Cleaning, Sanitizing, and Residual Protection Protocols for Rehousing Individuals after High Water Events

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ABSTRACT

Damage to homes by hurricanes that make landfall in the south and southeastern United States, or sub-tropical and tropical regions, during the hot, humid summer months is compounded by the growth of mold fungi on wetted building materials. Most homeowners are better equipped to deal with construction problems associated with storm damage than to control the growth of mold fungi. Following hurricane Katrina, this, coupled with newspaper articles published both before and after the storm equating molds in flooded or wet homes to the “Black Plague”, and “instant” mold experts saying that molds are “toxic”, led many homeowners to destroy otherwise habitable structures and remove the building materials from the site or to pay for costly “mold remediation” procedures. This issue is discussed in detail.

Key words: mold fungi, sanitization, mold remediation, mold control, water-damaged homes, clean-up protocol

INTRODUCTION

High wind and water events such as tornadoes and hurricanes cause millions of dollars in damages annually and cause physical and mental stress to homeowners during cleanup and rehousing efforts. These victims, whose homes have been severely damaged by winds and rainfall or by winds and flooding, also find themselves confronted with the rapid growth of mold fungi on the wetted interior building components. The mold that occurs after these tragic events has the potential of causing health concerns according to the Environmental Protection Agency (EPA) and the Centers for Disease Control (CDC). Unfortunately, hurricanes such as Katrina and Rita (2005) or Harvey, Irma, Maria, and Nate (2017), tornadoes (VanZandt Co., TX, 2017), and other high-water events (e.g., the Louisiana floods, 2016) often occur during the summer in the hot, humid southern and southeastern United States. The environmental conditions occurring at this time of year also are ideal for the growth of mold fungi, and long-term residents of this region understand that air-conditioning, fans, and ventilation not only make the temperatures in their homes more comfortable but also decrease the likelihood of mold growth by decreasing the moisture of air within homes. However, following a hurricane, tornado, or other high-wind event, many homeowners with no electricity to power fans or air-conditioning units find the components of their homes exposed to rain wetting or flooding with no way to decrease their moisture. Such homeowners must recognize that wetted interior walls and flooring mean that wall or flooring components (e.g., wall coverings and insulation) are wet (often with septic water) and will remain so for a protracted period of time. The wetted walls and flooring are capable of supporting the growth of mold fungi and must be removed as soon as possible. If treated with a biocide within a few days, only the sections of wall coverings and insulation that were flooded need to be removed and the exposed wall cavities treated with a mold-control biocide (as recommended later in the text).

The days and weeks following these high wind and water events are often very stressful for individuals affected. Unfortunately
mispelminfornion is often disseminated by various media outlets that provide false and incomplete information about the care and remediation of storm-damaged structures. This type of information can inflate the effects of mold on humans and can add trauma to individuals, creating a false hysteria that can lead to improper decisions on remediation and repair plans. After hurricanes Katrina and Rita, a reasonable approach to controlling molds was, in several instances, replaced by near hysteria caused by newspaper articles and instant “mold experts” convincing owners of damaged structures that their homes contained “toxic molds” that threatened their lives. This reaction to molds in homes was fueled by earlier media accounts of “sick homes” caused by molds. As this phenomenon continued, some in the media likened the growth of molds in structures to the Black Plague. While some mold control experts with legitimate mycological credentials came to assist homeowners following hurricanes Katrina and Rita, other questionable “mold experts” convinced homeowners that their mold control programs, costing hundreds of dollars, would save them from “toxic molds”. Others convinced homeowners that the only way to control molds was to tear down their homes and remove the building materials from the site. A group of attorneys recognized the occurrence of the “toxic mold” phenomenon and opened a web site called “mold is gold.” The perceived growth of “toxic mold fungi” within the walls of otherwise habitable structures was of concern to many hurricane victims whose homes were either flooded or were wetted by rainfall. What was not made clear to these homeowners was that relatively few mold species are “toxic” to humans; rather most molds are allergens. It is important to cause minimal disturbance to building materials when mold is present because this disturbance can result in airborne allergens and, if toxins are present, it could result in a mode of entry into humans. Stachybotrys, a mold that causes toxic responses in humans, can occur on wet building components, but its spores are not airborne and unlikely to be contacted by building inhabitants unless direct contact occurs. The spores of most molds are airborne, and those of some species contain allergens that elicit an allergic response in some individuals exposed to large numbers of spores. This would be similar to allergic responses to tree pollen, ragweed, etc., when these airborne units are inhaled in large numbers.

