.

Mould Remediation Chart



Mould Remediation Chart Instructions

ACTION WITHIN 24-48 HRS

Actions are for damage caused by clean water. If you know or suspect that water is contaminated by sewage or chemical or biological pollutants, consult a professional. Do not use fans unless the water is clean or sanitary. If mould has grown or materials have been wet for more than 48 hours, consult Clean-up Method in chart.

1. Discard non-valuable items.
2. Photocopy valuable items, then discard.
3. Freeze (in frost-free freezer or meat locker) or freeze-dry.
4. Remove water with water-extraction vacuum.
5. Reduce humidity levels with dehumidifiers.
6. Accelerate drying process with fans and/or heaters.
 - Don't use heat to dry carpet.
 - Use caution applying heat to hardwood floors.
7. Discard and replace.
8. May be dried in place, if there is no swelling and the seams are intact. If not, then discard and replace.
9. Ventilate wall cavity.
10. For all treated or finished woods, porous (linoleum, ceramic tile, vinyl) and non-porous (metal, plastic) hard surfaces, vacuum or damp-wipe with water or water and mild detergent and allow to dry; scrub if necessary.
11. For porous flooring and carpets, make sure that subfloor is dry. If necessary clean and dry subfloor material according to chart.
12. Wet paneling should be pried away from walls for drying.

CLEAN-UP METHODS

Methods are for damage caused by clean water. If you know or suspect that water is contaminated by sewage or chemical or biological pollutants, consult a professional.

These are guidelines only. Other cleaning methods may be preferred by some professionals. Consult **Action within 24-48 hrs** in the chart if materials have been wet for less than 48 hours and mould growth is not apparent. If mould growth is not addressed promptly, some items may be damaged beyond repair. If necessary, consult a restoration specialist. **A.** Wet-vacuum the material. (In porous material, some mould spores/fragments will remain but will not grow if material is completely dried.) Steam cleaning may be an alternative for carpets and some upholstered furniture.

B. Damp-wipe surfaces with water or with water and detergent solution (except wood - use wood floor cleaner); scrub as needed.

C. Use a high-efficiency particulate air (HEPA) vacuum once the material has been thoroughly dried. Dispose of HEPA-vacuum contents in well-sealed plastic bags.

D. Remove water-damaged materials and seal in plastic bags inside containment area, if there is one. Dispose of as normal waste. HEPA-vacuum area once it is dried.

PPE (PERSONAL PROTECTIVE EQUIPMENT)

Use professional judgment to determine PPE for each situation, particularly as the size of the remediation site, and the potential for exposure and health effects, increase. Be prepared to raise PPE requirements if contamination is more extensive than expected.

M Minimum - Gloves, N-95 respirator, goggles/eye protection.

L Limited - Gloves, N-95 respirator or half-face respirator with HEPA filter, disposable overalls, goggles/eye protection.

F Full - Gloves, disposable full-body clothing, head gear, foot coverings, full-face respirator with HEPA filter.

CONTAINMENT

Use professional judgment to determine containment for each situation, particularly as the size of the remediation site, and the potential for exposure and health effects, increase.

NR None Required

L Limited – From floor to ceiling, enclose affected area in polyethylene sheeting with slit entry and covering flap. Maintain area under negative pressure with HEPA-filtered fan. Block supply and return air vents in containment area.

F Full - Use two layers of fire-retardant polyethylene sheeting with one airlock chamber. Maintain area under negative pressure with HEPA-filtered fan exhausted outside of building. Block supply and return air vents in containment area.

Notes

a) Upholstery may be difficult to dry within 48 hours. For items with monetary or sentimental value, consult a restoration specialist.

b) Follow manufacturer's laundering instructions.

With grateful acknowledgment, based on *Mold Remediation in Schools and Commercial Buildings*, published by the United States Environmental Protection Agency, March 2001.