

# HVAC&R Nation

AN AIRAH PUBLICATION



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Duct design  
procedure

# A growing concern

## The dangers of toxic mould

# A GROWING CONCERN



We all recognise mould as undesirable in the indoor environment, but we are now discovering that even small amounts can be debilitating to building occupants. **Sean McGowan** reports on the impacts of mould on human health.

According to the Department of the Environment and Energy, Australians spend 90 per cent of their time indoors. And with indoor air pollution consistently ranked among the top five environmental risks to public health by the US EPA and its Science Advisory Board, it's easy to wonder whether this is slowly killing us.

Although we know that the quality of indoor air can be adversely affected by introducing gases and other chemicals, organic pollutants such as fungi and microbial contamination can be hard to identify, and their impacts on human health even harder to understand.

"I don't believe we know the extent of mould in homes and workplaces, and how it might affect the occupants," says Jesse Clarke, M.AIRAH, building science manager at Pro Clima Australia and president of AIRAH's Building Physics Special Technical Group.

"We do know, however, that mould can have adverse effects on health," he says, "as mould is generally the same all over the world and much literature has been published on this."

The effects of mould on building occupants are varied. For some, it could cause an allergenic reaction such as asthma. For others, the impact could be pathogenic and cause disease.

"Some who are genetically susceptible suffer a chronic inflammatory response, and at sufficient levels it can be toxicological for anyone," says Dr Tim Law PhD, architectural scientist at Archsciences.

"Most health practitioners will be familiar with the allergenic, pathogenic and toxicological effects of

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mould," he says, "but in contrast it is the aspect of Chronic Inflammatory Response Syndrome that is not as well-known and medically recognised in Australia."

The term Chronic Inflammatory Response Syndrome, or CIRS, was created by Dr Ritchie Shoemaker, an American physician and researcher. It is used to describe an illness caused by the body's reaction to biotoxins produced by a number of microorganisms, including mould.

Symptoms can include chronic illnesses such as chronic fatigue syndrome, fibromyalgia and even multiple sclerosis (MS).

Yet according to Law, CIRS is virtually unknown in the building and HVAC industries, particularly here in Australia.

“The idea that even small, invisible quantities of mould can be debilitating to occupants is still a foreign concept,” he says.

## MOULD IN BUILDINGS

Clarke says understanding mould and understanding the conditions that allow mould to grow are two very different things.

If microbiologists are experts in mould and mould growth, engineers are the ones with the knowledge to limit the conditions in which mould can thrive in an indoor environment.

“Understanding psychrometrics is critical in limiting moisture conditions in building components, HVAC services and building assemblies that can be conducive to mould growth,” says Clarke.

“You just need to know the limits at which mould will germinate and thrive.”

So while you might usually associate mould with tropical humid climates, or with old, run-down buildings where damp is a problem, the truth is that mould can occur anywhere in the indoor environment where moisture remains present for a prolonged period.

And unfortunately for humans, mould likes the same temperature conditions that we do – meaning the potential for mould growth is exponentially greater than most would imagine.

“Even in climates not commonly associated with high humidity, such as a temperate climate, there are daily cycles of dew and even frost formation,” says Law. “In parts of the building where condensation regularly forms and does not regularly dry out, there is every likelihood that mould will be present.”

Even in well-sealed buildings where water leaks are not occurring, water activity can be caused by a high dew point and low surface temperature. The former is created by the addition of heat and moisture to the building interior (as well as a lack of ventilation), while the latter is a result of thermal bridging.

“High insulation levels won’t guarantee there will be no mould interstitially within the structures and the assembly layers,” says Clarke.

“Surfaces contained within the building envelope can easily reach 80 per cent humidity if the internal air is allowed to migrate into the structure and contact cooler surfaces towards the outer layers of the assembly. This is simple psychrometrics.”

In such cases, Clarke says there is the potential to create a petri dish within the building.

“Surfaces on the outside of a building get cold in any climate in Australia due to the re-radiation of energy to the night sky,” he says. “The more insulation you have, the colder they will get, and more thought needs to be given to high humidity within the construction.”

## SPORE STOPPERS

Jesse Clarke, M.AIRAH, says there are four crucial steps to keeping the structure of a building dry.

### Drain the rain

Weatherproof using properly sealed water barriers with highly durable (50+ years) tapes in favour of sealants and mastics that only last five to 10 years before failing and allowing water leaks.

### Seal it tight

Prevent internal humidity entering the structure by using taped and sealed internal air barriers.

### Selection

Select vapour control properties for internal and external water control and air control layers (AS/NZS 4200.1-2017) using dynamic hygrothermal analysis based on the external climate and internal HVAC systems, with designed temperature and humidity set points. See ASHRAE 160 Criteria for Moisture-Control Design Analysis in Buildings.

### Ventilate right

Ventilate the internal space with minimum outdoor air rates according to AS/NZS 1668.2. Humidity control of the supply air or internal environment is a must in humid climates.

“And do not use metal sheet as a weather barrier,” says Clarke. “Do not use insulative foam sheathing (PIR, XPS, EPS) over the outside of structures insulated with fibrous insulation.”

