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200. Water treatment series: gas chlorination can sanitize water. Majka, J. M., Argo, B., Fisher, P., and Hong, C. Greenhouse Management and Production 28(8):17-19. 2008.

Water can be treated with chlorine gas to control *Pythium* and *Phytophthora* as well as algae and slime from iron bacteria.

By Jill Marie Majka, Bill Argo, Paul Fisher and Chuanxue Hong

Gas chlorination works Page 18

Water treatment series: Gas chlorination can sanitize water

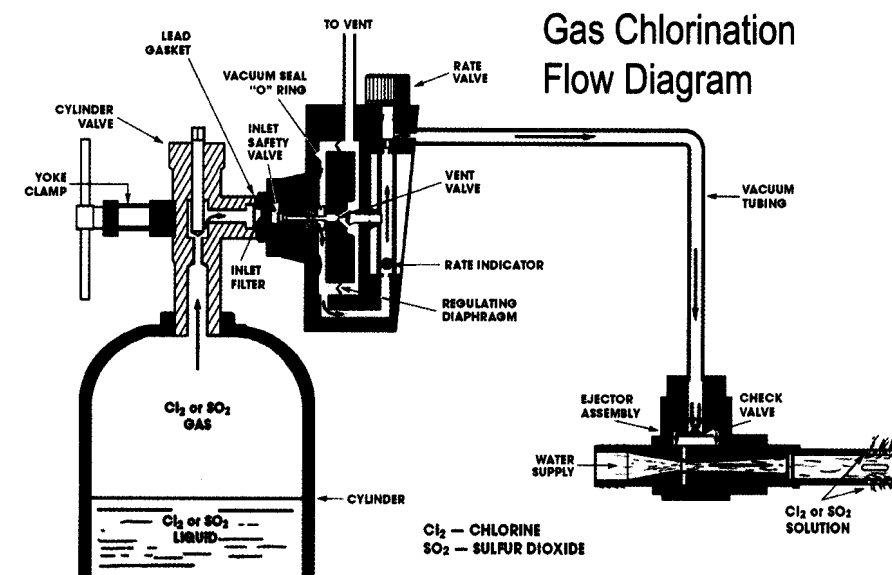
GAS CHLORINATION is used successfully in nurseries to control pathogens such as *Phytophthora* and *Pythium* in addition to algae and iron bacteria. Chlorine gas can be injected directly into irrigation water by an ejector designed to improve safety and precise dosage. Chlorine gas reacts quickly with water to form hypochlorous acid (a sanitizing agent) and hydrochloric acid.

chlorine gas (Cl_2) + water (H_2O) → hypochlorous acid (HOCl) + hydrochloric acid (HCl)

Chlorine gas has a slightly acidic effect on irrigation water pH at low concentrations (0.5 to 10 parts per million free chlorine at the chlorine source) at which it is usually applied. This acidity is an advantage because sanitation from hypochlorous acid is most effective at a slightly acid pH.

Greenhouses that have high-alkalinity water sometimes provide additional acid injection (usually sulfuric acid) to maintain the water pH in the optimal range of 6-7.5 for hypochlorous acid, or inject a higher dose of chlorine. When setting up an acid-injection system, inject the acid first for pH control before injecting the chlorine gas.

When chlorine gas is applied con-



tinuously (the most commonly used method), enough chlorine is injected to maintain 0.5 to 2 ppm of free residual chlorine at remote outlets in the irrigation system. Research has found that 2 ppm of free residual chlorine at pH 6-7.5 successfully controls zoospores of *Pythium* and *Phytophthora*. This level of chlorine also controls algae and slime from iron bacteria.

When, where to inject gas

Algae and iron bacteria, which cause slime to form in irrigation lines or filters, can be controlled with chlorine gas. However, chlo-

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Gas chlorination works for Lancaster Farms

Gas chlorination isn't a new idea. Almost three decades ago, the operators of Lancaster Farms, a 200-acre wholesale container nursery in Suffolk, Va., discovered that the recycled water used in the company's irrigation system was introducing disease pathogens to all of its nursery stock, especially *Phytophthora* and *Pythium* in azaleas. As a result, the nursery installed chlorine gas treatment equipment in 1979 to clean and maintain the irrigation system.

"Pathogens in our recycled water got to be so bad, it was about to put us out of business," said Bill Daughtry, Lancaster Farms vice president, herbicides and water specialist.

"We tried fungicides of different combinations and rates, but nothing seemed to take care of the problem. We knew of a nursery in New Jersey that was using chlorine gas. We thought they were crazy. But when gas chlorinators changed to vacuum systems they became much safer."

Lancaster Farms initially installed a gas



Bill Daughtry said the gas chlorinators his company installed reduced the loss of plants due to disease and cut fungicide costs in half.



chlorinator in only one pump house.

