

Review of Products for remediation, cleaning and home maintenance.

Cleaning is an important part of maintaining a healthy home. Even homes without mold damage need to be regularly cleaned. Outdoor dust, dirt, pollen, mold and a variety of other biological particles are constantly entering our living space and will build up over time. This increase of normal or common types of filth has been shown to cause increased upper airway irritation resulting in allergy and asthma reactions in sensitive people. Cleaning becomes increasingly important in mold contaminated homes.

Increased cleaning can provide temporary benefits in homes that have not yet been remediated by helping to remove excess spores and fungal fragments as they migrate from areas where growth has occurred into other areas of the home. Once the remediation has been completed, the cleaning of the home and personal possessions helps return the contaminated building to a normal status. Continuing the routine cleaning helps maintain the environmental quality of our living space.

New and improved, latest and greatest, fantastical products guaranteed to solve your mold problems are popping up all the time. Many incredible claims are made, but rarely provide the implied benefits. Some of these products are useful if used properly for the intended purpose. There are just as many products that are either useless, or if misused can cause more harm than good. There is a long history of chemicals being used to kill or control mold having major harmful side-effects. Lead was used in paint for many decades with one of its primary purposes being to prevent mold from developing on the paint. The heavy metal would sometimes makeup as much as 50% of the paint. Unfortunately, lead has had a major harmful impact especially in young children. The use of high levels of lead in paint was outlawed in the late 1970's, but its decades of use ensured that older buildings have lead based paint that continues to have the potential to cause harm.

During the 1980s lead was replaced with mercury which also did a great job of inhibiting mold growth, but also caused major problems due to mercury poisoning. By the 1990s high levels of mercury in paint was also banned. Other chemicals for controlling mold in paint have been less effective. Over the years, numerous products have been developed claiming to be great at controlling mold. They will typically indicate in the fine print that the materials need to be kept clean and dry in order for them to be able to prevent mold. Well, if you keep your home clean and dry, you won't have mold able to grow anyway. Mold always needs moisture!

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Attempting to kill mold may in fact make matters worse by stimulating the molds defense mechanism resulting in the home environmental quality becoming worse. When under attack, a number of types of molds can produce additional mycotoxins. There is one method to control mold, which is both harmless to humans and 100% effective against mold. The key to mold control is simple - It is keeping our homes clean and dry.

Maintaining a dry home prevents the growth in the first place which in turn eliminates the harmful interactions mold causes with our homes, personal possessions and our families. Some of the most useful tools available on the market may not even be advertised as mold fighting tools, but they are the tools that maintain a dry home. When mold has already grown, the best method for getting rid of it is to develop and follow a mold relocation program. Actual mold growth is physically removed and sent to the retirement home for molds known as the landfill where it can continue to cohabitate with all the other molds that are already there performing their intended duties - to break down or compost organic materials and return them to the soil. Settled spores, fragments and other residues must be cleaned from the indoor surfaces that remain and relocated to the landfill.

When deciding to clean mold growth from a surface, it is important to decide if the material needs remediation by physical removal or if it can be rehabilitated. In general, hard non-porous surfaces such as glass, metal, plastic, ceramic tile, concrete, grout, brick, or stone can be cleaned. The mold is not actually growing into the material and is instead using a biofilm on the surface as a nutrient. Porous materials such as gypsum wallboard with actual growth penetrating the paint or hidden inside the wall cavity should be remediated by using containment, removing and discarding the affected material.

Settled spores, mold fragments and residues can generally be cleaned to remove them during the completion steps in a mold remediation and as a part of routine cleaning and maintenance to keep the normal mold levels of settled spores under control. In order to be effective, cleaning should be able to remove both the particulates (spores and fragments) and any metabolic residues such as mycotoxins or other fungal metabolites that have deposited on the material. I have already discussed the most effective methods for cleaning up particles including mold spores and fungal fragments using HEPA vacuums and microfiber cloths. Even after the most effective methods are used there can still be some residue left on surfaces.

Dampening the microfiber cleaning cloth helps remove water-soluble residues. Some but not all mycotoxins are water soluble. What remain are the residues that stick to the surfaces dissolved into the grease or oil film that coats most surfaces in our homes. These oily films come from a variety of sources:

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- Some oils are added deliberately such as when we polish or oil our furnishing or surfaces in our homes
- Cooking oils or deep fat frying can spatter grease that coats surfaces.
- Oil from our skin and from our pets is constantly being shed in the form of skin cells.
- We leave oil deposits on everything we touch. This is what causes finger prints.

In order to effectively clean mold residues from surfaces we need to be able to clean the oil from the surfaces in our home.

