Management of Indoor Moulds
Part I Introduction of Indoor Moulds

January 2019

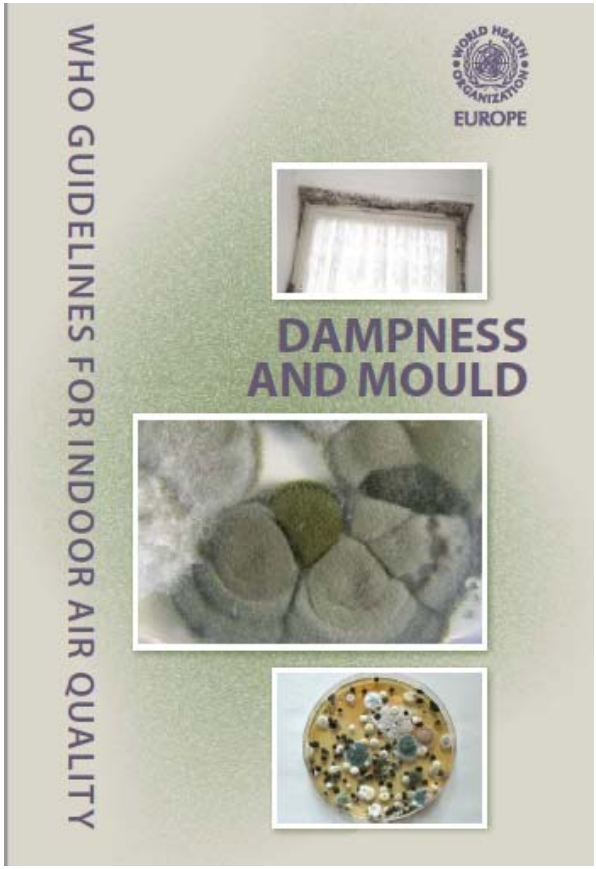
環境保護署
Environmental Protection Department

Management of indoor moulds – why and how?

- **Prevention and control of mould growth** in indoor environment is essential to **protect occupant health**.
- Indoor mould problems can be kept under control
  - through good **building design**,
  - effective **housekeeping** practices, and
  - maintain a clean and dry **environment**.

Indoor microbes with health concerns

- Two major groups of **microbes** that can **affect human health** in indoor environments **– bacteria and moulds (fungi)**.
- A number of important cognizant authority publications on the health effects of exposure to mould growth indoors are available, notably the ***“World Health Organization Guidelines for Indoor Air Quality— Dampness and Mould (2009)”***.

