Special Report:

Mold Home Remedy Recipes & Instructions

for making low-cost fungicides and antimicrobial coatings

by Phillip Fry, Certified Mold Inspector, Certified Mold Remediator, Certified Environmental Hygienist, and Certified Home Inspector; Author of Do-It-Yourself Mold Prevention, Inspection, Testing, & Remediation; Mold Health Guide; and Mold Legal Guide.

Table of Contents

The use of mold disinfectant and antimicrobial coatings must be an integral part of your overall mold remediation plan, and can NOT be your only mold remediation step. Here is a brief summary of the **25 required steps for successful do-it-best-yourself mold remediation** ---

25 Recommended Steps for Effective Mold Cleaning, Mold Killing, Mold Removal, Mold Remediation, Mold Mitigation, and Mold Abatement of Mold Contamination and Infestation

Excerpt from the Mold Removal page of Mold Inspector.com (http://www.moldinspector.com/mold_removal.htm)

Just four words neatly summarize what has to be done in effective and safe mold removal, mold remediation, mold mitigation, and mold abatement: **CONTAIN**, **KILL**, **REMOVE**, and **PROTECT**.

(1) CONTAIN the mold from spreading into uncontaminated areas;
(2) KILL the mold;
(3) REMOVE the dead mold; and
(4) PROTECT the cleaned out area against future mold infestations.

Whether you plan on doing your own mold removal and remediation, or hiring a Certified Mold Contractor or Certified Mold Remediator, follow these twenty-five steps to completely and safely remove mold problems, contamination, and infestation from your home, condominium, rental apartments, office, warehouse, retail store or other real estate building. Where relevant, mold testing and mold remediation suggestions from the U.S. Environmental Protection Agency are included below.

1. Learn the techniques and procedures recommended for safe and successful toxic mold inspection, testing, and remediation – whether you prefer do-it-yourself or to hire a Certified Mold Remediator (CMR). How? Read mold remediation self-help books and internet mold advice websites, plus get professional guidance. Visit the website Bleach Mold Myth. Read this entire chapter (Chapter IV) for updated mold remediation skills. Learn how to make your own, low-cost, easy-to-make homemade fungicides and antimicrobial coatings (from readily-available in your community) in our special report Home Mold Remedy Recipe. If you are concerned about mold health problems, plus want to learn of all available mold medical diagnostic and treatment procedures, please read our updated Mold Health Guide ebook. If you need information about prosecuting or defending a mold legal claim, read the Mold Legal Guide ebook. Both books are available online at Mold Mart.

2. Locate and fix all sources of mold-causing water intrusion such as recurring flooding, plumbing leaks, leaky roofs or siding, blocked air-conditioning condensation drain lines, and high indoor humidity (e.g., above 50-60%). Follow the dozens of water-intrusion prevention and remediation suggestions in this chapter.

3. **Inspect and mold test inside, above, and below each water-penetrated ceiling, wall, and floor** with a fiber optics inspection device, a hidden moisture meter, do-it-yourself mold test kits or a mold inspection by a Certified Mold Inspector [CMI], and by cutting small core dry wall samples. Remove and look in the middle and back of each core for visible mold growth. You can also cut off thin veneer moldy slices from each core sampling, and then insert each veneer slice into a do it yourself mold test kit to watch for mold growth over a 7 day time period. More valuable to you in mold insights, would be to put each sample into a separate ziplock bag properly labeled with property address, precise testing location at that address, date of testing, name of tester [you probably], and your full contact info, and then to mail your collected samples to our USA, or Germany, mold analysis lab after pre-payment of the lab fees at our **online mold products catalog. For low-cost mold testing, use inexpensive Scotch®Tape to do lift tape mold sampling, and then send the tape samples to our mold analysis laboratory.**

4. Find and locate all toxic mold infestations (visible and hidden) in the entire home or building by thorough, all-around mold inspection and mold testing (with mold laboratory analysis and mold species identification of collected mold samples). "You may suspect hidden mold if a building smells moldy, but you cannot see the source, or if you know there has been water damage and residents are reporting health problems. Mold may be hidden in places such as the back side of dry wall, wallpaper, or paneling, the top side of ceiling tiles, the underside of carpets and pads, etc. Other possible locations of hidden mold include areas inside walls around pipes (with leaking or condensing pipes), the surface of walls behind furniture (where condensation forms), inside ductwork, and in roof materials above ceiling tiles (due to roof leaks or insufficient insulation)," warns the U.S. Environmental Protection Agency.

    - For all building locations wherein you see visible mold, use the clear Scotch tape lift sampling method that is explained in the mold test kit instructions section on the Mold Mart website, or scrape visible mold particles into a mold test kit.

    - Conduct a mold control test using a do-it-yourself mold test kit outside your home or building with the test kit being at least five feet out from any roof or porch overhang. You need this outdoor control test for comparison of results from your indoor mold testing.

    - Use a fiber optics inspection device, a hidden moisture meter, and internal wall and ceiling mold testing to search for hidden mold growth.

5. **Test the outward airflow from each heating/cooling duct register for elevated levels of airborne mold spores.** If there is a serious toxic mold infestation anywhere in a building, airborne mold spores from such mold locations will usually enter and contaminate the heating/cooling equipment and ducts, as well as the rest of the building. Use our do it yourself mold test kits to collect possible mold spores in the outward air flow from each register with the system running on fan ventilation.

6. **Replace mold-infested heating/cooling equipment and ducts if the owner can afford to do so.** Otherwise, do repeated mold fogging with a mold fogging machine and an EPA-registered fungicide or a mold home remedy recipe into the return air duct while the system is running on fan ventilation to deliver the fungicide to internal surfaces.

Air conditioning-heating equipment and duct mold problems. When humid air passes over chilled cooling coils, water condenses and drips through the coils into a collection pan, from which it continuously drains. Problems with these systems may occur when this water collects and becomes stagnant either on the coils or in the drip pan. When standing water is present, a biofilm will develop. This biofilm is composed of bacteria and fungi that are embedded in a slimy matrix. Other organisms such as amoebae and algae may also occupy this comfortable growth site, feeding off the accumulated organic material. Learn how to deal with this important problem at Cooling Coil. In addition, it is common for the condensation line from the cooling equipment to become clogged, backing up water into the air conditioning unit and then, from there, into the house or building.

If there is a serious mold problem anywhere in a home or other building, airborne mold spores from those points of mold contamination will enter into the heating/cooling ducts and/or equipment to mold contaminate both, and thus the entire building. Of course, the opposite is also true: if there is mold infestation growing inside the heating/cooling ducts and/or equipment, the heating/cooling system will efficiently spread airborne mold spores through out the entire home or building through air distribution of the running system. In any home or building with mold infestation, you need to mold test the outward air flow from each heating/cooling duct register for the possible presence of elevated levels of airborne mold spores in comparison with your outdoor mold control test. Use either a Certified Mold Inspector or our do-it-yourself mold test kits.

When doing mold remediation of a house or building, the heating/cooling mold problems should be fixed first, and then you can seal tightly with plastic sheeting all inward and outward duct registers. Don't run the system until the rest of the home has been effectively mold remediated and the building

has passed mold clearance tests done by an independent Certified Mold Inspector not involved in the mold remediation work, or by your use of our do-it-yourself mold test kits.

If you fog a fungicide into the return air duct while the system is running on fan ventilation, you can get substantial amounts of fungicide delivered throughout the system. While spraying or fogging a mold fungicide [spraying/fogging step 1] and subsequently an EPA-registered fungicidal coating or a Mold Home Remedy Recipe [spraying/fogging step 2] inside the heating/cooling ducts and equipment, no one [except the protected applicator] should be in the home or building during the spraying or fogging application. The person doing the spraying or fogging application needs to wear proper personal protective gear, as explained at point 13 below.

7. **If any residents or workers are experiencing any possible toxic mold health symptoms, or if there is a strong smell of mold, or if there are visible signs of major mold growth anywhere in the building, or if the building tests positive for elevated levels of airborne mold spores, the occupants should move temporarily to a mold-safe place until after successful mold remediation and clearance testing.**

Hot Tips: **Do you want or need quick and immediate mold relief?** The first immediate action you can take is to remove almost all of the airborne mold spores 24 hours per day from the air you breathe in your moldy home, apartment, or workplace by running one or more of the best air cleaners in different areas of your house, rented house/apartment, or place of employment. Your second immediate action is to use our mold fogging machine to fog low-cost home-remedy fungicide in all rooms, attic, basement, crawl space, garage, and the heating/cooling equipment and ducts [through the return air duct while you are fogging directly into the return air duct] of your home, condominium, apartment, office, or other building. You can also place small to large fans in key areas of rooms/areas being mold-fogged to help the mold fog to reach all areas of a room or area. Let each fungicidal fogging dry for about one to two hours while the fungicide is killing the mold. Then fan dry the area quickly to remove excess moisture from the fogging procedures. Then fog with two layers of homemade antimicrobial coating to help protect the areas against future mold growth. After each fogging, let the fog set for about one to two hours, then dry the area quickly with fans. The person doing the fungicidal spraying or fogging application needs to wear proper personal protective gear, as explained at point 13 below.

8. **Occupants moving out should not take any clothing, personal possessions, furnishings, furniture, or equipment until after such items have been effectively mold decontaminated outdoors [or in a clean room built from plastic sheeting] to avoid mold cross contamination of the temporary living or working quarters.**

9. **Do not paint over mold problems**. Mold loves to eat paint as a snack food. Don't expect to kill mold successfully by using paint containing a mildicide [too mild to kill existing toxic mold infestation] or with a paint primer sold to hide water damage stains. Do not rely on Kilz to kill mold or anything---it does **not** kill mold, and the product is NOT an EPA-registered fungicide. Kilz is an excellent product to hide or camouflage defects like water damage stains prior to painting over problem areas.

10. **Before beginning to work in the mold-afflicted areas, contain the moldy work area (and thus contain the toxic mold spores that will be released into the air by opening up mold-contaminated areas) by using wall-to-wall, floor-to-ceiling plastic sheeting as containment walls.** How to make effective mold containment walls, including a mold-secure entry way into the mold containment area, is explained in detail in our ebook Do-It-Best-Yourself Mold Prevention, Inspection, Testing, and Remediation. Use 6 mill thick, clear plastic sheeting that you can buy at a hardware store or home improvement center.

11. **After the installation of air tight mold containment walls, dry the work area [especially if still wet from flooding or a now fixed water leak or roof leak] with one or more large dehumidifiers or an industrial size dehumidifier.** Improper fan drying can spread mold spores to cross contaminate an entire building and its heating/cooling system.

12. **Inside the mold containment area, use a large fan in the window to exhaust air directly outside on a continuous basis to expel airborne mold spores and remediation-caused dust**---or better yet, use an industrial hepa filter to filter out mold, with a flexible hose directly venting the exhaust air flow to the outdoors. You need to exhaust more air to the outside than is entering the containment area to create negative air pressure. (You know you have negative air pressure when the plastic containment sheets are being sucked inward toward the work area rather than bulging outward away from the work area.)

13. **While working inside the mold containment area, always wear effective protective gear** such as protective biohazard suit. [$10 at safety stores] or painter's coveralls and booties or a long sleeve shirt and pants; gloves; and a one piece, full face breathing respirator mask using an organic vapor cartridge filtration, available from local safety, hardware, and home improvement stores. You also need such personal protective gear when you spray EPA-registered mold fungicide or lower-cost **Mold Home Remedy Recipes**, followed up with the EPA-registered fungicidal coating or with a low-cost, homemade antimicrobial coating Here are more details on advisable personal protective gear---

    - **Tyvek protective biohazard suit**. [available at safety stores] or painter's coveralls and booties, or long sleeve shirt and pants.

    - **Gloves**: either disposable latex or good work gloves. "Long gloves that extend to the middle of the forearm are recommended. When working with water and a mild detergent, ordinary household rubber gloves may be used. If you are using a disinfectant, a biocide such as chlorine bleach, or a strong cleaning solution, you should select gloves made from natural rubber, neoprene, nitrile, polyurethane, or PVC. Avoid touching mold or moldy items with your bare hands," recommends the U.S. Environmental Protection Agency.

    - **Avoid breathing in mold or mold spores.** Wear a 3M brand one piece, full face breathing respirator mask using an organic vapor cartridge filtration, available from your local safety store, Home Depot, Lowe's and other home centers and hardware stores. Alternatively (but less comfortable in your ease of breathing) you can use hole-free Chem-Splash eye goggles ($4) along with a separate breathing mask with cartridge filters ($30) from the same stores. Alternatively, "In order to limit your exposure to airborne mold, you may want to wear an N-95 respirator, available at many hardware stores and from companies that advertise on the Internet. (They cost about $12 to $25.) Some N-95 respirators resemble a paper dust mask with a nozzle on the front, others are made primarily of plastic or rubber and have removable cartridges that trap most of the mold spores from entering. In order to be effective, the respirator or mask must fit properly, so carefully follow the instructions supplied with the respirator. Please note that the Occupational Safety and Health Administration (OSHA) requires that respirators fit properly (fit testing) when used in an occupational setting; consult OSHA for more information (800-321-OSHA or osha.gov," advises the U.S. Environmental Protection Agency.

    - **Wear goggles.** Wear eye goggles with no holes [such as Chem-Splish] if you are not wearing the 3M brand one piece, full face breathing respirator. "Goggles that do not have ventilation holes are recommended. Avoid getting mold or mold spores in your eyes," advises the U.S. Environmental Protection Agency.

    HOT TIP: You can order a custom-fitted full face breathing mask by contacting your local 3M branch. Custom-fitted full face masks do a better job of keeping mold spores from entering inside the mask [and therefore into your body].

    HOT TIP: If you have a beard, shave it off prior to wearing a full face mask breathing respirator to obtain a tighter fit to your face to help keep mold stores from entering inside the mask and your body.

14. **Spray or fog visible mold with one or two wet sprayings or foggings** of either the EPA-registered mold fungicide or with an effective mold home remedy if the mold remediation funds

are low---read Mold Home Remedy Recipes. While spraying or fogging a fungicide no one else should be inside until the spray or fog has dried. Most fungicide manufacturers recommend in their usage instructions only to use their product on non-porous surfaces [e.g., a kitchen counter top], the easy surfaces upon which to kill mold.

IMPORTANT OZONE WARNING: Do not use an **Ozone Air Purifier/Ozone Generator** to kill mold. Ozone is ineffective in killing mold. Ozone can only kill what it comes into contact with. Ozone cannot get at, and thus cannot kill, mold growing INSIDE drywall, wall, carpeting, upholstered furniture, wall cavities, ceiling cavities, and floor cavities. Besides being ineffective at killing hidden mold [the worst type], a high ozone treatment can easily damage all rubber and plastic parts it comes into contact with such as rubber and plastic components of appliances, electronics of all types, exposed electric lines and extension courts, and hvac controls. Ozone is also unhealthy to humans according to the **U.S. Environmental Protection Agency**, which specifically discourages the use of ozone for mold remediation. For more information on the ineffectiveness of **Ozone** and the **Ozone Air Purifier** to kill mold and other indoor air contaminant, read the highly-informative U.S. Federal Appeals court decision: Federal Trade Commission and the Court of Appeals.

15. **Do not use chlorine bleach [sodium hypochlorite] to kill mold or disinfect moldy areas.** Bleach is ***not*** an effective or lasting killer of toxic mold growth and mold spores on and inside porous, cellulose building materials such as wood timbers, drywall, plasterboard, particleboard, plywood, plywood substitutes, ceiling tiles, and carpeting/padding. Learn more about bleach and mold.

16. **After the killing of all visible surface mold, the next step is to clean off as much surface mold growth as possible. "**Dead mold may still cause allergic reactions in some people, so it is not enough to simply kill the mold, it must also be removed," recommends the U.S. Environmental Protection Agency. Persons cleaning mold should be free of mold symptoms and allergies. A good first step is to use a hepa vacuum cleaner to remove loose [invisible to the eye] airborne mold spores and mold growths deposited on all surfaces such as ceilings, walls, floors, and upholstered furniture. Vacuum at least twice, going in a different movement direction each time you do the vacuuming---e.g., horizontally the first time and vertically the second time. Wash all surfaces [including furniture and appliances with Borax and/or TSP [done separately, not mixed together], which is explained later in this paragraph. Gloves should be worn during cleaning. The cleaned area should then be thoroughly dried. Dispose of any sponges or rags used to clean mold. Scrub and clean moldy surfaces and mold growth areas with either Borax laundry detergent (a natural mold cleaner) in warm water or TSP (trisodium phosphate) from a hardware or building supply store. For best results, use borax or trisodium phosphate (TSP) *mixed into distilled water* [so that no minerals or other contaminants in the water can possibly interfere with the mold cleansing process] to clean moldy surfaces or building materials. As to Borax, you can use up to 1.5 pounds of Borax detergent per gallon of distilled water. That much Borax solution is, of course, thick but very effective in scrubbing off mold growth. If you wish to use a lesser Borax concentration, do what you believe is most suitable for your cleaning efforts. When using either product to clean, wear rubber gloves to protect your hands. As to TSP, follow the directions on the TSP package for mixing the cleaner with water before you clean. After you clean with either Borax or TSP, let the surface dry. After a thorough Borax or TSP-scrubbing, washing, and rinsing, if there is still any remaining visible mold growth, wash and scrub the area again with a different mold cleaner [e.g., use TSP next if you first used Borax, or vice versa]. You must rely on scrubbing and cleaning to get rid of mold growth buildup. If you cannot clean off the mold growth, that fact tells you that you probably need to replace the building materials themselves with new ones---preventively-treated with both EPA-registered fungicide and EPA-registered fungicidal coating. "If you are unsure about how to clean an item, or if the item is expensive or of sentimental value, you may wish to consult a specialist. Specialists in furniture repair, restoration, painting, art restoration and conservation, carpet and rug cleaning, water damage, and fire or water restoration are commonly listed in phone books. Be sure to ask for and check references. Look for specialists who are affiliated with professional organizations," recommends the U.S. Environmental Protection Agency.

17. **Except for wood support timbers and building materials to be saved, remove and safely discard all other mold-contaminated building materials** (such as particle board, drywall, plaster, plasterboard, ceiling tiles, paper-backed insulation, mold-laden insulation, plywood, plywood substitutes, and carpeting/padding) in doubled up construction trash bags (double bagging) with a 6 mil thickness. "Absorbent or porous materials, such as ceiling tiles and carpet, may have to be thrown away if they become moldy. Mold can grow on or fill in the empty spaces and crevices of porous materials, so the mold may be difficult or impossible to remove completely," advises the U.S. Environmental Protection Agency.