Cleaning Fallacies

Many times cleaning doesn't really get materials clean, it merely makes them look or smell clean.

- The color may be bleached out or dyed so that the stain disappears
- optical brighteners that glow when exposed to UV light make our whites look cleaner when they are exposed to the natural UV rays contained in sunlight
- Sometimes cleaners spread a small concentrated spot out over a larger surface area until it blends into the background making it appear that the soils have been eliminated

The truly effective cleaning is performed when the mold is actually removed from the environment and not redistributed throughout the building. Mold spores, hyphae (mold growth structures) and fragments don't just disappear. They have to go somewhere. It is important to know that it is being removed and going to the landfill, down the drain or exhausted to the outside where it can be diluted down and re-enter the natural cycle of nature.

Special chemicals are rarely needed as a part of mold remediation and cleaning and in some cases will make matters worse. Many times people want to kill the spores. Capital punishment does not work. According to the U.S. Environmental Protection Agency "It is necessary to clean up mold contamination, not just to kill the mold. Dead mold is still allergenic, and some dead molds are potentially toxic." The document goes on to state that using biocides such as chlorine bleach for mold remediation is not recommended. Bleach and hydrogen peroxide do a good job of "bleaching" or removing color. But creating invisible mold still leaves the allergenic or toxic effects behind. In the case of bleach, the growth loses its color. Collecting a tape lift from the surface and adding a stain results in the mold hyphae and spores that remain on the surface to be able to be seen under a microscope. The bleached surface is not really clean and the allergens and mycotoxins remain in the fungal biomass that remains on the surface. Testing the surface before and after may show a reduction in biomass, allergens and mycotoxins, but the mold hasn't really been eliminated. The fungal biomass that no longer remains on the surface has instead been redistributed.

Once mold spores have dried and become dormant they are invisible hard seed like structures. They typically will have a hydrophobic or water repellent coating on their outside surface. When chlorine bleach or other water based chemicals are sprayed onto a mold contaminated

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surface a substantial number of spores and fungal fragments are discharged into the air and float around for a period of time before they settle somewhere else. These dispersal mechanisms have already been discussed in greater detail in Chapter 1 - *Outdoor Fungal Ecology*. The act of spraying or disturbing the material causes a substantial portion of the fungal material to be released and spread. Testing a surface before and immediately after it has been disturbed will show a reduction of the amount of fungal biomass. This is not because the mold is gone, it has just moved from the surface that is being tested and redistributed elsewhere in the home. When visible mold growth is seen on a surface, the mold growth is present at a density of over one million colony forming units per square inch. The growth is made up of a combination of the hyphae (root-like structures) as well as the spores. Although the spores tend to be hydrophobic, the growth thrives on being able to absorb moisture. What this means is that when a product advertises that it kills mold, there may be some truth to that claim in that the growth structures can be killed when treated with a biocide. But this does not mean that spores are killed or that having those high levels of dead biomass is okay.

Effective remediation requires:

- containing the mold to a work area so that it will not be redistributed into other parts of your home.
- removing the materials that will not be salvaged so their redistribution within the work area is limited.
- Effective cleaning to remove the fragments and residues from surfaces so they are removed from your home.

Many times natural or safe products are used for cleaning in ways that are ineffective for removing mold residues or mycotoxins that are stuck to the grease or oil film that is present almost everywhere in our homes. However, when armed with more information, there are safe ways to clean up mold residues using products that are safe and effective.

Cleaning is an important part of removing mold spores and fungal fragments from surfaces in a contaminated home. Rather than recommend products by name, I am going to discuss a variety of ways to evaluate your situation to decide what types of cleaning products makes sense to use and what should be avoided.

Essentials

The Essentials - Information Boxes provide quick practical guidance for important information with a minimum amount of technical explanations.

Essentials - The "Butter Test"

Most mycotoxins are water soluble, but a few are soluble in oils or fats. When fat soluble mycotoxin containing mold spores or fungal fragment land on a greasy surface the bulk of the toxins remain in the settled particulates, but some of the mycotoxins diffuse into the surface film. Cleaning these fat soluble residues is easy when you use methods that are able to cut through and remove grease. A simple test can be used to determine if a household cleaning product will be effective at cleansing fats, lipids, grease or oils and the mycotoxins they contain from surfaces. Smear a small amount of butter or other cooking fat onto a dish or plate. Use the product you wish to test to clean the butter off the plate. Since dish detergent or dish soap is manufactured for this purpose, it passes the "butter test" and will work every time. Mycotoxins will be removed right along with the oily residues.