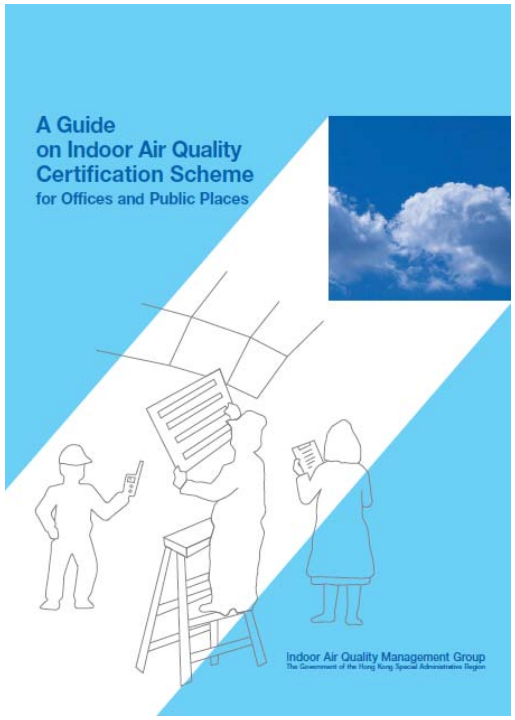


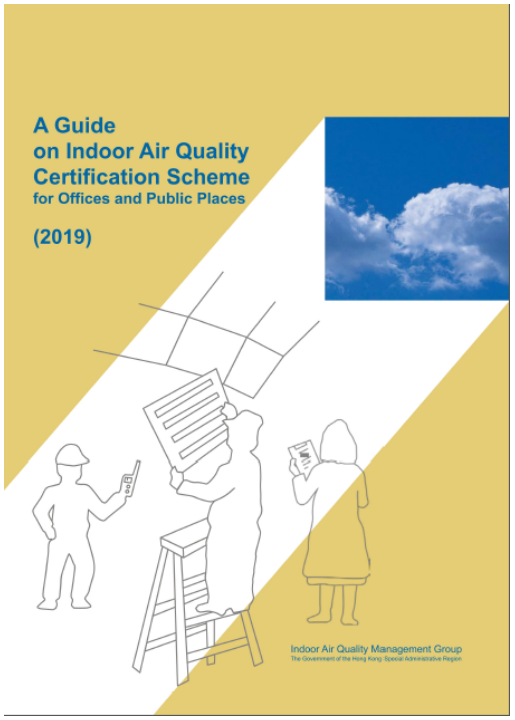
Indoor mould management programme

'Mould' will be added as another criterion under the Indoor Air Quality (IAQ) Certification Scheme for Offices and Public Places.

Parameter	Unit	Averaging Time	Old Objectives (Effective since 2003)		New Objectives (Effective on 1 July 2019)	
			Excel-lent Class	Good Class	Excel-lent Class	Good Class
Room Temperature	°C	8 hours	20 to <25.5	< 25.5	---	
Relative Humidity	%	8 hours	40 to <70	<70	---	
Air Movement	m/s	8 hours	<0.2	<0.3	---	
Carbon Dioxide (CO_2)*	ppmv	8 hours	<800	<1,000	800	1,000
Carbon Monoxide (CO)	ppmv	8 hours	<1.7	<8.7	1.7	6.1
Respirable Suspended Particulates (PM_{10})*	µg/m³	8 hours	<20	<180	20	100
Nitrogen Dioxide (NO_2)	µg/m³	8 hours	<40	<150	40	150
		1 hour	---	---	100	200
Ozone (O_3)	µg/m³	8 hours	<50	<120	50	120
Formalde-hyde (HCHO)	µg/m³	8 hours	<30	<100	30	100
		30 mins	---	---	70	100
Total Volatile Organic Compounds (TVOC)	µg/m³	8 hours	<200	<600	200	600
Radon (Rn)	Bq/m³	8 hours	<150	<200	150	167
Airborne Bacteria	cfu/m³	8 hours	<500	<1,000	500	1,000
Mould*	---	---	---	---	Assessment in the form of walkthrough inspection	

** Measurement for CO_2 and PM_{10} is required for 1st to 4th annual re-certification for certificate renewal in a 5-year cycle. Assessment of mould is also required when the new IAQ objectives are adopted.*





Compliance assessment of mould

This involves:

- A prescriptive **Compliance Checklist**,
- **Technical Guidelines** developed to enhance understanding and implementation of the Checklist, and
- **A Guide on Prevention and Control of Indoor Mould** to provide background information and practical guidelines to identify, control and prevent indoor mould problems.

What are indoor moulds?

What is mould?

- Mould is a common term for a group of microscopic fungi, which are microorganisms that live on dead organic matter.