18. **Remove all mold growth from the mold-infested wood surfaces.** All wood beams, wall timbers, roof trusses, floor joists, plywood surfaces, and other lumber to be saved need to be totally cleaned of mold growth by using power tools such as a planer, grinder with wire brush attachment, and sander---or replace the moldy timbers. Mold cannot eat polystyrene insulating board such as Pinkboard or Blueboard, but mold can grow on organic dust which lands on the insulating board. "The only sure way to [kill mold] requires the physical elimination of mold and moldy materials by thorough cleaning or removal of the affected materials."---American Industrial Hygiene Association.

19. **Re-spray twice the cleaned out area** with another wet spraying of the EPA-registered mold fungicide, or an effective mold home remedy to kill any remaining, living toxic mold spores or mold growths.

20. **Spray a protective fungicidal coating on all remediated-surfaces** prior to rebuilding and closing in the mold-remediated area. The fungicidal coating helps to protect the wood and other cellulose-based building materials against future mold growth.

21. **After the final drying of the fungicidal coat spraying, it would be helpful to spray all cleaned timbers and other wood surfaces with a clear, liquid, plastic coating** [available from a well-stocked local paint dealer, hardware store, or home improvement center] to make a hard, impenetrable water barrier [upon drying] to protect the wood from future high humidity and water leaks.

22. **After the toxic mold remediation is completed, mold test (clearance testing) all of the remediated surfaces plus the air of each room, attic, basement, crawl space, garage, and the outward air flow from each heating/cooling duct register** to find out if those areas are now mold safe prior to rebuilding the cleaned out areas with new building materials. "Surface sampling may be useful to determine if an area has been adequately cleaned or remediated," advices the U.S. Environmental Protection Agency.

23. **Remove mold from all personal property, furnishings, furniture, and equipment that have been exposed to building mold** by washing the items outdoors or in a plastic-sheet-built clean room with Borax laundry detergent (a natural mold cleaner) in warm water. In addition, the property owner can spray EPA-registered fungicide on all surfaces. Learn the recommended mold decontamination procedures for each type of clothing, furniture, electronics equipment, and other personal property in the ebook **Do-It-Best-Yourself Mold Prevention, Inspection, Testing, and Remediation**, available at the **online mold products catalog**.

24. **Close in the mold-remediated area with mold-free, new building materials that been have carefully inspected to be mold-growth-free**, and which have been pre-treated by spraying with one to two wet coatings of both an EPA-registered mold fungicide and an EPA-registered fungicidal coating.

25. **On-going cleaning, building maintenance, mold maintenance, and all-around building inspection on a regular basis (including air conditioning/heating equipment and ducts, plumbing, roof, siding, windows, and water supply/sewer lines) are required to help prevent the re-occurrence of toxic mold infestation problems.** A mold-safe building is not a one-time effort.

How to Kill Mold in Porous Materials

Porous means permeable to water, air, or other fluids. Moisture, water, humid air, organic dirt (additional food for mold growth), and mold spores can easily enter into porous materials and cause mold growth beneath the surface.

Mold-killing fungicides can only kill mold spores and mold growth to the extent that the fungicide spray or fog can soak into the porous materials. For that reason, the manufacturers of all EPA-registered fungicides recommend that their mold killing disinfectants only be used on hard surfaces (where mold is easy to both clean off and kill).

The more porous the surface being remediated, and the more organic matter that is present, the les likely that any disinfectant will work in killing mold! That is one reason why the removal of mold-laden building materials is often a necessary remediation step to achieve a successful mold remediation.'

Whether you are trying to do a major mold kill prior to removal of the moldy building materials, or trying to save the moldy materials or trying to save the moldy materials only by spraying or fogging, you need to do at least two very wet applications of the fungicidal spray or fog to allow for maximum penetration and soaking of the building materials. The inability of chlorine to soak into building materials is a major reason why bleach fails as a mold remediation tool.

Another way to impact mold growing inside porous building materials and inside walls, ceilings, and floors, is to pressure inject Tim-bor (preferably) or Borax laundry detergent (if you cannot afford the low-cost of Tim-bor). Pressure injection (easy-to-do) of Tim-bor into building timbers, walls, etc. is explained in the Tim-bor/Borax Section below.

Low-Cost Mold Remediation Treatment: Tim-bor and Borax Laundry Detergent

Tim-bor is an EPA-registered fungicide, but U.S. Borax (the manufacturer of Tim-bor) described Tim-bor NOT as a fungicide, but as follows: "Tim-bor is a unique product for the protection and remedial treatment of wood against all wood destroying organisms. Tim-bor can also be used for general pest control." You can consider using either Tim-bor or Borax to be a low-cost mold remediation treatment.

Tim-bor Application (from the manufacturer of Tim-bor)

Technical Information

Tim-bor® Professional is an EPA-registered termiticide and insecticide for use by professional Pest Control Operators. Tim-bor is a unique product for the protection and remedial treatment of wood against all wood destroying organisms. Tim-bor can also be used for general pest control.

How does Tim-bor work?

Tim-bor can be applied as a solution, foam or dust for wood treatment against wood destroying organisms and as a solution or dust for general insect control. Tim-bor applied as a solution or foam to wood, will penetrate into the wood to various depths dependent on the moisture in the wood and the wood species. The active ingredient does not break down, therefore as normal moisture changes occur in the wood. Tim-bor is always available to be drawn deeper into the wood over time, providing long lasting protection. When used as a dust or as a crack and crevice solution. Tim-bor is not repellent to general pests.

The mode of action for Tim-bor is that of a slow acting stomach poison to insects and a contact poison to decay fungi. As wood destroying insects or their larvae feed on, tunnel in and/or digest wood, they accumulate the active ingredient into their systems. General insects such as cockroaches, ants, crickets, etc. will ingest Tim-bor through their normal preening habits after contacting deposits. The accumulation of the boron into their systems acts to poison the insect.

Since Tim-bor is slow acting, TERMITES that have fed on treated wood can accumulate the active ingredient and still move among other individuals in the colony. The transfer of food from workers to nymphs, soldiers and reproductive will also transfer the ingested Tim-bor. Affected individuals also exhibit behavioral changes, becoming sluggish, stop feeding and become moribund. Others in the colony will avoid these individuals as well as areas where these individuals have died. The Tim-bor treated wood is not the first choice for feeding, therefore Tim-bor treated wood is avoided by foraging termites. In addition, the Tim-bor powder used as a dust in wall voids and injected into galleries is toxic to termites.

Tim-bor treated wood also deters wood destroying BEETLE larvae. Eggs deposited on the surface of treated wood by beetles will have a reduced hatch rate. Larvae that may hatch from eggs will soon die after attempting to eat into Tim-bor treated wood. In infested wood, the larvae will die from ingesting Tim-bor treated wood as they tunnel toward the surface of the wood to pupate. Depending on the life cycle of the beetle, type of beetle, and seasonality of treatment, adult beetle may emerge, but will not re-infest the wood.

Carpenter ants do not consume wood but they can cause substantial and rapid damage by excavating cavities in wood for nesting. Tim-bor treated wood is very unpalatable, and is not excavated by carpenter ants. Treated wood along may not prevent or eliminate a carpenter ant infestation, since the ants can penetrate construction features and avoid chewing treated wood. However, Tim-bor powder used as a dust in nesting sites in wood and in wall voids and around conduit and plumbing will control these pests. The Tim-bor powder adheres to the carpenter ants' body and is ingested as the insect attempts to clean the powder off.

DECAY FUNGI can infect and rapidly destroy wood where there are moisture problems. Some fungi can actively transport moisture from the ground or a leak to wood of lower moisture content in efforts to expand the colonization of the wood. Tim-bor is highly toxic to decay fungi and will kill the fungi present and/or protect against future infections.

Application of Tim-bor to control wood destroying organisms must be a part of an Integrated Pest Management (IPM) Strategy. Problems which may have led to the infestation or that may do so in the future must be corrected. This includes correcting moisture leaks, providing adequate ventilation and moisture barriers and removal of debris from crawl spaces. After the initial treatment, inspections should be performed on a regular basis and additional preventive spray treatments of Tim-bor (up to 4) can be made. Each additional treatment will increase the borate loading and penetration into the wood, further protecting it from insect and fungus attack.

Tim-bor is also active against other GENERAL PESTS like cockroaches, ants, silverfish, earwigs, and crickets. Tim-bor powder can be applied directly to insect harborage areas or in solution as a crack and crevice application. When the insect crawls over treated areas, the tiny particles of powder adhere to the insect's body. Tim-bor is ingested as the insect attempts to clean the powder from its legs and antennae.

Directions for Use

Mixing Instructions

Always estimate the amount of Tim-bor solution needed. Approximately 1 gallon of solution will be needed to treat 200 square feet of wood surface area. Tim-bor can be applied as a 10% solution or 15% solution as shown on the illustration below (Table A).

Solution

Using a slightly oversized container/bucket, fill with water to about 80% of the final required volume. To prepare of a 10% Tim-bor solution, add 1 lb. of Tim-bor powder per gallon of required solution, and then add the remainder of the water, agitating until the Tim-bor has dissolved. To prepare a 15% solution, add 1.5 lbs. of Tim-bor powder per gallon of required solution (or 3 lbs. for 2 gallons), then add the remainder of the required solution of the water and mix as previously. (**Note:** 15% solutions should be used immediately and not stored).

Foam

Prepare a 15% solution and add foaming agent. Typically 1-2 ounces of a foaming agent added to the 15% solution will produce dry foam with the desired expansion ratios of approximately 20:1 (approximately 20 gallons of foam per gallon of aqueous solution). Tim-bor foam should be of a consistency that adheres to wood surfaces, so that the run-off is minimized. Since each foam machine can produce different foams, refer to the equipment manufacturer manuals and the foaming agent's label for the specific instructions.

Troubleshooting / hints

- Warm water will dissolve the *Tim-bor* more readily.
- While 10% solutions are stable true solutions, the 15% solutions are super saturated and may form precipitates if allowed to stand or be stored overnight, or lose water via evaporation.
- You may use a hand paddle or mechanical mixer.
- Oversized containers help prevent careless spills and minimize splashing during mixing.
- Always add the powder to water; adding water to dry powder is not recommended. This tends to form clumps of material that dissolve slowly.

A SIMPLE "GREEN", non-toxic, environmentally-safe, and very effective treatment for mold!

The HygienicAire process is SIMPLE...it works by vaporization of the biodegradable HygienicAire into the indoor air. HygienicAire is completely safe and you can stay in the home building as it works over a period of weeks, although results can become obvious in a few days. So if you have mold or have a musty odor in your indoor air, HygienicAire may be your ticket for improved health for you and your home!

HygienicAire™ Product Use Instructions & Directions

HygienicAire™ has been formulated from a very unique combination of polymers, water, fragrances, stabilizers and Tea Tree Oil the main active ingredient (Melaleuca Alternifolia). Tea Tree Oil has been tested by many Universities and institutes which show that it has the characteristics of being a Fungicide/Biocide/Germicide. Tea Tree oil displays many characteristics other than being a mask of bad odors from cigars, mold, mildew, and other decaying organic matter. HygienicAire™ is derived from a natural resource that is harvested and is renewable. HygienicAire™ is biodegradable.

1. Simply remove the lid of the container. Place in a desired location (out of the reach of children, pets and direct sunlight). HygienicAire™ will evaporate into the air spreading the unique vapors through out the area. If you select to stop the vapor process, simply close the container with ts lid until needed again.

2. At first the fragrance may seem different. You will soon become use to the fresh smelling fragrance in the background. The fragrance is not meant to be overpowering. Just as an indicator that the vaporization of HygienicAire™ is working.

3. Place HygienicAire™ in a moving air supply such as a fan, air conditioner or an open window. Anywhere there is an air supply.

4. Some useful places to use HygienicAire™: where pets sleep or eat, in cars, in bathrooms, next to your computer, under your bed, on top of your refrigerator, where you smoke, on a shelf, in a closet, in the basement, in the RV or camper.

5. It is time to replace the HygienicAire™ container when all that remains is a dark color residue in the bottom of the empty container; this is the emulsion that binds both the Tea Tree oil and water. It is time to replace with a new container of HygienicAire™.

6. HygienicAire™ manufactures larger containers if you wish to use in your restaurant, office, hotel, hospital, nursing home or your home. Please contact your Distributor/Agent for pricing and availability.

7. For thousands of years, the native indigenous people of Australia have used Tea Tree plant and the oil to cure many ailments that cause discomfort and death to humans.

MOLD INSPECTOR LABORATORY INTERNATIONAL
PCI, National Highway, Botong, Lumbangan, Negros Oriental, Philippines
Email address: moldinspector@yahoo.com
Phone: +639213521287
Website: http://www.moldinspector.com

Microbiological Analysis of HygienicAire as Remediator against Mold Growth

I. Abstract

Microbiological analysis was done to determine the efficiency of HygienicAire ™ Mold and Mildew Treatment product against mold growth. Two experimental set – ups were designed for this experiment. The first experimental set – up involved the direct application of HygienicAire™ to a semi - porous surface of wooden closet initially infested with molds. The second set - up involved the assessment of HygienicAire™ effectiveness through vaporization into the indoor air of a moldy drawer.

II. Introduction

HygienicAire™ Mold and Mildew Treatment is specially prepared from steam distillation of the essential tree tea oil of *Melaleuca alternifolia.* This species is exclusive to Australia and native to Northern New South Wales. Research projects have demonstrated that tree oil has a broad range of both antibacterial and antifungal activities. Tea tree oil contains over a hundred components such as monotorpenes, sesquiterpenes and their alcohols. A specific tea tree oil component, terpinen – 4 – ol is present at the highest level and is responsible for most of the antimicrobial and antifungal activities.

III. Objectives

- To determine the effectiveness of HygienicAire™ as an antifungal agent when directly applied to a certain area of a mold – infested wooden cabinet;
- To determine if the musty odor due to presence of molds will be eliminated by HygienicAire™; and
- To determine the antifungal efficiency of vaporization of the biodegradable HygienicAire™ into the indoor air of a mold – infested drawer.

IV. Materials and Methods

A. Direct Surface Contact Efficiency Test

- Two external parallel sides of a drawer with a surface area of 699.77cm^2 infested with molds were tested;

- One side was directly applied with a layer of HygienicAire™ while the another parallel side of the mold – infested drawer was left untreated which served as the control; and

- A one – week observation was done and recorded.

B. Odor Vaporization Efficiency Test

- An uncovered plastic Petri bottom plate was filled with an estimate amount of 20ml HygienicAire™ and was placed inside a mold – infested drawer with surface area of 2, 528.57 cm^2; and

- A one – week observation was done and recorded.

V. Results and Discussion

A. Direct Surface Contact Efficiency Test

Based on the data obtained, direct application of HygienicAire™ yielded a positive result in mold remediation. After the direct wiping off of mold growth with HygienicAire™ on the variable set – up surface, a one – week observation was done on both the control and variable set – ups with the same surface area of 699.77cm^2. It was noted that the mold infestation was totally eliminated and future infestation, within a time – frame of one week, was hindered as well on the variable external side - drawer. Kindly refer to Table A below.

Although the one – week time frame for the experiment was completed, the variable side – drawer had been observed for another five days and still no mold growth was observed.

Therefore, direct application of HygienicAire™ unto a mold – infested surface served as another effective alternative use of HygienicAire™ for combating mold growth due to its immediate response and long – term effect in hindering possible future mold infestation. However, it must be recommended to perform continuous monitoring of the set – up in order to determine how long the antifungal efficiency of HygienicAire™ will last.

Table A. Comparison between control mold – infested surface area [not applied with HygienicAire™] versus variable mold – infested surface area [applied with HygienicAire™].

Days	***Control External Side – Drawer***	***Variable External Side – Drawer***
0 – day ***Nov. 4***	Abundant growth	All mold surface growth was eliminated upon application
1st day ***Nov. 5***	Abundant growth	Negative Growth
2nd day ***Nov. 6***	Abundant growth	Negative Growth
3rd day ***Nov. 7***	Abundant growth	Negative Growth
4th day ***Nov. 8***	Abundant growth	Negative Growth

5th day ***Nov. 9***	Abundant growth	Negative Growth
6th day ***Nov. 10***	Abundant growth	Negative Growth
7th day ***Nov. 11***	Abundant growth	Negative Growth

B. Odor Vaporization Efficiency Test

A coverless Petri plate bottom was filled with an estimated amount of 20 ml HygienicAire™ and was left inside the variable drawer to dissipate while the control drawer was left as is. The surface area of both variable and control drawers is 2, 228.57 cm^2 and were observed to have an approximate 80 - 90% of mold growth on their entire surface area.

Based on the data obtained, it was observed that the vaporization of HygienicAire™ into the indoor air of the mold – infested drawer was effective in minimizing mold growth through time at a slow rate. Kindly refer to Table B. On the 1st and 2nd day, no difference was noted. Mold growth layer started to thin out slowly on the 3rd day at 0.50% out of the entire surface area. The antifungal effect of HygienicAire™ vaporization was observed to take into effect at a gradual phase as noted on the 5th, 6th, 7th, and 8th day wherein a small estimated thinning of mold – surface area was observed to take place at 1.09%, 1.76%, 3.96%, and 5.36%, respectively. However, on the 9th and 10th day, notable mold growth thinning was observed to be 9.19% and 12.25% out of the total surface area, respectively.

Furthermore, the control drawer not subjected to HygienicAire™ vaporization smells musty due to presence of mold growth while the variable drawer's musty smell was counteracted by HygienicAire™ with its minty odor. Thus, HygienicAire™ served as an effective deodorizer.

Therefore, the vaporization antifungal capacity of HygienicAire™ requires sufficient period of time due to its gradual effect to take place. The surface area to be treated, amount of HygienicAire™ to be used, and duration of exposure must be taken into consideration when using HygienicAire™ as an antifungal vaporizer.

Table B. Comparison between the mold – infested variable drawer with vaporizing HygienicAire™ versus the mold – infested control drawer.

