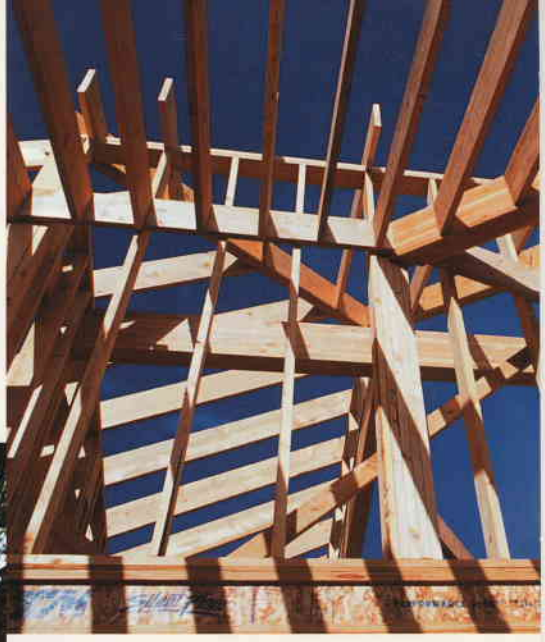
Borates – the best of biostats



Borates' environmental credentials in wood preservation are many . . . they protect living trees, extend the service life of timber and provide alternatives to tropical rain forest timber.

Borates defend conifers, homes and rubberwood furniture from insect and fungal attack.

Borates – the best of biostats

Safe yet effective

Jeff Lloyd, Ph.D.

Borates are all around us, everywhere in nature. They are essential plant micronutrients that help growth and yet they are, strangely, also effective preservatives that can prevent growth. Insights into boron chemistry suggest that both effects are likely to result from the same biological property. In solution, borates form negative ions which can link with certain organic substances containing alcohol groups. Scientists suggest that this could be one important role of boron in plant essentiality in regulating metabolism. The other side of the coin is that if the borate concentration is massively increased, regulation will turn to inhibition and stop cells from growing. Stopping cell growth rather than killing the cell makes borate a biostat, rather than a biocide.

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This is important for several reasons. It explains how and why borate compounds can control so many different pests and why acquired resistance to borates, a common problem with other substances in pest control, is unlikely. The mild biostatic effect also makes borates non-harmful to humans.

Efficacy and performance

Biostatic activity against microorganisms and insects has led to the widespread use of borates as a safe method of control. Natural borate compounds have been shown to work against and control fungi, algae, bacteria and many insects like cockroaches, beetles, ants, wasps, fleas, termites, flies and moths.

To the microbiologist, boron usage as a plant food in agriculture is particularly interesting in disease resistance and control. It is generally believed that boron-sufficient, healthy plants are less susceptible to disease. But other bonuses, such as reductions in the very poisonous fungal smut ergot in barley, and club root disease in cabbages, may also be direct fungistatic effects.

Where borates definitely provide biostatic fungal disease control in agriculture, or more specifically forestry, is their use in controlling 'fomes' disease in conifers. These trees are susceptible to a root and butt rotting disease, caused by a fungus whose spores are released from mushroom-like bodies on trees and stumps and spread over great distances. They infect stump tops created by thinning and clear-felling, and then infect nearby trees when roots touch. This renders the valuable butt sawlogs useless, and prevents new trees from being planted. The disease is simple to control with borates – either sprinkled on the surface as a fine powder, or sprayed on by automated felling machines.

Bio-protection

Borates' environmental credentials in wood preservation are many, but a good example is in treating rubberwood, a plantation tree grown for latex. After its productive life its wood is useless unless protected, because wood boring beetles readily attack it, attracted by its very high natural starch and sugar content. Furniture or other materials made from it can be destroyed in a matter of months.

Protected with borates, however, it is now found in many homes as furniture and other products. Prevention of insects' attentions has allowed the use of this otherwise waste material, and reduced the demand for tropical rain forest timber.

Further, in Hawaii, borates have exclusively been used since 1991 to protect buildings against the Formosan subterranean termite, the most voracious of its many relatives. Studies at the University of Hawaii show that borate pretreated wood resists their attack and this excellent performance has led to borate-treated wood winning about 80 percent of the house construction market there.

***Cladosporium resinae*...the most common fungal contaminant of aviation jet fuels... succumbs to speciality borates.**

Professionals are also turning to borates to solve the growing termite problems in the southern U.S. In Europe, borates are extensively used instead of insecticides, carried in organic solvents, or as a replacement for arsenic in traditional exterior preservatives.

Other natural fiber products, receiving increased attention as a result of the trend towards the use of renewable raw materials, are also being borate bio-protected. They are now being used in dozens of different applications including structural and non-structural construction uses, insulation, and fillers or strenghtheners of other materials such as plastics and concrete. They use natural cellulosic fibers derived from waste paper, hemp, bagasse, cotton, flax, coconut and straw, and non-cellulose fibers like sheep's wool. The bioprotection of such products is often a national requirement. For example, the official British Standard for constructional straw products requires borate to prevent *Psocopteran* (booklouse) infestation.

Data showing the bacteriostatic properties of borates were produced as early as 1929, and these properties are in widespread commercial use today. Good examples are in caviar*, cosmetics and eye drops, metal lubrication fluids, cooling water, additives in air conditioning systems, and as in-can preservatives for paints instead of lead, mercury and formaldehyde. Zinc borate is particularly favored for this and shows efficacy against many 'spoiling' bacteria.

Microbial growth can also occur in liquid fossil fuels contaminated with water, as organisms are able to use the fuel itself as food where the fuel and water are in contact. There are a number of problems associated with microbial growth in fuels – from straightforward degradation, to more severe problems such as tank, gasket or coating corrosion, valve and gauge blockages, and even problems in fuel lines and carburation systems.

While many types of bacteria can be associated with fuel problems, particularly corrosion, one of the most interesting organisms taking advantage of this 'home from home' is a fungus called *Cladosporium resinae*. It's the most common fungal contaminant of aviation jet fuels and, because of its filamentous growth and effect on fuel supply, is referred to as 'rather significant'. But it succumbs to specialty borates.

The preservation of fuel becomes of greater interest as research continues to develop fuels from renewable resources, such as sunflowers and oilseed rape. Who knows, perhaps borates will help with the development of this major environmental breakthrough as with so many other natural and alternative materials.

**Although borates are not approved additives for food, the European Union Directive 95/2/EC does allow the minor and traditional application of borates as a preservative and antioxidant in Beluga caviar.*

Borates protect jet fuel, caviar and eye drops from spoilage organisms.

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