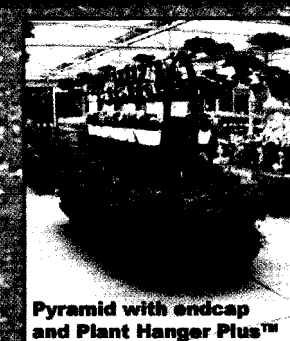
"We couldn't believe the difference it made in just 30 days, so we installed them in the other pump houses," Daughtry said. "It turned the whole nursery around. Our plants were so much healthier. We paid for the equipment the first year and it cut our fungicide costs in half."

Proper handling and training are key components with gas chlorination (as with all chemical treatments). Lancaster Farms has trained a select group of four employees to operate the gas chlorinators.

The company uses 1.3 million gallons of water per day that is treated with continuous gas chlorination. Sixteen Regal gas chlorinators treat the water pumped from six ponds. Daughtry said the direct-cylinder-mounted gas chlorinators are quick to install and easy to use and maintain.

For more: Lancaster Farms, (800) 336-2200; www.lancasterfarms.com. Chlorinators Inc., (800) 327-9761; www.regalchlorinators.com.

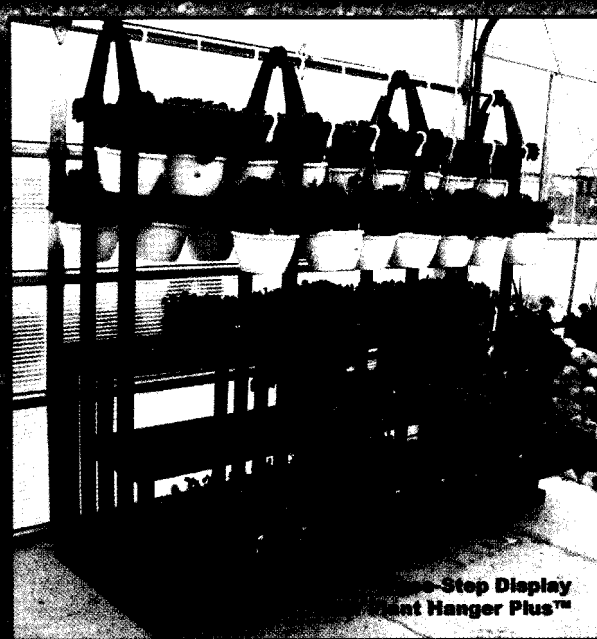
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rine gas is most effective for preventive maintenance on a new or clean irrigation system. An irrigation system already clogged with bacterial slime or deposits should be cleaned and sanitized before chlorine gas will be effective.

Gas chlorine should be injected ahead of water filters. Chlorine passing through the filters prevents bacterial growth from occurring inside each filter. Treating with chlorine immediately after back-flushing reduces the amount of chlorine required and minimizes the sticking action of slime that becomes trapped in the filter.

To improve safety, manufacturers have developed chlorine gas ejectors that work on a vacuum principle. A venturi ejector creates a vacuum,

which actuates the gas ejector. This design prevents chlorine gas from being added unless the irrigation system is operating so that the gas is immediately dissolved in the irrigation water.

Chlorine gas released into the air is toxic. As with other sanitation chemicals, it is essential to use injection equipment designed with safeguards and to train employees how to correctly operate the equipment.

Chlorine gas costs about \$1 per pound (average U.S. cost). Depending upon water quality and chlorine demand, 1 pound of chlorine gas can treat 24,000 gallons of irrigation water, based on a dosage of 5 ppm. The operating cost for chlorine gas is very favorable compared to other

sanitation chemicals.

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Chemical names and trade names are included as a convenience. The use of brand names and any mention of commercial products or services does not imply endorsement by the University of Florida, nor discrimination against similar products or services not mentioned.

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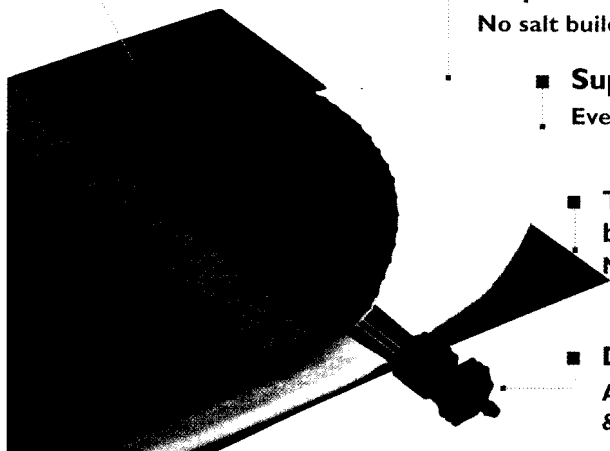
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