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By Ratus Fischer, Paul Fisher and Anne Frances

Copper ionization is a residual water treatment that treats the whole production system from water source to plant roots.

Water treatment series:

Water treatment with copper ionization

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MODERN COPPER IONIZATION TREATMENTS are more effective, precise and environmentally responsible than their older counterparts. Copper has been used for centuries as a fungicide, mostly in the form of copper sulfate or mixed with lime as Bordeaux mixture. You may be familiar with traditional copper sulfate fungicides that were applied to grape plants and left blue stains on the leaves.

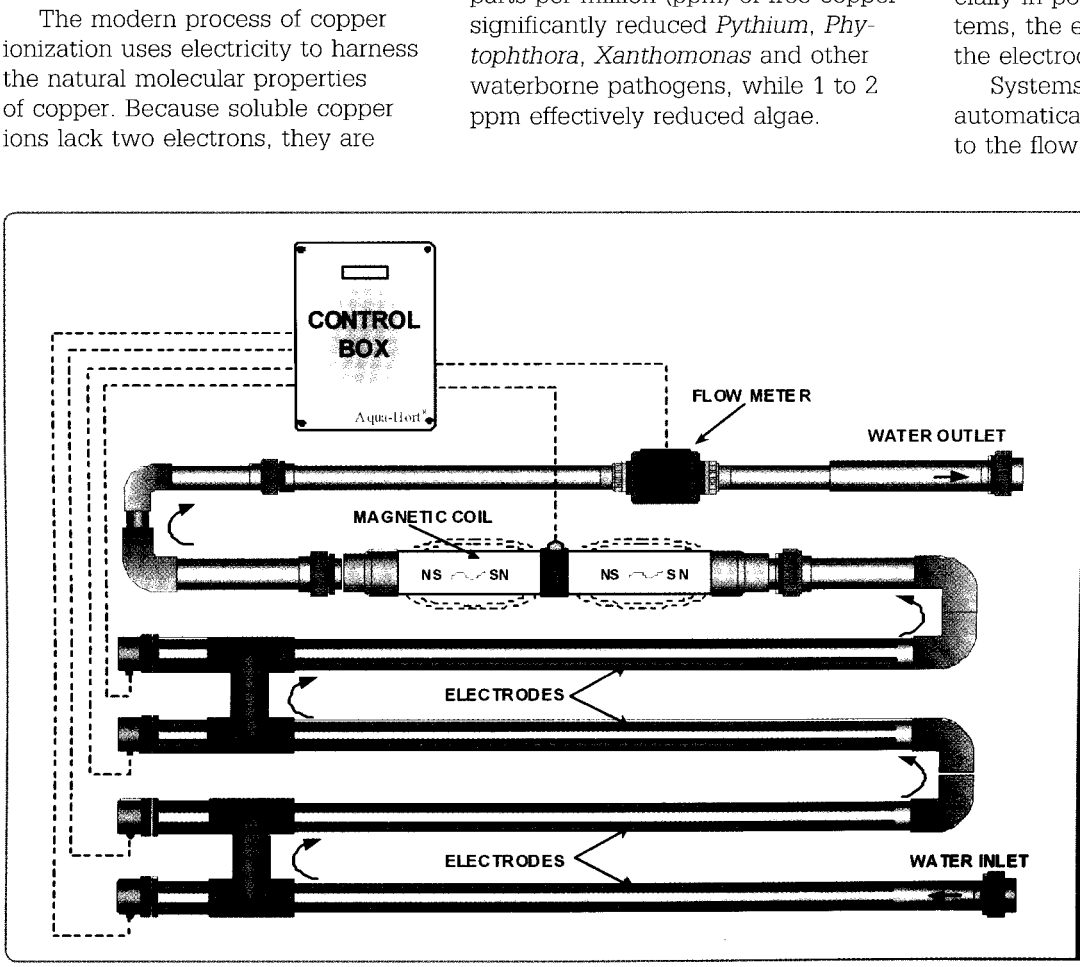
The modern process of copper ionization uses electricity to harness the natural molecular properties of copper. Because soluble copper ions lack two electrons, they are "eager" to bond with other suitable atoms that can supply the missing electrons. When copper ions encounter organic matter, including plant pathogens, they firmly attach themselves and disrupt the pathogens' cell walls, killing the organisms.

Studies by professor Walter Wohanka at Geisenheim Research Center in Germany and in the United States demonstrated that 0.5 to 1 parts per million (ppm) of free copper significantly reduced *Pythium*, *Phytophthora*, *Xanthomonas* and other waterborne pathogens, while 1 to 2 ppm effectively reduced algae.

