Opinion & Information on Boric Acid

By Michael R. Cartwright, Sr.

(Michael R. Cartwright, Sr. is a third generation licensed professional in the fields of structural pest control and building construction and is also licensed in agriculture pest control. His qualifications are too extensive to print but are available on request from The Reporter.)

Over the past years I have seen, in many homes and restaurants, boric acid covering everything. Carpets, floors, toys and furniture, in kitchen cabinets, on counter tops and tables, in refrigerators, clothing, etc. Why? Because environmentalists, helped by an uninformed news media, tell them to. Why don't the news media also explain the possible dangers of applying something not normally found in the home environment, that you or your animals will come in direct contact with?

I'm writing this article even though a California environmentalist group advised me not to say anything against boric acid and that I would pay dearly for only trying to mislead the public. My company uses a lot of boric acid, but not as described above.

Under an OSHA Hazard Communication Standard, based on animal chronic toxicity studies of inorganic borate chemicals, boric acid and/or borates are Hazardous Materials. California has identified boric acid as a hazardous waste. The above information is taken from Material Safety Data Sheet (MSDS) 25-80-2320 (Section 2 and 13) supplied by U.S. Borax Inc. (the major supplier of borax to many industries).

The National Academy of Sciences reports that children may be uniquely sensitive to chemicals and pesticide residues because of their rapid tissue growth and development. Most laboratory tests are performed on fully grown adult laboratory animals.

On page 312 of the National Academy of Sciences' report Pesticides in the Diets of Infants and Children (under the section entitled "Non-dietary Exposure to Pesticides") boric acid is cited as one of the pesticides/fungicides that can induce adverse skin reactions such as contact dermatitis and hyperkeratosis with dermal contact of treated surfaces.

Boric acid and/or borates are important and promising pesticides and fungicides, for my industry as well as for the general homeowner, for the control of fungus, termites, roaches and other insects as well as a wood preservative. Using appropriate application methods, boric acid and/or borates can be safe and long lasting pesticides and fungicides without having any negative side effects on the environment.

Boric acid is generally known as a desiccant; in other words, it kills by removing the moisture from the body of the target pests, causing severe dehydration which will affect electrolyte metabolism with the potential of metabolic acidosis. In fact, boric acid is a stomach poison normally ingested, along with the fact that it can also enter the blood by inhalation. Boric acid is an acid. Acid will decrease the pH level with the possible side effects of renal, respiratory, and cardiovascular failure. Symptoms and signs of boric acid poisoning are nausea, vomiting, diarrhea, headache, dysphagia, cold sweats, dyspnea, muscular debility, scarlatinal eruptions,

subnormal temperature, cardiac weakness, cyanosis, coma, collapse, etc. Boric acid is 3 parts hydrogen, 1 part boron, and 3 parts oxygen. Recently U.S. Borax discovered that boric acid contains traces of arsenic. Before California Prop 65 there were few, if any, human studies on boric acid. When human studies were requested from U.S. Borax they said they were unable to supply us with any at that time. But in the late 1980's they had started doing new and extensive toxicity tests on rats and mice as a result of California Prop 65. As a result of these tests, they discovered a decrease in sperm count and the stopping of fetal and embryonic development in rats and mice. In early 1993, U.S. Borax had asked for, and has received, additional time to complete their laboratory studies from the State of California.

The Environmental Protection Agency (EPA) has adopted a *"de minimus"* policy, which accepts that zero is not absolute, but a very, very small amount. But environmental groups protested the EPA policy, and the U.S. Ninth Circuit Court in California struck down the *de minimus* clause, thus establishing zero as absolute zero.

Boric acid contained traces of arsenic, a chemical known to the State of California to cause cancer. U.S. Borax was able to use the EPA *de minimus* policy, which accepts that zero is not absolute, but very, very small to remove arsenic from its Material Safety Data Sheet. I personally do not see any risk with the trace amount of arsenic at 1 part per million in boric acid and/or borates if used in an **appropriate** application method. *But, not where there will be constant direct contact.*

Others in the pesticide manufacturing industry have found that boric acid is an effective and reliable long term pesticide. Consider the fact that the environmentalist groups approved of its use, contrary to their stand on the EPA *de minimus* policy. When they discovered a possible decrease in sperm count and no development of the egg capsule or ovum plus the stopping of fetal and embryonic development in roaches with the potential to similarly affect other insects, this made it the perfect pesticide, and with the blessings of the environmen- talists.