Days	***Variable Drawer with Vaporizing HygienicAireTM***	***Percent Thinning of Mold Growth***	***Control Drawer***
0 – day ***Nov. 4***	No reaction	0%	Abundant mold growth
1st day ***Nov. 5***	No reaction	0%	Abundant mold growth
2nd day ***Nov. 6***	No reaction	0%	Abundant mold growth
3rd day	Slight thinning of mold growth – estimated area		Abundant mold growth

Nov. 7	of 6.35 cm x 2 cm	0.50%	
4th day ***Nov. 8***	No difference noted	0.50%	Abundant mold growth
5th day ***Nov. 9***	Greater area of thinning mold growth – estimated area is 8.75 cm x 3.14 cm	1.09%	Abundant mold growth
6th day ***Nov. 10***	Slight progress compared to that of the 5th day – estimated area is 10.86 x 4.10 cm of thinning growth	1.76%	Abundant mold growth
7th day ***Nov. 11***	Notable progress compared to that of the 7th day – estimated area is 20.48 cm x 4.89 cm of thinning growth	3.96%	Abundant mold growth
8th day ***Nov. 12***	Greater area of thinning mold growth – estimated area is 26.67 cm x 5.08 cm	5.36%	Abundant mold growth
9th day ***Nov. 13***	Slight progress compared to that of the 8th day – estimated area is 28.50 x 8.15 cm of thinning growth	9.19%	Abundant mold growth
10th day ***Nov. 14***	Notable progress compared to that of the 9th day – estimated area is 30.48 cm x 10.16 cm of thinning growth	12.25%	Abundant mold growth

VI. Summary and Conclusion

Based on the two types of experiment conducted, it can be concluded that HygienicAire™ as mold and mildew treatment has a varying antifungal effects depending on the type of method it was utilized. Its effectiveness is at the highest level when applied directly unto a mold – infested surface area. It was observed that it could hinder possible future mold growth for a certain period of time and as based on the experiment, the applied surface area showed no fungal growth up to fifteen days of continuous monitoring. However, the definite time of its antifungal extent is not determined due to limited extension time to conduct further experimental monitoring.

On the other hand, the HygienicAire™ vaporization antifungal effect comes second. The vaporization antifungal efficiency was noted to be a slow and gradual process to take place as based on the data obtained. It is likely that using HygienicAire™ as an antifungal vaporizer would take a certain long period of time in order to eliminate mold growth entirely and several factors must also be taken into consideration such as the indoor surface area to be treated, the appropriate amount of HygienicAire™ to be vaporized into the allocated indoor surface area, and the required time of dissipation into the indoor air.

Lastly, HygienicAire™ is proven to be an effective deodorizer as it can counteract the musty odor caused by mold growth.

As a conclusion, HygienicAire™ is a versatile antifungal environmental treatment with a varying rate of efficiency depending on the method of its utilization.

VII. Recommendations

It is further recommended that extended duration of monitoring of both the Direct Surface Contact Efficiency Test and Odor Vaporization Efficiency Test set – ups must be done so as to be able to determine the extent of the HygienicAire™ antifungal effectiveness.

For the direct surface contact efficiency test, extended monitoring of the set – up will determine until when will the HygienicAire™ effectiveness can hinder future mold growth on a surface area which has been initially mold – infested. While for the odor vaporization efficiency test, extended monitoring of the set – up will provide an estimate of the total surface area that will be acted upon by the HygienicAire™ vaporization which will, in turn, determine the efficiency of HygienicAire™ based on the period of time it took to combat mold growth in terms of the affected thinning moldy surface area.

VIII. References:

Diagnostic Test
http://www.edma-ivd.be/labo01.htm

HygienicAire™ Mold & Mildew Treatment
http://www.moldmart.net/hygienic-aire-cleaner.htm

Tree Tea Oil Research Group
http://www.meddent.uwa.edu.au/teatree/#RIRDC_summaries_and_reports

Performed and prepared by:

Ma. Adee Light E. Hilado
Mold Microbiologist
November 17, 2005

Report Available online at: http://www.moldmart.net/hygienicaire-effectiveness-report.htm

Wood destroy organism control

Wood Application procedures

1. Spray

The *Tim-bor* solutions or foam should be applied evenly to wood using a medium to coarse spray at low pressures (20-30 psi). Application rate is 1 gallon per 200 square feet of wood surface area. Ensure that all accessible wood surfaces are thoroughly wetted. Wood will absorb *Tim-bor* solution at different areas. Surfaces that absorb rapidly can be re sprayed immediately.

Troubleshooting / hints

- The best results and penetration will be obtained with temperatures above 55 degrees F. Wood does not take up water as readily at lower temperatures.
- Occasionally, *Tim-bor* solutions may drip or run onto glass surfaces such as windows and doors. After dying, a white residue may appear. This can be easily being removed with warm water and a mild soap solution. DO NOT use window cleaners to clean windows with *Tim-bor residues.*
- Heartwood is more difficult to penetrate with water-based solutions as compared to sapwood. Logs may have knots in them that consist predominantly of heartwood. A white residue may remain in these areas after *Tim-bor* application. This can be removed with a damp cloth.
- *Tim-bor* will not corrode metals normally used in construction. This includes ferrous metals, galvanized metals, screws and nails. *Tim-bor* will not affect electrical wiring either, but it is recommended that applications to wood be performed before wiring is in place. Treated wood can be machined, shaped and glued.

2. Pressure injection

Tim-bor solution and foams can be injected into infested wood. Drill into the infested wood and inject until the liquid or foam runs out of openings, damaged areas or kick holes in the wood. This procedure is not an alternative to spraying, rather should be an addition to spraying when structural timbers are greater than 4 inches thick, and for selected wood destroying organisms

Tim-bor solution can also injected to uninfested wood including wood adjacent to the infested areas. This procedure should also be used for painted or sealed wood. The sprayer or application equipment should be able to maintain 60-75 pounds of pressure. Only liquid solution will penetrate uninfested wood. Refer to the directions below for specifics on drilling and placement of drill holes.

a) Injection holes (typically 7/64 or 1/8 inch in diameter) should be drilled in the area of the suspected infestation. The holes should be drilled in a diamond pattern with the long axis along the grain and the holes spaces every 12 to 16 inches. Holes should be spaced approximately 4 to 6 inches across the grain. (See figure 1) When possible, the wood should be treated one diamond length pattern beyond the immediate area of visible infestation.
b) Drill the holes through the widest dimension available; Drill approximately ¾ the width of the beam. If the widest surface is not accessible, holes can be drilled the narrower surface as in Figure 2. Drill holes approximately 8-10 inches apart.
c) Press and hold the injection tip firmly into each hole and inject solution until run off is observed from other holes, galleries, kick-holes, etc. When injecting solid wood, maintain the injection pressure for 15 to 60 seconds at each hole. Longer times give better penetration.
d) Release the trigger, wait briefly and withdraw the injection tip. Excess solution can be absorbed with paper towels and collected for disposal (ordinary trash).

Troubleshooting / hints

- Injection tips should be brass or other metal and fit snugly into the drilled hole to prevent drippage or sprayback.
- Use short injection tip (approximately 1 inch). This will allow the solution to flow into the drilled wood.

If drilling overhead, be prepared for solution to exit galleries; tarp or cover surfaces below.

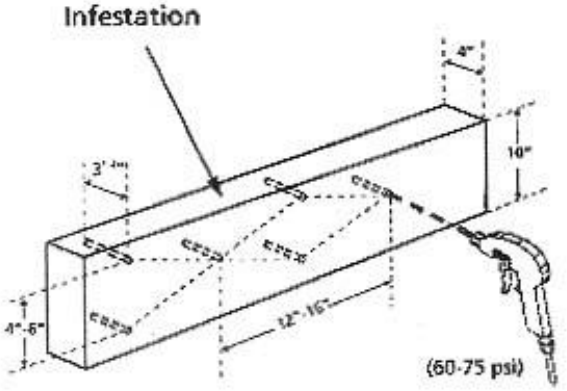


Figure 1: Drill and pressure injection of a 4"x 10" structural beam with Tim-bor solution.

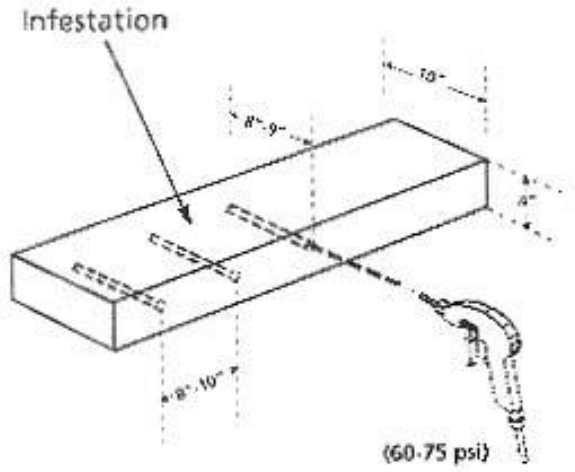


Figure 2: Alternative pressure treatment of a 4" x 10" structural beam.

-

3. Dust

Dust techniques may be used for control of carpenter ants or drywood termites. Any of the standard dusting equipment can be used to perform this application.

Tim-bor treated wood is not palatable to carpenter ants. However, it is sometimes difficult to spray all wood susceptible to attack by carpenter ants. Fortunately, carpenter ants nesting or moving in wall voids can be effectively controlled by dusting wall voids through electrical outlet and switch box access points.

a) Apply approximately ½ ounce of *Tim-bor* dust to all accessible wall voids (or 12-14 grams per sq. ft.). Focus on dusting the lower portions of the wall voids and ant guidelines / accessible such as electrical and plumbing lines. Dust through cracks and crevices and into hidden areas where ants may be entering or colonies may be active.
b) Locate and seal access points on the exterior of the structure by caulking holes and replacing damaged wood. Correct moisture problems.

For control of drywood termites, *Tim-bor* powder may be injected into infested wood or be used to dust attics or areas where drywood termite swarmers may find entrance into a structure. Apply dust by drilling directly into the galleries. *Tim-bor* powder may be applied to wood surfaces and into wall voids as described above by using any of the commercially available dusters on the market.

Troubleshooting / hints

- Use of a MSHA/NIOSH approved dust/mist mask respirator is recommended in confined spaces to prevent irritation during application.
- Dust above and below fireblocks in certain types of wall construction.
- Areas to be dusted should be dry.
- Dusting large open areas for carpenter ants is not recommended since these ants tend to follow specific structural features to enter such as cracks, ridges, utility entrances, ect., rather than open areas.

Table A
The following table describes the best application scheme for the target organism:

Organism	**Application Method**
Fungi	1 spray or foam (10 % or 25%); serious infections, 2 applications 1-24 hours apart or inject *Tim-bor at source.*
Beetles	1 spray or foam (10%-15%)
Subterranean Termites	For remedial use, 2 sprays at 10%, 1-24 hours apart or 1 spray or foam at 15%. When accessible, drill and inject solution directly into wood where galleries are detected.
Formosan Sub. Termites	2 sprays or foam at 15%, 6-24 hrs apart. When accessible, drill and inject solution directly into wood where galleries are detected.
Drywood Termites	For Remedial use, 2 sprays at 10% 1-24 hours apart or 1 spray or foam at 15%. When accessible, drill and inject solution or dust directly into galleries and spray or foam all accessible wood surfaces. Use *Tim-bor* powder as a dust on wood surfaces to prevent re-infestations.
Carpenter Ants	1 spray at 15% to wood will prevent nesting; use of the dust in wall voids along ant entrances or trails will control these pests.
Preventive Application	2 or more sprays at 10% or 15%, 1 hour to 1 year apart. This treatment against wood destroying organisms is intended only as part of an ongoing preventive maintenance and inspection plan.

4. Foam

Tim-bor can be applied as 15% foam. The foam can be applied directly to wood surfaces, injected into infested galleries, applied to joints or cut tends of wood and injected into void areas such as studded and block walls. Foam is not to be used as a soil treatment technique. The foam should be of a consistency that adheres to the wood surface, minimizing runoff. Where possible, place foam between wood joints or abutting surfaces. In wall voids, inject enough foam to contact the wood surfaces of the studs in the wall or the area desired. When using foam to inject into galleries refer to Pressure injection directions.

Specifications for Structural Applications: Remedial and Preventive Treatment

Basement or crawlspace structure

Spray *Tim-bor* solution on all bare wood accessible in the flooring and subfloor. This application will control an infestation even when certain parts of a gallery are not directly sprayed. In addition, steps must be taken to correct moisture problems (leaks, etc.) that may have led to and sustained the infestation.

Attics

Spray *Tim-bor* solutions to all accessible wood: rafters, trusses, top-plates, ceiling, joists, plywood, particle board, etc. Accessible areas with known infestations should be drilled and injected depending on the type of infestations (see Table A). This has been a very effective technique in spot treating for control of drywood termites.

Exterior Wood

Tim-bor can be applied to bare siding, trims or logs. Applications can be made by spray or pressure injections techniques. Painted or sealed wood can be treated by pressure injection or the sealing coat can be removed prior to application. Following treatment, the exterior wood should be sealed to protect *Tim-bor* diffusing out. Wood should be completely dry (at least 48 hrs) before a sealing coat (paint, varnish or waterproofing seal) can be applied. When properly applied, *Tim-bor* will not interfere with application of the sealants. DO NOT apply *Tim-bor* in inclement weather. *Tim-bor* is not recommended to be used on wood in direct contact with soil.

Deck treatment

Tim-bor can be used to treat wood decks. Prepare the deck by removing any dirt, debris or sealants that will interfere with the application and absorption of *Tim-bor.* After the deck has dried (dry to the touch, no standing puddles), 2 applications of 10% or 1 application of 15% *Tim-bor* can then be applied to the wood. Protect any surrounding plants, ornamentals from accidental contact with the solution. Following the treatment, the deck should be allowed to dry before a sealing coat can be applied. Any commercially available sealants, stains or paints can then be applied.

Pre-treatment to wood

New Construction

Spray application of *Tim-bor* solutions may be made to wood during construction. All accessible barewood surfaces should be sprayed including: flooring, subflooring, sill plates, top plates, wall studs, trusses, rafters, roofing, plywood, etc. Application should be performed after framing and roofing are in place and before insulation and drywall are installed. Avoid spraying any electrical component. Protect treated wood from excessive rain.

End Cut Treatment

Certain pressure treated lumber should be treated when cut at a construction site because typical wood preservatives do not penetrate some wood species effectively. Spray, brush or dip the end cuts over a plastic drop cloth to collect any runoff. Spray or brush generously until the wood will accept no more solution. Alternatively, dip each end-cut about 5 minutes.

Estimating Amounts for Application

Tim-bor can be applied to wood as two 10% sprays or one 15% spray depending on the the Infestation (see Table A). Calculating the amount of the *Tim-bor* to be used for a particular treatment is important. Approximately 1 gallon of *Tim-bor* solution will be needed to treat 200 sq. ft. wood area. You should always try to avoid extra, left-over solution, especially if you are using the 15% mixture. The amounts of solution needed will depend on the total square footage of wood to be treated and the technique to be used (100% or 15% spray foam).

There are some predetermined factors which you can use as multipliers for a given situations to calculate the square footage of wood to be treated:

For example, if you had to spray a piece of wood that was 10 feet long and 6 inches wide, one side of the piece of wood will be 5 sq. ft. of wood surface area (10 ft x 0.5 ft. = 5 ft.^{2}). If you spray all four sides once, the total square footage would be 20 ft. ^{2} requiring 0.1 gallons of either 10% or 15% for one application. (Remember, 1 gallon treats 200 sq. ft.). If the target organism (see Table A), requires a second application of 10% sprays then you will need to apply another 0.1 gallon after the required waiting time.

When calculating square footage of wood surface area in a crawl space or basement, you have to consider all the wood preset. The calculations are easily done. First, determine the square footage of the crawl area, by multiplying the length by the width, i.e. a 20 ft. x 40 ft. crawl space is 800 sq. ft. Multiply this by 2.5 and the result is an approximation of the total square footage of wood surface area for all the wood in the crawl space. Therefore, a 20 ft. x 40 ft. crawl area would be 2000 sq. ft. needing 10 gallons of *Tim-bor* solution for one application.

In estimating the amount for a pretreatment, there are many sections to consider: attics, interior walls, exterior walls and flooring. The guideline to use here is to obtain the square footage for the living area of the structure from the builder and multiply by 9. If a crawl space or basement is involved, then use the calculations above and add that number to the amounts calculated here. For example, the structure to be treated will be 2000 sq. ft. and have a 20 ft. x 40 ft. crawl space. Wood surface area is 2000 multiplied by 9, equaling to 18000 sq. ft. Add 2000 sq. ft. for the crawls space to get 20,000 sq. ft. of wood surface to be treated. This is 100 gallons of *Tim-bor* solution per application.

General insect control

Application (interior only)

Tim-bor 15% solutions and powder can be used for the control of cockroaches, ants, silverfish, and earwigs inside structures. *Tim-bor* can not be used for flea control. *Tim-bor* 15% aqueous solution is limited it crack and crevice applications only.

Tim-bor powder can be dusted into wall voids and hiding places such as in cracks and crevices, moist areas, openings around pipes and sinks, under refrigerators, behind baseboards, meter boxes and manholes. No powder visible after application must be brushed into crack and crevices or removed. Apply only in areas inaccessible to children and pets. Avoid contamination of food and feedstuffs. Do not use in serving areas when food is exposed.

Food Handling Areas

Application of *Tim-bor* powder of 15% aqueous solution is limited to crack and crevice treatment in food areas of food handling establishments. Apply *Tim-bor* powder or 15% aqueous solution between different elements of construction, between equipment and floors, openings leading to voids and hollow spaces in walls, equipment legs and bases where insects hide. Care should be taken to avoid depositing the product onto exposed surfaces or introducing the material into the air. Avoid contamination of food and / or food processing surfaces.

Care of Spray Equipment

1. Normal care and maintenance of spray equipment is sufficient.
2. *Tim-bor* solutions are compatible with stainless steel, brass and all plastic components of spray equipment. Solutions should be mixed as needed and drained from equipment. Solutions should be mixed as needed and drained from equipment daily. See advisory on mixing and storing 15% solutions.
3. After use, equipment should be rinsed with clear, warm water if desired to flush any remaining *Tim-bor* from the sprayer. The rinsate can be saved in approximately labeled service containers for the future preparations of *Tim-bor* solutions (in place of fresh water). It is always best to try use up all products on site.

Troubleshooting / hints

- Some solids may form from 10% solutions after prolonged exposure to cold or if water has been allowed to evaporate over an extended period of time resulting in a solution greater than 10%. Bring cold solutions to room temperature and agitate until all solids redissolved.
- Do not use a solution with solids preset; the mixture is not at the required 10% or 15% concentration.
- Under some condition, spray tips may clog due to evaporation. Spray tips can be unclogged by flushing or soaking with warm water.