Safe & Effective Household Cleaners

Soap or Detergent

Adding soap or detergent to water makes the cleaning of oils, grease and fatty deposits easy. When we think about oily surfaces in our home, it is common to only think about the kitchen where cooking oil spatters from frying foods. However, a more prevalent source of oil comes from our own bodies. One of the most common particle found in house dust is skin cells. These cells contain natural oils, which slough away as our skin cells fall away. Oil films accumulate almost everywhere due to the oils in our skin cells and from fingerprints. Plain water does a poor job of cleaning grease from surfaces.

The tricothecene mycotoxins produced by *Stachybotrys* mold are fat-soluble. When these toxins combine with the oily surface films found in our homes, they become practically impossible to remove with plain water. The surfactant characteristics of soaps and detergents causes the mycotoxin containing grease films to dissolve in the water, making it easy to remove them from washable surfaces.

Not all mycotoxins produced by mold are fat-soluble. Some mycotoxins are water soluble such as fumonisins from *Fusarium* type mold. Fortunately, soapy water is effective for cleaning both water and fat-soluble films from surfaces. The type of soap does not need to be fancy or

What are Soaps and Detergents?

Soaps and detergents are cleaners that increase the ability for fats, oils and greases to dissolve in water. Soaps are detergents that are made from natural ingredients. The first soaps were made by leeching lye from hardwood ashes, then reacting the lye with lard or other animal fats to make soap. The chemical reaction that occurs is called saponification. The soap molecule is able to remove or clean oil residues from surfaces by binding to the grease or fat present in oily dirt or fatty food particles. The soap makes the unwanted deposits water-soluble so they are easily washed away.

Detergents are chemicals that perform the same grease emulsifying function as soaps. In the case of tri-sodium phosphate (TSP) this chemical detergent is highly alkaline (pH 12). The TSP saponifies the grease on the surface being cleaned to make it water-soluble so it is easily rinsed away.

expensive. It just needs to be able to cut grease and clean surfaces without causing other problems. I am especially partial to having my clients use whatever dishwashing detergent they use for hand-washing dishes. I am not going to suggest a specific brand because everyone has different sensitivities and preferences, but if the soapy water works on greasy cookware it will remove grease from other surfaces as well. It doesn't take a lot of soap in the water and it doesn't take a lot of water, especially if you are using microfiber cleaning cloths.

Although I like soapy water for most clean-ups, the cleaning solution has to be used properly to avoid a soap film or to avoid damaging materials that can't handle the moisture. Cooking utensils are rinsed after they are clean. Nevertheless, many of the personal possessions and surfaces in our homes would be damaged by the liquid. If you use just the right amount of soap in water to damp clean instead of washing, you will be able to dissolve and pick up all the

grease without leaving a residue. If you leave too much soap behind, wiping the surface again with another clean microfiber cloth wetted only with water can effectively lift away the excess soap. If you do not use enough soap then some oils may remain. However, this is easy to check and correct by following the tips found in the Effective Cleaning chapter. Additional rounds of cleaning should remove any excess oils and mycotoxins that have been left behind.

Water

Mold won't grow without water, but water is also an important part of being able to effectively clean settled spores, mold fragments mycotoxins and other dirt from surfaces. Water is necessary for soap or detergent to work. It is the amount of water and how quickly it dries that makes the difference. Cleanrooms are essential for a number of industries. A tiny speck of dust can easily ruin a pharmaceutical or computer chip. Many of the same principles for establishing a cleanroom apply to effective cleaning of mold residues. The wipe shouldn't be too wet or too

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dry. Leaving puddles behind will result in too many mold spores remaining on the surface. Proper damp wiping leaves a minor film of moisture that quickly evaporates.

The quality of the water also makes a difference in the ability for soaps and detergents to clean. The water you use for cleaning will typically come from your tap. If you are getting your water from a city or county (municipal) water supply, you will either need to work with the water you have been supplied or make decisions about how you will treat it to make it better for cleaning. Well or spring water can vary dramatically in its quality, whereas municipal water is supposed to comply with standards that are regulated by the Environmental Protection Agency (US EPA). Vinegar, baking soda, and borax can help adjust the quality of water before soap or detergent is added so that it is more effective in cleaning. In order to get the most cleaning ability from your water it is necessary to understand more about the source of your water and the easy ways you can determine if pre-treatment is needed.

Municipal, Well and Spring Water

If you are using municipal or city water, you should receive information about the quality of your community's water supply on an annual basis. Water quality reports are also generally posted at the website for your county. The major factors that affect the ability of water to clean are the minerals that are present (hard water) and the pH (acidity or alkalinity).

