

MOULD IN THE INDOOR ENVIRONMENT

Introduction

When we think of mould we usually think of “that black stuff” between the tiles in the bathroom. But what is mould really?

Mould is a group of organisms from the fungus kingdom which consists of large organisms like mushrooms and toadstools as well as moulds and yeasts which may be small or microscopic. Many fungi are edible and make up a part of our normal diet. Mushrooms are an obvious example and truffles are considered a delicacy. Yeasts are used in food production such as in bread, cheese and beer. Some fungi are even used in making medicine, penicillin being probably the most famous example.

But there are many types of fungi that are harmful to human health or even deadly. Many mushrooms and toadstools are poisonous, including the aptly named Angel of Death mushroom. Moulds too can be harmful and produce toxins, cause disease or trigger allergic reactions.

In general, fungi grow in moist or wet areas where there is some form of nutrient present such as dirt, plant or animal matter. Dark areas away from direct sunlight are preferred. Most fungi produce spores (roughly equivalent to plant seeds) to reproduce and proliferate. Spores are quite small, measuring only a few micrometers in diameter (less than a tenth of the thickness of a human hair).

Visible fungus that does not grow in any particular shape is usually termed “mould”. It may look like small black spots, large discoloured or multi-coloured areas, or even a fluffy “carpet”.

Health Effects

Exposure to moulds can have a wide variety of health effects in people. These may be minor allergic reactions such as sore eyes or nasal congestion. More severe symptoms include: shortness of breath, sore throat, coughing, headache, rashes and dermatitis, upper respiratory complaints and asthma attacks. These can be quite serious and even fatal.

There are three main mechanisms by which moulds and other fungi can affect health.

Allergy : About 90% of moulds produce spores. These spores can cause allergic reactions in some people. Obviously some species of mould produce spores that are more allergenic than others and different people have varying reactions. Increased exposure may sensitise people so that they react to much lower levels. Even dead spores can cause reactions.

Toxins : Moulds produce toxins as a natural defence against competitors and predators. These toxins are known as mycotoxins and some are among the most poisonous substances known. Exposure to large amounts of mycotoxins can have serious health effects and may even be fatal. A classic example would be eating a poisonous mushroom but this is by no means the only mechanism. Some moulds even release mycotoxins into the air.

Infection : Much as bacteria and viruses can cause infections, so too can some types of mould and other fungi. In some cases this is “opportunistic” infection where the individual is immunocompromised in some manner. However there are fungi that are true pathogens (disease-causing agents). Infections of the lungs, skin, nails, ears, eyes and other areas are common.

Types of Mould	Potential Health Effects	Comments
Alternaria	May cause allergic reactions. A common trigger of asthma attacks in asthmatics. It has been associated with hypersensitivity pneumonitis, sinusitis, dermatomycosis and invasive infection.	Extremely widespread and ubiquitous. Outdoors it may be isolated from samples of soil, seeds, and plants. It is often found in carpets, textiles and on horizontal surfaces in building interiors.
Aspergillus	May cause allergic reactions. Some species may cause serious lung infections as well as infections of the skin, ears and eyes.	Common on decaying vegetation, soils, stored food and feed products in tropical and subtropical regions.
Cladosporium	A common allergen. Common cause of extrinsic asthma. Acute symptoms include oedema and bronchospasms, chronic cases may develop pulmonary emphysema.	Most commonly identified outdoor fungus. Commonly found on the internal surfaces of air handling systems. It is found on dead plants, woody plants, food, straw, soil, paint and textiles.
Epicoccum	A common allergen.	Found in plants, soil, grains, textiles and paper products.
Fusarium	May cause allergic reactions. Frequently involved in eye, skin and nail infections. Several species can produce potent toxins that affect the circulatory, alimentary, skin and nervous systems.	A common soil fungus. It is found on a wide range of plants. It is often found in humidifiers.
Mucor	Generally relatively harmless but may trigger allergic reactions in some people. Can cause infections in immuno-compromised individuals.	Often found in soil, dead plant material, horse dung, fruits and fruit juice. It is also found in leather, meat, dairy products, animal hair and jute.
Penicillium	It may cause hypersensitivity pneumonitis and allergic alveolitis in susceptible individuals. May cause allergic reactions and trigger asthma attacks.	Often found in aerosol samples. Commonly found in soil, food, cellulose and grains. It is also found in paint and compost piles as well as carpet, wallpaper and in fibreglass duct insulation.
Stachybotrys	Several strains of this fungus may produce a mycotoxin which is poisonous by inhalation. People exposed to this toxin may experience cold and flu symptoms, sore throats, diarrhoea, headaches, fatigue, dermatitis, intermittent local hair loss and generalized malaise. Also suppresses the immune system.	This dark coloured fungi grows on building material with a high cellulose content and a low nitrogen content. Areas with relative humidity above 55% and subject to temperature fluctuations are ideal for toxin production. Often difficult to find in indoor air unless disturbed.
Trichophyton	Can cause ring worm, athlete's foot, skin, nail, beard, and scalp infections.	Found on soil and skin.

CONDENSATION IN BUILDINGS

Traditionally our buildings were not built airtight and had very little or no insulation. The result of changing occupant practices (such as closing windows to exclude external noise or retain conditioned air) and the introduction of mandatory energy efficiencies and enhanced bushfire construction requirements, building practices are changing, requiring a change in detailing so that moisture related problems of condensation are adequately managed.

