Dave Carnell's Boatbuilding Page

Chemotherapy for Rot

Once rot gets a toehold in wood it is difficult to cure completely -- it is like a cancer. Digging out the rotted wood will still leave spores and water in the sound wood. After you fill in the cavity with something like epoxy, the rot continues to flourish underneath. Products promoted to make rotted wood sound and stop rot penetrate only until they meet water, with which they do not mix. Under the solid repair rotting goes on. With one exception (more later), the commercial products sold to treat dry wood to prevent rot are completely ineffective against established rot in wet wood because they are dissolved in petroleum solvents and oil and water do not mix.

There are two commonly available inexpensive materials that will kill rot in wood and prevent its recurrence. First, there are borates (borax-boric acid mixtures) which have an established record in preventing rot in new wood and in killing rot organisms and wood-destroying insects in infested wood. Second, there is ethylene glycol, most readily available as auto antifreeze-coolant. Glycol is toxic to the whole spectrum of organisms from staphylococcus bacteria to mammals. All of the published material on its effectiveness against wood-destroying fungi and insects that I am aware of is the result of my investigations over the past 15 years.

Both borate solutions and glycol penetrate dry and wet wood well because they are water-soluble; in fact, penetration by glycol is especially helped by its extreme hygroscopicity -- its strong attraction for water. For both, the fact that they are water-soluble means they are not permanent solutions to rot in wood that is continually exposed to water-below the waterline and in ground-where they will eventually be extracted-dissolved out.

I first was interested in glycol as a wood-stabilizing agent, where it is in many ways superior to polyethylene glycol (PEG), and it was during this work that I realized the useful effect of glycol on organisms, though I was pretty dense in interpreting the first experiment.

The ladies immerse the stems of greenery such as magnolia branches in glycerin to keep them green. Glycol is very similar to glycerin in all its physical properties and much cheaper, so I stuck a magnolia branch in antifreeze. The next day it was brown. After the third attempt I tumbled to the fact that the glycol was killing

the greenery. This was the reason that glycol never replaced glycerin in applications such as a humectant for tobacco and an ingredient of cosmetics and pharmaceutical ointments, though it had all the desirable physical properties.

I had two 2" thick slabs of a 14" diameter hickory tree that had just been cut. I treated one with antifreeze and left one untreated. I was looking at wood stabilization, not rot prevention. After about six months stored inside my shop the untreated control was not only cracked apart, but it was sporting a great fungal growth, while the treated slab was clean.

The local history museum wanted to exhibit two "turpentine trees", longleaf pines that had many years ago been gashed to harvest the sap that made everything from turpentine to pine tar. The trees delivered to us after cutting were infested with various beetles and had some fungal growth. I treated them with antifreeze outside under a plastic tarpaulin every few days for three weeks. They were then free of insects and fungus and have remained so after being moved inside and installed in an exhibit over four years ago.

I took three pieces from a rotting dock float that were covered with a heavy growth of fungus, lichens, etc. I treated one with antifreeze painted on with a brush, the second with a water solution containing 23% borates (as B2O3), and left the third untreated as a control. They were left exposed outdoors and were rained on the first night. By the next morning the growth on the antifreeze-treated piece was definitely browning and the borate-treated piece showed slight browning. After two months exposure to the weather the growth was dead on the antifreeze- and borate-treated pieces and flourishing on the control.

I have a simple flat-bottomed skiff built of plywood and white pine, which has little resistance to rot. After ten years some rot developed in one of the frames. It may have begun in the exposed end grain. It consumed the side frame, part of the bottom frame, and part of a seat brace fastened to the side frame. The plywood gusset joining the side frame to the bottom frame was not attacked. I excised the rotted wood, saturated all with ethylene glycol antifreeze to kill all the rot organisms, and there has been no further deterioration in four more years afloat with wet bilges. I have not replaced any pieces, as I am building another boat that can replace it; that is more fun, anyway.

I have a 60+-year old case of the fungus infection known as "athlete's foot". Many years ago it infected the toenails extensively. The whole thing was pretty grotesque. My dermatologist and druggist both assured me there is no known cure. About six years ago I started using antifreeze applied under the nails with a

medicine dropper about every five days. The professionals are technically right. I have not completely cured it, but the nails have grown out pink and thinned almost to the ends and I never have any trouble with blistering, peeling, or itching between the toes as I had had for six decades. No drug company is going to have any interest in this because the information has been in the public domain for so long that there is no opportunity for any proprietary advantage. The various wood-rotting organisms cannot be anywhere near as tough.