Safety

1. *Tim-bor* is a light powder and can generate dust. Use of an MSHA/NIOSH approved dust/mist mask respirator is recommended when utilizing *Tim-bor* powder or solutions in confined spaces. Refer to MSDS for specific information.
2. Eye protection (e.g. goggles) should be worn to prevent splashing or dripping of solution into eyes. Waterproof gloves are also recommended when mixing and applying *Tim-bor.*
3. Accidental exposure: Consult the MSDS for more information.
    a. Skin – Wash with mild soap and water.
    b. Eyes – Flush with tepid water for 15 minutes. If the irritation persists, consult a physician.
    c. Inhalation – Remove to fresh air.
    d. Ingestion – Drink plenty of water and contact a physician or poison control center.

Storage

1. *Tim-bor* should be stored in a dry place above ground where children and animals cannot gain access.
2. *Tim-bor* 10% solutions may be stored indefinitely in carefully labeled sealed containers and should be kept from evaporating or freezing. *Tim-bor* 15% solutions are not stable. They should be used immediately and not stored.
3. There is no fire hazard with *Tim-bor* powder or its solutions.

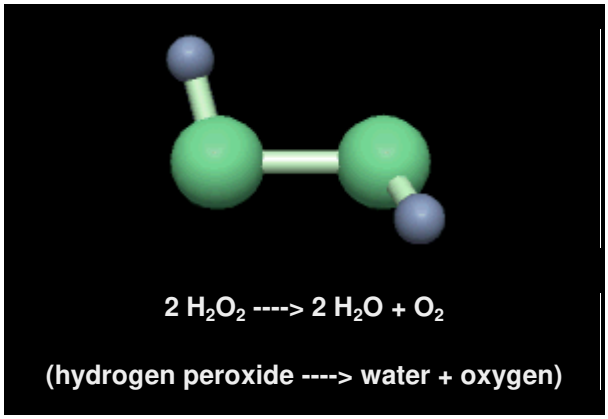
Environmental

Boron is an essential micronutrient for plant life, however, 10% and 15% solutions are concentrated enough to kill or seriously damage foliage.

- Do not carelessly spill or apply *Tim-bor* to croplands, ornamental plants, trees, or lawns.
- Do not apply *Tim-bor* to any body of water. Certain aquatic life forms are very sensitive to excess boron concentrations.

Hydrogen Peroxide: Another Effective and Low-Cost Mold Killer

Please also read the attached Appendix 4, **"Occupational Safety and Health Guideline for Hydrogen Peroxide"** from the U.S. Department of Labor Occupational Safety & Health Administration.



Hydrogen peroxide [H_2O_2] is well-established as an environmentally-friendly deodorizing and disinfectant agent. Its uses include cosmetic applications, household cleaning and disinfecting, killing mold and bacteria, organic and inorganic chemical processing, municipal odor control, and industrial waste treatment (detoxification). There are many more applications for hydrogen peroxide and these uses are continually expanding, making it a necessity not only to understand the mode of hydrogen peroxide application but the safe handling of the chemical as well.

Hydrogen peroxide is very powerful - H_2O_2 is one of the most powerful oxidizers known -- stronger than chlorine, chlorine dioxide, and potassium permanganate. Hydrogen peroxide is safe. Despite its power, H_2O_2 is a natural metabolite [something essential for metabolism] of many organisms, which decompose the H_2O_2 they produce into oxygen and water. H_2O_2 is also formed by the action of sunlight on water -- a natural purification system for our environment. Consequently, H_2O_2 has none of the problems of gaseous release or chemical residues that are associated with other chemical oxidants. And since H_2O_2 is totally miscible with water, the issue of safety is one of concentration. The definition of "miscible" is: Two liquids are miscible if they dissolve completely in each other whatever the proportions of the components. Industrial strength H_2O_2 is a strong oxidizer and as such requires special handling precautions.

Properties and Mold Remediation Uses of Hydrogen Peroxide

A basic understanding of the properties of hydrogen peroxide is essential to its safe handling. Hydrogen peroxide is clear, colorless, and water-like in appearance with a characteristic pungent odor. Usually nonflammable itself, especially if diluted to 8% level or less, it is miscible [completely mixable] with water in all proportions and is sold as a water solution.

Please Note: Hydrogen peroxide in concentrations significantly above 8% by weight in water solution [such as 20% or more] are a strong oxidizer and will initiate or sustain a combustion process quite readily. (Oxidizers are chemicals that release oxygen during a reaction.) If concentrated hydrogen peroxide solution evaporates on a combustible material such as clothing, a fire may result spontaneously, without the need for an ignition source. Hydrogen peroxide was also used as an early rocket fuel oxidizer. Thus, you certainly need to follow all safety precautions in its use in your home or other building!

The amount of hydrogen peroxide in commercial solutions is expressed as a percentage of the solution's weight. Thus, a 35% solution contains 35% hydrogen peroxide and 65% water by weight.

Most municipal and industrial applications call for 35% or 50% concentrations**. Learn all of the possible grades and concentration levels of hydrogen peroxide in attached Appendix 3**.

To kill mold it would be highly-effective [in making a mold killing fungicide] to dilute a 35% solution technical grade commercial solution [explained later] to make the hydrogen peroxide concentration approximately eight percent. **If you cannot find 10% hydrogen peroxide in your community, use 6% to 20% hydrogen peroxide concentration which is readily available at beauty supply stores.**

RECIPE: While wearing eye protection, rubber gloves, and clothing that covers your skin completely, pour one container of 35% solution technical grade hydrogen peroxide solution slowly and carefully into a larger container which contains at least three times as much volume of distilled water to obtain a dilution of approximately eight percent of hydrogen peroxide in water. Where to buy 35% solution technical grade for your use in mold remediation: http://www.h2o2-4u.com/price.html

Although you can use over-the-counter three percent solution [3%] hydrogen peroxide from your drug store or discount store, it has only a 3% percentage of hydrogen peroxide and 97% water by weight. Thus, over the counter hydrogen peroxide is relatively weak in power to kill mold. **RECIPE: You could use the readily-available 3% solution for cleaning and killing small amounts of mold, such as wiping off minor surface mold growth on walls and ceramic tile.**

Solutions containing more than 8% hydrogen peroxide are classified by the U.S. Department of Transportation (DOT) as an oxidizer, requiring special hazardous materials shipping requirements compliance. The US Department of Transportation requires a DOT Oxidizer label on a product container for concentrations of 8 to 52% peroxide (49CFR 172.101).

Storage Safety of Hydrogen Peroxide

Under normal conditions hydrogen peroxide is extremely stable when properly stored.

Decomposition of hydrogen peroxide liberates oxygen and heat. **In dilute solutions the heat evolved is readily absorbed by the water present.** In more concentrated solutions, the heat raises the temperature of the solution and accelerates the decomposition rate. Special stabilizers are added during the manufacture of all grades of hydrogen peroxide to inhibit the catalytic decomposition effect of metals and other impurities that may accidentally contaminate the chemical during shipment, storage, and handling.

However, since no additive will prevent decomposition if excessive contamination occurs, the best practice is to prevent contamination through proper handling. All handling procedures must, therefore, be directed towards maintaining the same degree of purity and freedom from contamination as is maintained during the manufacturing process:

- Storage of hydrogen peroxide should be restricted to its original shipping.
- Hydrogen peroxide that has been removed from the original shipping container should not be returned to it.
- All containers must be properly vented, and preferably stored away from sources of direct heat and combustible materials.
- Adequate ventilation and ample water supply for thorough flushing of accidental spillage on personnel and property should be provided.

Hydrogen peroxide itself will not burn, but its decomposition liberates oxygen which supports combustion. Fires involving hydrogen peroxide are best controlled by using large quantities of water.

Hydrogen peroxide is not considered an explosive. However, when it is mixed with organic substances at significant concentrations, hazardous impact-sensitive compounds may result. Small amounts of other materials that contain catalysts (silver, lead, copper, chromium, mercury, and iron oxide rust) can cause rapid decomposition and an explosive pressure rupture of the containing vessel if it is not properly vented.

In addition to accelerated decomposition through contamination, the decomposition rate of hydrogen peroxide is increased with alkalinity, contact with certain materials of construction, and increasing temperatures. The rate of decomposition increases approximately 2.2 times for each 10 degrees C rise in temperature in the range from 20 degrees C to 100 degrees C, or 1.5 times for each 10 degrees F rise from 68 degrees F to 212 degrees F.

Decreasing temperatures have little effect on hydrogen peroxide until they drop substantially below 0 degrees C. Crystals do not begin to appear in 35% and 50% solutions until -33C (-27.4F) and -52.2C (-62F), respectively.

Eye Protection

Hydrogen peroxide and its decomposition products are not systematic poisons but contact with hydrogen peroxide can be irritating. Concentrated vapors cause discomfort in the mucous membranes and the eyes. Contact of the eyes with hydrogen peroxide is particularly dangerous because corneal burns can occur very rapidly. Therefore, safety glasses or, preferably, goggles should always be worn when handling concentrated hydrogen peroxide. If, however, any hydrogen peroxide does get in the eyes, flush eyes thoroughly with water and consult a physician promptly.

Protective Clothing

In addition to eye protection, rubber gloves and suitable protective clothing such as aprons or coveralls made of polyester acrylic fiber, polyvinyl chloride, polyethylene, or neoprene should be worn when handling concentrated hydrogen peroxide. Protective clothing, which lacks fire resistance, must be washed thoroughly with water should it come in contact with hydrogen peroxide. If allowed to dry in the fabric, the chemical may cause fire, particularly if the clothing is soiled.

Contact with moderate concentrations of hydrogen peroxide will cause whitening of the skin and stinging sensations. The whitening is due to the formation of gas bubbles in the epidermal layer of the skin. The stinging, in most cases, subsides quickly after thorough washing, and the skin gradually returns to normal without any damage. Highly concentrated hydrogen peroxide can cause blistering if left on skin surfaces for any length of time.

Inhalation of hydrogen peroxide vapors can cause irritation and inflammation of the respiratory tract. For this reason., The American Conference of Government Industrial Hygienists has determined a Threshold Limit Value (LTV) or 1 ppm (1.4mg/m3) of hydrogen peroxide vapor in air as a maximum exposure limit for any eight-hour workday of a normal 40-hour work week. If hydrogen peroxide vapor is inhaled, fresh air should be sought at once; if the inhalation has been prolonged, a physician should be consulted immediately.

Accidental Swallowing

Hydrogen peroxide, a mild disinfectant, is useful in counteracting various microorganisms. Because of their antiseptic action, dilute hydrogen peroxide solutions (3% or less) are frequently used to treat open wounds and can be used as a gargle or mouthwash. However, contact or concentrated solutions (over 3%) with the members of the mouth is to be avoided. Under no circumstances should hydrogen peroxide be taken internally. If hydrogen peroxide is swallowed, drink water immediately to dilute, and contact a physician but do not attempt to cause vomiting.

In using hydrogen peroxide, safety should be first in the minds of everyone, and as with any other chemical, initial steps should be taken to familiarize all personnel with its safe and proper handling. Acceptance of hydrogen peroxide in a wide variety of industrial applications is a reflection of its simplicity in use.

Maximum safety in handling hydrogen peroxide is assured through the use of proper materials of construction, recognition of the need for venting in storage, and overall avoidance of contamination. The oxygen and water by-products of decomposition are innocuous, but splashing, inhaling vapor, and ingesting hydrogen peroxide must be avoided. If by unusual circumstances an accident should take place, flushing with large quantities of plain water is the simple corrective action needed. By adhering to straight-forward common sense procedures, every aspect of your operation will be aimed toward safety and a clean environment.

Benzalkonium Chloride, 50% solution

Another effective and affordable mold killer is Benzalkonium chloride. Benzalkonium chloride is part of the family of "quats"---a nickname for disinfectants based on quarternary ammoniums of one type or another. The following information on Benzalkonium chloride was written by the U.S. Environmental Protection Agency's National Antimicrobial Information Network.

Benzalkonium Chloride [Scientific name: *Alkyldimethylbenzylammonium chloride*]

Benzalkonium chloride is an antimicrobial pesticide introduced to the United States in 1935. It is used widely in medical and domestic settings. Benzalkonium chloride belongs to a group of chemicals known as quaternary ammoniums or "quats". Although treated as a single chemical, Benzalkonium chloride consists of a mixture of quarternary ammonium chlorides with varying carbon chain lengths.

What are the uses of Benzalkonium chloride?

Products containing Benzalkonium chloride that claim antimicrobial activity are regulated by the U.S. E.P.A. Benzalkonium chloride inhibits or kills many bacteria, viruses, fungi, molds, mildews, and algae. Its uses range form sanitization to low-level disinfection of surfaces, materials, humidifiers, toilet bowls, swimming pools, vehicles, air, water pipes, industrial water and other sites. High level disinfection is achieved when used in conjunction with other quats or alcohols. Benzalkonium chloride is also used as a pharmaceutical in spermicides, post-operation wound care products, eye drops, and most recently mouth washes and toothpastes.

What are the advantages of Benzalkonium chloride?

Benzalkonium chloride is economical t use, has low acute toxicity when diluted properly, is useful on a variety of sites from fabrics to hard surfaces, and is effective against a wide variety of microorganisms.

What are the disadvantages of Benzalkonium chloride?

Benzalkonium chloride's effectiveness is limited by the presence of organic matter (dirt, blood, excrement) as well as soap and hard water. It may be neutralized or absorbed by some materials and fibers, including cotton and wool. Long term (chronic) use can lead to allergic responses in some individuals.

How does Benzalkonium chloride work?

Benzalkonium acts by disrupting the cell wall of disease-causing bacteria. A similar mechanism is assumed to affect the outer coating of viruses and other microorganisms. Prior to use, surfaces must be thoroughly cleaned of dirt and grime. Typical directions instruct the user to spray the solution,

wetting the surface thoroughly, waiting for the appropriate amount of time and rinsing or allow to air dry. However, directions are specific to every product and should be followed carefully.

How effective is Benzalkonium chloride?

Benzalkonium chloride, when used alone, acts as a low-level disinfectant. It is capable of inactivating viruses and killing bacteria, fungi, algae, molds and mildews. When formulated with ethanol, isopropanol, various quaternary ammoniums, or other specific chemicals, it can be an effective high-level disinfectant.

How toxic is Benzalkonium chloride?

Benzalkonium chloride is classified as moderately toxic (EPA Class II). Benzalkonium chloride poses minimal risk to dogs when used at proper dilutions.

With proper use, the risk of individual harm from Benzalkonium chloride is extremely low. Common used dilutions [0.1% to 0.5%] can cause temporary irritation and discomfort to the eyes, nose, and throat. There is evidence of the development of allergic responses, as well as occupational asthma, with chronic use. With repetitive use, it may sometimes cause skin irritation. Highly concentrated Benzalkonium chloride [10% or greater] is moderately toxic. Between one and six teaspoons is lethal for a 150 lb. person. Deaths have occurred after accidental ingestion or intravenous injection of concentrated solutions of 10% to 15%.

Where to buy Benzalkonium chloride?

Because Benzalkonium chloride is commonly recommended by allergy doctors to their patients for cleaning the patients' homes of allergens, Benzalkonium chloride is often carried in a diluted, ready-to-use mixture by drug stores. Ask your pharmacist.

Natural, Non-Commercial Mold Removal Recipes

Mildew and molds can grow anywhere there is moisture, dirt and heat. They especially like warm, dark areas, such as bathrooms, closets, basements, and crawl spaces. You can find mildew on draperies, bed linens, clothes, shoes, books, furniture and the exterior siding of your home. It can not fabrics and discolor walls and wood surfaces if it is allowed to continue to grow. Signs of a moisture problem include musty odors in the home, as well as characteristics black, gray, white or even pink splotches on your walls, furniture, bathroom tile or clothes.

- Any kind of mold can make you sick. More information about "toxic molds."
- All molds may be allergenic, whether alive or dead
- Testing for mold is usually not feasible
- You can't compare it to guidelines; there aren't any.

How to Prevent and Control Mildew

- Keep your home, furnishings and fabrics dry and clean.
- Prevent the flow of moisture around and through the home.
- Provide good ventilation in and around the home (crawlspace ventilation information)

MILDEW CONTROL CHECKLIST

	Air conditioner or dehumidifier is used when relative humidity is above 60%.
	Sheets of polyethylene have been installed over 80% of the crawlspace. (If it's an existing home, watch for signs of excess drying and wood shrinkage.)
	Foundation vents are kept open to provide cross ventilation.
	Ventilate the attic. Continuous soft-fit and ridge vents in combination are recommended.
	Ventilating fans, vented to the outside, are used in the kitchen and bathroom.
	Gas heaters and gas logs are vented to the outside using an approved flue.
	Clothes dryers are vented to the outside of the house. Damp clothes and linens are hung to dry, not left around damp or wet.
	Home and clothes are kept clean. (Remember that mildew begins on dirt).
	Wet shower curtains are stretched out after every shower.
	Moisture-absorbing materials are used during times of high humidity. Some examples are silica gel, activated charcoal, calcium chloride, and kitty litter.
	A low-wattage light bulb is kept on in closets to dry out the area.
	Heating system is turned on when the humidity is very high.
	Leather goods are waxed.
	Shrubs that grow close to the foundation are trimmed so that there is 1 foot of air space around the house.
	Mildew is cleaned from any exterior area of the house before repainting.

How to Remove Mildew

Moisture control is the key to mold control. It is important to dry water damaged areas and items within 24-48 hours to prevent mold growth. If mold should be a problem in your home, you will need to clean up the mold and get rid of the excess water or moisture. Fix any leaky plumbing or other sources of water. Wash mold off hard surfaces with detergent and water. Rinse the area with clean water and collect excess rinse water. Dry the entire area as quickly as possible. After cleaning has removed all visible molds and other soiling from the contaminated surfaces, a disinfectant may be used to kill the mold missed by the initial cleaning. The disinfectant is made from mixing ¼ to ½ cup bleach per gallon of water and applying to the surfaces where the mold sprayer, sponged on, or applied by other methods. Collect any run-off of bleach solution with a wet/dry vacuum, sponge or mop. Do not rinse the area where the bleach solution was applied. In other cases, you may want to use detergent, ammonia, white vinegar, washing soda or some combination of these ingredients. **CAUTION: Never mix liquid chlorine bleach and ammonia. This can produce toxic fumes.**

There are a number of excellent commercial mildew removal products on the market. Many of these products come with a spray nozzle which makes them easy to apply. They cost more than homemade mildew removers, but sometimes work faster. If you use a commercial mildew remover, follow the directories on the container.

TAKE STEPS TO PROTECT YOURSELF

Whether you use a commercial or a homemade mildew remover, make sure you have plenty of ventilation. Raise a window or use an exhaust fan. To further protect yourself and minimize your exposure, use rubber gloves, eye goggles, outer clothing (long sleeves and long pants) that can be easily removed in the work area and laundered or discarded, and a medium-efficiency or high-efficiency dust mask.