Most community water supplies have had the water buffered to maintain a pH between 6.5 and 8.5. A pH of 7.0 is neither acid or alkaline. The lower the pH number, the more acidic the water will be. Acidic water is corrosive water that can dissolve pipes and metals. Alkaline water is generally (but not always) hard water that has more minerals. It is more likely for hard water to clog pipes with mineral deposits and reduces the ability of soaps and detergents to suds and clean-up mycotoxin containing films of oil. Community water treatment seeks to reach a balance between an acceptable taste, appearance and safety on a budget. The ability for water to clean well is typically a lower priority.

Water Testing Services

National Water Testing Laboratories is a private company that offers a wide variety of water testing services. They are at:

<http://www.ntllabs.com>

800-452-3330

444-449-2525

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If you get your water from a well or spring, you will be faced with many of the same challenges faced by municipal water systems, but will generally not have the ability to blend multiple water sources to meet water quality goals. In this case, you will be responsible for implementing your own water quality controls. Many counties offer water-testing services to members of their community. The tests they provide are frequently limited to the minimum parameters required by law. You can also easily test the hardness and pH of water yourself. Inexpensive test kits are available from swimming pool and aquarium supply stores. These can be used to help determine what forms of water treatment can be used to help treat your water for maximum cleaning ability. Private testing services are also available.

More information about drinking and household water quality and available treatment options is in my book *Prescriptions for a Healthy House: A Practical Guide for Architects, Builders and Homeowners*. By architect Paula Baker LaPorte; John Banta, CIH; and Erica Elliott, MD.

When it comes to cleaning the following can be used to treat your tap water to make it work better in combination with the soap or detergent of your choice.

- Borax can be added to soften hard water to "boost" the cleaning ability of your soap or detergent. If you already have soft water, or the detergent you are using already has borax, then additional borax isn't needed.
- Acidic water can be brought to a neutral or slightly alkaline pH by adding baking soda to the water prior to adding your soap or detergent. If the pH is between 6.5 and 8.5, then no adjustment is needed.
- Highly alkaline water can be brought to a neutral or slightly alkaline pH by adding distilled white vinegar to bring the water to a pH between 6.5 and 8.5 prior to adding your soap or detergent.

The use of borax, baking soda and vinegar are discussed in more detail in the section below on ineffective mold cleaners (than may have other useful purposes).

Ineffective Mold Cleaners (That May Have Other Useful Purposes)

The following are some additional readily available cleaning materials that may assist with certain types of specialty cleaning but are typically not helpful or necessary for cleaning up mold. The first thing you should always use for cleaning mold is a non-toxic soap or detergent and water in the laundry, dishwasher or cleaning solution. These other cleaners or cleaning aids should be used to supplement the cleaning using soap or detergent and water. It is important to determine whether they are used separately or mixed into the soap/detergent solution.

Alcohol

Alcohol is a great disinfectant for bacteria, but does not do a good job of disinfecting or removing mold spores, mold fragments or mycotoxins. It has already been pointed out that the goal is not killing mold - it is removal of the spores, fragments and other residues. An alcohol wipe may be able to remove loose surface dirt, but won't do that any better for dirt than plain water. Performing the "butter test" confirms that alcohol does not remove grease films effectively. Since alcohol fails the "butter test", it does not do a good job of cleaning oils or grease films from surfaces which have mold spores or fragments stuck to them. This means it will not clean up mycotoxins that are bound up in the greasy surface coating. Alcohol can dissolve and damage some surface finishes such as shellac, which does in turn remove some residue from the surface. However the goal is usually not to strip the finish but to remove the dirt grease and grime from the surface and leave the protective finish intact.

Some people do not tolerate being around rubbing alcohol, isopropyl alcohol, wood alcohol or denatured alcohols where a chemical has been added to discourage drinking the mixture. Many people with these sensitivities find using potato vodka or other distilled drinking alcohols a better choice. As already mentioned alcohol can be a great disinfectant for certain types of bacteria as well as stripping certain types of finishes. It may have some other useful purposes such as cleaning fabric softener clothes-dryer sheet residue off walls, ceilings, floors and personal possessions.

Many mold sensitive people find they are hypersensitive to the perfumes and residues that deposit from fabric softener clothes dryer sheets on the walls or other surfaces in the home and laundry areas. This is especially a problem in those instances where the clothes dryer is vented improperly, or the vent duct becomes loose or leaks air into the living space. A common ingredient used in clothes dryer sheets and room deodorizers is benzyl acetate and stearic acid. Benzyl acetate and stearic acid are both more soluble in alcohol than in water so cleaning surfaces with alcohol can help remove the benzyl acetate and stearic acid residues and the perfumes that can deposit and spread from laundry rooms.