Those in the fungicide and wood preservative manufacturing industries discovered that boric acid and/or borates are effective and reliable long term fungicides and preservatives. When wood was treated with boric acid and/or borates and then placed in a damp and warm area, the ideal environment for fungus growth you would have no fungus growth. These chemicals also work as a termiticide (prevents and/or kills termites and other wood destroying insects) -- unlike other fungicides and preservatives, which would also break down. Boric acid and/or borates are derived from natural elements, therefore they do not break down readily. When boric acid and/or borates are used as fungicides and preservatives, they serve as a growth regulator rather than a desiccant.

Fungi are plants that contain no chlorophyll. Therefore, they cannot make their own food and so they must have an outside source of food, in this case wood. There are four requirements for fungus growth; first is food, such as cellulose and lignin which is contained in all wood; second is air; third is warmth; and, fourth is moisture.

I do not wish to see the loss of boric acid and/or borates as we have seen in the past the loss of so many other fine pesticides, due to improper methods of application, which in many cases unnecessarily exposed people to hazardous chemicals. Boric Acid is one of the safest pesticides

if used correctly.

THIS IS NOT AN INDICTMENT OF U.S. BORAX for they have always been forthright about providing any new information regarding any of their products. U.S. Borax has the only correct Material Safety Data Sheet (MSDS) on boric acid that I have seen to date. Most, if not all, other manufacturers of pesticides that contain boric acid have incomplete information contained in their MSDSs about boric acid and/or borates.

When talking with U.S. Borax about use of their product, technical grade boric acid, for reformulating or repackaging into registered products, they do not necessarily approve of anyone using boric acid in any manner inconsistent with their original label. But there is nothing they can do if its recommended use is inconsistent with its own original label when it has been re-labeled by still others. U.S. Borax indicated that if they were to try to stop reformulators or repackagers from registering products with recommendations that were inconsistent with their product label on boric acid, that would be considered restraint of trade. It is entirely up to the discretion of the EPA to oversee how a pesticide is labeled.

Broadcast application of boric acid (to cover entire areas or surfaces) is not one of U.S. Borax's recommended methods of application on its registered label. Based on U.S. Borax's label, broadcast application would not be the normal occupational exposure and not what I would consider the normal human exposure to boric acid.

Limiting the use (application methods and locations) of pesticides and/or reducing of unnecessary human and/or animal contact with pesticides regardless of their perceived safety is of the utmost importance. Many illnesses may be directly related to a pesticide or chemical but because of its perceived safety could be overlooked.

Because Michael Cartwright feels that the information provided to The Reporter would be helpful in understanding his opinion on the use of boric acid and derivative products for pest control, he has included additional supporting information relating to the basic principles of toxicity testing. This information will be presented as Part II of this article in the next issue of the Reporter. What I actually received from Mr. Cartwright is a presentation nearly an inch thick of background information, including MSDSs on various commonly used flea control products and relevant reference articles.)

Boric Acid, Part II *By Michael R. Cartwright, Sr.*

Part I of Mr. Cartwright's article addressed the use of Boric Acid (the main ingredient in many flea control products such as Fleabusters) in a method that is inconsistent with that recommended by the manufacturer -- i.e. broadcast application, or spreading over a large area where there will be constant direct contact. This type of application can lead to exposure to the chemical which can have harmful effects. Particularly susceptible would be children and animals. Some side-effects noted were adverse skin reactions such as contact dermatitis and hyperkeratosis. Testing done on rats and mice showed a decrease in sperm count and the stopping of fetal and embryonic development.

The following information relating to the basic principles of toxicity testing is given by Mr. Cartwright to provide a better understanding on the use of boric acid for pest control.