COMMON MILDEW CLEANING SOLUTIONS

Interior Wood Surfaces. Make a solution of 8 to 10 tablespoons of washing soda and 1 gallon water. Scrub the mildewed surface using a soft-bristled brush. Then rinse with clear water and dry. This solution can be used on most painted or stained wood surfaces. If the mildew has grown under the paint or varnish, it may be necessary to use an abrasive cleaner to scrub the wood. After scrubbing, use the solution above adding 1 cup of chlorine bleach to the solution. Then rinse well with water. Dry thoroughly as quickly as possible. Apply a wood preservative before repainting.

Exterior Wood Siding. Prepare a solution of 3 quarts warm water, 1 quart chlorine bleach, 1 ounce detergent and 3 ounces trisodium phosphate (TSP). if you cannot find TSP at a paint pt hardware store, substitute 4-6 tablespoons of powdered laundry detergent. Use a long-handled brush to scrub the surface, and then rinse with a garden hose. The solution can also be applied with a garden sprayer.

Ceramic Tile. Wash with a solution of ½ cup ammonia, ½ cup white vinegar, ¼ cup washing soda, abd 1 gallon warm water. Rinse thoroughly. For heavy mildew stains, make a paste of baking soda and liquid chlorine bleach, then scrub with a small toothbrush. If the grout is badly stained, apply pure bleach with a cotton-tipped swab. Allow the bleach to remain on the tile for 30 minutes, then rinse and dry.

To prevent reappearance, apply a coat of silicon wax or a good liquid car wax to the tile. Do not wax floors in shower or bathrooms as it may cause dangerous slipping. Transparent silicone waterproofing intended for waterproofing masonry walls may be applied to grout using an artist's paint brush. This will prevent mildew from reoccurring in the grout.

Washable Apparel. First, take the clothing outdoors and brush off the mildew. Then apply a detergent to the stain and launder. If the stain remains and the fabric may be bleached in chlorine bleach, soak it in a solution of ¼ cup liquid chlorine bleach and ¾ cup water. Rinse and then launder. Instead of bleach, you can use salt and lemon juice and let the fabric dry in direct sunlight. Do not use

bleach on silk, wool, or when stated on the label that it is not safe. Test garments in a seam or the hem for colorfastness if you are unsure.

Leather Goods. Make a diluted alcohol solution by mixing one cup of denatured alcohol with 1 cup of water. Using a cloth dampened with this solution, wipe mildew off leather. Dry in a current of air. If mildew remains, clean with thick suds of mild soap, saddle soap, or a soap containing a fungicide or germicide. Wipe the suds off with a damp cloth and dry in an airy place. Polish leather with a good wax dressing.

Mildew Stains and Odor from a Rug. A musty odor often indicates mildew in a rug or carpet. Take a rug outside if possible. Brush with a broom or use a vacuum cleaner. Empty or change the vacuum cleaner bag immediately to prevent growth of the mold in the cleaner. Sun and air the rug outdoors. If not possible, use an electric heater and a fan to air and dry it. If the mildew remains, sponge the rug with thick suds of detergent or rug shampoo. Rinse with a sponge dampened in clean water. Dry thoroughly.

Room Heating/Cooling Equipment. Install advanced 3M brand Filtrete (purple packaging) with this highest 3M rating for mold spore removal. 3M has three different heating/cooling filters available at stores like lumber stores, Home Depot, and Lowe's. Tape the filters (if not the exact size required) or otherwise install them in or over the return air supply ducts (wherein air from your home returns to the heating/cooling system for more heating or cooling treatment), and the outward air flowing duct registers in each room.

More How to Remove Mold & Mildew Recipes

WARNING: It should be remembered that any chemical can be very dangerous when used or handled improperly. For this reason, the publisher of these formulas IS NOT responsible for any mishaps associated with these formulas. THEY ARE OFFERED AS INFORMATION ONLY!

BORAX/ VINEGAR MOLD KILLER SOLUTION

To remove mold and mildew from bathtubs, bathroom curtains and tile, make a mixture of: ½ cup vinegar; ½ cup of Borax cleaning detergent; and 2 cups of water. Pour it on the dirty areas and let it sit for a few minutes, and then scrub with a cloth. If mildew is still visible, use the mixture twice. To clean the toilet bowl, combine equal parts of baking soda, Borax cleaning detergent and white vinegar. Pour generously around the bowl and scrub with a brush. Or leave it over night if badly stained.

Mildew Removers

- Scrub mildew spots with borax/water solution (1/2 C. borax to 1 gallon water) using a nylon scouring pad. To prevent mold or mildew from forming, don't rinse of the borax.
- Scrub with a vinegar and salt paste.
- If you have major problems, the best solution is heat. Applying heat to an area will kill mold and mildew.
- 5% vinegar will kill 82% of all molds.
- Sodium borate, borax, salt and lime will kill all mold, but they also may kill plants.

TEA TREE TREASURE

The following easy-to-follow, natural mold killer spray is tested to offer successful mold remediation effect on moldy ceiling from a leaking roof, on a musty bureau, a musty rug, and a moldy shower curtain. Tea tree oil is expensive, but a little goes a very long way. Note that the smell of tea tree oil is very strong, but it will dissipate in a few days.

Ingredients:
2 tsp. tea tree oil
2 cups water

Combine in a spray bottle, shake to blend, and spray on problem areas. Do not rinse. This recipe makes 2 cups and the preparation will take less than a minute.

STRAIGHT VINEGAR SPRAY

Straight vinegar reportedly kills 82% of mold. Pour some white distilled vinegar straight into a spray bottle, spray on the moldy area, and let set without rinsing if you can put up with the smell. It will dissipate in a few hours. You can also use Hydrogen peroxide, Fels Naptha, and Castile Soap to remove stains.

NATURAL CLEANING RECIPES

You can also use the following natural housecleaning recipes from Annie Berthold-Bond's book, *Clean & Green* [available at the Bastyr Dispensary]. You can also create your preferred scent of the recipes by adding a few drops of an essential oil or a few drops of scented pure castile soap.

General All-Purpose Fantastic Cleaner
1 tsp. Borax
½ tsp. washing soda
2 tbps. vinegar or lemon juice
¼ to ½ tsp. vegetable-oil-based liquid soap
2 cups of very hot tap water
spray bottle

Combine the Borax, washing soda, vinegar, and liquid soap in a spray bottle. Add very hot tap water, shaking the bottle gently until the minerals have dissolved. Spray onto the area to be cleaned and wipe off with a sponge, rag or cellulose sponge cloth.

Vinegar Mold Killer
What you need is full-strength white vinegar. Saturate a sponge with vinegar and scrub the moldy area. Rinse well.

Undiluted Ethyl Alcohol as Mold Killer
Apply full-strength undiluted ethyl alcohol (bought over the counter at drug stores) to the stained area.

Another Mold Cleaner: Citrus Seed Extract
20 drops citrus seed extract
2 cups water, spray bottle

The advantage of using citrus seed extract instead of tea tree oil for killing mold is that it is odorless. Combine the citrus seed extract and water in a spray bottle, shake to blend, and apply to problem areas. Do not rinse. Leave in bottle – it has a long shelf-life.

Borax Disinfectant and Mold Killer
1 tsp. to ¼ cup borax, up to 2 cups hot tap water

Place the Borax in a container and dissolve completely in hot tap water. Saturate a sponge with the mixture and wash the moldy area. If the infestation is severe, use an even higher concentration of Borax and/or leave the solution on for a few hours or overnight, then rinse well. The more Borax, the more residues to rinse off, but Borax really works. This can even be used to clean plaster walls that have been penetrated by mold by using an almost straight Borax paste. Leave the Borax on the walls for a number of days and when it is completely dry, and vacuum up the powder.

Mold Home Remedy in One's Body
Here is a quoted home remedy submitted by one of our website readers:

"I had and I still have the mold in my system pretty bad. And wanted to let you know when I first began to clean it out of my system (after I was out of the apartment), I drank and am currently drinking approximately ½ gallon of water per day, and the herb "milk-thistle extract" made a huge difference in initially helping to break up the mold and start to clean it out. In fact, every time I do a clean out, it makes me sick because there is still so much of it in my system. You can get the milk thistle from Wal-Mart and it is relatively inexpensive – about $6 for ninety pills."

Another reader (a visitor of the mold website http://www.moldinspector.com) suggested the following information.

"How are you guys doing today? My name is Leni, and I just wanted to share some information with you about Stachybotrys. I had that type of mold in a town home that I lived in for about 3 years. I was getting sick for more apparent reason, and finally after residing there for about a year and a half in the mold infestation, I went online to research how to detoxify it from my body, and not one website informed me how to do that. So I just wanted to let you know what I did so you could add it to your site to let everyone know, that their symptoms can most of the time be cured. (Some people, I would assume have irreversible health issues due to the fact that they resided wherever the mold was present, they are less allergic to the spores etc). This info is by no means professional, even doctors don't that much about it.

1. I drink and continue to drink ½ to 1 gallon of purified water per day. I have been drinking that way for about a year and a half and would suggest up to 2 years to totally detox it because the mold spores are sticky and will stay in areas of your body with bad circulation like your head, hands and feet for years, and then cause problems years later!

2. I took milk thistle extract (2 capsules) a day and still take them. Get the milk thistle from any vitamin section of any stores; I got mine from Wal-Mart for about $5-$9 per bottle. Please consult a physician before doing anything and that includes taking the milk thistle extract to make sure you are not allergic to it. It's an herb, but you know how some people are allergic to anything they come in contact with!

3. Sweat as much as possible, this is very important. I went in the steamroom at the gym and the sauna, as much as was healthy and safe, basically work out as much as possible and try to sweat, as much as you can. However, do not over work yourself.

Thank you for your time!

Appendix I

New Study Proves Chlorine Bleach Kills Household Mold, Neutralizes Mold Allergens (but only on hard surfaces)

By: University of Arizona News Services, March 24, 2004

Today at the American Academy of Allergy, Asthma & Immunology's (AAAAI) 60th Annual meeting, Kelly Reynolds, a research scientist at the University of Arizona, announced the results of a new study that proves, for the first time, a chlorine bleach solution not only effectively kills mold but also neutralizes the indoor mold allergen. The study, funded by a grant from The Clorox Company, also found mold spores, a common trigger for allergies in America, to be present in 100% of the homes surveyed.

When sensitive individuals are exposed to allergens, such as mold spores, by either direct contact or inhalation, allergy and asthma symptoms may result. Some of these symptoms may include sinus congestion, coughing, upper respiratory distress, chronic headaches and flu-like symptoms. In fact, mold spores are suspected in the tripling of the asthma rate in the past 20 years and have been blamed by a 1999 Mayo Clinic Study for nearly all of the chronic sinus infections afflicting 37 million Americans.

The primary cause of allergic responses from exposure to mold can be attributed to surface allergens. These allergens become a problem when they become airborne and contaminate indoor air quality. The study found that low concentrations of chloride bleach, such as those common to commercial household products certified to kill mold and mildew, were proven to be effective at not only killing the mold spores, but also denaturing, or neutralizing, the surface allergen, making it essentially unable to produce an immune response in sensitive individuals.

"Renaming fragments of dead mold can linger indoors long after the mold spores have been inactivated, and can be as harmful as live mold," said Kelly Reynolds, lead investigator for the study from the University of Arizona. **"The study results confirm that denaturing the mold spores with a dilute chlorine bleach solution appears to be the most effective and efficient way to reduce mold allergen on hard surfaces."** [**Please note**: The Certified Mold Inspectors & Contractors Institute explains that a hard surface would be something like a kitchen counter top or ceramic floor and wall tiles. Almost any household disinfectant can kill mold sitting on hard surfaces. The problem is mold growth in porous building materials like wood timbers, drywall, chip board, plywood, furniture, and carpeting/padding].

Molds can be classified as either the mycotoxin producing molds such as Penicillium and Stachybotrys and the non-toxic molds such as Trichophyton. While to toxicities differ, all mold spores contain allergens, which according to the Asthma and Allergy Foundation of America (AAFA), can aggravate symptoms of both allergies and asthma.

The University of Arizona study yielded 1, 330 mold samples and evaluated the growth rate and distribution of household mold on indoor surfaces in 160 homes in seven geographical regions. The regions where sites were frequently positive for fungal counts include the far west (San Francisco), Southwest (Tucson, Dallas), Midwest (Chicago), Southeast (Atlanta, Tampa, Fla), abd Northeast (New York) regions of the United States.

The study, which also looked at consumer perceptions towards mold, demonstrated that mold is far more pervasive in the home than people believe. While consumers understand that mold is a health concern, they are confused with the extent of the problem in their homes, with just 17 percent believing mold is an issue inside their own homes. Significant confusion also exists with the best way to effectively treat the issue.

The abstract for this study, "Efficacy of Sodium Hypochlorite Disinfectant on the Viability and Allergenic Properties of Household Mold," (abstract 617) was published in the February issue of the Journal of Allergy & Clinical Immunology.

Contact Information
Kelly Reynolds
University of Arizona
(520) 626-2309
reynolds@u.arizona.edu

Adrienne Hymes Adrienne.hymes@pr21.com
CLOROX Company (310) 566-2292

Appendix 2

Mold spores and organic dirt and dust landing on exterior siding, roofs, and concrete/brick/block/masonry surfaces enable mold to grow on those surfaces. Read the helpful how-to article below about pressure washing, which if done on a routine maintenance basis, can get rid of the build up of mold spores, mold growth, and organic dirt and dust.

Prevent building damage with pressure washing

By: Bill Griffin, cmmonline.com, June 1, 2004

All building surfaces will deteriorate and require maintenance overtime to prevent premature failure and internal damage. Pollutants from industry, the atmosphere and combustion have increased the need to maintain the building envelope.

Regular cleaning and maintenance not only enhances the appearance of a building and prevents the damage, but it also helps in delaying the need for expensive and time-consuming restoration, repair or replacement of building materials.

Pressure Washing It Clean

Many contractors use high or low pressure washing systems to clean building exteriors. The system is effective on a wide variety of surfaces and quite productive, which helps reduce high labor costs associated with other manual cleaning processes.

Most contractors agree that pressure-washing systems are more efficient at cleaning brick, stone and concrete exteriors.

In many cases, high-pressure water without any special cleaning materials will successfully clean masonry surfaces.

High-pressure cleaning may be used on most hard, textured clay brick – this includes reds, buffs, grays and other through-the-body colors.

However, it is safest to keep pressure well below 1000 PSI when cleaning buffs, grays, etc., since these colors are more susceptible to mineral oxidation, which could be aggravated by excessively deep penetration of water.

High-pressure water cleaning can damage soft brick or stone and erode mortar joints: Keep the pressure low and the nozzle tip a safe distance from the surface to avoid damage.

Basic Pressure Washing Procedure in II Steps:

1. Inspect the structure and surface for needed repairs, special cautions or treatment prior to cleaning.
2. Tape with plastic adjacent metal, glass, wood, etc. surfaces as required to prevent damage or exposure to harsh chemicals.
3. Test clean an area and let it dry before inspection, approval and proceeding.
4. Pre-wet/saturate the masonry surface with water before cleaning. This includes all immediate areas to be cleaned, as well as areas below and adjacent to the area being cleaned.
5. When cleaning soft brick, be sure to soak the surface heavily with water before applying a cleaning solution. Use a surfactant cleanser so that the cleaning chemical will stay on the surface of the brick and remove the soil.
6. Mix the cleaning solution. Use the concentration level that is recommended by the manufacturer.

7. Once the surface is completely saturated with water, apply the cleaning solution starting at the top of the wall or area. Cleaning solutions may be applied effectively and safely by brush or a low-pressure sprayer (maximum 40 PSI).
8. Let the cleaning solution dwell on the surface for 5 to 10 minutes or as directed on product label. Agitation with a brush may be needed.
9. Rinse the surface with high pressure water from top to bottom so all dissolved soil and particles will be completely flushed from the surface.
10. Inspect your work and redo as needed or proceed as appropriate.
11. Remove tape and plastic from windows, wood and metal areas, shrubbery and adjacent areas.

Bill Griffin is the President, Cleaning Consultant Services, Inc., Seattle.

Appendix 3

Hydrogen Peroxide Grades

3% Hydrogen Peroxide (Drug/Grocery Store Variety)
Used as antimicrobial agent for treating wounds and sanitizing agent
[Made from 50% Super D Peroxide, Diluted. Contains stabilizers - phenol, acetanilide, sodium stanate, tetrasodium phosphate among them.]
[This peroxide contains known chemicals do not ingest!]

6% Hydrogen Peroxide
Used by Beauticians for Coloring Hair. Used as sanitizing agent.
Comes in strengths labeled 10,20,40 volume. Must have activator added to be used as a bleach.
[Contains stabilizers, additives, and impurities dependent on manufacturing and dilution process. Do not ingest.]

30% Re-Agent Hydrogen Peroxide
Used in medical research.
[Contains stabilizers, additives, and impurities dependent on manufacturing and dilution process. Do not ingest.]

30-32% Electronic Grade Hydrogen Peroxide
Used for washing transistors and integrated chip parts before assembly.
[Contains stabilizers, additives, and impurities dependent on manufacturing and dilution process. Do not ingest.]

35% Food Grade Hydrogen Peroxide (Also 50% Food Grade H2O2)
Used in food products like cheese, eggs, whey products. Also used to spray inside of foil lined containers for food storage - known as the aseptic packaging system. Used for the disinfection of potable water. Also used (diluted) to disinfect, kill bacteria, sanitize wounds and introduce oxygen into the body. Eg. bathing, gargle, toothpaste, treat drinking water, etc. [Contains stabilizers, additives, and impurities dependent on manufacturing and dilution process].

35% Technical Grade Hydrogen Peroxide **What you should buy to dilute for mold remediation.**
Used for waste water treatment and the disinfection of potable water, cosmetics, and laundry applications. Also used (diluted) to disinfect, kill bacteria, sanitize wounds and introduce oxygen into the body. Eg. bathing, gargle, toothpaste, treat drinking water, etc.[May contain a small amount of phosphorus to neutralize any chlorine in the water it is combined with.]

35% Standard Grade Hydrogen Peroxide (Also 50%, 60%, 70% Standard Grades)
Used mainly for bleaching in the pulp and paper industry and in the textile industry; oxidation reactions in the chemical industry; environmental processes (detoxification and deodorization). Used for Waste water treatment. [Contains stabilizers, additives, and impurities. Do not ingest.]

90% Hydrogen Peroxide
Used by the military as a source of Oxygen at Cape Canaveral. Used as a propulsion source in rocket fuel.

