MOLDS: HOW CAN YOU PROTECT YOUR OPERATION FROM THEM?

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Introduction

In recent months, newspapers and talk shows have been filled with reports of toxic molds in houses that sicken occupants, kill pets, and like anything else in the U.S., lead to litigation. Wood products have been implicated in a number of these instances, but there is little evidence that wood is the main culprit. So what can you do to reduce your risks? How should you respond to customer concerns? What can you do to ensure that the material you produce is mold free?

In order to answer all these questions, this report will provide some background about fungi and their growth on wood, then discuss methods for preventing growth of these fungi.

Fungi on Wood

Wood products can be colonized by a variety of fungi. Molds are primary colonizers that grow on freshly exposed surfaces of a variety of materials including paints, food, and wood. The damage caused by these fungi is mainly cosmetic due to the presence of pigmented spores. Stain fungi are also primary colonizers, but their discoloration extends more deeply into the wood. Decay fungi are usually secondary colonizers (meaning that they enter the wood some time after it is harvested), and they damage the structural polymers that make up the wood

While wood has been used for thousands of years, there is relatively little information on the types of fungi colonizing a given wood species. One recent study found that Douglas-fir sapwood was colonized by over 45 species and that colonization increased with storage time. Further studies to identify the fungi associated with various building products would greatly assist those attempting to assess the role of molds on wood.

Molds on Wood

Molds are fungi that are characterized by the production of pigmented spores on the substrate they grow on. Like all fungi, molds obtain energy from the substrate, in this case, the sugars, proteins and other compounds stored in the ray cells of the wood. The life cycle of a mold typically begins when a spore lands on the wood surface and germinates to produce strand-like hyphae that grow into the wood through the cell lumens, moving from cell to cell through the pits and tending to grow more heavily in the rays. Once the fungus has obtained enough energy, it begins to produce spores on the wood surface. These spores are normally produced asexually, but sometimes conditions are suitable for sexual reproduction. Mold fungi can grow extremely rapidly, producing spores in as little as 24 to 48 hours and grow at rates approaching 1 inch along the grain in a single day. Mold spores are dispersed in the air and float until they land on another suitable surface, where they germinate to repeat the cycle. Mold spores are everywhere

and it is only a matter of time before freshly sawn wood surfaces are colonized by one or more species of mold.

Although mold fungi grow throughout the sapwood, the damage is not visible to the naked eye. It does, however, make the wood more permeable, leading to differential drying. The visible damage is confined to the pigmented spores on the wood surface whose colors can be green, black, yellow, orange and many shades in between.

What Conditions Allow Mold to Grow?

All fungi require liquid water for growth to occur and mold fungi are no exceptions. Free water is generally considered to be present at moisture contents greater than 24 to 30% (by weight), depending on species. This moisture requirement must be viewed with some caution. Mold fungi grow so rapidly that wetting an area of wood for only a few days can allow for growth. This often perplexes manufacturers who receive complaints about mold on a shipment, but find moisture levels well below 20% when they test with a moisture meter. This can happen when units containing some wet boards are wrapped and left out in the sun. Moisture is released from the heated wood but is trapped inside the wrap. This moisture condenses as the unit cools, leaving liquid water on the lumber surface and allowing fungi to grow under seemingly improbable conditions. Careful quality control to minimize the presence of wet boards can reduce the risk of this damage.

Wood remains susceptible to mold growth whenever it becomes wet, even after it has dried. Most of the growth will occur in the sapwood, because this is where the majority of stored compounds are available. Like most fungi, molds have broad temperature tolerances, with some growing at temperatures as low as 40°F and others growing at temperatures above 104°F. Most molds, however, have optimum growth at 68-86°F.

Where Do Molds Come From?

Mold spores are everywhere. We ingest mold spores in every breath we take. Most people are not bothered by these spores, but some are exceptionally sensitive. There are a wealth of different species of molds in the air and the species present depend to an extent on where you live.

In some cases, fungi are already present inside the wood at the time of sawing. The practice of dry decking logs allows fungi, including molds, to invade the cut ends, branch stubs and bark wounds on the felled logs. The longer the period between felling and processing, the more likely that the wood will be colonized by mold, stain and decay fungi. Once the log is processed, these fungi seem to literally explode on the lumber surface, but in reality they were already there at the time of sawing. A quality control program that minimizes deck storage and the application of water sprays can minimize this colonization.

What Do Mold Fungi do to Wood?

Mold fungi generally concentrate their attack on the ray cells and move between cells by dissolving the pits. This damage tends to make the wood more permeable, which can lead to excess absorption of preservatives and uneven finishing. In addition, moldy wood in a kiln charge tends to dry faster and may experience higher levels of degrade as a result of overdrying.

While properties related to permeability are altered by molds, there is no evidence that these fungi in any way reduce the structural properties of the wood. As a result, wood with mold colonized wood is allowed in nearly all structural applications.

Why Are People Concerned About Molds?