Essentials - Alcohol as a Cleaner

Alcohol fails the "butter test" and is not an effective cleaner for mold, but it can help with a number of other types of cleaning. Alcohol can be used to:

- Strip shellac type finishes
- Remove clothes-dryer fabric softener residues.
- Evaporate minor amounts of moisture from wet surfaces.

When used for cleaning, pure "drinking alcohols" such as vodka seem to be better tolerated by most persons with chemical sensitivities than rubbing alcohol, wood alcohol, and denatured alcohol. These alcohols are either naturally poisonous or have chemicals added to prevent consumption.

An important precaution is that the vapor from alcohol can be flammable when exposed to open flames or high temperatures. NEVER use alcohol at flammable levels inside clothes dryers or around open flames to try to remove the odors. Any level of alcohol above 100 proof (50% alcohol) is flammable.

Alcohol does combine easily with water, and since it evaporates more quickly, it may have value in some cleaning applications where the surface needs to dry more quickly. Using alcohol with a disposable microfiber cleaning cloth to wipe a surface after cleaning with soap and water can help pickup residual fine dust particles and help the surface to dry more quickly. Although the benefit of using alcohol is often negligible as long as the cleaning that is being done uses damp and not wet wiping, surfaces will commonly dry quickly enough to prevent the germination and development of mold. As long as materials dry within 24 hours, mold does not grow.

Baking Soda

Baking soda, also known as sodium bicarbonate, does not cut grease well and therefore by itself fails the "butter test". It is a weak alkaline (pH 9), so it is less able to dissolve or saponify oils when compared to soaps or detergents. Baking soda can make some, but not all detergents work better by raising the pH and helping to soften the water. Detergents can be anionic (negatively charged), cationic (positively charged) or non-ionic (uncharged). Mixing baking soda with cationic cleaners will neutralize the cleaner and make the cleaning agent less effect. Using detergents that already have baking soda as an ingredient help remove the guesswork since the manufacturer will know if the baking soda will boost or neutralize the cleaning action.

Using baking soda mixed with water can help remove the acid stains that form when mold grows on tile grout. This is because the alkalinity of baking soda neutralizes acids. Baking soda is

Essentials - Baking Soda as a Water Treatment

Baking Soda fails the "butter test" and is not an effective cleaner for mold, but it can help to treat the water used for a number of types of cleaning and for other purposes. Baking soda can be used to:

- Absorb food odors from your refrigerator.
- Adjust acidic water to a Neutral or slightly alkaline pH.
- Neutralize spilled acids such as vinegar and lemon juice.
- Remove some types of stains.

When used together baking soda and vinegar neutralize each other to form carbon dioxide gas and salt. This reaction may be helpful for some types of stain removal (Also see - vinegar).

Always pretest fabrics and other materials to be sure they are colorfast and won't be damaged.

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helpful in neutralizing acidic spills or by-products such as develop when ozone gas has been used at too high a concentration and reacts with natural rubber or other isoprene containing compounds to produce formic or acetic acid.

If the baking soda is mixed into a paste with water it can provide a mild abrasive action which helps to physically scrub out the stains. This should then be followed by rinsing and if needed cleaning with a safe non-toxic soap or detergent based tile cleaner to clean the fats, oils, grease or scum.

Borax

Many times people will purchase borax laundry booster to use for washing their clothes. Borax is not a soap or detergent. Borax is a "booster" and does not do a good job of cleaning fats, oils or grease by itself so it fails the "butter test". A careful reading of the product instructions for the product say to add it along with your regular soap or detergent as a "booster".

The primary reason for adding borax to the laundry is to treat hard water so that laundry soap or detergent can work more effectively in hard water situations. If you are getting your water from a municipal water system that meets water quality recommendations, it is unlikely your water is hard enough to benefit significantly from the addition of borax with laundry detergents, which are already formulated for using with hard water. To see if you might benefit from adding borax to your wash, add the laundry detergent of your choice to your washer along with the clothes you are going to wash and let it fill up and start the agitation cycle. Stop the cycle after about a minute of agitation and reach into the water to moisten your fingers. Now rub your fingers together. Do they feel a little slippery from the soap? If so, you probably have the appropriate water hardness for use with that particular detergent. If your fingers do not feel slippery then borax may help soften the water and make the detergent work better. Borax in hard water for laundry may be a benefit; however, some people do exhibit a hypersensitive to borax.

Essentials - Borax as a Water Treatment

Borax fails the "butter test" and is not an effective cleaner for mold, but it can help treat hard water and make the soap or detergent more effective.

