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PACKINGHOUSE NEWSLETTER

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All previous and present Packinghouse Newsletters (PHNL) are available on the Internet at the University of Florida's postharvest web site (http://postharvest.ifas.ufl.edu) and can also be accessed through our citrus resources web site (http://flcitrus.ifas.ufl.edu). Those who signed up to receive the PHNL via e-mail should have already received a copy electronically. Please contact me if you wish to sign up for electronic delivery or if you did not receive your electronic copy.

Sanitizers for Citrus Packinghouse Recirculated Water Systems

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Proper sanitation of water (especially recirculated water) used in drenches, dump tanks, etc. of fresh citrus packinghouses is important for delivering quality produce to the consumer. Not only do unsanitary conditions promote direct product loss through decay, but rising food safety concerns regarding human pathogens are becoming increasingly important to consumers. Because water is one of the most common carriers of pathogens, it must be treated (either chemically or physically) to prevent the accumulation of pathogens in the water, and prevent inadvertent contamination of clean produce. Such chlorine treatments are not particularly effective at reducing pathogen levels already on the surface of produce; it is much more effective to prevent contamination in the first place.

Although chlorine is currently the sanitizer of choice for most fresh citrus packinghouses, other chemicals have been approved by the EPA for contact with food products. This article briefly lists some of the approved antimicrobial chemicals and discusses advantages and disadvantages of using each.

Chlorine

Chlorine is currently the predominant method used by citrus packinghouses to sanitize water systems. Although chlorine is available in three forms - sodium hypochlorite, calcium hypochlorite, or chlorine gas - it is the resulting hypochlorous acid (HOCl) form in aqueous solution that is primarily responsible for killing pathogens. In high pH solutions, most of the hypochlorous acid disassociates to form hypochlorite ion (OCl^-), which is much less effective at killing pathogens than HOCl. Chlorine solutions with pH above 8 are relatively ineffective against pathogens. Free chlorine testing kits measure both HOCl and OCl^-. For this reason, both pH and free-chlorine must be measured in order to know the sanitizing strength of one's chlorine solution. For citrus, IFAS recommends maintaining a minimum concentration of 75 parts per million (ppm) of free chlorine and a pH between 6.5 and 7.5. Recent studies suggest that greater than 100 ppm chlorine is needed to effectively kill some pathogens.

The main advantages to using chlorine are that it is effective at killing a broad range of pathogens and is relatively inexpensive. It also leaves very little residue or film on surfaces. However, chlorine is corrosive to equipment and water pH must be monitored and adjusted often to maintain chlorine in its active form. Continual addition of chlorine without changing the water can result in the accumulation of high salt concentrations that may injure some produce, though citrus does not appear to be sensitive to concentrations below 10,000 ppm Na. Further, chlorine can react with organic matter to form small amounts of trihalomethanes (THMs) that are thought to be carcinogenic. However, the relative risks from chlorine-generated THMs on the surface of fresh horticultural produce is extremely low.

Chlorine dioxide (ClO_2)

Chlorine dioxide is a synthetically produced yellowish-green gas with an odor similar to chlorine. ClO_2 is typically used at concentrations between 1 and 5 ppm. However, it usually must be generated on-site since the concentrated gas can be explosive and decomposes rapidly when exposed to light or temperatures above 50 ^oC (122 ^oF). These concentrated gases also pose a greater risk to workers than sodium or calcium hypochlorite. Noxious odors from off-gassing can be a common problem, especially at higher concentrations, which restricts the use of ClO_2 to well-ventilated areas away from workers. Unlike chlorine, ClO_2 does not hydrolyze in water and is virtually unaffected by pH changes between 6 and 10. It does not react with organic matter to form THMs. Some generators produce free chlorine in addition to ClO_2, which may form THMs. ClO_2 may produce other potentially hazardous byproducts (e.g. chlorate and chlorite). One additional drawback is that simple assays to monitor chlorine dioxide concentration are not currently available.

Peroxyacetic Acid (PAA)

Peroxyacetic acid (e.g. Tsunami) is a strong oxidizer formed from hydrogen peroxide and acetic acid. The concentrated product (40% PAA) has a pungent odor and is highly toxic to humans. PAA is very soluble in water with very little off-gassing and it leaves no known toxic breakdown products or residue on the produce. Unlike chlorine and ozone, it is stable in water containing organic matter, which can greatly increase the longevity of the sanitizer, and it is not particularly corrosive to equipment. PAA is most active in acidic environments (pH 3.5 to 7). Activity declines rapidly at pHs above 7-8. High temperatures and metal ion contamination also reduce its activity.