WHY ARE MOLDS GROWING ON BUILDING COMPONENTS AND HOW CAN THEIR GROWTH BE CONTROLLED?

While they are primitive organisms, the factors required for the growth of molds are the same as ours:

1. Air – As for humans, air is needed to respire.
2. Temperature – Temperatures favored by many mold species are similar to those that are comfortable to humans (60° F - 90° F).
3. Water – Molds cannot exist without sufficient water and neither can we. For example, molds cannot grow on wood whose moisture content is less than about 20%. Building components not subject to wetting would be expected to have an average moisture content between 10-15%.
4. Food – Molds can obtain nutrients from a variety of building components.

If the growth of mold fungi is to be prevented or controlled, one or more of these four basic factors must be altered (e.g., dry building components to below 20% mc; add mold-inhibiting fungicides to the food source).

WHAT ARE MOLD FUNGI?

Now that hurricanes Harvey, Irma, and Nate have made landfall in the southern United States during the summer months (2017), homeowners must understand what molds are and how they can be controlled. Mold fungi are primitive organisms that obtain their food from various materials on which they grow. Molds growing on wood building components utilize simple sugars and other products stored within specialized wood cells. Molds do not cause structural damage to wood. The reproductive units of molds are called spores, and these can be seen on the surface of materials colonized by them. These small spores are pigmented and,
depending on the mold species, may be black, green, red, yellow, or other colors. While the spores of the “toxic mold” Stachybotrys are black, other species of mold fungi also have black spores. In small quantities, these spores are very unlikely to elicit an allergic response. When present in large numbers, as may occur in flooded or rain-wetted houses, mold spores can trigger respiratory allergic responses in some individuals. Other irritants, such as the dust created when wall coverings such as gypsum sheetrock are removed, also may cause allergic responses. Susceptible individuals should take precautions, such as wearing using proper protection equipment (PPE). Examples of proper PPE would be N95 masks, respirators with high protection level cartridges, non-porous gloves, protective eye wear, rubber boots, and light-weight moisture-resistant coveralls. After natural disasters and in most instances, it is unnecessary to spend money and time on identification of the mold species present. The visual presence of extensive mold growth is sufficient to verify that building components are wet and proper protocols should be utilized to eliminate and remediate the molds present in the affected structure.

CLEANING/CONTROLLING MICROBES IN FLOODED AND RAIN-WETTED HOMES

The interior building materials of structurally sound, flooded homes on the Gulf Coast and southeastern United States were wet and very warm for several weeks following hurricanes Katrina and Rita (2005), Harvey, Irma and Nate (2017) and the Louisiana floods (2016) before repairs were begun. Flood waters usually are septic and can deposit bacteria and chemical contaminants in the structures. Warm, wet conditions also result in the widespread growth of mold fungi and, in instances where house framing remains wet for prolonged periods of time, wood decay fungi. Anyone with known mold allergies should not attempt to clean these structures. Even those without mold allergies should make provisions for avoiding the inhalation of air-borne materials during cleaning activities (use particulate masks or other respiratory equipment as recommended by the EPA and CDC). Light-weight moisture-resistant coveralls should be worn during cleaning operations. These should be washed separately, at the cleanup site if possible, and not mixed with normal laundry. Finally, good personal hygiene should always be practiced. For safety, it should be verified that the electricity and gas have been turned off prior to all cleaning activities. If using a biocide, it is important not to use household bleach in confined areas and bleach should never be mixed with ammonia-based products due to the potential harmful off gassing per the EPA.

FLOODED HOMES

First, open all windows for ventilation and remove all carpets, furniture, clothes and other items wetted by flood waters.