99.6% Hydrogen Peroxide
This was first made in 1954 as an experiment to see how pure a hydrogen peroxide could be manufactured.

Appendix 4

Use of Baking Soda as a Fungicide

By George Kuepper, Raeven Thomas,
and Richard Earles
NCAT Agriculture Specialists

ATTRA Publication #IP130/102

Abstract

There has been considerable interest in the use of baking soda (sodium bicarbonate, $NaHCO_3$) and potassium bicarbonate ($KHCO_3$) to control powdery mildew and other fungal diseases of plants. This publication provides a brief survey of observations, research, and recommendations on the use of bicarbonates in horticulture.

The use of baking soda as a fungicide is not a new idea. In Alfred C. Hottes' *A Little Book of Climbing Plants*, published in 1933 by the A.T. De La Mare Co. of New York, mention is made of using one ounce of baking soda per gallon of water to control powdery mildew (PM) on climbing roses. The author credits the idea to a Russian plant pathologist, A. de Yaczenski.(1)

In the August, 1985 issue of *Organic Gardening* magazine, a short article by Warren Shultz entitled "Recipe for Resistance" reports that researchers in Japan obtained effective control of PM on cucumbers, eggplants, and strawberries. They suggested weekly sprays of ¼ ounce baking soda per gallon of water.(2)

An article in the June, 1990 issue of *Greenhouse Manager* magazine summarizes the results of three years of testing baking soda as a fungicide for roses. Cornell University researcher Dr. R. Kenneth Horst observed suppression of PM and blackspot—both major problems for New York rose growers. Roses were sprayed every 3 to 4 days with a water solution of baking soda and insecticidal soap. The latter was included for its surfactant qualities. (Surfactants are chemical agents that alter the surface properties of a liquid.) The soap improved the effectiveness of the bicarbonate by making it stick to, and spread evenly over, the leaf surface. Further experimentation proved that the insecticidal soap itself was not responsible for suppressing the diseases. While no specific concentration of baking soda is indicated as being most effective in PM suppression, the article states that a 0.5% solution was most effective in preventing blackspot.(3)

Some of the work at Cornell has focused on controlling fungal diseases on cucurbits.(4) A single spray application (to runoff) of 0.5% (wt./vol. of water) baking soda, plus 0.5% (vol./vol. of water) SunSpray UFP® horticultural oil almost completely inhibited PM on heavily infected pumpkin foliage. Baking soda **without** spray oil was ineffective, and a 2% (wt./vol. of water) solution of baking soda damaged the leaves. Baking soda/oil sprays also provided good control of urocladium leaf spot in cucumber, alternaria leaf blight in muskmelon, and gummy stem blight in muskmelon.(5) Other diseases against which baking soda may prove effective include anthracnose in cucurbits (6); rust, dollar spot, and pythium blight in turf; late blight in potato; rust in wheat; and diseases affecting peanuts, banana, and alfalfa.(7)

Researchers in Israel reported the successful use of baking soda and SunSpray oil in controlling PM on euonymus.(8) In this research a 2% baking soda and 1% oil solution proved most effective.(9)

On-farm observations on melon acreage in Virginia resulted in one farm operation switching from synthetic fungicides to a baking soda/oil spray. These growers incorporated a liquid fertilizer into the mix.(10)

Research in Germany evaluated baking soda as a control for PM on `Bacchus' grapes. Three spray applications were made, beginning when symptoms first appeared. Good control was achieved with no loss of grape quality. The optimum concentration was a 1% solution.(11)

An article in the February, 1996 issue of *GrowerTalks* magazine follows up on the continuing research at Cornell. Testing with a variety of bicarbonates revealed that selecting the correct bicarbonate for a particular disease is important. Dr. Horst's research team found that ammonium bicarbonate had the strongest effect on some diseases, while potassium and sodium bicarbonates worked best against others. Potassium bicarbonate provided the best control of PM. "Sodium bicarbonate is okay, but it's not as good," Horst is quoted as saying. "And ammonium bicarbonate doesn't do the job on powdery mildew." He points out that while conventional chemical controls for PM are preventatives only, bicarbonates can eliminate the disease after it has already appeared on certain crops—he mentions roses and an unspecified ornamental—provided the infection is not severe. The only plant damage associated with bicarbonates applied in the trials was foliar burning when application rates exceeded recommended concentrations. Testing established that sodium bicarbonate does not increase the levels of sodium in plant tissues, soil, or runoff water. While their precise mode of action against fungi is not understood, Horst states that bicarbonates seem to damage the cell wall membrane in PM spores. He also believes pH to be a factor in bicarbonate effectiveness. In any case, bicarbonates are contact fungicides, and kill PM within minutes.(7)

The Federal EPA ruled (as of December, 1996) that sodium and potassium bicarbonates are exempt from residue tolerances.(12) This action served to facilitate the development and release of commercial bicarbonate products for horticultural use. It also lent weight to the belief that these materials are largely innocuous from a food safety perspective.

Connecticut researchers evaluated the effects of a spray solution containing 1% each of baking soda and horticultural oil on PM infection in zucchini, pumpkin, and cantaloupe. Four applications were made and disease suppression was definitely observed, accompanied by reduced insect pest damage. These researchers maintain that the treatment is preventative—*not* curative; that it is only necessary in years where early outbreaks may threaten yields; and that spraying should accompany proper nutrition and water management.(13)

In 1998, Church & Dwight Co. (14)—the manufacturer of Arm & Hammer™ baking soda—received EPA registration for Armicarb 100®, a potassium bicarbonate formulation, for use against PM, downy mildew, botrytis, and alternaria leaf-spot.(15) This product is the direct result of Dr. Horst's research at Cornell, which was funded by Church & Dwight. Armicarb 100 is now available from Helena Chemical Company.(16) A similar product is sold under the name FirstStep® by the W.A. Cleary Chemical Co.(17)

The EPA and the California Department of Environmental Protection have provided registration to Monterey Chemical Co. (18) for a product called Kaligreen®. A potassium bicarbonate fungicide for PM control, it is cleared for use on grapes, cucumbers, tobacco, roses, strawberries, and a wide range of other crops.(19, 20, 21) Directions for use include the addition of a sticker-spreader surfactant and a caution against use in acidic spray mixes. Since the product contains 30% potassium it is also touted for its fertilizer value.(22) One source of Kaligreen® is Peaceful Valley Farm Supply.(23)

Yet another potassium bicarbonate product, Remedy®, by Bonide™ (24), is now available from Gardener's Supply Co.(25) This formulation, which includes a surfactant oil, is labeled for use on ornamental, nut, and fruit trees, shrubs, and many vegetable plants. Said to control PM, black spot, leaf spot, anthracnose, phoma, phytophthora, scab, botrytis, and many other diseases, Remedy is particularly targeted toward rose growers.(26)

Various carbonates and bicarbonates have been proven effective against gray mold, the number one post-harvest disease of grapes. Researchers found that carbonates were more effective than bicarbonates at reducing gray mold *(Botrytis cinerea)* spore germination, and that sodium and ammonium bicarbonates were better than potassium bicarbonate.(27)

While industry was in the process of developing bicarbonate products for commercial and home horticulture, a number of recommendations for using kitchen-grade baking soda surfaced in print. These include:

- J. Howard Garrett—a well-known horticultural columnist and radio personality in the Dallas, Texas, area—recommends baking soda sprays at a concentration of 4 teaspoons per gallon of water for control of PM, blackspot, brown patch, and other fungal diseases. He also suggests that a light soil spray of baking soda solution can suppress fungus gnat problems, while cautioning that overuse should be avoided because of possible negative effects (sodium accumulation and alkaline pH) on the soil.(28)
- The authors of an organic pest control handbook suggest the same concentration mixture as Garrett, but advise the addition of an equal quantity of liquid dish soap or insecticidal soap as a surfactant.(29)
- The P. Allen Smith Gardens website advises mixing 1 heaping tablespoon of baking soda, 1 tablespoon of dormant oil, and ½ teaspoon of insecticidal or dish soap in one gallon of water as a PM spray. Stating that plants should be well hydrated prior to spraying, this source recommends irrigating a couple days in advance.(30)

References

1. Williams, Greg and Pat Williams. 1993. Baking soda vs. powdery mildew: *Not a new idea!* HortIdeas. June. p. 62.

2. Williams, Greg and Pat Williams. 1985. Baking soda for powdery mildew control. HortIdeas. September. p. 101-102.

3. Anon. 1990. Baking soda can ward off fungus. Greenhouse Manager. June. p. 24.

4. Ziv, O. and T. A. Zitter. 1992. Effects of bicarbonates and film-forming polymers on cucurbit foliar diseases. Plant Disease. Vol. 26, No. 5. p. 513-517.

5. Williams, Greg and Pat Williams. 1992. More on baking soda/horticultural oil vs. fungal disease. HortIdeas. June. p. 69.

6. Hofstetter, Bob. 1993. Homemade pesticides. The New Farm. February. p. 14-16.

7. Moore, Sallyann Roberts. 1996. Bicarbonates offer effective disease control. Grower Talks. February. p. 72.

8. Ziv, O. and A. Hagiladi. 1993. Controlling powdery mildew in euonymus with polymer coatings and bicarbonate solutions. HortScience. Vol. 28, No. 2. p. 124-126.

9. Williams, Greg and Pat Williams. 1993. Baking soda and horticultural oil vs. powdery mildew. HortIdeas. May. p. 51.

10. Byczynski, Lynn. 1995. New ideas for a new year. Growing for Market. January. p. 1, 4-5.

11. Williams, Greg and Pat Williams. 1997. Sodium bicarbonate for control of mildew on grapes. HortIdeas. June. p. 70.

12. Otten, Paul. 1997. Can kitchen products control powdery mildew? Northland Berry News. Fall. p. 20.

13. Elmer, Wade H. and Frank J. Farandino. 1997. Managing powdery mildew of cucurbits. The Natural Farmer. Summer. p. 26-27.

14. Church & Dwight Co., Inc.
469 N. Harrison St.
Princeton, NJ 08543-5297
609-683-5900
800-221-0453

15. Anon. 1998. EPA approves reduced-risk fungicide. The Grower. December. p. 8.

16. Helena Chemical Co.
225 Schilling Blvd. Suite 110
Collierville, TN 38017
901 537-7280
www.helenachemical.com/sales.html
Armicarb® is available in 5 and 25 lb. bags, for about $5/lb. Call the number above or visit the website to locate the Helena Chemical dealer nearest you.

17. W. A. Cleary Chemical Co.
1049 Corporate Rt. 27
Somerset, NJ 08875
800-524-1662
FirstStep® is available in 5 lb. bags and 20 lb. cases. Call the number above for price information.

18. Monterey Chemical Co.
P. O. Box 35000
Fresno, CA 93745-5000
559-499-2100
www.montereychemical.com
Kaligreen is available in 5lb. and 10lb. bags. Prices vary from dealer to dealer.

19. Anon. 1998. Powdery mildew fungicide. The Grower. March. p. 6.

20. Anon. 1999. EPA expands Kaligreen label. The Grower. August. p. 10.

21. Anon. 2000. Label Changes (Kaligreen) American Vegetable Grower. March. p. 14.

22. Anon. 1998. Peaceful Valley Farm Supply 1998-1999 Main Catalog. Peaceful Valley

Farm Supply. Grass Valley, CA. p. 92.

23. Peaceful Valley Farm Supply
P. O. Box 2209
Grass Valley, CA 95945
530-272-4769
888-784-1722
www.groworganic.com

24. Bonide Products, Inc.
Oriskany, NY 13424
315-736-8231

25. Gardener's Supply Co.
128 Intervale Rd.
Burlington, VT 05401-2850
800-863-1700
www.gardeners.com
e-mail: info@gardeners.com

26. Anon. 1998. Fungus remedy. B.U.G.S. Flyer. Vol. 12, No. 1. p. 5.

27. Anon. 1999. Baking soda and gray mold. Conference notes: ESA and APS joint meeting. IPM Practitioner. April. p. 10-11.

28. Garrett, J. Howard. 1989. J. Howard Garrett's Organic Manual. Lantana Publishing Co. Dallas, TX. 104 p.

29. Ellis, Barbara W. and Fern Marshall Bradley. 1992. The Organic Gardener's Handbook of Natural Insect and Disease Control. Rodale Press. Emmaus, PA. 534 p.

30. Anon. 1997. Garden lore—Baking soda solution. P. Allen Smith Gardens. Hortus Ltd. www.pallensmith.com/index.php?option=com_content&task=view&id=46.

By George Kuepper, Raeven Thomas, and Richard Earles
NCAT Agriculture Specialists

IP130
Slot 102

Use of Baking Soda as a Fungicide Agronomy Technical Note

ATTRA - National Sustainable Agriculture Information Service
PO Box 3657
Fayetteville, AR 72702
Phone: 1-800-346-9140 --- FAX: (479) 442-9842

By George Kuepper, Raeven Thomas, and Richard Earles
NCAT Agriculture Specialists
November 2001

- The use of baking soda as a fungicide is not a new idea. In Alfred C. Hottes' *A Little Book of Climbing Plants*, published in 1933 by the A.T. De La Mare Co. of New York, mention is made of using one ounce of baking soda per gallon of water to control powdery mildew (PM) on climbing roses. The author credits the idea to a Russian plant pathologist, A. de Yaczenski.

- In the August, 1985 issue of *Organic Gardening* magazine, a short article by Warren Shultz entitled "Recipe for Resistance" reports that researchers in Japan obtained effective control of PM on cucumbers, eggplants, and strawberries. They suggested weekly sprays of ¼ ounce baking soda per gallon of water.

- An article in the June, 1990 issue of *Greenhouse Manager* magazine summarizes the results of three years of testing baking soda as a fungicide for roses. Cornell University researcher Dr. R. Kenneth Horst observed suppression of PM and blackspot—both major problems for New York rose growers. Roses were sprayed every 3 to 4 days with a water solution of baking soda and insecticidal soap. The latter was included for its surfactant qualities. (Surfactants are chemical agents that alter the surface properties of a liquid.) The soap improved the effectiveness of the bicarbonate by making it stick to, and spread evenly over, the leaf surface. Further experimentation proved that the insecticidal soap itself was not responsible for suppressing the diseases. While no specific concentration of baking soda is indicated as being most effective in PM suppression, the article states that a 0.5% solution was most effective in preventing blackspot.

- Some of the work at Cornell has focused on controlling fungal diseases on cucurbits. A single spray application (to runoff) of 0.5% (wt./vol. of water) baking soda, plus 0.5% (vol./vol. of

water) SunSpray UFP® horticultural oil almost completely inhibited PM on heavily infected pumpkin foliage. Baking soda **without** spray oil was ineffective, and a 2% (wt./vol. of water) solution of baking soda damaged the leaves. Baking soda/oil sprays also provided good control of urocladium leaf spot in cucumber, alternaria leaf blight in muskmelon, and gummy stem blight in muskmelon. Other diseases against which baking soda may prove effective include anthracnose in cucurbits; rust, dollar spot, and pythium blight in turf; late blight in potato; rust in wheat; and diseases affecting peanuts, banana, and alfalfa.

- Researchers in Israel reported the successful use of baking soda and SunSpray oil in controlling PM on euonymus. In this research a 2% baking soda and 1% oil solution proved most effective.

- On-farm observations on melon acreage in Virginia resulted in one farm operation switching from synthetic fungicides to a baking soda/oil spray. These growers incorporated a liquid fertilizer into the mix.

- Research in Germany evaluated baking soda as a control for PM on `Bacchus' grapes. Three spray applications were made, beginning when symptoms first appeared. Good control was achieved with no loss of grape quality. The optimum concentration was a 1% solution.

- An article in the February, 1996 issue of *GrowerTalks* magazine follows up on the continuing research at Cornell. Testing with a variety of bicarbonates revealed that selecting the correct bicarbonate for a particular disease is important. Dr. Horst's research team found that ammonium bicarbonate had the strongest effect on some diseases, while potassium and sodium bicarbonates worked best against others. Potassium bicarbonate provided the best control of PM. "Sodium bicarbonate is okay, but it's not as good," Horst is quoted as saying. "And ammonium bicarbonate doesn't do the job on powdery mildew." He points out that while conventional chemical controls for PM are preventatives only, bicarbonates can eliminate the disease after it has already appeared on certain crops—he mentions roses and an unspecified ornamental—provided the infection is not severe. The only plant damage associated with bicarbonates applied in the trials was foliar burning when application rates exceeded recommended concentrations. Testing established that sodium bicarbonate does not increase the levels of sodium in plant tissues, soil, or runoff water. While their precise mode of action against fungi is not understood, Horst states that bicarbonates seem to damage the cell wall membrane in PM spores. He also believes pH to be a factor in bicarbonate effectiveness. In any case, bicarbonates are contact fungicides, and kill PM within minutes.

- The Federal EPA ruled (as of December, 1996) that sodium and potassium bicarbonates are exempt from residue tolerances. This action served to facilitate the development and release of commercial bicarbonate products for horticultural use. It also lent weight to the belief that these materials are largely innocuous from a food safety perspective.

- Connecticut researchers evaluated the effects of a spray solution containing 1% each of baking soda and horticultural oil on PM infection in zucchini, pumpkin, and cantaloupe. Four applications were made and disease suppression was definitely observed, accompanied by reduced insect pest damage. These researchers maintain that the treatment is preventative—*not* curative; that it is only necessary in years where early outbreaks may threaten yields; and that spraying should accompany proper nutrition and water management.

- In 1998, Church & Dwight Co.—the manufacturer of Arm & Hammer™ baking soda—received EPA registration for Armicarb 100®, a potassium bicarbonate formulation, for use against PM, downy mildew, botrytis, and alternaria leaf-spot. This product is the direct result of Dr. Horst's research at Cornell, which was funded by Church & Dwight. Armicarb 100 is now available from Helena Chemical Company. A similar product is sold under the name FirstStep® by the W.A. Cleary Chemical Co.

- The EPA and the California Department of Environmental Protection have provided registration to Monterey Chemical Co. for a product called Kaligreen®. A potassium bicarbonate fungicide for PM control, it is cleared for use on grapes, cucumbers, tobacco, roses, strawberries, and a

wide range of other crops. Directions for use include the addition of a sticker-spreader surfactant and a caution against use in acidic spray mixes. Since the product contains 30% potassium it is also touted for its fertilizer value. One source of Kaligreen® is Peaceful Valley Farm Supply.

- Yet another potassium bicarbonate product, Remedy®, by Bonide™, is now available from Gardener's Supply Co. This formulation, which includes a surfactant oil, is labeled for use on ornamental, nut, and fruit trees, shrubs, and many vegetable plants. Said to control PM, black spot, leaf spot, anthracnose, phoma, phytophthora, scab, botrytis, and many other diseases, Remedy is particularly targeted toward rose growers.