Toxicology, The Science of Poisons, By University of California, Berkeley

Toxicity Testing

Before a chemical can be released for sale as a pesticide or drug, extensive toxicity tests must be performed to establish its effectiveness and safety. Indeed, the concept of toxicity testing is now being extended to virtually all manufactured chemicals, not just pesticides and drugs, because of Proposition 65.

A new chemical is tested to establish the type of toxicity and the dose necessary to produce a measurable toxic reaction. Because in the past it has been difficult to compare the results of toxicity tests done in different laboratories, there are now rather strict testing procedures. Toxicity testing has become expensive and extensive, involving many phases. Since different species of animals respond differently to chemicals, a new chemical is generally tested in mice, rats, rabbits, and dogs. The results of toxicity tests in these animals are used to predict the safety of the new chemical to humans.

Toxicity tests are based on two premises. The first premise is that information about toxicity in animals can be used to predict toxicity in humans. Years of experience have shown that toxicity data obtained from a number of animal species can be useful in predicting human toxicity, while predictions based on data obtained from a single animal species may be inaccurate. The second premise is that by exposing animals to large doses of a chemical for short periods of time, we can predict human toxicity due to exposure to small doses for long periods of time.

Acute toxicity studies:

A new chemical first undergoes a series of acute toxicity studies. These tests establish how dangerous it is. The test animals are given various amounts of the chemical in either one oral dose or by a single injection, and are then observed for 14 days. This test often determines the chemical's LD50 dose. The LD50 number is the dosage that will kill 50% of the test animals.

From this test, an estimate is made of the dose of the chemical which will kill 10% of the animals (LD10). The LD10 is then used as the highest dose in a 14 day repeated dose study. At the end of this test, the animals are killed and thoroughly examined (autopsied/necropsied) for any signs of toxic effects (pathology). The purpose of the repeated dose study is to establish the highest dose of the chemical that does not produce any signs of short-term toxicity.

Subchronic toxicity studies:

The next step in toxicity testing is the subchronic toxicity study which is carried out for a period of 90 to 150 days. The highest dose tested during the subchronic study is the dose that was found to produce no signs of toxicity in the earlier 14 day study. Lower doses are also tested.

During this study, the animals are observed closely to see if they develop any signs of toxicity. At the end of the study period, they are autopsied (necropsy), and based on the findings, a maximum tolerated dose (MTD) is selected. The MTD is the highest dose of the chemical that does not alter the animals' life span and it should not have any severely detri- mental effects on the animals' health. The MTD must be established before testing for carcinogenesis.

Chronic toxicity studies on carcinogenesis (oncogenesis):

Carcinogenesis and oncogenesis both mean the production of tumors. The terms tumor, cancer, and neoplasm are all used to mean an uncontrolled progressive growth of cells. In medical terminology, a cancer is considered a malignant (potentially lethal) neoplasm. There are many different types of neoplasm with many different names. Carcinogenic or oncogenic substances are substances which can cause the production of tumors.

Carcinogenesis testing is probably the most expensive part of toxicity testing because these animal studies generally take from 18 months to two years to complete. During carcinogenesis testing, the highest dose of the chemical given is the MTD. It is administered to the animals each day using the same route of exposure that would occur in humans. A close watch is kept on the animals throughout the entire study.

The treated animals are compared to animals who have not been exposed to the test chemical (controls). As animals become older, they start to develop tumors spontaneously (all by themselves). Thus, it is necessary to compare the treated animals with untreated animals to find out whether the effects observed are due to the chemical.

Complete autopsies (necropsies) are done on all the animals, either as they die or at the end of the study. The organs are examined microscopically for tumors or signs of pretumorous change. The government sets strict guidelines for the collection of data and its subsequent evaluation.

Four criteria are used and accepted as evidence of oncogenicity: 1) tumors occurring more often in treated animals than in untreated ones; 2) tumors occurring sooner in treated animals than in untreated ones; 3) treated animals developing different types of tumors than untreated ones; and, 4) tumors occurring in greater numbers of individual treated animals than in individual untreated ones. If the chemical being tested gives rise to any one of the four criteria, it is considered to be oncogenic.