- Borax can help soften hard water.
- If your water is already soft - then the addition of borax is not necessary.
- Many detergents already have borax or other water softening agents added. The label for the detergent you are using may indicate that it already has borax or that it is specially formulated for use in hard water.

Borax has been used as a fire retardant and antifungal additive ingredient for insulations and upholstery stuffing. Because of this, some people incorrectly believe that washing clothes or linens with borax is a good treatment for preventing future mold growth. It is not going to work. If your clothes get wet and aren't dried soon enough they will develop mold. You can't add enough borax to the laundry wash to prevent it, and the borax washes out during the rinse cycle. Please DO NOT try powdering your clothing with borax as an antifungal - it is too harsh a salt to be used this way. Just keep your clothing and linens dry or dry them down quickly after they get wet and that will be all it takes to keep mold under control.

Hydrogen Peroxide

Hydrogen Peroxide is a strong oxidizing agent that can help remove or bleach mold stains from hard non-porous surfaces such as tile grout. While it can remove staining, it is not able to remove oily residues so it fails the "butter test" as a cleaner.

Hydrogen peroxide is inherently unstable and quickly breaks down into oxygen and water. It is usually mixed with about 5% peroxyacetic acid to help stabilize it in the bottle until it is used. When hydrogen peroxide is used to remove discoloration it is typically at a concentration between 3 and 6%. It should only be used at these lower concentrations because higher concentrations of peroxide can react violently with explosive force and ignite organic materials when used around any heat or ignition sources. Even at lower concentrations hydrogen peroxide is a strong oxidizer of metals and can damage fasteners such as screws and nails as well as a variety of metal brackets, electrical and plumbing system components. Rinsing the residues from metals immediately after use may help to reduce the damage from corrosion. The ability of hydrogen peroxide to bleach the color from materials means that it can cause damage to items by discoloring them.

Using hydrogen peroxide directly on mold growth on walls or porous surfaces needing remediation is not recommended. The spraying or wiping action can spread the mold spores and fragments. The bleaching action removes the color and gives the

Essentials - Hydrogen Peroxide as an Alternative to Bleach

Hydrogen peroxide fails the "butter test" and is not an effective cleaner for mold, but it can help remove stains. It is often present in "non-chlorine" bleaches.

- Hydrogen Peroxide can help disinfect surfaces contaminated with bacteria - but not all mold residues.
- Removing the color from mold does not mean it has been removed or is safe.
- Adding peroxide to a detergent may cause the peroxide to break down so that it is useless.
- If you want to use hydrogen peroxide for stain removal - choose a product that already has the hydrogen peroxide pre-mixed with the detergent as an ingredient.

false impression that the mold has been removed. Tape lifts or direct microscopic examination of moldy peroxide treated surfaces has shown that the mold hyphae and spores can remain or have been spread around the work area. Hydrogen peroxide does not satisfy the standard of care requirements for remediation which calls for the removal of the porous materials like gypsum wallboard which has offending mold growth and not merely chemically removing its color. The lack of staining also makes it more difficult for the environmental consultant to judge where to collect surface samples to determine if the remediation area has passed.

Formulations that premix hydrogen peroxide with detergent are manufactured and sold. These products pass the "butter test". The detergents already have the proper amount of peroxide in them. These products work well for cleaning hard, non-porous materials such as mold stained bathroom tile, grout, fiberglass tub enclosures and window sills stained with mold growth that has developed on the surface from condensation. If the mold growth is more than a few square inches, is usually best to preclean the hard non-porous surface by HEPA vacuuming to remove the bulk of any loose mold that is present, this is then followed by cleaning with the peroxide based detergent which removed any grease or oils and the remaining stains.

Vinegar

Vinegar is a mild acid. It fails the "butter test" because it does not clean up grease or fat residues. Remember the adage "Oil and Vinegar Don't Mix". Vinegar is best used for dissolving water spots on glass and the built-up lime deposits on fixtures such as coffee makers. The mineral deposits are usually alkaline salts so the mild acid in the vinegar dissolves the build-up. The chemical reaction of an acid such as vinegar and an alkaline such as lime deposits or baking soda is to form water and salt. So premixing vinegar and baking soda neutralizes any benefit that they have when used alone and does nothing to help clean away the oil or grease.

There are instances where certain types of food and other stains such as rust can be removed by using baking soda and vinegar mixed together on the spot. Pour some powdered baking soda onto the stain then add some distilled vinegar directly

Essentials - Vinegar as a Water Treatment

Vinegar fails the "butter test" and is not an effective cleaner for mold, but it can help to treat highly alkaline water and for a number of types of cleaning. Vinegar can be used to:

- Clean mineral deposits (water spots) on glass and other hard non-porous surfaces.
- Remove scale from pans used for boiling water or coffee makers and distillation water purifiers.
- Neutralize an alkaline pH.

