

Chelated Copper Compounds-- No Advantage Over Copper Sulfate

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Copper sulfate is commonly added to ponds to kill algae or to control protozoan fish parasites. When copper sulfate dissolves in the pond, it breaks down into copper ions and sulfate ions. It is the copper ions that are presumed to be toxic to algae, parasites and fish.

In ponds that have a high pH and alkalinity, copper ions quickly react with other ions in the water and form insoluble compounds that are no longer effective. At low pH and alkalinities, the copper ions stay in the water for such a long period that it is difficult to kill algae and parasites without also killing the fish.

To solve these problems, several companies have introduced "chelated" copper products. Other farmers have relied on homemade approaches like mixtures of copper sulfate and citric acid. The chelating chemicals bind to the copper ions and keep them from precipitating out when the alkalinity is high. This means that the copper in chelated forms should be more toxic to fish, algae and parasites at high alkalinity than plain copper sulfate. This is a good thing because it means that copper treatments could be effectively used in high pH, high alkalinity water. In low pH and alkalinity water, the chelating compounds are supposed to bind to the copper ions and make them less toxic so that copper can be safely used.

There has been surprisingly little work that compares the effectiveness of chelated compounds to plain copper sulfate at high and low pH and alkalinities. In a 1993 study published by David Straus and Craig Tucker, they tested the toxicity of plain copper sulfate and a chelated product (Copper Control®

by Argent) at a variety of alkalinities. They found that at very low alkalinity (16 ppm) the chelated copper and copper sulfate were equally toxic to catfish. This shows that the chelation was not protecting the fish from copper toxicity at low alkalinity. At all other alkalinities tested (76, 127, and 240 ppm) the chelated compound was less toxic than copper sulfate alone. This means that it takes more of the compound to kill fish (and presumably algae and parasites) than would be required if plain copper sulfate was used. Thus, the chelated copper is not more effective at high alkalinity than plain copper.

The Straus and Tucker data show that at alkalinities of 76-240 ppm, it takes almost twice as much of the chelated compound to be effective. These findings were published more than 10 years ago, but farmers are still interested in chelated compounds and many believe that even though these compounds are more expensive than plain copper sulfate, they are better at high and low alkalinities.

In the last few years, UAPB Extension Specialists have been reporting considerable interest in the chelated copper product EarthTec® and in a homemade copper sulfate: citric acid mixture. We did a study to look at the toxicity of these compounds to channel catfish, at pH 7.2 and low alkalinity (35 ppm), and at pH 8.2 and high alkalinity (150 ppm). Our results using these two compounds were very similar to those of Straus and Tucker. At low alkalinity, the three forms of copper (2 chelated and plain copper sulfate) had an identical toxicity to catfish. That is, 1 ppm of copper ions in the form of copper sulfate has the same toxicity

as 1 ppm of copper ions in EarthTec or with citrate. The chelation does not make the copper safer at low alkalinity. In the high alkalinity experiments, the chelated copper was less toxic than copper sulfate. Thus, 1 ppm of chelated copper was less effective than 1 ppm of copper in copper sulfate. From our data, we conclude that there is no advantage to using chelated copper compounds. However, there is still a small possibility that chelated compounds differ in some characteristic that might affect their ability to kill parasites or algae, but not their toxicity to fish. A collaborative research project at UAPB and SNARC will compare chelated copper compounds and copper sulfate for the treatment of Ich.

It is interesting to compare the cost of different forms of copper. Remember that the active ingredient is copper ions, and that the copper ions in a chelated product are only worth more if the chelating chemicals help the copper to be more effective than the copper ions that come in simple copper sulfate.

The work done by Straus and Tucker and here at UAPB do not demonstrate that there is a difference between the two copper forms. Currently, copper sulfate sells for about \$32 for a 50 lb. bag. Copper sulfate pentahydrate is 25 percent copper by weight, so the 12.5 lbs of copper ions in a 50 lb bag cost about \$2.56/lb. Aquaculture suppliers currently charge about \$675 for 30 gallons of EarthTec that is 5 percent copper ions by weight and weighs 10 lbs/gallon (per manufacturer's website www.earthscience-labs.com). Thus, 30 gallons contain about 15 lbs of copper ions costing \$45/lb.