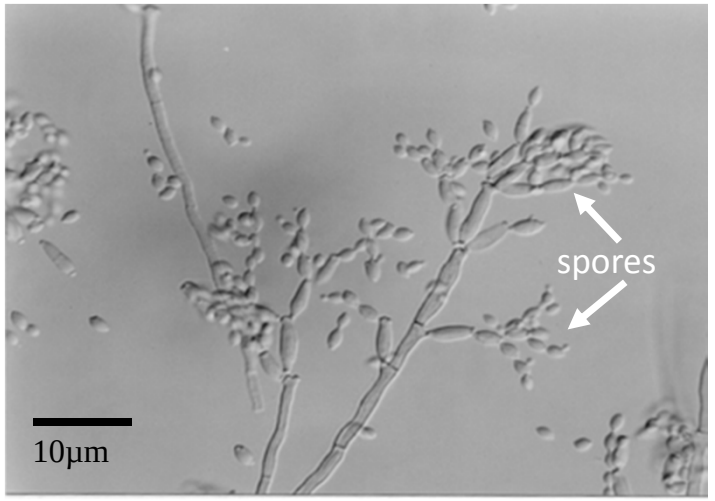
- Indoor moulds break down dead organic matter and can cause damage to food, various building materials, textile, leather, carpets, etc.

Extensive mould growth on wall surface and bread

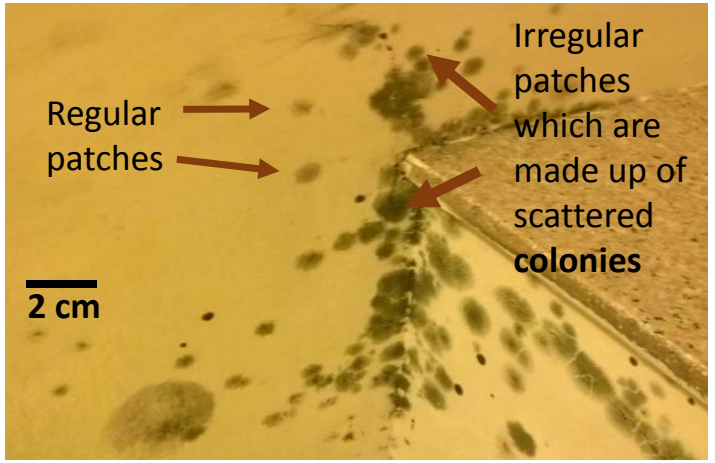
Indoor moulds (1): invisible microscopic structures and visible colonies

- Mould produce **tiny spores** which are not visible to the naked eyes.
- These tiny spores act like seeds and **can grow into mould patches** if the conditions are right, including the presence of nutrients (viz. organic matter), at suitable temperature with sufficient moisture.
- These patches are referred to as '**colonies**' and are typically
  - very small (mm in range) to large areas of heavy growth, and
  - usually in various shades of green or black but can be of any colour.
- When **many 'colonies'** grow together, **irregular patches** will appear.

Microscopic parts of a mould



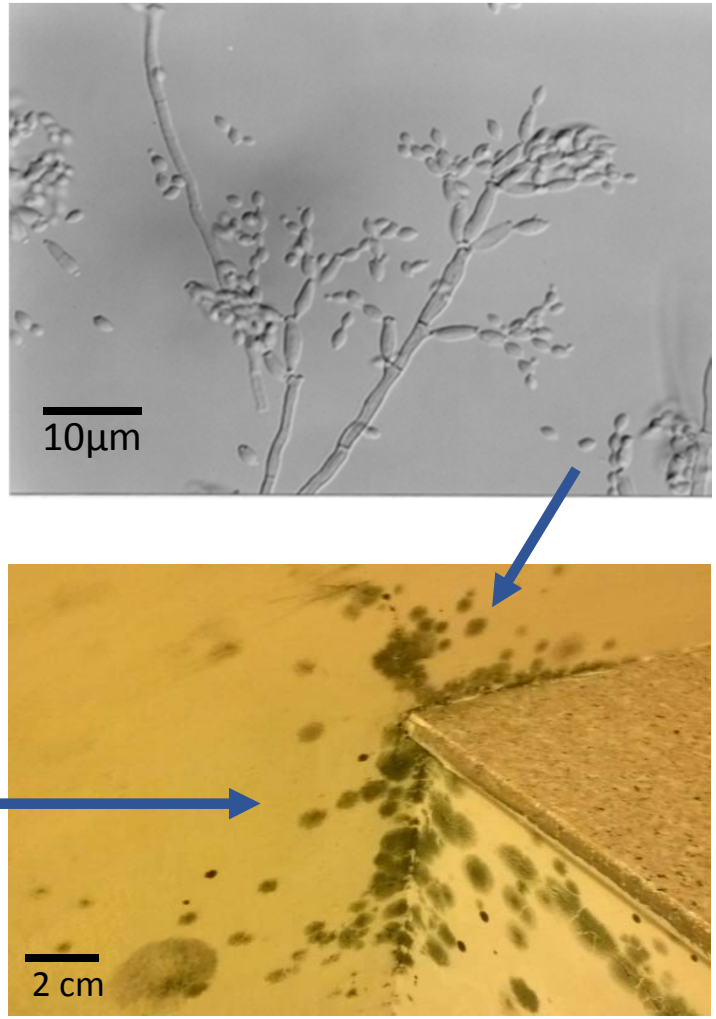
Dark round patches comprised of many dark colour colonies