Improved effectiveness

One reason copper ionization was effective for only some growers in the past is that copper atom output changes depending on the water flow and electrical conductivity. As the electrical conductivity fluctuates with the quality of the water, especially in pond and recirculation systems, the electric current between the electrodes also changes.

Systems are now available that automatically adjust copper output to the flow rate of the water, and



This Aqua-Hort copper system is equipped with copper electrodes inside pipes. An electric current passes through the system to turn solid copper metal electrodes into soluble copper ions. A magnetic coil increases activity of the copper ions. The control box corrects ionization rate based on water flow and water electrical conductivity to maintain a constant copper concentration.

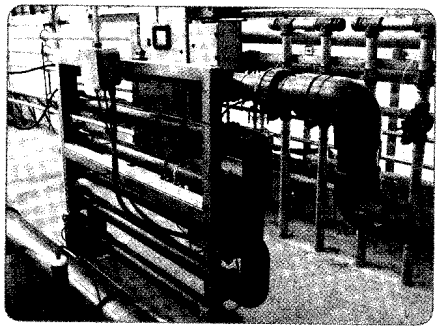
28(12):18,20-21

compensate for the electrical conductivity of the water. By keeping the electrical current constant, the copper output remains constant. It is therefore possible to set a desired ppm concentration that remains stable independent of the water.

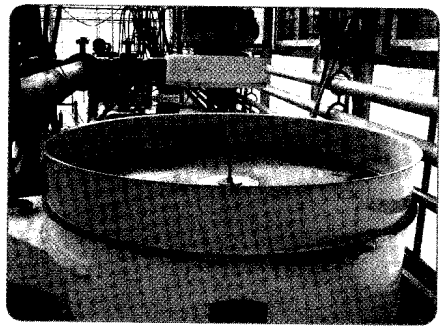
Properties of copper

Copper is also a plant nutrient. The amount of copper added to water for the treatment of pathogens is within the range of nutritional copper. Since plants normally do not take up more copper than they require, accumulation is not a problem. Peat and other organic growing media components absorb excess copper.

Copper pollution of leached water is not an issue when ionization systems are correctly designed and operated. Although the release of small amounts of copper fall within accepted safety standards, releasing significant amounts of copper-containing water is not a recommended practice.



Installation of a copper ionization system in a commercial greenhouse operation.



A copper ionization system can be combined with other water treatment technologies such as filtration.

Copper residual effects

Copper ionization is a residual water treatment. That means the copper ions travel with the water and treat the whole growing system, from water source to plant roots. Ultraviolet light, another popular water disinfection treatment, has no residual effect. This means any contamination downstream of the treatment source would not be treated by ultraviolet light.

Many plug producers use copper ionization alone. However, copper can be combined with other technologies, such as filtration and ultraviolet light, to provide both point and residual treatment. Copper sanitizes the whole water and growing system. Ultraviolet light provides additional, but non-residual reduction of pathogens.

Selecting and maintaining a copper system

Copper ionization systems are simple to operate, require little maintenance and are safe for employees. Initial cost for a system starts around $5,000 depending on flow rate, electrical conductivity and other system requirements. Copper ionization systems can be designed for flow rates from a few gallons per minute to thousands. Automatic control of copper output is essential.

Select a system specifically designed for horticulture, not for a simpler application suitable for swimming pools, etc. There is a trade off between copper ionization and other water-treatment systems. Initial investment is higher for copper ionization than for oxidizers such as hydrogen peroxide or chlorine, but operating costs tend to be lower over the long term because copper electrodes only need to be replaced once every year or two.

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Copper ionization applications

Some typical applications of copper ionization include:

- Eliminating pathogens from ponds before the water is distributed throughout the irrigation system.
- Sanitizing well or city water to protect susceptible crops and control algae growth on benches, floors and in pots.
- Maintaining clean water in recirculating flood floor and ebb-and-flow bench systems by adding copper ions to the holding tank or to the water each time it circulates to and from the floor or bench.

Types of copper ionization systems

Depending on the application, copper ion systems are available in different versions, including:

- A closed system with copper electrode rods inside pipes, for water with an electrical conductivity more than 0.3, and in-line pressurized systems.
- A closed tank with copper plate electrodes for water with a low electrical conductivity between 0.1 and 0.3. The greater copper surface allows enough current to flow though the water despite the low conductivity.
- An atmospheric tank with copper plates for low electrical conductivity when the water is discharged into an open tank. This system is the most cost-effective, is simple to build and maintain, and can easily handle flow rates of 1,000 gallons or more per minute.