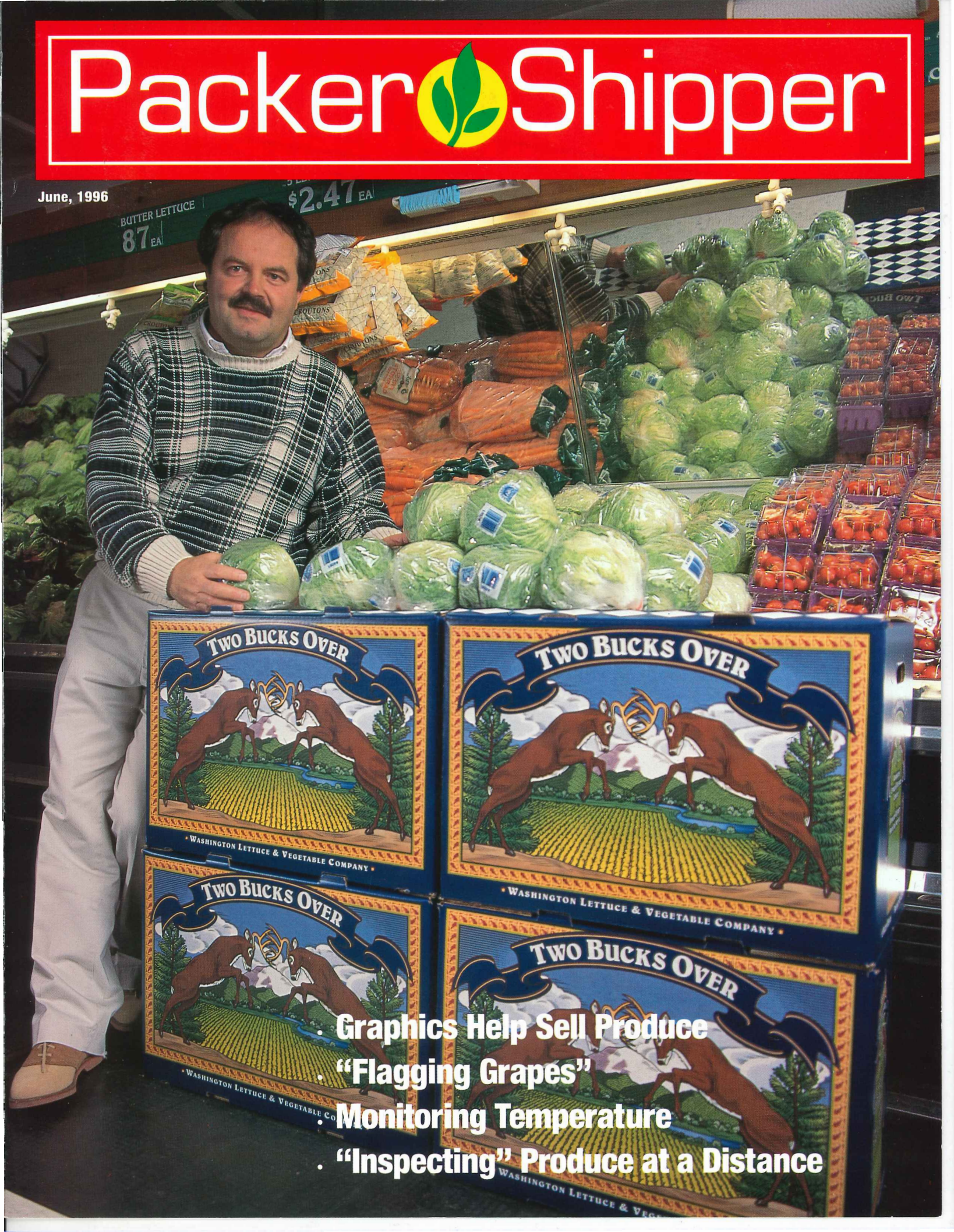
Packer Shipper

June, 1996



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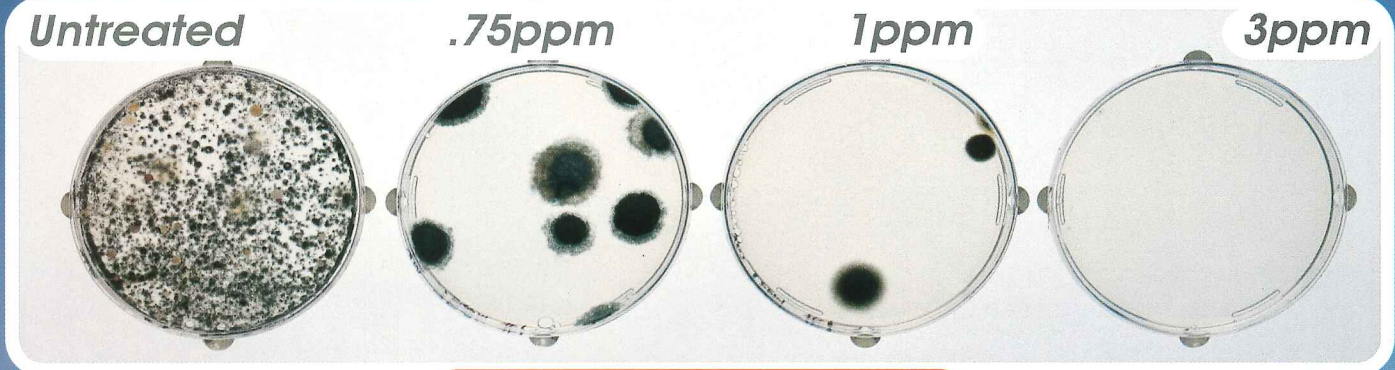