When used together baking soda and vinegar neutralize each other to form carbon dioxide gas and salt. This reaction may be helpful for some types of stain removal (Also see - baking soda). Always pretest materials to be sure they are colorfast and won't be damaged.

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to the baking soda. The mixture will begin to foam and get warm. Work the mixture into a paste and rub it into the spot. It may be necessary to rinse and repeat a few times, but many types of stains will disappear.

NEVER mix vinegar with chlorine bleach. When mixed - toxic chlorine gas is released. This can be quite harmful and sometimes deadly. Inhaling the released gas can result in a chemical pneumonia.

Other Considerations

Botanical Oils

A number of oils such as tea tree oil, citrus oil, neem oil, thieves' oil, and thyme oil have been promoted as having antimicrobial properties including the ability to kill mold. It is questionable whether treating with oil kills mold and even if it does, killing mold does not make it safe.

- Mold spores have a hard and durable outside coating that makes them difficult to kill.
- Even if mold can be killed using these special oils, the process of spraying or treating mold growth will likely release mold spores into the environment causing further cross contamination and exposure.
- Attacking and trying to kill the mold may also cause certain types of molds to turn on their mycotoxin production and cause the environment to become even more toxic.
- There are already plenty of oily surfaces present in our homes so that we don't need to add more oil, simply clean up the oils that are present with soap and water.
- Drying materials to prevent mold amplification and physically removing it and sending it to the landfill works best.

Some soap or detergent cleaners are advertised as being better because they have botanical or essential oils added. Adding oil to a soap solution during manufacture binds to the lipid molecules to the soap molecules neutralizing its ability to clean up additional grease. In order for a soap or detergent with added oils to clean there needs to be an adequate amount of extra soap present above and beyond that which has been neutralized by the oil. The product may be a good cleaner because of the extra soap that is present and it may also be anti-bacterial. The addition of botanical oils may be beneficial or desirable, but that does not mean it will have special properties that make it more effective for mold clean ups.

Do not use botanical oils if you are going to be treating with ozone gas. The by-products of ozone reacting with terpene containing essential oils include formaldehyde. (See Ozone Chapter)

Coconut Oil or Peanut Butter

Sometimes you may encounter a spot of residual adhesive or other sticky substance that won't clean off a surface using soap and water or any of the usual safe non-toxic cleaners. Rather than reaching for the harmful solvent, try using coconut oil or peanut butter. Of course these are oils, so they don't pass the "butter test", but by using them first you can convert some residues

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that can't be cleaned up with soap and water into a compound that can be cleaned up with soap and water.

Peanut butter has been the classic way to remove chewing gum from clothing and children's hair. Peanut oil in the peanut butter can be used to help clean other residues as well. A course ground peanut butter (somewhere between creamy and chunky will also provide some abrasive action. Coconut oil can do the same thing, but isn't abrasive. The semi-solid nature of peanut butter or coconut oil at room temperature concentrates the oils on the area you are attempting to clean. Gum, unknown sticky substances and many adhesives are oil soluble or will at least be loosened from the surface. After the offending substance has been removed, a cleaning with soap and water will remove the residual oil film that was left behind by the coconut oil or peanut butter.

Fragrances, Perfumes, Deodorizers and Fresheners

In addition to removing biomass, remediation and effective cleaning also means the absence of malodor. Odors from mold are caused by gases called "Microbial Volatile Organic Compounds" (mVOCs) These musty moldy odors are discussed in more detail in Chapter 3 - *Water Damage Molds*. Proper effective remediation and cleaning and keeping your home dry will eliminate these odors and keep them from returning. The use of fragrances, perfumes, deodorizers and air fresheners doesn't eliminate mold problems from a home and will often cover-up the mustiness that indicates something in the home is wrong.

The number of people that are hypersensitive to a variety of odors appears to be increasing. In many cases the sensitivity to the odor is based on whether the fragrance is of natural origin or synthetic, but not always. Some people are individually sensitive to certain natural odors.

Fragrances, perfumes, deodorizers and air fresheners usually reduce odors by one or more of the following processes:

1. Some products change odors by altering their chemistry so they can no longer be smelled
2. Others cover the odor by using a fragrance or perfume to overpower or outcompete the odor
3. Some deodorizers do not eliminate the odor but instead deaden the nerve endings thus preventing the odors from being detected by the nasal receptors.

