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The Household Health Effects of Microorganisms in Floor Coverings

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The indoor growth of mold and mildew, as a result of moisture intrusion into and under installed flooring materials, is known to impact on household air quality and the health of inhabitants. Recently, I had the opportunity to discuss with Hank Brufloft the topic of microorganisms and their health effects. Hank enumerated various microorganism concerns confronting the flooring industry. I've decided to use our discussion as the basis of this article.

First, let's cover some basics. **Mold** and **mildew** are essentially the same thing. As organisms, they have more in common with plants than animals. Other microorganisms include **viruses**, which are essentially free-standing chemicals, and **bacteria**, which are more animal than plant in their nature. **Fungus**, which is neither pure plant nor pure animal, falls -- for classification purposes -- into a kingdom of its own.

Although viruses and bacteria can be dangerous organisms, they have relatively little impact on indoor air quality (IAQ). Even second-hand smoke ranks higher on the IAQ scale than bacteria. However, fungi is No. 1 on the list of problem IAQ components.

When construction products like carpeting or drywall are maintained for two days or more at a relative humidity of 70%, fungal spores -- which are present in all indoor and most exterior environments -- begin to multiply. In fact, under the proper conditions, as many as 2,000 different species of fungal spores may begin to grow in a given saturation area.

As they vie with each other for available water and the food sources, **each specie of fungi produces toxins** formulated to poison competing fungal species. Eventually, a few of the most powerful species overtake the others by producing very complex compound toxin chains called *mycotoxins*.

These substances, which are formally called *trichothecene mycotoxins* (pronounced "try-koe-they-seen my-co-toxins"), are composed of several different chemical agents. The most popular trichothecene mycotoxins are *satratoxin-h*, *satratoxin-g*, and *t-2*.

These three mycotoxins (saratoxins), according to a former head of the U.S. Army's biological weaponry department, are banned for use as biological weapons by international peace treaty. In fact, a biological "weapon" is essentially a concentrated amount of trichothecene mycotoxin.

Several fungal species produce trichothecene mycotoxins. However, the most common fungal species cited in IAQ studies are:

Stachybotrys atra (pronounced "stackie-bah-ter-us a-tra") or chartarum ("shar-tah-rum"). Note: atra and chartarum are the same.
Aspergillus ("as-per-jil-us")
Cladosporium ("clad-oh-spor-ee-um")
Alternaria (al-ter-nare-ee-ah")
Penicillium All of these species produce trichothecene mycotoxin. The toxins created by each fungus have different unspecified health effects on humans and animals. These effects largely depend on whether the toxin was inhaled, ingested or contacted by skin.

Primary health effects include asthmatic allergies, upper-respiratory tract problems (runny nose, watery eyes) and skin rashes. Some experts believe certain toxins can produce malaise, chronic fatigue, difficulty with mental concentration, gastrointestinal disorders, and other nonspecific health effects.

Although there currently is no evidence of causality, there is a strong correlation between trichothecene mycotoxicosis and these health effects. In other words, existing evidence suggests that these toxins are extremely dangerous and must be removed properly. But to date, no cause-and-effect relationship has been demonstrably proven.

Generally speaking, to experience the health effects I described, a human subject must be exposed to trichothecene mycotoxins for a considerable length of time. The human body initially resists their influence, but then loses its ability to withstand exposure. Some researchers say three to six months of exposure are necessary to produce negative health effects.

But ultimately, how quickly these problems manifest themselves depends on the victim's immune system, age and overall health. Infants who have died due to mold exposure were found to have bleeding in the lungs (pulmonary hemorrhage), because certain mycotoxins attack rapidly expanding cells. Immuno-compromised people and the elderly suffer from mycotoxicosis because their cell structures cannot rebuild themselves quickly.

No standards or laws concerning acceptable mold spore counts have yet been established. The state of New York has written its own IAQ guidelines, but there is as yet no federal standard, and scientists argue just how one can quantify an acceptable amount of mold.

Generally speaking, when mold spore counts -- measured in colony-forming units per square meter (CFU) -- are higher in the

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interior of the building than they are on the exterior, they are considered to be in the problem range. If you can see mold or smell musty odors, it is usually indicative of a serious problem.

Mold species grow on nitrogen-free materials, particularly those that are cellulose in structure. Mold spores are present in all interior environments, live within the same temperature ranges as people, and find nutrients in anything organic -- from cotton fibers to a human skin follicle. (In fact, human skin follicles constitute more than 90% of household dust.) Humidity control is the only means of holding mold proliferation in check.

This is because **all microorganisms require water to grow**. Water is the major component in cytoplasm, and it must be present to stabilize metabolic activity, activate enzymes and transport metabolic reactants and products. Floor components and microscopic soils provide the food source.

All organic molecules contain energy within their bond structures. A microorganism's metabolism breaks these bonds in a controlled fashion and directs the resulting energy to fuel its own growth. Adhesives and vinyl felt backings contain a variety of energy-rich organic compounds, including latex, oils, resins, soap and paper.

The warm environment of the home provides optimum conditions for microorganism growth, once water is added to the equation. The microorganisms remain dormant in dry conditions, and begin to grow when their living conditions improve.

The effect of their growth on the floor covering is both unsightly and mechanically damaging. Because the flooring and adhesive serve as food, the floor covering is changed and ultimately consumed by these microorganisms. The accompanying adhesive deterioration permits the vinyl to be easily lifted from the concrete, and delamination of the felt backing creates instability and extremely poor durability in vinyl floor coverings.

When first informed of the potential relationship between slab moisture emissions and microorganism growth, officials with the California Department of Health said they didn't think that a 3- to 12-lbs. of vapor emissions were sufficient to support a problem. Later, a scientist who studies moisture emissions from concrete said, "I think the volume of water is insignificant, but the degree of sustained humidity is everything."

Studies on mold-infested homes and condominiums demonstrated that moisture emissions beneath carpet achieve 100% relative humidity. Therefore, with installations over concrete slabs, floor covering professionals should be particularly concerned about preventing the growth of microorganisms at the juncture of the slab line.

Anybody who experiences a serious level of mold growth, particularly to a degree that would warrant demolition, should contact his county health office immediately to file a report. Although an industrial hygienist can often make an assay of the situation, a lab that specializes in diagnostics should be employed.

Remediation requires formal abatement procedures using negative air ventilation, Tyvek suits and respirators. I've encountered installers who -- without any type of special protection -- unknowingly removed mold- and mildew-infested materials from job sites, only to be stricken subsequently with respiratory disorders.

The floor covering industry must be extra cautious when dealing with any type of moisture condition that may lead to unchecked growth of mold, mildew or fungus. Failure to do so could lead to serious personal liability litigation.



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