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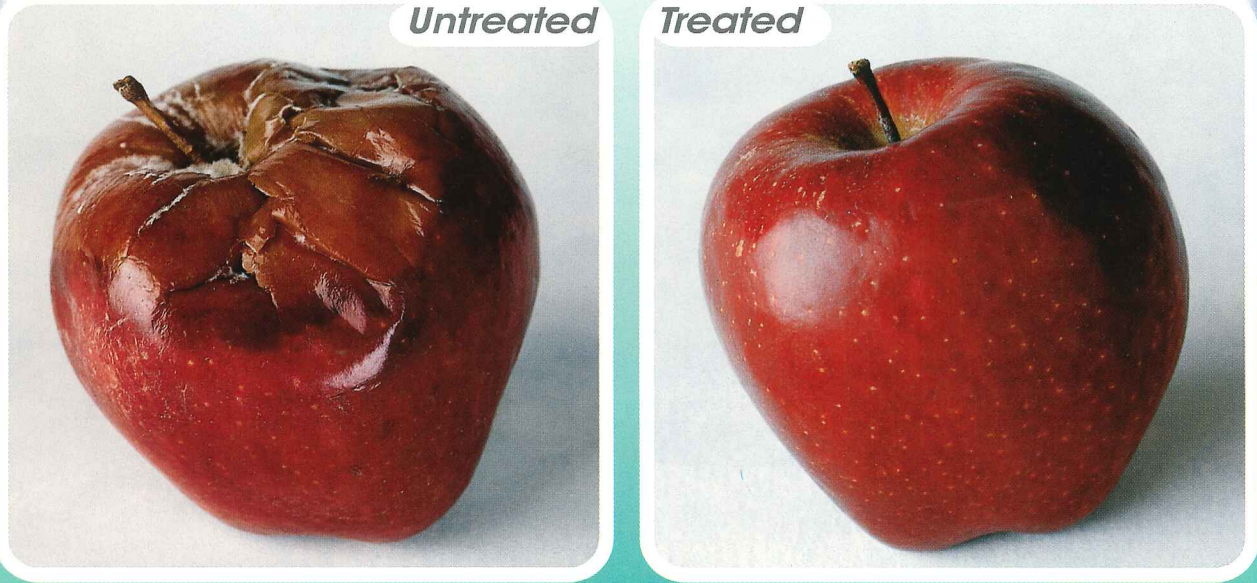

CH2O INTERNATIONAL

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Chlorine Dioxide: An Alternative to Chlorine?

