Toxic Effects of Some Common Indoor Fungi

Issue of mycotoxins in indoor environments; An explosion of cases related to toxigenic fungi and mycotoxins have been reported or discovered throughout the United States and Canada over the past several years. Courthouses in Florida were closed for extensive decontamination, with costs as much as the price of the original building. Recently, an old school building in Canada, infested with toxigenic fungi, had to be burned. This extreme measure underscored the importance of indoor fungal problems. Furthermore, the unusual weather conditions in many parts of the U.S.A. and Canada over the past years have provided conditions for the growth of toxigenic fungi and potential human exposure to mycotoxins and other secondary fungal metabolites.

What are toxigenic fungi and mycotoxins?

Some fungi have been known to produce toxins that are harmful to animals and humans when ingested, inhaled or in contact with the skin. The fungi that produce toxins are known as toxigenic fungi. The earliest known toxigenic fungi, primarily *Claviceps purpurea*, produce the substance ergot. The ergot fungi infect rye, grains and other grasses. Ingestion of ergot contaminated rye or other cereals causes ergotism. There are two types of ergotism recognized clinically: gangrenous and convulsive. Gangrenous ergotism affects the extremities as well as causes gastrointestinal symptoms. Convulsive ergotism affects the nerve system causing brain and spinal lesions which can lead to death or permanent mental impairment.

Many fungi in addition to ergot fungi produce secondary toxic metabolites, such as alkaloids, cyclopeptides, and coumarins. Metabolites that can produce adverse health effects (mycotoxicoses) in animals and humans are collectively known as mycotoxins. The latest World Health Organization (WHO) publication on mycotoxins, available in 1990, indicated that there are more than 200 mycotoxins produced by a variety of common fungi. Historically, mycotoxins are a problem to farmers and food industries and in Eastern European and third world countries. However, many toxigenic fungi, such as *Stachybotrys chartarum* (also known as *Stachybotrys atra*) and species of *Aspergillus* and *Penicillium*, have been found to infest buildings with known indoor air and building-related problems.

In addition to mycotoxins, volatile organic compounds (moldy odors) released from actively growing fungi may also pose a health risk.

What are the common toxigenic fungi found indoors?

Many species in the genera *Aspergillus, Penicillium* and *Cladosporium* are known to produce mycotoxins. These three groups of fungi are also very common indoors. Other toxigenic fungi frequently found indoors are *Alternaria, Trichoderma, Fusarium, Paecilomyces, Chaetomium, Acremonium*.

Another fungus that has increasingly been linked to building-related problems is *Stachybotrys chartarum*. It is common in nature and grows on cellulose-rich plant

materials. It has frequently been found to grow on water-damaged cellulose-containing materials, such as dropped ceiling tiles, wall paper and sheet-rock wall board, in residential and commercial buildings. Many indoor air quality related problems have been traced to the growth of this fungus in buildings. Almost without exception, these buildings have usually had chronic water or moisture problems.
When discussing mycotoxins, species of *Aspergillus* deserve special attention. Species of *Aspergillus* produce such well known toxins as aflatoxins, ochratoxins, and sterigmatocystin. Aflatoxins that are produced by *Aspergillus flavus* and *Asp. parasiticus* are detected in stored peanut and grains. Ochratoxins are produced by many species of *Aspergillus* as well as *Penicillium*. *Sterigmatocystin* is produced by *Asp*. *versicolor*. These fungi grow well on many common building materials soiled or damaged by water. Their ability to grow on common building materials makes them a significant problem in buildings where maintenance is poor or non-existent.

What are the health effects of mycotoxins?

Mycotoxins may cause a variety of short-term as well as long-term adverse health effects. This ranges from immediate toxic response and immune-suppression to the potential long-term carcinogenic effect. Symptoms due to mycotoxins or toxins-containing airborne spores (particularly those of *Stachybotrys chartarum*) include dermatitis, recurring cold and flu-like symptoms, burning sore throat, headaches and excessive fatigue, diarrhea, and impaired or altered immune function. The ability of the body to fight off infectious diseases may be weakened resulting in opportunistic infections. Certain mycotoxins, such as zearalenone (F2 toxin), can cause infertility and stillbirths in pigs. Because these symptoms may also be caused by many other diseases, misdiagnoses of mycotoxin exposures are common. There are very few physicians with the experience or expertise in correctly diagnosing mycotoxin exposures or mycotoxicoses. Occupational or building-related exposures to mycotoxins through inhalation are slowly being recognized as a major indoor air quality problem. Generally, removal of causative agents is necessary. Treatment for symptomatic mycotoxicosis may be required. If exposure to fungi and mycotoxins is suspected, consult an occupational health professional.

What are the options to avoid toxigenic fungi and mycotoxin related problems?

Fungal growth in an indoor environment is often related to the availability of nutrient, water/moisture, proper temperature range and the presence of inoculum (often fungal spores). The key factor is water/moisture. Moisture control to reduce condensation and free water will prevent or control fungal growth.
In an environment where water/moisture-related problems often lead to fungal growth, rapid response to the problem is the key solution. Fungi-infested materials should be removed and replaced (see also below). Materials that can not be replaced should be decontaminated or treated. Consult an environmental microbiologist for such decontamination treatments. Proper project design and procedures are an important factor in a successful decontamination project. Biocidal application may be necessary

under certain conditions. More importantly, before any decontamination is performed, water and excessive moisture must be controlled and eliminated.
Most importantly, fungal infestation may be directly correlated with building operation and maintenance. Spores of *Stachybotrys chartarum* are wet and slimy. They do not easily become airborne. Their dissemination is likely through insects (such as cockroaches), rodents, water incursion or air stream. Without the assistance of insects, rodents and free running water, the likelihood of *Stachybotrys* chartarum spreading from one location to the other requires the disturbance of a dried slimy spore mass. Spores and hyphae of *S. chartarum* have been detected in air samples. Any detection of *S. chartarum* spores in indoor air should be considered significant.

To prevent or eliminate fungal infestation in buildings, the following procedures should be observed:

Heating, ventilating and air-conditioning systems must be properly filtered and maintained.

Water intrusion must be taken care of within 24 hours. Never overlook small leaks. Ignored small leaks are much more problematic than a properly handled major flood.

Proper handling and storage of food to keep insects and rodents away from buildings.

In a warm, humid climate, a building engineer should be consulted to make sure that a moisture barrier is properly installed and that no condensation will occur.
Install dehumidifiers in areas where humidity is constantly high.
Keep relative humidity below 60%.

<u>Recommend %RH settings to reduce risk of condensation on windows and inside wall cavities. Preventing condensation “DEW POINT” will reduce the risk for mould growth and conditions conducive to mould growth</u>
If large areas of contamination are determined consult a Mould Remediation Company