Indoor moulds (2): visible growth

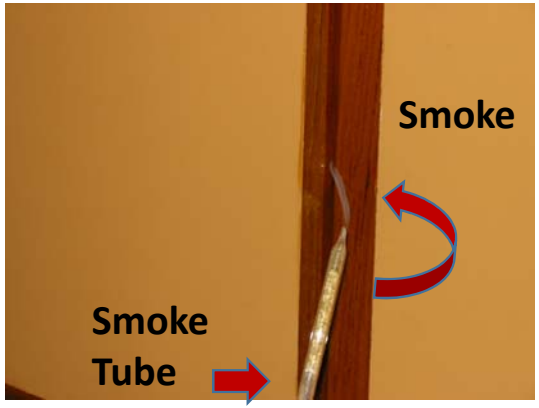
- **There are billions of spores where visible mould is seen**

- When **indoor conditions are suitable** (e.g. moist plaster wall in a bathroom, bread placed in a cupboard in the kitchen), **each spore can grow into a mould colony**.



Indoor moulds (3): where do they come from?

- Normally **moulds live on decaying organic matter in the outdoor environment**, e.g. dead leaves, and can be found in soil in the outdoor environment.
- Mould spores are **carried into buildings** from outdoor air and **wind-blown soil particles through open windows** and **doors**, and **fresh air inlets** in buildings with mechanical ventilation and air condition (MVAC) system.
- Mould spores are also carried into buildings **via clothes & shoes** as well as **objects brought into a building**.



Direction of flow of "smoke" from Smoke Tube indicating infiltration of outside air into an indoor environment

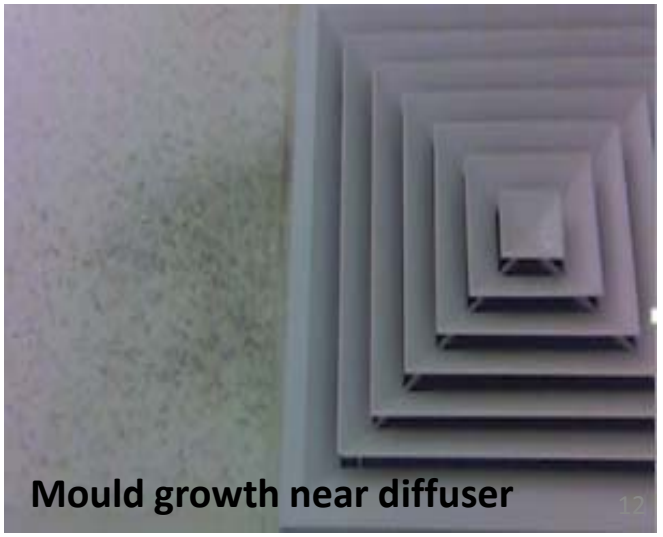
Indoor moulds (4): musty odour and moulds

- Sometimes **mould growth is not obvious,** e.g. when the growth is:
  - behind wallpaper,
  - inside ventilation ducts, and
  - under carpets.
- **Musty odour** is a reliable **indicator of active mould growth** usually but not always in damp conditions:
  - **Volatile Organic Compounds** (VOCs) are released as the fungi grow, and
  - VOCs have characteristic **“musty” smell**.