Northwest fruit packers are looking for alternatives to traditional sodium hypochlorite as a sanitizer and some are turning to chlorine dioxide as an alternative.

"We're trying to get away from chemicals, period," according to Randy Grimes, maintenance supervisor at Clasen Fruit & Cold Storage in Yakima, Washington. "That's why we went this way. It's safer and more of a peace–of–mind thing."

Clasen uses a system manufactured by CH_2O International of Olympia, Washington, that generates chlorine dioxide on–site for use in the packinghouse. CH_2O officials say the firm has sold more than 50 such units in the Washington fruit industry since they began manufacturing them.

"I like it because it isn't chlorine and I can control my pH in my tanks," Grimes says. "It's safer."

At Stadelman Fruit, Inc., in nearby Zillah, Washington, plant manager Jan Daley says he has been using a CH_2O unit for about two years and saving money on sanitizing costs.

"We don't have to run as high in parts per million as we did before to be effective," Daley explains. "We're definitely glad we made the change."

Chlorine dioxide is a biocide which can be used in three separate areas of the packinghouse, according to Dr. Gary Apel of Michelsen Packaging Company, Yakima, Washington. It can be used for treating process water, sanitizing hard surfaces and sanitizing fruit wash water.

"To understand why chlorine dioxide might be used instead of hypochlorite for water treatment, we must delve into basic chlorine chemistry," Dr. Apel wrote in the June, 1993, issue of the Washington State University Tree Fruit Postharvest Journal. "Chlorine is lethal to fungi and bacteria at very low concentrations, like a few parts per million. Yet the recommended dosage rates for process waters are in the neighborhood of 100 parts per million.

"When you add sodium hypochlorite to a fresh dump tank on Monday morning, some of the hypochlorite will take on a hydrogen ion and become hypochlorous acid. The amount that becomes hypochlorous acid and the amount that stays as hypochlorite ion depends on the pH of the water. At a pH of about 7.5, the two forms will be present in equal concentrations.

"Chlorine test kits are designed to measure either free chlorine or total chlorine. Both hypochlorous acid and hypochlorite ion are considered to be free chlorine. They are not equally effective as disinfectants, however. Depending on the target organism, hypochlorous acid may be 100 times more effective than hypochlorite ion."

Apel warned that free chlorine reacts with organic compounds to form trihalomethanes like chloroform, a priority pollutant which has prompted free chlorine effluent limits in wastewater discharge regulations in Washington state. Because chlorine combines with ammonia and ammonia–like compounds to form chloramines, some of the effectiveness of wash water may be lost. This is especially true, the longer the solution has been in use, according to Apel.

"In well–used process waters, such as a five–day–old dump tank, all of the chlorine will probably be in combined form," Apel wrote. "Although some chloramines can be disinfectants, their activity is much slower than free chlorine. The point is that for a constant level of total chlorine, as water quality changes, it becomes increasingly difficult to determine just what form the chlorine will take and whether it is adequately disinfecting the tank."

While chlorine dioxide has drawbacks, too, it is different from sodium hypochlorite in a number of significant ways.

First of all, chlorine dioxide is not affected by pH because it merely dissolves in water and does not react with it.

"Unlike chlorine, you may use chlorine dioxide in combination with acid," Apel wrote. "Chlorine dioxide does not form trihalomethanes or other chlorine–additive products. Chlorine dioxide does not form chloramines.

"There is little ambiguity about the concentration of chlorine dioxide. If an adequate residual of chlorine dioxide exists, the water is being disinfected. Because it is less involved in competing reactions, it is much easier to maintain an effective residual of chlorine dioxide. Maintaining a residual disinfectant throughout the water stream destroys spores as soon as they enter the tank, an efficient, practical method."

Drawbacks include the fact that chlorine dioxide is not stable enough to be shipped and must be generated at the point of use, but units available from CH_20 International are self–contained, free–standing units in steel compartments which generate ClO_2 on–site. Precision metering equipment has been implemented to insure exact dilution rates of $Cl0_2$ for the product. Two spray bar application is standard on the equipment.