- Various carbonates and bicarbonates have been proven effective against gray mold, the number one post-harvest disease of grapes. Researchers found that carbonates were more effective than bicarbonates at reducing gray mold *(Botrytis cinerea)* spore germination, and that sodium and ammonium bicarbonates were better than potassium bicarbonate.

- While industry was in the process of developing bicarbonate products for commercial and home horticulture, a number of recommendations for using kitchen-grade baking soda surfaced in print. These include:

    - J. Howard Garrett—a well-known horticultural columnist and radio personality in the Dallas, Texas, area—recommends baking soda sprays at a concentration of 4 teaspoons per gallon of water for control of PM, blackspot, brown patch, and other fungal diseases. He also suggests that a light soil spray of baking soda solution can suppress fungus gnat problems, while cautioning that overuse should be avoided because of possible negative effects (sodium accumulation and alkaline pH) on the soil.
    - The authors of an organic pest control handbook suggest the same concentration mixture as Garrett, but advise the addition of an equal quantity of liquid dish soap or insecticidal soap as a surfactant.
    - The P. Allen Smith Gardens website advises mixing 1 heaping tablespoon of baking soda, 1 tablespoon of dormant oil, and ½ teaspoon of insecticidal or dish soap in one gallon of water as a PM spray. Stating that plants should be well hydrated prior to spraying, this source recommends irrigating a couple days in advance.

ATTRA is the national sustainable agriculture information service operated by the National Center for Appropriate Technology under a grant from the Rural Business-Cooperative Service, U.S. Department of Agriculture. These organizations do not recommend or endorse products, companies, or individuals. NCAT has offices in Fayetteville, Arkansas (P.O. Box 3657, Fayetteville, AR 72702), Butte, Montana, and Davis, California.

REFERENCES:

Williams, Greg and Pat Williams. 1993. Baking soda vs. powdery mildew: *Not a new idea!* HortIdeas. June. p. 62.

Williams, Greg and Pat Williams. 1985. Baking soda for powdery mildew control. HortIdeas. September. p. 101-102.

Anon. 1990. Baking soda can ward off fungus. Greenhouse Manager. June. p. 24.

Ziv, O. and T. A. Zitter. 1992. Effects of bicarbonates and film-forming polymers on cucurbit foliar diseases. Plant Disease. Vol. 26, No. 5. p. 513-517.

Williams, Greg and Pat Williams. 1992. More on baking soda/horticultural oil vs. fungal disease. HortIdeas. June. p. 69.

Hofstetter, Bob. 1993. Homemade pesticides. The New Farm. February. p. 14-16.

Moore, Sallyann Roberts. 1996. Bicarbonates offer effective disease control. Grower Talks. February. p. 72.

Ziv, O. and A. Hagiladi. 1993. Controlling powdery mildew in euonymus with polymer coatings and bicarbonate solutions. HortScience. Vol. 28, No. 2. p. 124-126.

Williams, Greg and Pat Williams. 1993. Baking soda and horticultural oil vs. powdery mildew. HortIdeas. May. p. 51.

Byczynski, Lynn. 1995. New ideas for a new year. Growing for Market. January. p. 1, 4-5.

Williams, Greg and Pat Williams. 1997. Sodium bicarbonate for control of mildew on grapes. HortIdeas. June. p. 70.

Otten, Paul. 1997. Can kitchen products control powdery mildew? Northland Berry News. Fall. p. 20.

Elmer, Wade H. and Frank J. Farandino. 1997. Managing powdery mildew of cucurbits. The Natural Farmer. Summer. p. 26-27.

Church & Dwight Co., Inc.
469 N. Harrison St.
Princeton, NJ 08543-5297
609-683-5900
800-221-0453

Anon. 1998. EPA approves reduced-risk fungicide. The Grower. December. p. 8.

Helena Chemical Co.
225 Schilling Blvd. Suite 110
Collierville, TN 38017
901 537-7280
http://www.helenachemical.com/sales.html

Armicarb® is available in 5 and 25 lb. bags, for about $5/lb. Call the number above or visit the website to locate the Helena Chemical dealer nearest you.

W. A. Cleary Chemical Co.
1049 Corporate Rt. 27
Somerset, NJ 08875
800-524-1662

FirstStep® is available in 5 lb. bags and 20 lb. cases. Call the number above for price information.

Monterey Chemical Co.
P. O. Box 35000
Fresno, CA 93745-5000
559-499-2100
http://www.montereychemical.com

Kaligreen is available in 5lb. and 10lb. bags. Prices vary from dealer to dealer.

Anon. 1998. Powdery mildew fungicide. The Grower. March. p. 6.

Anon. 1999. EPA expands Kaligreen label. The Grower. August. p. 10.

Anon. 2000. Label Changes (Kaligreen) American Vegetable Grower. March. p.

Anon. 1998. Peaceful Valley Farm Supply 1998-1999 Main Catalog. Peaceful Valley Farm Supply. Grass Valley, CA. p. 92.

Peaceful Valley Farm Supply
P. O. Box 2209
Grass Valley, CA 95945
530-272-4769
888-784-1722
http://www.groworganic.com

Bonide Products, Inc.
Oriskany, NY 13424
315-736-8231

Gardener's Supply Co.
128 Intervale Rd.
Burlington, VT 05401-2850
800-863-1700
http://www.gardeners.com
e-mail: info@gardeners.com

Anon. 1998. Fungus remedy. B.U.G.S. Flyer. Vol. 12, No. 1. p. 5.

Anon. 1999. Baking soda and gray mold. Conference notes: ESA and APS joint meeting. IPM Practitioner. April. p. 10-11.

Garrett, J. Howard. 1989. J. Howard Garrett's Organic Manual. Lantana Publishing Co. Dallas, TX. 104 p.

Ellis, Barbara W. and Fern Marshall Bradley. 1992. The Organic Gardener's Handbook of Natural Insect and Disease Control. Rodale Press. Emmaus, PA. 534 p.

Anon. 1997. Garden lore—Baking soda solution. P. Allen Smith Gardens. Hortus Ltd. http://www.pallensmith.com/report_library/archive/347_baking-soda.html.

Appendix 5
Occupational Safety & Health Guideline for Hydrogen Peroxide from U.S. Department of Labor Occupational Safety & Health Administration

200 Constitution Avenue, NW Washington, DC 20210

DISCLAIMER:

These guidelines were developed under contract using generally accepted secondary sources. The protocol used by the contractor for surveying these data sources was developed by the National Institute for Occupationa Safety and Health (NIOSH), the Occupational Safety and health Administration (OSHA), and the Department of Energy (DOE). The information contained in these guidelines is intended for reference purposes only. None of the agencies have conducted a comprehensive check of the information and data contained in these sources. It provides a summary of information about chemicals that workers may be exposed to in their workplaces. The secondary sources used for supplements 111 and 1V were published before 1992 and 1993, respectively, and for the remainder of the guidelines the secondary sources used were published before September 1996. This information may be superseded by new developments in the field of industrial hygiene. Therefore readers are advised to determine whether new information is available.

INTRODUCTION:

This guideline summarizes pertinent information about hydrogen peroxide for workers and employers as well as for physicians, industrial hygienists, and other occupational safety and health professionals who may need such information to conduct effective occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs.

Recommendations may be superseded by new developments in these fields: readers are therefore advised to regard these recommendations as general guidelines and to determine whether new information is available.

SUBSTANCE IDENTIFICATION

Formula: H(2)O(2)

Structure: (for structure, see paper copy)

Synonyms: Hydrogen dioxide, perhydrol, albone, hydroperoxide, inhibine, perone, superoxol, t-stuff, hydrogen peroxide 90%, hydrogen peroxide 30%

Identifiers:

1. CAS No.: 7722-84-1
2. RTECS No.: MX0899000 or (MX0900000)
3. DOT UN: 2015 47 (aqueous solutions, > 60% hydrogen peroxide); 2014 45 (aqueous solutions, greater than or equal to 20 percent and less than 60 percent; 2984 45 (aqueous solutions, greater than or equal to 8 percent and less that 20 percent)
4. DOT label: Oxidizer, corrosive (2014 and 2015); oxidizer (2984)

Appearance and Odor: Hydrogen peroxide is a colorless liquid with a bitter taste.

CHEMICAL AND PHYSICAL PROPERTIES

Physical Data:

- Molecular Weight: 34.02
- Boiling point (at 760 mm Hg): 152 degrees C (305.6 degrees F) (90%)
- Specific gravity: 1.46 (90%) at 0 degrees C (32 degrees F)
- Vapor density: Data not available.
- Melting point: -0.43 degrees C (-45.4 degrees F) (90%)

- Vapor pressure at 30 degrees C (86 degrees F): 5 mm Hg (90%)
- Solubility: Soluble in alcohol, ether, and water; insoluble in petroleum ether; decomposed by many organic solvents.
- Evaporation rate: Data not available.

Reactivity

- Conditions contributing to instability: Exposure to radiant heat (sunlight), sources of ignition, such as, heat or open flame; and physical or mechanical disturbances can create a potential fire or explosion hazard.
- Incompatibilities: Contact between hydrogen peroxide and combustible materials such as, wood, paper, oil, etc., may cause immediate spontaneous ignition or combustion. Mixed with organic materials such as alcohols, acetone, and other ketones; aldehydes, and their anhydrides; and glycerol can cause violent explosions. Spontaneous ignition may occur when hydrogen peroxide is added to cotton (cellulose). Contact with metals including iron, copper, chromium, lead, silver, manganese, sodium, potassium, magnesium, nickel, gold, platinum; metal alloys such as, brass or bronze; metal oxides such as lead oxides, mercury oxides, or manganese dioxide; and many metal salts, like potassium permanganate or sodium iodate could result in violent explosions. Tremendous explosions can also be caused by unstable mixtures with concentrated mineral acids.
- Hazardous decomposition products: None reported.
- Special precautions: Containers of hydrogen peroxide should be kept shock-free, covered and properly vented.

Flammability

Hydrogen peroxide is not combustible, but it is a powerful oxidizer [NIOSH 1994]. The National Fire Protection Association has assigned a flammability rating of 0 (minimal fire hazard) to hydrogen peroxide.

1. Flash Point: *data not available*
2. Auto-ignition temperature: *data not available*
3. Flammable limits in air: *data not available*
4. Extinguishant: For small fires use water only; no dry chemical or carbon dioxide. Flood fire area with water from a distance to fight large fires involving hydrogen peroxide.

Fires involving hydrogen peroxide should be fought upwind from the maximum distance possible. Keep unnecessary people away; isolate the hazard area and deny entry. Isolate the area for ½ mile in all directions if a tank, rail car, or tank truck is involved in the fire. For a massive fire in a cargo area, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from the area and let the fire burn. Emergency personnel should stay out of low areas. Vapors are an explosion and poison hazard indoors, outdoors, or in sewers. This substance may ignite other combustible materials such as wood, paper, oil, etc. Mixed with fuel they may react violently or even explode. Explosions can also be caused by friction, heat or contamination. Containers of hydrogen peroxide may explode in the heat of the fire and should be moved from the fire area if it is possible to do so safely. If this is not possible, cool fire exposed containers from the sides with water until well after the fire is out. Stay away from the ends of containers. Firefighters should wear a full set of protective clothing and self-contained breathing apparatus when fighting fires involving hydrogen peroxide.

EXPOSURE LIMITS

OSHA PEL

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for hydrogen peroxide is 1 part per million (ppm) parts of air (1.4 milligrams per cubic meter) as an 8-hour time-weighted average (TWA) concentration (29 CFR 1910.1000, Table Z-1).

NIOSH PEL

The National Institute for Occupational Safety and health (NIOSH) has established a recommended exposure limit (REL) for hydrogen peroxide of 1 ppm (1.4 mg/m^3 as a TWA for up to a 10-hour workday and a 40-hour workweek (NIOSH 1992).

ACGIH TLV

The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned hydrogen peroxide a threshold limit value (TLV) of 1ppm (1.4 m/m^3 as a TWA for a normal 8-hour workday and a 40-hour workweek (DOT 1993, Guides 45 to 47).

Rationale for Limits

The NIOSH limit is based on the risk of eye, mucous membrane, and skin irritation (NIOSH 1992).

The ACGIH limit is based on the risk of irritation (ACGIH 1991, p. 782).

HEALTH HAZARD INFORMATION

Routes of Exposure

Exposure to hydrogen peroxide can occur through inhalation of the vapor or mist, ingestion, and eye or skin contact (Sittig 1991).

Summary of Toxicology

1. Effects on Animals: Hydrogen peroxide is an eye, skin, and mucous membrane irritant. The LC(50) in rats is 2,000 mg/m(3) (1,333 ppm) for 4 hours, and the dermal LD(50) in rats is 4,060 mg/kg [NIOSH 1995]. Dogs exposed to a 7 ppm airborne concentration of 90 percent hydrogen peroxide for 6 hours per day, 5 days per week for 6 months developed external body irritation, sneezing, lacrimation, and bleaching of the hair. At autopsy, their skin was observed to be thickened and their lungs were seen to be irritated [ACGIH 1991]. Rabbits exposed daily to 22 ppm daily for 3 months exhibited irritation around the nose and bleached hair [ACGIH 1991; NLM 1992]. Application to the eyes of rabbits shows that hydrogen peroxide in concentrations of 5 percent or above can cause lasting damage [Grant 1986]. Oral administration of hydrogen peroxide in mice has caused adenomas and carcinomas of the duodenum [IARC 1985]. The International Agency for Research on Cancer has concluded that there is limited evidence of hydrogen peroxide's carcinogenicity in animals [IARC 1985]. Hydrogen peroxide is mutagenic in bacterial test systems and causes DNA damage, sister chromatid exchanges, and chromosomal aberrations in mammalian cells in vitro [IARC 1985].

2. Effects on Humans: Hydrogen peroxide is an irritant of the eyes, mucous membranes, and skin. Inhalation of high concentrations of the vapor or mist may cause extreme irritation of the nose and throat [Hathaway et al. 1991]. The inhalation of 7 ppm causes lung irritation in humans [NLM 1992]. Severe systemic poisoning may cause headache, dizziness, vomiting, diarrhea, tremors, numbness, convulsions, pulmonary edema, unconsciousness, and shock. Exposure for a short period of time to the mist or spray may cause stinging and tearing of the eyes [Hathaway et al. 1991]. Splashes of high concentrations of hydrogen peroxide in the eyes may cause severe corneal damage. At very low concentrations (1 to 3 percent), instillation of hydrogen peroxide into the eye causes severe pain that later subsides [Grant 1986]. Skin contact with liquid hydrogen peroxide causes a temporary whitening or bleaching of the skin; if the skin is not washed promptly, redness and blisters may develop. Ingestion of hydrogen peroxide may cause irritation of the upper gastrointestinal tract and severe damage to the esophagus and stomach [Hathaway et al. 1991]. Hydrogen peroxide has caused DNA damage in in vitro human test systems [NIOSH 1995].

Signs and Symptoms of Exposure

- Acute exposure. The signs and symptoms of acute exposure to hydrogen peroxide include irritation if the eyes, nose, throat, and lungs, ranging from mild bronchitis to pulmonary edema. Corneal ulceration, redness and blisters on the skin, and bleaching of hair may occur after contact of the eyes or skin with the liquid or vapor.
- Chronic exposure: No signs or symptoms of chronic exposure to hydrogen peroxide have been reported in humans.

EMERGENCY MEDICAL PROCEDURES

Emergency Medical Procedures: (NIOSH to supply)

RESCUE: Remove an incapacitated worker from further exposure and implement appropriate emergency procedures (e.g., those listed on the Material Safety Data Sheet required by OSHA's Hazard Communication Standard [29 CFR 1910.1200]). All workers should be familiar with emergency

procedures, the location and proper use of emergency equipment, and methods of protecting themselves during rescue operations.

EXPOSURE SOURCES AND CONTROL METHODS

The following operations may involve hydrogen peroxide and lead to worker exposures to this substance:

- The manufacture and transportation of hydrogen peroxide
- Use in the synthesis of inorganic peroxygen compounds (e.g., sodium perforate and sodium percarbonate);
- Use as an intermediate in the synthesis of plasticizers, organic peroxygen compounds (e.g. methyl ethyl ketone peroxide, benzoyl peroxide), peroxycarbonates, and amine oxides;
- Use to bleach textiles, mechanical wood pulps, oils, waxes, fats, discolored silk, straw, ivort, concentrated acids, flour, bone, feathers, fruit, fur, hair, soap, gelatin, glue, and a variety of additional items;
- Use to eliminate pollutants in industrial and municipal wastewater treatment systems;
- Use to remove hydrogen sulfide from the steam produced by geothermal power plants, and to generate oxygen in respiratory protective equipment;
- Use in the manufacture of glycerol acetone, antichlor, benzoyl peroxide, buttons, disinfectants, felt hats, sponge rubber, and pesticides;
- Use in various steps during the mining and processing of uranium, pickling of copper and copper alloys, and cleaning of metals and silicon semiconductors used in the electronics industry;
- Use in a variety of small-volume applications in photography, cosmetics, antiseptics, painting and engraving restoration, and cleansing agents;
- Use as a sterilizing agent in food and wine processing;
- Use as a polymerization promoter, a foaming agent, to age wines and liquors, to disinfect water and hides, to refine oils and fats, and for gilding and silvering of metal surfaces (NLM 1995);
- Use as a rocket fuel (the 90% solution), an ingredient of explosives, and in military applications;
- Use as a component in nonprescription drugs, and as a cleansing and tropical antiseptic agent;
- Use in medicine to remove ear wax and to treat gingivitis; and
- Use as a laboratory reagent, a seed disinfectant, and a viscosity control for starch and cellulose derivatives.

Methods that are effective in controlling worker exposures to hydrogen peroxide, depending on the feasibility of implementation, are as follows:

- Process enclosure
- Local exhaust ventilation
- General dilution ventilation

Personal Protective Equipment

Workers responding to a release or potential release of a hazardous substance must be protected as required by paragraph (q) of OSHA's Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120).

Good sources of information about control methods are as follows:

- ACGIH (1992). Industrial ventilation – a manual of recommended practice. 21st ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
- Burton DJ(1986). Industrial ventilation – a self study companion. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
- Alden JL, Kane JM [1982]. Design of industrial ventilation systems. New York, NY: Industrial Press, Inc.

- Wadden RA, Scheff PA (1987). Engineering design for control of workplace hazards. New York, NY: McGraw-Hill.
- Plog BA (1988). Fundamentals of Industrial Hygiene. Chicago, IL: National Safety Council.