1. Remove interior wall coverings and insulation in the sections of walls that were flooded (to expose wall cavities) and between floor joists.

2. Wash the wall cavities and wall framing with an aqueous low-phosphate detergent solution using low to moderate pressure. Phosphate residues remaining following the use of high-phosphate detergents can stimulate the growth of mold fungi on moist surfaces. Several people have advocated using sodium hypochlorite (household bleach) solutions for such operations, but this is not recommended except when small areas or non-porous materials (e.g., tile) are to be cleaned. While sodium hypochlorite is germicidal, it is corrosive and can compromise electrical connections, etc. In addition, large amounts of sodium hypochlorite will be absorbed by building materials. This will cause the gradual loss of chlorine gas into the living space for an extended period, a situation to be avoided. Prolonged exposure of wet wood to bleach can result in loosening of wood fibers, essentially pulping the wood surfaces, and corrosion of nails or other fasteners. Sodium hypochlorite is an EPA-registered pesticide, but it is not labeled for treatment of wood or other porous building materials.

3. Spray-treat all exposed flooring, counters, framing, and wall cavities with a non-volatile sanitizing antimicrobial that is registered
by the EPA for that use. Pesticides not registered (illegal) for use in habitable spaces were used by some “mold control experts” following hurricane Katrina. All pesticides should be applied according to label directions. Restricted-use pesticides should be applied by licensed, certified pesticide technicians. Borate products supplemented with a mold-control agent are recommended because borates are biocidal to bacteria and decay fungi as well as insects such as termites and roaches. A mold-control agent must be added to increase the biocidal activity of borates to mold fungi. In addition, borates have low mammalian toxicity (essentially non-toxic to humans and pets), are corrosion inhibitors, and are colorless and odorless. Properly labeled products should be used for cleaning, sanitizing, and controlling mold and contaminites after high water events. While there are many products that can be used, it is very important to utilize properly labeled products and use per the labeled instructions. NeutraQuat™, DSV™, and MPerial™ are a few commercially available products.

4. As soon as possible, place fans throughout the structure and open all interior doors to increase ventilation and the rate of drying.

5. When the framing is dry, the electrical connections and plumbing within the walls should be checked by licensed professionals.

6. After the wall cavities have completely dried, the wall cavities should be treated with a product that will provide residual control of mold and other organisms, especially for areas where the structure is susceptible to repeated high-water events. Some of the most effective and safest are products containing borate, a mold-control agent, and offer water repellent properties. The application of the described products provides residual protection and can potentially decrease the rehousing time in the event that another high-water event occurs. It is important to insure that the products chosen are formulated to be utilized within habitable spaces. The use of these protocols will decrease the rehousing time for individuals affected by high-water events. The use of DDAC-based sanitizers combined with a borate-based product or products containing borates for treating the wall cavities have proven to be very effective in past studies and applications. It is very important to follow label instructions and to allow for the wall cavities to be dry before closing up the walls.

7. Replace wall insulation and wall coverings on sections of walls that had been flooded. It is recommended that all closet doors be louvered to increase interior ventilation.

**RAIN-WETTED HOMES**

The points discussed above for flooded homes apply to homes “flooded” by rain water, except for item three. The wall cavities should be relatively clean and free from septic water when exposed and not require a detergent wash. In most instances, homes wetted by rainfall have experienced roof damage, so all wall coverings and insulation must be removed to permit drying of wall cavities. A priority item should be to make temporary roof repairs to prevent additional wetting of interior materials. In essence, mold fungi are not to be feared, but they should be treated with respect.

**AUTHORS’ COMMENTS**

The information in this document was assembled by the authors in an effort to disseminate current information based on scientific and industry research and applications. The products discussed are not intended to be a review of all products labeled for the intended purpose but are the result of the some or all of the authors’ experiences as of the publication date of this manuscript. It is the hope of all the authors that this information will be disseminated to state and federal agencies, disaster relief groups, mold and high water remedial companies, contractors, and, most of all homeowners affected by these tragic events to decrease the amount of rehousing time.
SELECTED REFERENCES


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