At the Washington State Tree Fruit Research and Extension Center in Wenatchee, Washington, Dr. Rodney Roberts reports he has studied the effects of chlorine dioxide against postharvest decay fungi and against filamentous fungi on fruit packinghouse surfaces.

"Chlorine dioxide has desirable properties as a sanitizing agent for postharvest decay management when residues of postharvest fungicides are not desired or allowed," Roberts writes. "Control of postharvest diseases of tree fruits, especially apples, pears and cherries, is becoming increasingly difficult. In 1989, loss of the postharvest registra

tion for benomyl (Benlate) and, in 1992, the loss of dichloronitroaniline (Botran) severely restricted the number of effective materials for control of postharvest decay in fruits.

"With the loss of several fungicides and decreasing residue tolerance for those that remain, sanitation of both fruit and environmental surfaces must necessarily take a more prominent position as a disease management tool."

Roberts says chlorine as hypochlorous acid (sodium hypochlorite in water) has long been the standard sanitizer for fruits and vegetables, but it has several disadvantages, including extensive corrosion of metal equipment, reliance on manual monitoring of chlorine concentrations, sensitivity to organic loads in the water and pH, and the formation of chlorinated by–products such as chloroform. Chlorine dioxide is proving to be a useful alternative.

"The antimicrobial activity of chlorine dioxide in the presence of high levels of organic matter such as those found in immersion dump tanks and flume processing waters is not diminished as readily as is that of chlorine," he writes.

Roberts studied aqueous chlorine dioxide in various concentrations against fungi for different contact times.

"Because the probability of decay development is strongly influenced by inoculum concentration, it seems prudent to implement a regular program of prophylactic treatment of packinghouse surfaces to minimize or prevent the growth and sporulation of fruit decay fungi, especially *P. expansum*," Roberts concludes. "Our data show that chlorine dioxide can be used to reduce inoculum in both aqueous and hard surface environments and may ultimately prove a tool in integrated management of postharvest diseases of fruits and vegetables." ■

Reducing Mold and Yeast Spores

Recent tests using chlorine dioxide (ClO_2) on apples at eight packing operations in Washington State resulted in "significant" reductions in mold and yeast spores on the fruit, according to CH_2O International, the firm that conducted the tests.

Mold and yeast spore counts were reduced 80 to 98 percent on apples treated with chlorine dioxide versus untreated fruit. Likewise, mold and yeast spores in dump tank water at the packing operations declined 80 to 90 percent after treatement with ClO_2 at .75 ppm and 98 to 99 percent on apples treated with 5 ppm ClO_2 through a spray bar.

The tests show low levels of ClO_2 can be effective as a fungicide for mold and yeast spores on apples, according to CH_2O officials, who are promoting their Fresh-Pak™ chlorine dioxide system as an alternative to chlorine gas and hypochlorite solutions as sanitizers for fruit.

In late 1995, the firm took swab samples from apples, dump tank water and other surfaces at eight apple packing operations at actual operating levels of ClO_2. Swabs were placed on potato dextrose agar media and analyzed 10 to 18 days later.

Among the findings: mold and yeast spores on apples rinsed in dump tanks treated with .5 ppm ClO_2 were, on average, 90 percent less numerous than those found on untreated apples. That also was true for dump tank water treated with .7 ppm ClO_2.

Reducing mold and yeast spores eliminates or significantly reduces product repacking, according to CH_2O International officials. Because ClO_2 is effective at low levels and does not produce undesirable byproducts (such as chloro-amines typically associated with gas chlorine or hypochlorite products), flume and dump tank water can be used longer and disposal costs are reduced. Tests have also shown equipment corrosion rates for chlorine dioxide are much lower than when using gas chlorine or hypochlorite solutions.

Contact CH_2O International, Olympia, Washington, (360) 943-6063 or (800) 445-0450 (outside Washington) or (800) 562-6184 (inside Washington). ■

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