Mycologists (people who study fungi) have long known that some fungi can affect human health. For example, aflatoxins in peanuts are produced by a fungus colonizing the nut. There are also a variety of fungi that can attack humans, primarily those with weakened immune systems.

Many other fungi have the ability to produce broadly toxic substances and it is these fungi that have emerged in the popular literature as a concern in all buildings, not just those made of wood. Among the most frequently discussed is *Stachybotrys chartarum*, but there are many others. Fungi may produce toxins in their spores which cause problems when inhaled at high levels, produce gases, or may even produce water soluble toxins. There is currently a great debate concerning the real risks posed by these fungi and a considerable amount of misinformation. While there is no doubt that some people are especially sensitive to these fungi, most are not. It is often difficult to separate fungal-induced symptoms from other health-related problems. The current litigation has encouraged considerable research to better understand the role of mold fungi on human health. Hopefully, carefully controlled studies will provide better information on the real risks posed by various fungi in buildings.

Is Mold Damage in Buildings on the Increase?

The frequency of mold in structures does appear to be increasing. Some of this increase can be tied to the higher proportions of sapwood in second growth timber, but changing building practices have largely contributed to the problem. Recent media reports have also heightened homeowner's sensitivities to the issue, increasing the frequency that such problems are reported. Practices that include shortened roof overhangs, slab construction and increasing weatherization have all combined to sharply increase the likelihood that wood in a building will get wet and moisture resistant membranes virtually guarantee that once water enters a building cavity, it will have a difficult time leaving. Added to these problems are an increasing array of more complex building designs and a declining level of training for the trades people who install them. All of these factors place structures at an increased risk of wetting which can allow mold fungi (and eventually decay fungi) to grow.

What Can Be Done to Prevent Mold?

As long as the wood remains wet, there is always the risk of fungal attack. Drying, either by air seasoning or kiln drying, is the simplest way to inhibit fungal attack. Where this is not possible, the lumber should be protected by surface applications of a fungicide registered for lumber stain and mold control. There are a variety of fungicides on the market and tests at OSU as well as elsewhere have shown that all work when used at the proper concentration. The proper concentration, however, depends on wood species, prior storage conditions, temperature, and the protective period expected. A number of other factors can also affect chemical performance including the time interval between sawing and treating and maintaining proper solution concentration.

Chemical treatments are usually applied using dip or spray systems. While dip systems are less technically intensive, they usually require a separate dipping step of the bundled lumber. Spray systems can be used in-line, thereby eliminating a process step,

but care must be taken to maintain solution concentrations and ensure that nozzles are operating properly.

One emerging application for spray systems for mold and stain prevention is chemical application immediately after the planer for kiln dried wood. While this may seem unnecessary (since the wood is dry), some manufacturers feel that this treatment provides supplemental protection should the wood become wet at a later date.

The protection period provided by most chemical treatments is 6 months, but this period can vary with treatment concentration and environmental conditions. The potential protective period of chemical applied to kiln dried lumber remains largely unknown.

What Can You Do to Limit Your Mold Liability?

While complete prevention of fungal attack in a lumber operation is probably impossible, there are a number of steps you can take to reduce your liability. These steps are primarily management and quality control-oriented and include:

1. Rigorous management of log decks to minimize storage time.
2. Sprinkling of logs being careful to ensure that they do not remain under water too long (where they become susceptible to enzymatic stains).
3. Sanitation around plant to eliminate old, woody debris, vegetation and standing water.
4. Rapid reduction of surface wood moisture contents below 25% to limit the potential for spore germination.
5. Where drying is restricted, treat with fungicide within 24 hours after sawing.
6. Maintaining proper treatment solution concentrations through periodic checking of both solutions and the treated wood
7. Keeping treated material protected to prevent loss of chemical during rainy periods.
8. Be ready to provide information to customers should mold issues arise. Do not hide from the customer- this can be expensive in the long run!

What Can Be Done Once There Is Mold on Wood?

There is a great debate about what to do about mold on wood. Some advocate for leaving the spores on the wood surface and sheathing the wood to seal in and presumably, isolate the fungus from the occupants. For minor amounts of mold, this probably is an acceptable solution except where the occupant is highly sensitive to molds.

In some instances, the mold can be removed by washing the surface with a dilute solution of bleach (5%) taking care to wear safety glasses and gloves. While bleach will not kill all of the fungi present, it can reduce the spore load. Allowing the wood to dry after cleaning further reduces the risk of renewed fungal growth.

In cases where heavy mold growth occurs within a building cavity and is extremely dense, it is generally advisable to hire a professional mold remediator who can limit the risk of contaminating other parts of the structure and creating a larger cleanup problem. An important part of this process is to identify and eliminate the sources of moisture to prevent a recurrence of the problem.

For Further Information

The Western Wood Products Association has produced an informative brochure entitled "Molds, Housing and Wood" which can be accessed at www.wwpa.org.

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