Chronic toxicity studies on teratogenesis:

Teratogenesis is the production of birth defects. A teratogen is anything that is capable of producing changes in the structure or function of the offspring when the embryo or fetus is exposed before birth. Teratogens affect the normal development of the embryo or fetus but not the reproductive genetic characteristics of the offspring. Thus, teratogenic effects are limited to the offspring and are not passed on to future generations.

Teratogenesis studies of new chemicals are generally carried out in three phases in mice, rabbits, and rats. In the first test, male rats are exposed to the chemical for 60 days and female rats are exposed for 14 days. The animals are then mated and the females are treated with the chemical throughout pregnancy and until the offspring are weaned. This phase tests for nonspecific reproductive toxicity.

In the second test, two species of pregnant animals are given the chemical during the most sensitive stage of pregnancy, when the organs of the embryo are starting to develop. At the end of this test, the fetuses are delivered by cesarean section and examined for abnormalities.

The third test for teratogenicity is done on pregnant animals exposed to the chemical during the last third of the pregnancy period and through weaning. This is a less sensitive time for the fetus, but the test is useful for discovering toxicity associated with delivery and early growth. Control animals which are not exposed to the chemical are compared with those treated with the chemical to detect teratogenicity.

Teratogens have a threshold dose level below which teratogenic effects are not pro- duced. There is no direct relationship between teratogenesis and either oncogenesis or mutagenesis.

Chronic toxicity studies on mutagenesis:

Mutagenesis is the production of changes in genetic structure (mutations). Many oncogens are mutagenic and many mutagens are oncogenic. Mutagenic effects are not limited to the offspring and are passed on to future generations. In order for mutagenic effects to be passed on, they must occur in reproductive cells. Thus, mutagenesis is a type of reproductive toxicant.

Mutagenicity testing determines whether or not a chemical might cause genetic alter- ations in humans. This cannot be done directly, but relies on many tests done with bacteria, cell cultures, and animals.

Reproductive toxicity:

The effects of chemical on reproduction are tested by exposing male and female rats to the chemical. The rats are then mated and the number of offspring recorded. If the test chemical has a harmful effect on fertility, it will decrease the number of offspring produced. Other tests can then be done to find out if the chemical is affecting males, females or both.

Special studies:

Occasionally observations made during standard acute and chronic toxicity testing indicate that special studies are needed to examine unusual types of toxicity. For example, if the test animals appear to be behaving strangely, behavioral studies may be done to examine the problem. A chemical may produce only slight depression and drowsiness without other evi- dence of toxicity. However, these effects can be extremely hazardous in situations where a person has to work with dangerous equipment, and behavioral toxicity is especially important in industrial toxicology.

Epidemiological studies:

Delayed toxicity may occur many years after exposure to a chemical and is most often only discovered in retrospective epidemiological studies (studies of the incidence and distribution of toxic effects). Epidemiological studies are crucial to the detection of further occurrences of delayed toxicity.

In Summary:

Obviously we cannot remove all chemicals from our environment. Equally obviously, we cannot afford to spread them around indiscriminately. The focus of toxicity testing is the prevention of harmful effects. Since we cannot think of or test for every type of toxicity that could possibly develop, there have been surprises, some of major importance. However, toxicity testing today is more extensive and more rigorous than ever before. Thus, its level of reliability in predicting toxic effects in humans is also better than ever before. These tests are continually being improved, and continued improvement of the testing procedures will lead to an even greater reliability.

Familiarity with the basic principles of toxicology makes it easier to understand that chemical poisons can be used safely, and that is the first step toward the middle ground of rational use with minimal risk.

(Michael R. Cartwright, Sr. is a third generation licensed professional in the fields of structural pest control and building construction and is also licensed in agriculture pest control. His qualifications are too extensive to print but are available on request from The Reporter. If you or anyone you know has had animals come up with any type of problem after using a boric acid based product in the broadcast application method, Mr. Cartwright would be interested in knowing the details. Send your information in care of The Reporter (Lake Elsinore address).