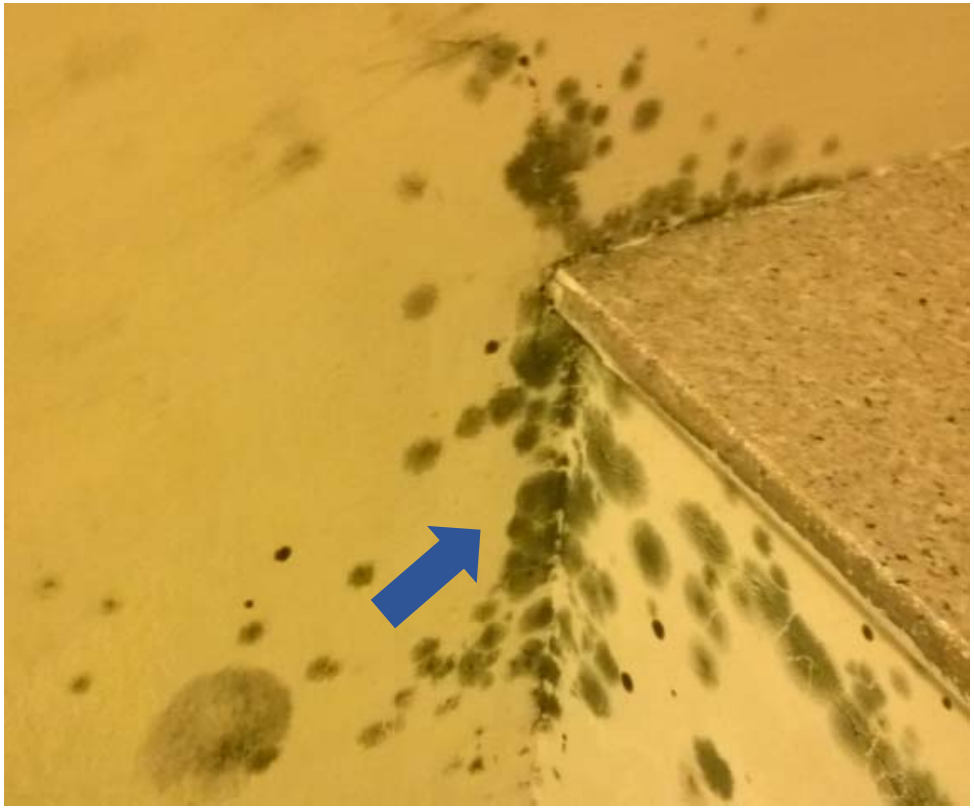
Mould growth behind wall paper

Mould growth indoors (1)