MEDICAL SURVEILLANCE

OSHA is currently developing requirements for medical surveillance. When these requirements are promulgated, readers should refer to them for additional information and to determine whether employers whose employees are exposed to hydrogen peroxide are required to implement medical surveillance procedures.

Medical Screening

Workers who may be exposed to chemical hazards should be monitored in a systematic program of medical surveillance that is intended to prevent occupational injury and disease. The program should include education of employers and workers about work-related hazards, early detection if adverse health effects, and referral of workers for diagnosis and treatment. The occurrence of disease or other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e.g., industrial hygiene monitoring, engineering controls, and personal protective equipment). A medical surveillance program is intended to supplement, not replace, such measures. To detect and control work-related health effects, medical evaluations should be performed (1) before job placement, (2) periodically during the term of employment, and (3) at the time of job transfer or termination.

Preplacement Medical Evaluation

Before a worker is placed in a job with a potential for exposure to hydrogen peroxide, a licensed health care professional should evaluate and document the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and physiologic and laboratory tests appropriate for the anticipated occupational risks. These should concentrate on the function and integrity of the eyes, skin, and respiratory system. Medical surveillance for respiratory disease should be conducted using the principles and methods recommended by the American Thoracic Society.

A preplacement medical evaluation is recommended to assess medical conditions that may be aggravated or may result in increased risk when a worker is exposed to hydrogen peroxide at or below the prescribed exposure limit. The health care professional should consider the probable frequency, intensity, and duration of exposure as well as the nature and degree of any applicable medical condition. Such conditions (which should not be regarded as absolute contraindications to job placement) include a history and other findings consistent with diseases of the eyes, skin, and respiratory system.

Periodic Medical Evaluations

Occupational health interviews and physical examinations should be performed at regular intervals during the employment period, as mandated by any applicable Federal, State, or local standard. Where no standard exists and the hazard is minimal, evaluations should be conducted every 3 to 5 years or as frequently as recommended by an experienced occupational health physician. Additional examinations may be necessary if a worker develops symptoms attributable to hydrogen peroxide exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of hydrogen peroxide on the eyes, skin, or respiratory system. Current health status should be compared with the baseline health status of the individual worker or with expected values for a suitable reference population.

Termination Medical Evaluations

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic or laboratory tests that were conducted at the time of placement should be repeated at the time of job transfer or termination to determine the worker's medical status at the end of his or her employment. Any changes in the worker's health status should be compared with those expected for a suitable reference population.

Biological Monitoring

Biological monitoring involves sampling and analyzing body tissues or fluids to provide an index of exposure to a toxic substance or metabolite. No biological monitoring test acceptable for routine use has yet been developed for hydrogen peroxide.

WORKPLACE MONITORING AND MEASUREMENT

Determination of a worker's exposure to airborne hydrogen peroxide is made using a midget fritted glass bubbler (MFGB) containing 15 mL TiOSO(4). Samples are collected at a recommended flow rate of 0.5 liter/minute until a recommended collection volume of 100 liters is reached. Analysis is conducted by colorimetric methods. This method (OSHA VI-6) is partially validated and is described in the OSHA Computerized Information System [OSHA 1994].

PERSONAL HYGIENE PROCEDURES

If hydrogen peroxide contacts the skin, workers should flush the affected areas immediately with plenty of water, followed by washing with soap and water.

Clothing contaminated with hydrogen peroxide should be removed immediately, and provisions should be made for the safe removal of the chemical from the clothing. Persons laundering the clothes should be informed of the hazardous properties of hydrogen peroxide, particularly its potential for causing irritation.

A worker who handles hydrogen peroxide should thoroughly wash hands, forearms, and face with soap and water before eating, using tobacco products, using toilet facilities, applying cosmetics, or taking medication.

Workers should not eat, drink, use tobacco products, apply cosmetics, or take medication in areas where hydrogen peroxide or a solution containing hydrogen peroxide is handled, processed, or stored.

STORAGE

Hydrogen peroxide should be stored in a cool, dry, well-ventilated area in tightly sealed containers that are labeled in accordance with OSHA's Hazard Communication Standard [29 CFR 1910.1200]. Containers of hydrogen peroxide should be protected from physical damage and should be stored separately from combustible materials such as, wood, paper, oil, etc., organic materials such as alcohols, acetone, and other ketones; aldehydes, and their anhydrides; glycerol, cotton (cellulose), metals including iron, copper, chromium, lead, silver, manganese, sodium, potassium, magnesium, nickel, gold, platinum; metal alloys such as, brass or bronze; metal oxides such as lead oxides, mercury oxides, or manganese dioxide; and many metal salts, like potassium permanganate or sodium iodate; and mineral acids.

SPILLS AND LEAKS

In the event of a spill or leak involving hydrogen peroxide, persons not wearing protective equipment and clothing should be restricted from contaminated areas until cleanup has been completed. The following steps should be undertaken following a spill or leak:

1. Notify safety personnel.
2. Remove all sources of heat and ignition.
3. Ventilate the area of the spill or leak.
4. Keep combustibles (wood, paper, oil, etc.) away from the spilled material.
5. Water spray may be used to reduce vapors, but the spray may not prevent ignition in closed spaces.
6. For small liquid spills, flood the area with large amounts of water.
7. For large liquid spills, flood the area with large amounts of water and dike far ahead of the spill to contain the hydrogen peroxide for later reclamation or disposal.

SPECIAL REQUIREMENTS

U.S. Environmental Protection Agency (EPA) requirements for emergency planning, reportable quantities of hazardous releases, community right-to-know, and hazardous waste management may change over time. Users are therefore advised to determine periodically whether new information is available.

Emergency Planning Requirements

Employers owning or operating a facility at which there are 1, 000 pounds or more of hydrogen peroxide must comply with EPA's Emergency Planning Requirements.

Reportable Quantity Requirements for Hazardous Releases

A hazardous substance release is defined by EPA as any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment (including the abandonment or discharging of contaminated containers) of hazardous substances. In the event of a release that is above the reportable quantity for that chemical, employers are required to notify the proper Federal, State, and local authorities (40 CFR 355.40).

The reportable quantity of hydrogen peroxide is 1 pound. If an amount equal to or greater than this quantity is released within a 24-hour period in a manner that will expose persons outside the facility, employers are required to do the following:

- Notify the National Response Center immediately at (800) 424-8802 or at (202) 426-2675 in Washington, D.C. [40 CFR 302.6].
- Notify the emergency response commission of the State likely to be affected by the release [40 CFR 355.40].
- Notify the community emergency coordinator to the local emergency planning committee (or relevant local emergency response personnel) of any area likely to be affected by the release [40 CFR 355.40].

Community Right-to-Know Requirements

Employers are not required by EPA in 40 CFR Part 372.30 to submit a Toxic Chemical Release Inventory form (Form R) to EPA reporting the amount of hydrogen peroxide emitted or released from their facility annually.

Hazardous Waste Management Requirements

EPA considers a waste to be hazardous if it exhibits any of the following characteristics: ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR 261.21-261.24. Under the Resource Conservation and Recovery Act (RCRA) (40 USC 6901 et seq.), EPA has specifically listed many chemical wastes as hazardous. Although hydrogen peroxide is not specifically listed as a hazardous waste under RCRA, EPA requires employers to treat waste as hazardous if it exhibits any of the characteristics discussed above.

Providing detailed information about the removal and disposal of specific chemicals is beyond the scope of this guideline. The U.S. Department of Transportation, EPA, and State and local regulations should be followed to ensure that removal, transport, and disposal of this substance are conducted in accordance with existing regulations. To be certain that chemical waste disposal meets EPA regulatory requirements, employers should address any questions to the RCRA hotline at (703) 412-9810 (in the Washington, D.C. area) or toll-free at (800) 424-9346 (outside Washington, D.C.). In addition, relevant State and local authorities should be contacted for information on any requirements they may have for the waste removal and disposal of this substance.

RESPIRATORY PROTECTION

Conditions for Respirator Use

Good industrial hygiene practice requires that engineering controls be used where feasible to reduce workplace concentrations for hazardous materials to the prescribed exposure limit. However, some situations may require the use of respirators to control exposure limits. Respirators must be worn if the ambient concentration of hydrogen peroxide exceeds prescribed exposure limits. Respirators may be used (1) before engineering controls have been installed, (2) during work

operations such as maintenance or repair activities that involve unknown exposures, (3) during operations that require entry into tanks or closed vessels, and (4) during emergencies. Workers should only use respirators that have been approved by NIOSH and the Mine Safety and Health Administration (MSHA).

Respiratory Protection Program

Employers should institute a complete respiratory protection program that, at a minimum, complies with the requirements of OSHA's Respiratory Protection Standard (29 CFR 1910.134). Such a program must include respirator selection, an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, respirator fit testing, periodic workplace monitoring, and regular respirator maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program (including selection of the correct respirator) requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly. For additional information on the selection and use of respirators and on the medical screening of respirator users, consult the latest edition of the NIOSH Respirator Decision Logic [NIOSH 1987b] and the NIOSH Guide to Industrial Respiratory Protection [NIOSH 1987a].

PERSONAL PROTECTIVE EQUIPMENT

Workers should use appropriate personal protective clothing and equipment that must be carefully selected, used and maintained to be effective in preventing skin contact with hydrogen peroxide. The selection of the appropriate personal protective equipment (PPE) including gloves, sleeves, encapsulating suits, should be based on the extent of the worker's potential exposure to hydrogen peroxide. The resistance of various materials to permeation by hydrogen peroxide (30 to 70%) is shown below:

Material	**Breakthrough time (hr)**
Butyl Rubber	>8
Natural Rubber	>8
Nitrile Rubber	>8
Viton	>8
Responder	>8
Polyvinyl Chloride	>4
4H (PE/EVAL)	>4
Neoprene	Caution 1 to 4
Polyvinyl Alcohol	<1(*)

(*) Not recommended, degradation may occur

To evaluate the use of these PPE materials with hydrogen peroxide, users should consult the best available performance data and manufacturer's recommendations. Significant differences have been demonstrated in the chemical resistance of generically similar PPE materials (e.g., butyl) produced by different manufacturers. In addition, the chemical resistance of a mixture may be significantly different from that of any of its neat components.

Any chemical-resistant clothing that is used should be periodically evaluated to determine its effectiveness in preventing dermal contact. Safety showers and eye wash stations should be located close to operations that involve hydrogen peroxide.

Splash-proof chemical safety goggles or face shields (20 to 30 cm long, minimum) should be worn during any operation in which a solvent, caustic, or other toxic substance may be splashed into the eyes.

In addition to the possible need for wearing protective outer apparel (e.g., aprons, encapsulating suits), workers should wear work uniforms, coveralls, or similar full-body coverings that are laundered each day. Employers should provide lockers or other closed areas to store work and street clothing separately. Employers should collect work clothing at the end of each work shift and

provide for its laundering. Laundry personnel should be informed about the potential hazards of handling contaminated clothing and instructed about measures to minimize their health risk.

Protective clothing should be kept free of oil and grease and should be inspected and maintained regularly to preserve its effectiveness.

Protective clothing may interfere with the body's heat dissipation, especially during hot weather or during work in hot or poorly ventilated work environments.

REFERENCES

ACGIH [1991]. Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

ACGIH [1994]. 1994-1995 Threshold limit values for chemical substances and physical agents and biological exposure indices. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

ATS [1987]. Standardization of spirometry -- 1987 update. American Thoracic Society. Am Rev Respir Dis 136:1285-1296.

CFR. Code of Federal regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

DOT [1993]. 1993 Emergency response guidebook, guide 45 and 47. Washington, DC: U.S. Department of Transportation, Office of Hazardous Materials Transportation, Research and Special Programs Administration.

Forsberg K, Mansdorf SZ [1993]. Quick selection guide to chemical protective clothing. New York, NY: Van Nostrand Reinhold.

Genium [1992]. Material safety data sheet No. 44B. Schenectady, NY: Genium Publishing Corporation.

Grant WM [1986]. Toxicology of the eye. 3rd ed. Springfield, IL: Charles C Thomas.

Hathaway GJ, Proctor NH, Hughes JP, and Fischman ML [1991]. Proctor and Hughes' chemical hazards of the workplace. 3rd ed. New York, NY: Van Nostrand Reinhold.

IARC [1985]. IARC monographs on the evaluation of carcinogenic risk of chemicals to man. Volume 36. Lyon, France: World Health Organization, International Agency for Research on Cancer.

Lewis RJ, ed. [1993]. Hawley's condensed chemical dictionary. 12th ed. New York, NY: Van Nostrand Reinhold Company.

Mickelsen RL, Hall RC [1987]. A breakthrough time comparison of nitrile and neoprene glove materials produced by different glove manufacturers. Am Ind Hyg Assoc J 48(11): 941-947.

Mickelsen RL, Hall RC, Chern RT, Myers JR [1991]. Evaluation of a simple weight-loss method for determining the permeation of organic liquids through rubber films. Am Ind Hyg Assoc J 52(10): 445-447.

NFPA [1986]. Fire protection guide on hazardous materials. 9th ed. Quincy, MA: National Fire Protection Association.

NIOSH [1987a]. NIOSH guide to industrial respiratory protection. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 87-116.

NIOSH [1987b]. NIOSH respirator decision logic. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 87-108.

NIOSH [1992]. Recommendations for occupational safety and health: Compendium of policy documents and statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 92-100.

NIOSH [1994]. NIOSH pocket guide to chemical hazards. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 94-116.

NIOSH [1995]. Registry of toxic effects of chemical substances: Hydrogen Peroxide. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Division of Standards Development and Technology Transfer, Technical Information Branch.

NJDH [1985]. Hazardous substance fact sheet: Hydrogen Peroxide. Trenton, NJ: New Jersey Department of Health.

NLM [1995]. Hazardous substances data bank: Hydrogen Peroxide. Bethesda, MD: National Library of Medicine.

OSHA [1994]. Computerized information system. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration.
Parmeggiani L [1983]. Encyclopedia of occupational health and safety. 3rd rev. ed. Geneva, Switzerland: International Labour Organisation.

Patnaik P [1992]. A comprehensive guide to the hazardous properties of chemical substances. New York, NY: Van Nostrand Reinhold.

Sittig M [1991]. Handbook of toxic and hazardous chemicals. 3rd ed. Park Ridge, NJ: Noyes Publications.

USC. United States code. Washington. DC: U.S. Government Printing Office.

Windholz M, ed. [1983]. Merck Index 10th ed. Rahway, NJ: Merck & Company.

OHSA website: http://www.osha.gov

Occupational Safety & Health Administration 200 Constitution Avenue, NW
Washington, DC 20210.

ADDITIONAL REFERENCES:

The information on the "**Natural, Non-Commercial Mold Removal Recipes**" section of this book is also taken from the following sources:

www.care2.com/healthyliving
Hundreds of everyday solutions for a healthy lifestyle.

www.checnet.org
Free monthly e-mails from the Children's Environmental Health Coalition, offering simple steps to keep your baby in a healthy home. Also offers the video Not Under My Roof! Protecting Your Baby from Toxins at Home with Olivia Newton-John and Kelly Preston.

www.greenmarketplace.com

Shopping for the green home.

www.scorecard.org
This Environmental Defense website is an excellent resource for information about specific chemicals found in household products. Enter the name of a chemical in the search box, and you will be told about its toxicity and what regulatory lists it is on.

www.seventhgen.com
Environmentally friendly, nontoxic household cleaners and products, plus information on household toxins such as chlorine.

http://www.ces.ncsu.edu/copubs/home/care/
Additional North Carolina Cooperative Extension Resources:

http://www.ci.nyc.ny.us/html/doh/html/epi/moldrpt1.html
New York City Department of Health "Guidelines on Assessment and Recommendations of Fungi in Indoor Environment"

http://www.epa.gov/iaq/molds/mold_remediation.html
U.S Environmental Protection Agency Mold Remediation in Schools and Commercial Buildings

http://www.epi.state.nc.us/epi/oii/mold/
N.C. Department of Health and Human Services, Epidemiology Section Mold and Human Health

http://www.health.state.mn.us/divs/eh/indoorair/mold/
Minnesota Department of Health - Environmental Health in Minnesota Mold in Homes

http://www.advancedenergy.org/buildings/crawlspaces/
Current research on sealed crawlspaces by Advanced Energy

Sinus problems are usually mold-exposure related. Read this helpful article for----

Effective, Low-Cost Ways To Get Rid Of A Stuffy Problem – Sinusitis

Medical News Today, October 9, 2008

Home remedies often can reduce problematic sinus symptoms, according to the October issue of Mayo Clinic Women's HealthSource.

Symptoms, including nasal congestion, facial pain, headache and fatigue, are common. Annually, doctors report about 32 million cases of chronic sinusitis -- when patients' symptoms last 12 consecutive weeks. Evidence shows that home remedies are an inexpensive, effective first course of treatment. Consider these tips:

> Use nasal irrigation or a nasal spray. Researchers have found that flushing out the nose twice a day with a saltwater (saline) solution can effectively treat and even prevent sinusitis "attacks." (See a demonstration at http://www.MayoClinic.com. Type "nasal irrigation" in the search box.) Spraying a saline solution into the nasal cavity several times a day also eases congestion.
>
> Steam the sinus cavities. Drape a towel over your head as you breathe in the steam from a bowl of hot water. Hot showers also help.
>
> Apply warm compresses. Place warm, damp towels around your nose, cheeks and eyes for 20 to 30 minutes, two to four times a day to ease facial pain. Place hot water bottles over the towels to keep them warm.
>
> Drink plenty of fluids. Fluids help dilute mucus and promote drainage.
>
> Avoid alcohol. Drinking alcohol can worsen swelling of the lining of the nose and sinuses.
>
> Don't smoke. And avoid exposure to secondhand smoke.
>
> When symptoms persist, consult a physician for other treatment options. Most cases of sinusitis are caused by a viral infection -- which doesn't respond to antibiotics. But a secondary bacterial infection is possible. Generally, antibiotics are considered when symptoms worsen or don't improve after 10 days. Other treatment options are corticosteroids to reduce inflammation, decongestants or antihistamines for temporary relief of nasal congestion, or humidifiers or misters to add moisture to the air.
>
> When sinusitis occurs frequently or lasts for more than three months, work with your health care provider to identify possible noninfectious triggers for the condition and treatment options. Allergies, nasal polyps and other conditions could be related to sinusitis.
>
> Mayo Clinic
> 200 First St. SW
> Rochester, MN 55902
> United States
> http://www.mayoclinic.com