Altering Odor Chemistry

Oxidation such as with ozone changes the chemistry of an odorous molecule to make it odorless - but not necessarily safer. Chemical compounds such as those found in some room air

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fresheners and new carpeting can break down into less odorous, but even more dangerous compounds such as formaldehyde.^{1,2} Ozone generators will be discussed in more detail in their own section.

Covering Up Odors

Many fragrances and perfumes have a stronger odor that attempts to outcompete offending odors. Many times these include natural fragrances. Even natural fragrances may not be safe when used to cover up an offending substance. The lack of odor doesn't mean it has been eliminated. According to The National Resources Defense Council "NRDC's independent testing of 14 common air fresheners, none of which listed phthalates as an ingredient, uncovered these chemicals in 86 percent (12 of 14) of the products tested, including those advertised as "all natural" or "unscented." Phthalates have been implicated in causing hormonal abnormalities, birth defects, and reproductive problems.³

Deadening the Nasal Receptors

A variety of Volatile organic compounds (VOCs), including formaldehyde and benzene, eliminate our ability to smell the odors by blocking the nerve endings. While the odorous molecules are still present in their original concentrations, it is impossible for our noses to recognize them. According to a September 2012 article in Scientific American, these chemicals "can cause headaches, nausea, and aggravate asthma. They also have been linked to neurological damage and cancer."⁴

A major problem with ignoring odors and covering them up is that the odor may be a serious indicator of decay or problem organisms. On multiple occasions, I have found that broken sewage or septic lines, blocked plumbing vents or decay causing organisms caused by wet rot, dry rot or other types of water damage has caused bad odors.

In one case, a vacation property shared by a family of brothers and sisters was making one of the family members so ill that attending family get-togethers at the mountain property was no longer possible. I was hired to inspect and try to determine the problem. What I found was the home had 17 room air fresheners distributed throughout. These chemicals were more than enough to make the property unacceptable for the sensitive sibling. When I asked why they had so many room air fresheners throughout the home, I was told the place smelled bad without them. Further questioning revealed that they began use of the air fresheners about five years earlier. As the odor became worse, they added more air fresheners. It turned out the source of the odor was water intruding through a subterranean foundation wall into a crawlspace under the home. The water had resulted in deterioration of the supporting structure which was so severe that I was afraid the building was at risk of collapse. The cost to replace the structurally

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rotted foundation - not including correcting the water intrusion or mold remediation was over \$40,000.00. A building drainage problem had resulted in the water coming off the hill behind the home flowing into the substructure's wooden framing instead of being harmlessly diverted around the home. I'm sure the problem could have been inexpensively addressed for a few thousand dollars had they paid attention to the odor and had the home inspected by a structural or pest inspector five years earlier. By ignoring the early warning and covering it up with fragrances, perfumes, deodorizers and fresheners, the family almost lost the structure and the correction became more expensive.

When persistent musty, rotten, or sewage-like odors are noted, an inspection is vital to determine the cause. One of the first things I want to do when I enter a home for an inspection is see how it smells. This inexpensive, rapid inspection technique is frequently thwarted by the presence of chemicals used to disguise the odors that can often lead to a rapid diagnosis of the problem. Even unscented products can have the presence of chemicals designed to destroy the ability to smell offensive odors. So when choosing a product, it is important to base the decision on reputable product lines or safe household products that have stood the test of time, and not to rely on gimmicks to solve problems.

(1) Mason, Mark, Xiaoyu Liu, Krebs, Kenneth; Sparks, Leslie; "Full-Scale Chamber Investigation of Air Freshener Emissions"; *Journal of Environmental Science and Technology*, 2004.

(2) Morrison, G.C. and W.W. Nazaroff; "Ozone interactions with carpet: secondary emissions of aldehydes." *Environmental Science Technology* 36: 2185-2192, 2002.

(3) Protect Your Family from the Hidden Hazards in Air Fresheners, Natural Resources Defense Council Sept 2007.

(4) Avoid Harsh Chemicals in Commercial Air Fresheners with Homemade Alternatives, Scientific American, A Division of Nature America, Inc., September 9, 2012
<http://www.scientificamerican.com/article/nontoxicairfresheners/>

John Banta is a Certified Industrial Hygienist with approximately 30 years experience with healthy homes. He specializes in water damage and mold problems in buildings. John is a Coauthor for the book Prescriptions for a Healthy House: A Practical Guide for Architects, Builders and Homeowners.

John is working on a new book that focuses on mold problems in the home. This article on Effective Cleaning is a chapter from that book. If you would like to be added to the

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mailing list for book progress updates, please send an email to the address at the bottom of the page.

John provides telephone and on-site consulting services through RestCon Environmental. He can be reached at 510-769-7230 ext. 306.