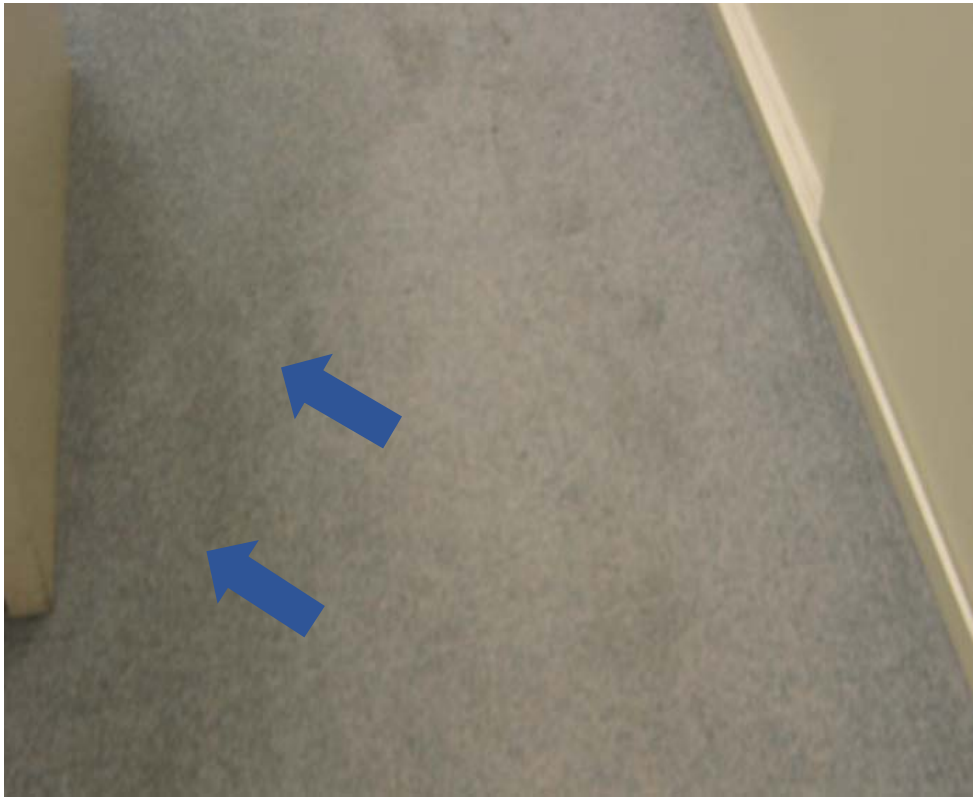
These fungi **grow well** in the indoor building environment, especially on **damp** materials (e.g. ceiling tiles, wallpaper, furniture, gypsum-plastered wall surfaces, carpets, etc.)



Mould growth indoors (2): common growth sites



Gypsum-plastered wall surface



Mould growth on carpet

Mould growth indoors (3): common growth sites

Dust accumulation and condensation around diffusers provided the conditions for mould growth

Caulking/sealant around window frame susceptible to water condensation supporting mould growth

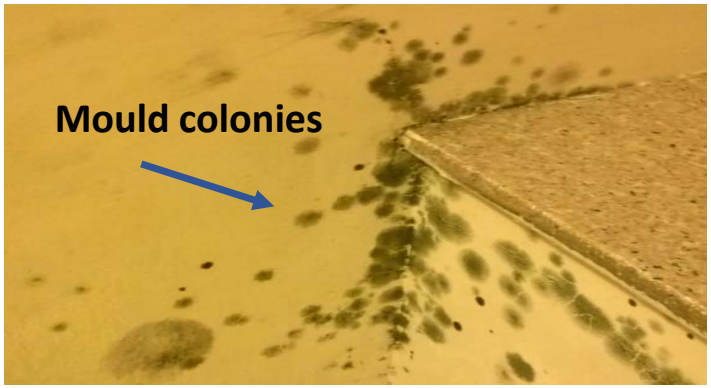
Mould growth indoors (4): common growth sites