There are two types of borate products commercially available for treating wood-solid sodium octaborate for making solutions in water (Tim-Bor® and Ship-Bor®) and a 40% solution of sodium octaborate in ethylene glycol (Boracare®). Their equivalents and more concentrated solutions can be easily prepared from borax, boric acid, and antifreeze at much lower cost. Keith Lawrence, editor of *Boatbuilder* offered to sell me advertising if I wanted to go in the business, but I might run afoul of patents (preparation for individual use is not prohibited), I would have to get EPA registration, and I could not deliver products anywhere near as cheaply as they can be made from raw materials available at your supermarket, drugstore, and discount store.

Glycol by itself has one big advantage over solutions of borates in either water or glycol. Glycol penetrates rapidly through all paint, varnish, and oil finishes (except epoxy and polyurethanes) without lifting or damaging those finishes in any way. You can treat all of the wood of your boat without removing any finish. The dyes in glycol antifreeze are so weak that they do not discolor even white woods. Once bare wood has been treated with glycol or the borate solutions and become dry to the touch it can be finished or glued. If a borate solution leaves white residues on the surface, it will have to be washed off with water and the surface allowed to dry.

This is my preferred process to treat rot. Once you find soft wood or other evidence of rot, soak it with antifreeze even if you cannot do anything else at the moment. Paint it on or spray it on with a coarse spray. Avoid fine mistlike spraying because it increases the likelihood that you will breathe in unhealthy amounts of glycol. Put it on surfaces well away from the really damaged wood, too. Use glycol lavishly on the suspect wood, which will readily absorb 10-20% of its weight of antifreeze.

Next dig out wood that is rotted enough to be weak. Add more glycol to wet the exposed wood thoroughly. Then add the 25% borate solution of the recipe below so long as it will soak in in no more than 2-3 hours. Then fill in the void with epoxy putty and/or a piece of sound treated wood as required. The reasons I use borates at all are: 1) it is a belt-and-suspenders approach to a

virulent attack, and 2) over a long period glycol will evaporate from the wood; especially, in areas exposed directly to the sun and the high temperatures that result.

If there is any question about water extracting the glycol or the borates, you can retreat periodically with glycol on any surface, painted or bare, and with borate solutions on bare wood.

Glycol's toxicity to humans is low enough that it has to be deliberately ingested (about a half cup for a 150 lb. human); many millions of gallons are used annually with few precautions and without incident. It should not be left where children or pets can get at it, as smaller doses would harm them, and they may be attracted by its reported sweet taste that I have confirmed by accident. The lethal dose of borates is smaller than of glycol, but the bitter taste makes accidental consumption less likely.

BORATE WOOD PRESERVATIVES: COMMERCIAL AND HOME-BREWED

Tim-Bor®: Solid sodium octaborate; dissolves in water to make approx. a 10% solution containing 6.6% borate (B_2O_3); about $3/lb. plus shipping.

Ship-Bor®: Same as Tim-Bor®; $19.95/lb. plus $2 shipping.

Bora-Care®: 40% solution of sodium octaborate in ethylene glycol; 27% borate content; $70/gal. plus shipping.

Home-Brew Water Solution of Borates:

> Based on U.S. Navy spec. of 60% borax-40% boric acid (this ratio gives the maximum solubility of borates in water); 65% water, 20 %borax, 15% boric acid; 15.8% borates; borax costs 54 cents/lb. (supermarket), boric acid costs about $4/lb. in drug stores (sometimes boric acid roach poison, 99% boric acid, is cheaper in discount stores); equiv. to Tim-Bor® or Ship-Bor® at 30 cents/lb. To make this solution mix the required quantities and heat until dissolved. The boric acid, in particular, dissolves slowly. This solution is stable (no crystals) overnight in a refrigerator (40°F.), so can be used at temperatures at least as low as 40°F.

Home-Brew Glycol Solution of Borates:

This is equivalent to Bora-Care® diluted with an equal volume of glycol to make it fluid enough to use handily; 50% glycol antifreeze, 28% borax, 22% boric acid. To make a stable solution you mix the ingredients and heat till boiling gently. Boil off water until a candy thermometer shows 260°F. This removes most of the water of crystallization in the borax. This solution is stable at 40°F and has a borate content of 26%. With antifreeze at $6/gal. and borax and boric acid prices as above, this is equivalent to Bora-Care® at about $15/gal.

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