## THE ROLE OF HVAC

According to Clarke, HVAC systems can play a critical role in preventing interstitial mould issues within the building fabric because they create the vapour pressure that drives moisture into and out of a building's construction assemblies.

"Mould is generally not an instantaneous problem," he says. "There is a time factor in the equation and moisture accumulation in the building envelope can take many years depending on the materials used."

It is therefore critical that relative humidity and temperature is controlled as intended for the lifetime of the building.

But of course, HVAC systems themselves can also be vehicles for mould growth and distribution within a building.

In air conditioning systems, mould can often be found where condensate exists, such as around cooling coils. It can grow and thrive in other areas of a system too, should it not be maintained and serviced adequately.

"Left unchecked, the (mould) spores transport through the ducts. There, in the presence of high relative humidity and relatively warmer conditions, they flourish," says Law.

## ONE OF OUR OWN

Working in and around buildings and HVAC&R systems on a daily basis, professionals in our industry are exposed to mould more often than they think.

This was unfortunately the case for Alex, a long-time member of AIRAH, and a regular contributor to HVAC&R Nation.

Having worked in the HVAC&R industry for more than 30 years, Alex was recently diagnosed with CIRS as a result of long-term exposure to toxic mould.

An active and senior member of the local HVAC&R industry, Alex had seen and worked on almost every air conditioning, ventilation and refrigeration system there is – from air-handling units to supply air, coolrooms, freezers and a variety of different buildings from manufacturing facilities to offices and homes.

"Prior to my diagnosis I was very fit," says Alex. "I jogged 5km every morning seven days a week, and played sport too, while working full-time in the trade, running my own small business."

But two years ago, Alex began to feel depleted, sick and run down.

Determined there was nothing wrong, Alex tried to maintain the same rigorous schedule of work and exercise, but became slower and weaker as each day passed.

"Eventually I knew there was something seriously wrong," Alex says. "I asked my doctors if my trade could be a factor in my illness, as we work with gases, oils, chemicals etc., but I never considered mould to be the cause."

After remaining undiagnosed and unwell for a year, Alex came across the term Toxic Mould Syndrome while she was attending an AIRAH event about Sick Building Syndrome.

## NOT TO BE UNDERESTIMATED

If you are working in environments where you suspect mould may be present, personal protection equipment (PPE) should be considered.

While it may be impractical to don a full-face respirator, HVAC&R professionals should consider wearing a HEPA mask and if possible, disposable clothing.

"Unfortunately, we cannot always see or smell mould, and this allows us to think we are safe," says Alex.

"The air filtration systems that we change, clean or service are commonly a collection centre for all types of contaminants, bacteria and debris that is more harmful than has been acknowledged in the past."

Alex cautions those who know they have worked in environments affected by mould to take precautions against transferring it to other environments, including your vehicle and home.

"And if you suffer from unexplained fatigue, or weird headaches, don't assume you are OK," says Alex.

"During the presentations, I began to realise I had all the symptoms," Alex says. "I went back to my doctor and requested specific blood tests be done."

Alex was subsequently diagnosed with Toxic Mould Syndrome late last year.

## TAKE THE TEST

The most common symptoms of Chronic Inflammatory Response Syndrome and Toxic Mould Syndrome are chronic fatigue and brain fog.

If you experience these symptoms, it may be worth taking a Visual Contrast Sensitivity (VCS) aptitude test. While not diagnostic by itself, VCS tests can be taken online via your computer screen, tablet or phone.

If you fail the VCS test (as Alex did), then you should follow up with more definitive health checks via your doctor. These can include Shoemaker symptom clustering, HLA genotype test, NeuroQuant volumetric MRI, blood biomarker tests and a MARCoNS swab.

An inexpensive VCS test can be taken by visiting [www.vcstest.com](http://www.vcstest.com)

"I had been exposed to mould for most of my career," Alex says. "Some of these exposures were more virulent than others, and in the process, I had contaminated my work van, my home and my possessions."

Almost a year on, Alex remains unwell and is now unable to work. Chronic fatigue remains the main symptom but there are others as equally debilitating.

"I am in constant pain, and suffer from numbness to my wrists, legs, shins and feet," says Alex. "I often can't

walk, have minimal energy most of the time, suffer from brain fog and headaches and struggle to hold onto a thought."

As well as the impact on Alex's health, there has been a lifestyle and financial impact too.

"I had to leave my home," says Alex. "I have given up all my possessions and changed my vehicle.

"I've spent thousands of dollars in medical costs to be diagnosed, and thousands in seeking advice and treatment. I am literally fighting with my body every day and I'm not getting better." ■

**Editor's note:** For legal and personal reasons, AIRAH has elected to protect Alex's identity and location. If you or someone you know identifies with aspects of Alex's story, we recommend seeking the advice of a medical professional.

## UNDERSTANDING THE GROWTH OF MOULD

Research conducted at the Fraunhofer Institute for Building Physics in Stuttgart, Germany, reveals the correlation between temperature and relative humidity in the development of mould within the built environment.

Dr Hartwig Künzle, the head of department at the Institute, will be keynote speaker at the AIRAH Building Physics Forum 2018 to be held in Wollongong from November 22–23.



Source: M. Krus, K. Sedlbauer, W. Zillig, H.M. Kunzel, Fraunhofer Institute for Building Physics, 2001