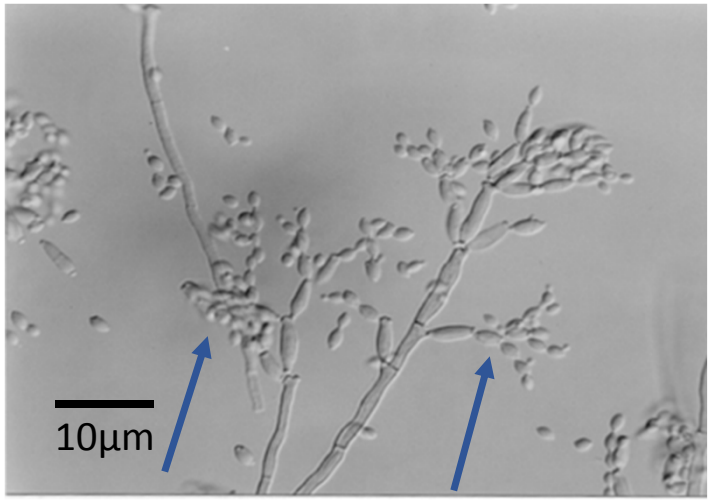
Wash basin border caulking

Carpet near the water dispenser from leaks and spills from the dispenser

Mould growth indoors (5): spore mobility

- The **billions of spores** from observable mould colonies can **disperse in air easily** without anyone touching them by:
  - air movement from the MVAC system, and
  - walking across a mouldy carpet.

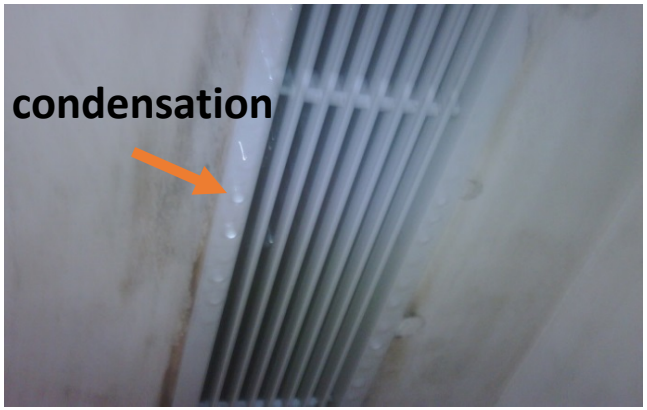




These spores can be easily dislodged without any physical disturbance. They will be suspended in air and affect the indoor air quality.

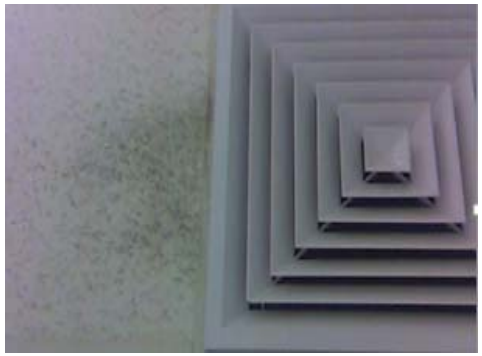
Factors supporting mould growth

Factors supporting growth (1): three major factors



FIRST and most important,

moisture



Growth on dust on the ceiling tile

SECOND, **nutrients** from the building material itself (e.g. growing on the paper and glue of wallpaper) and/or organic material in dusts

THIRD, any **temperatures** from 10–40°C

Most indoor moulds can grow well within a temperature range of 20 to 26°C. If the indoor temperature and relative humidity are both high , mould damage will occur more rapidly.

Factors supporting growth (2): water damage

Sources of moisture in the indoor environment include **spills, leaks, floods**, e.g.

a) Poorly sealed door – sign of mould growth on the wall next to a badly sealed door

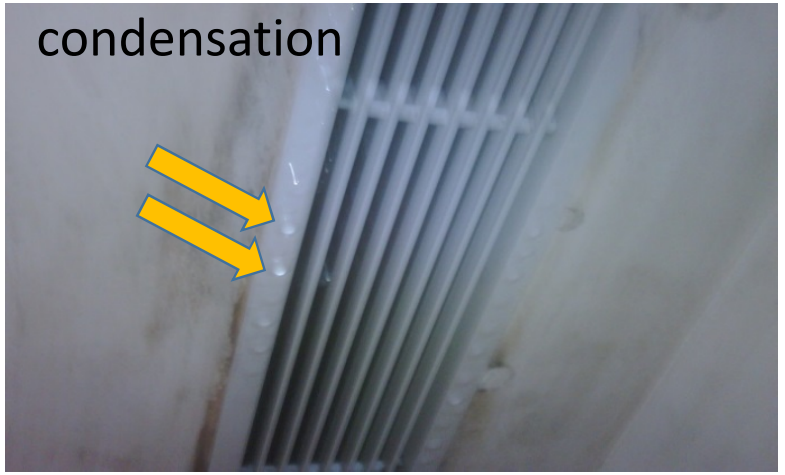
b) Water spills from leaky water dispensers – water dripped on carpet causing mould growth on carpet