Ozone (03)

Ozone is a water soluble gas formed by splitting O_2 (with electricity or UV light). The resulting individual oxygen atoms further react with additional O_2 to form O_3. Ozone gas is one of the strongest oxidizing agents and sanitizers available and is highly corrosive to equipment including rubber, some plastics and fiberglass. It is approved for food contact applications. Although ozone is not particularly soluble in water (30 ppm at 20 ^{o}C or 68 ^{o}F maximum), concentrations as low as 0.5 to 2 ppm are effective against pathogens in clean water with no soil or organic matter. In practice, concentrations as high as 10 ppm are difficult to obtain, and concentrations of 5 ppm or less are more common. There have been reports that ozone may induce resistance to subsequent fungal attacks in some horticultural products.

Ozone decomposes quickly in water, having a half-life of 15 to 20 minutes in clean water, but less than a minute in water containing suspended soil particles and organic matter. Thus, ozonated water should be filtered to remove these particulates. The antimicrobial activity of ozone is stable between pHs of 6 to 8, but decreases more rapidly at higher pHs. Ozone breaks down to oxygen and no toxic by-products have been reported. Ozone efficacy is diminished when dissolved iron, manganese, copper, nickel, hydrogen sulfide, or ammonia are present in the solution.

Because of its strong oxidizing potential, ozone is toxic to humans and must be generated on-site. Prolonged exposure to more than 4 ppm ozone in air can be lethal. Ozone has a pungent odor that can be detected by humans at 0.01 to 0.04 ppm. OSHA has set worker safety limits in air of 0.1 ppm exposure over an 8 hour period and 0.3 ppm over a 15 minute period. At concentrations in water above 1 ppm, off-gassing can result in concentrations in the air that exceed OSHA limits of 0.1 ppm.

Update on Grapefruit Quaternary Ammonia Injury

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As a follow-up to our previous report of quaternary ammonia (QA) injury on grapefruit peel (PHNL # 192), additional experiments were conducted in April of 2001 to determine if late-season fruit differed in their susceptibility to the injury and if treatments of 200 ppm chlorine (sodium hypochlorite), surfactant alone (0.025% N-101) or surfactant with 200 ppm chlorine caused peel injury. We found that late season fruit is just as susceptible to QA injury as earlier season fruit and that none of the additional treatments caused significant peel injury. The following points summarize research to date:

- Grapefruit contact with either fresh QA solutions or their re-dissolved residues (both as low as 300 ppm) can cause peel injury.
- Severity of peel injury increases as QA concentration increases.
- Contact of dry fruit with dry QA residue does not normally result in peel injury.

- Treatment of grapefruit with 200 ppm chlorine, surfactant alone, or chlorine with surfactant does not result in significant peel injury.
- Late-season fruit are as susceptible to QA injury as earlier season fruit.

Recommendations for preventing QA injury:

- Assure that the top manifolds of grove canker spray stations are turned off when trucks hauling fruit exit groves so that only the truck undercarriage, and not the fruit, receives the sanitizing treatment. Application directly to the fruit can result in severe damage.
- Rinse bins with fresh water after QA treatments in the packinghouse. Alternatively, sanitize bins with 200 ppm chlorine (pH between 6 and 7.5) instead of using QA.

Fortieth Annual Citrus Packinghouse Day

Thursday, August 30, 2001
Citrus Research and Education Center
700 Experiment Station Road, Lake Alfred, FL 33850

Mark your calendar for this year's Citrus Packinghouse Day on August 30th. Registration opens at 8:30 AM and the program begins at 9:30 AM. This year's theme is "Food Safety." Our keynote speaker is Dr. Jim Rushing from Clemson University who will discuss how food safety issues have affected other fresh produce industries and what Florida's citrus industry might learn from their experiences. Other local academic and industry presenters will address a number of important food safety issues for Florida's citrus packinghouses. Principals of food safety contained within the FDA's "Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables" will be discussed focusing on their application to citrus packinghouses. Researchers will also provide practical information on how to monitor microbial populations within packinghouses and discuss what "Traceback" means, why is it important, and how it can be implemented in our industry. A representative from Publix supermarkets will discuss their food safety requirements for fresh produce suppliers, and representatives from the Florida Citrus Packers Association will present their views on how food safety issues are affecting Florida's fresh citrus industry.

Not neglecting other important issues to fresh citrus packers, we have included updates on some exciting work on postharvest decay control and will present results on reducing stem-end rind breakdown. Finally, with the improving technology for optical grading and sorting, we will have a presentation on economic/labor factors involved in determining whether or not to invest in such a grading system.

Thanks to a generous donation from FMC FoodTech, one of several changes this year is that lunch is both improved and FREE for the first 200 people who register!! Representatives from FMC and more than 30 other leading companies will be on hand to provide valuable information for your business. We look forward to seeing you at this important event!