Air itself contains invisible water vapour in a given temperature. The higher the air temperature, the more water vapour it can hold. The lower the air temperature, the less water vapour it can hold. So therefore when air contains elevated levels of water vapour being below “**Dew Point**” lets say from a typical 15 minute shower which can produce at least 2 litres of water vapour when contacting a cold surface then condensation will form as water droplets that can absorb into surfaces such as paint work, clothing, upholstery, curtains etc; this can then form mould or mildew damaging property and causing health concerns.

Typical Condensation Areas

The most common problem areas effected by condensation are bathrooms, laundries, kitchens, bedrooms (particularly facing south or adjoining en-suite), built-in wardrobes and store cupboards. Condensation can be produce from ordinary day to day living activities people can produce up to half a litre water vapour just breathing overnight.

Other water vapour producing examples are:

- A 15 minute hot shower can produce up to two litres
- A washing machine (using hot water) or dishwasher can produce three litres per hour
- A clothes drier can produce as much as ten litres per hour
- Kerosene, gas heaters will produce considerable amounts if unflued

Water vapour can also travel from room to room throughout due to differences in air pressures.

New homes are also potentially at risk of condensation problems this is because of the large amounts of water used in the construction and inclement weather been absorbed into the exposed building structure. Good building practice is to ensure adequate ventilation for natural drying the use of heaters to dry out the structure is not recommended as damage from shrinkage and buckling timber may occur.

Condensation Types

There are two types of condensation there is the visible “**Surface Condensation**” that forms on surfaces within the building or “**Interstitial Condensation**” is caused by water vapour inside a building that is able to move via diffusion through a permeable building fabric or simply by air reaching a surface within the building cavity that is below the “Dew Point” temperature. The “Interstitial Condensation” can cause far more damage than “Surface Condensation” if the moisture becomes restricted from drying out it then can compromise the durability of the building materials and the health and well being of occupants. A good example of “Interstitial Condensation” would be a bathroom ceiling fan exhausting directly within a floor or roof cavity.

Thermal Bridging

This term is given when heat is transferred at a substantially higher rate than the surrounding area through a conductive or convective path that generally bridges past a high insulating material or construction.

Rising Cold Damp

This relates to an elevated building that has a subfloor cavity beneath the structure. What is “**Rising Cold Damp**”? it is the result of cold damp air in the subfloor environment migrating via floors and walls entering the upper building areas being attracted by the warmer internal air the cold damp will continue to rise until a “**Dew Point**” temperature is reached then condensation is formed.

The main cause of “**Rising Cold Damp**” is the inadequate cross flow ventilation and in some cases exacerbated by poor drainage this problematic condition is normally more prominent during the wet and colder months during the warmer months poor ventilation causes mould damage to under flooring & wall timbers, furnishings, ill health issues and is conducive timber pests such as Termites.

ideally good building practice in removing moist stale air within the subfloor environment also preventing “**Rising Cold Damp**” is to install suitable cross flow ventilation achieving at least 6-10 air change volumes per hour in accordance with AS3660.1 and BCA.

Other Problem Causes of Mould

The main factor that influences mould growth is the presence of water. Wherever sufficient water is present there are usually enough nutrients to support the growth of mould spores that are invariably found in the indoor air. Water may be from leaks, floods, overflowing sinks, blocked drains, condensation on cold surfaces, etc.

Following water leaks or floods (such as may be caused by a burst pipe) mould growth in carpet and other building material can be explosive. As a consequence, airborne microbial counts can increase from less than 100 cfu/m³ to many thousands of cfu/m³ in a matter of hours.

Drying out the material may not solve the problem either. Many moulds release spores when the moisture dries up as part of their normal lifecycle and this dramatically increases the airborne counts. The dry mould can continue to be a problem too since dead mould is often still allergenic and the toxins produced by the fungi during its growth period are still present.

Identification and Remediation Solutions

It is important for employers, building owners and managers to determine areas where mould might be a problem. This should be followed by proper identification and assessment of any risks.

This is even more critical in places where the occupants may be more susceptible than usual to the hazards of mould exposure. Wherever the elderly or the very young or those already in poor health are present, the utmost care should be taken to minimise the risks.

Remediation and clean up of any mould affected areas can be complicated and will not be successful unless the proper steps are taken. Appropriate biocides must be used and often materials such as carpet or insulation must be replaced entirely.

Preventative action should be taken to minimise mould growth in following the requirements of the Australian Standards and the Building Codes of Australia (BCA) is an important step.

Mechanical ventilation AS 1668.2 in bathroom, kitchen and laundry areas exhausting to atmosphere.

The ventilation of subfloors, walls and roof cavities in accordance AS 3660.1 and relevant BCA codes.

Provide Insulation in accordance with AS 3999 to the building cavities to achieve static room temperatures, minimising dew points, and significantly reduce heating & cooling costs. Conditioned air handling systems maintained and serviced in accordance AS 3666.

Expert advice should be sought to ensure that mould hazards are eliminated or controlled and to minimise risks. All care should be taken to protect the health and well-being of employees and other occupants of buildings.

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