c) Floods due to leaky or bursting water pipes from upper floor

Factors supporting growth (3): moisture – condensation

Condensation will be formed

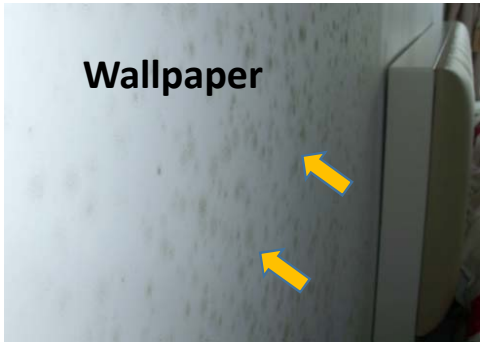
- when the **relative humidity** in the indoor air is **high**, and
- the **temperature** of building materials **surfaces are lower than the ambient air temperature.**



- **The surface of the diffuser border is cold due to the cold air emitting from within the diffuser.**
- **If the surface temperature is lower than the ambient air temperature, and the water vapour holding capacity of the surrounding air is exceeded (high relative humidity), water condensation will be formed.**

Factors supporting growth (4): moisture and hygroscopic materials

- **Dust is hygroscopic** which allows mould growth in carpets.
- **Building materials** like plaster walls and wallpaper **can absorb moisture** from the indoor air and thus support mould growth.
- **Some materials can absorb moisture easily**. This makes mould **growth MUCH more readily on these materials than others**, e.g. small amount of water is required to allow the growth of mould on paper, but it takes a lot to grow on solid wood.



Factors supporting growth (5): dust and dirt

- **Dust and dirt accumulation is an important reason for mould growth**.
- Dust is **derived from dead organic matter** such as dead cells of fungi, bacteria, pollens, human skin scales, house dust mites, lint from clothes, soil particles, etc. **which has become small particles**.
- **Settled dust** in carpets and the MVAC system is **highly hygroscopic**, readily absorbing water from humid air and **supporting mould growth**.

Accumulation of dust on floor

Dust (and probably mould growth) accumulated on the surface of the air diffuser

Moulds and Health

Moulds and health (1): are moulds harmful?

- **Mould and dampness** have the potential to **cause health problems**.
- Inhaling mould spores or particles, or touching mould patches on walls may **cause allergic reactions** in mould sensitised individuals.
- Exposed to mould and dampness in buildings is associated with increased risk of allergy **and non-specific symptoms** (e.g. headache) in both atopic and non-atopic individuals.
- Symptoms other than allergic and irritant types are not common.

Mould growth on the wallpaper in a bedroom

Mould growth on and around diffuser surface

Moulds and health (2): is there any acceptable level of exposure to moulds?

- To date, it is **impossible to set thresholds for health effects of moulds** because:
  - exposure to different fungi would lead to different effects, and
  - every person has a different sensitivity to mould.

BUT

- the **area of mould growth is an important indicator of potential level of exposure** for occupants.

If a person's desk is below this ceiling, he/she will be highly exposed.

Moulds and health (3): hidden mould counts

In the absence of effective high efficiency particulate air (HEPA) vacuuming in buildings with a hidden mould problem, most of the mould exposure comes from the carpet and other porous surfaces.

Moulds and health (4): prevention

- Thus it is advisable to remove all visible mould growth and apply remediation measures irrespective of the extent of mould growth.
- Establishing a regular schedule of HEPA vacuum cleaning can lead to an immediate reduction in exposure to particles including moulds, bacteria and dust particles.

END