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PACKINGHOUSE NEWSLETTER

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EXPERIENCES WITH OZONE FOR CITRUS DECAY CONTROL

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Recently, we have had several inquiries about the use of ozone to control decay of citrus fruit. Since several studies have been conducted with ozone for the control of spoilage in fresh fruits and vegetables, a summary of the citrus information follows.

What is ozone - Ozone is triatomic oxygen (O_3) which is similar to the oxygen we breathe (O_2). Ozone is found in the atmosphere at varying concentrations of 0.02 - 0.03 ppm, to levels as high as near 1 ppm under air pollution (e.g. smog) conditions. In these situations, it is formed in reactions with organic compounds associated largely with emissions from vehicles. Ozone has a pleasant, characteristic odor at concentrations less than 2 ppm, and is most irritating and injurious to the eyes and respiratory system at higher concentrations. Ozone is a powerful oxidizing agent that is highly unstable and must be generated at the site of application. Ozone is highly corrosive to rubber, fabrics, dyes and plastics. Glass and stainless steel, however, are resistant.

How is ozone generated and what are its uses and applications - Ozone is usually generated by passing dry air between two plate electrodes connected to an alternating current source of several thousand volts. Ozone has been used extensively as a disinfectant for air and water by virtue of its oxidizing power. In Europe, particularly in France, and in Canada, ozone has been used as a disinfectant in water treatment plants and swimming pools. It also is used as a bleaching agent in other industrial applications. In comparison to other disinfectants, ozone is ranked in the following order of decreasing efficiency: ozone > chlorine dioxide > hypochlorous acid > hypochlorite ion > dichloramine > monochloramine.

Ozone has been tested as a fumigant for the control of postharvest diseases. Numerous investigators have shown that at levels tolerated by fresh fruits and vegetables, ozone will not prevent development of decay after infection. Ozone will prevent growth and sporulation of fungi on the surface of produce, reduce viability of fungal spores in the atmosphere of storage rooms, and destroy offensive odors that may accumulate during storage. Being a strong oxidant like chlorine, ozone is also rapidly inactivated by reducing substances, such as organic matter in water, or plant tissue exposed at infection sites of harvested produce.

How has ozone been tested on citrus fruit and what have been the results - Ozone atmospheres have been tested as fumigants on citrus fruit for decay control during storage. A paper describing citrus decay control with ozone was published in 1949 by scientists E. F. Hopkins and K. W. Loucks of this laboratory. In their treatments, fruit were subjected to ozone for several minutes to 4 hours. Under their conditions, the ozone treatments at high concentrations caused fruit pitting in some cases, and an increase in stem-end rot and green mold. In other tests at lower ozone concentrations where pitting did not occur, mold was not affected but stem-end rot was increased. They concluded that while their results did not preclude the existence of an effective decay preventive treatment with ozone, they had no conclusive evidence that it was effective.

In a study in California in 1968, P. R. Harding, Jr. reported that storage of oranges and lemons in wooden crates for 15 days in an atmosphere of 1 ppm ozone effectively prevented sporulation of Penicillium digitatum (green mold) on infected fruit. It had relatively no effect on sporulation if fruit were packed and stored in vented or nonvented cartons. Once fruit were removed from ozone, sporulation resumed within 48 hours. Apparently, this method of ozone application was never adopted for commercial use. Problems of economics, application, equipment, and worker exposure may have circumvented its use.

REFERENCES

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HOPKINS, E. F. and LOUCKS, K. W. 1949. Has ozone any value in the treatment of citrus fruit for decay. The Citrus Ind. October, 3 p.

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SEPARATOR CHOICES FOR COLD DAMAGED CITRUS FRUIT

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Citrus fruit damaged by cold will dry internally making it possible to separate the more severely damaged from the less damaged or undamaged fruit by differences in specific gravity. In simple terms, the dryer ones are lighter in weight.

The first effective separators used water emulsions with "oil" (actually mineral spirits) to vary the specific gravity of the emulsion making the lighter fruit float. There are still a few of these separators in Florida.

The next generation water separator was larger, used only water in a fast-flowing, pump-driven stream and relied on the fact that lighter fruit would rise faster in the water stream than heavier fruit. There are several of these water separators in Florida. Both of the water separators are discussed in Circular 372 (see Available Publications) and in Chapter 11 Fresh Citrus Fruits.

An electronic separator found in California uses X-rays to detect internal dryness. This type of machine was brought to Florida in 1982 to attempt to separate freeze damaged fruit. There is presently not a separator of this type in Florida.

New technology may allow fruit to be separated for specific gravity using a cup sizer which has the capacity to size both by weight and size (actually volume estimated by optical measurement of fruit diameter). A few of these sizers are in place in Florida citrus packinghouses, and pending the availability of fruit one or more will be used commercially for freeze damaged fruit separation. The three Available Publications by W. Miller address some of the work leading to this new use for these sizers.

Of the three methods presently in Florida, the latter with no water is obviously less messy. None are easy, and all when done properly will yield about the same results. Oranges are easier to separate than grapefruit. It is not uncommon to have 25% of the packable fruit removed with the freeze damaged fruit. Even with this severe limitation, there can be economic justification to separate freeze damaged citrus fruit.

Some tips for efficient separation include: 1) eliminate all possible nonpackable fruit (e.g., small, blemished) before the separator, 2) separate fruit as an independent operation from packing, 3) do not overload the separator unit, 4) provide easy access to adjustment controls preferably at the sampling station, 5) calibrate and record settings for controls, 6) make the sampling station convenient for both the packable and eliminated fruit, 7) use prepared record sheets for each fruit lot to include all the crop data and settings data, 8) assign one skilled operator for each separation shift and 9) be prepared for constant adjustment during operation as the crop varies.

CITRUS PACKINGHOUSE DAY

The twenty-ninth Citrus Packinghouse Day is scheduled Thursday, September 6, 1990 at the Citrus Research and Education Center, Lake Alfred. Registration will begin at 8:30 AM where lunch tickets may be purchased. Equipment displays will be in the afternoon. More details will be published in a later Packinghouse Newsletter.

AVAILABLE PUBLICATIONS

Available from Dr. W. Wardowski, CREC, 700 Experiment Station Road, Lake Alfred, FL 33850

Three articles listed under References in ozone article in this issue.

Separation and Grading of Freeze Damaged Citrus Fruits, by W. F. Wardowski and W. Grierson. Fla. Coop. Ext. Serv. Circ. 372. April 1972.

Automated Density Separation for Freeze-Damaged Citrus, by W. M. Miller, K. Peleg, P. Briggs. Applied Engineering in Agriculture 4(4): 334-348. 1988.

Comparison of Two Classification Approaches for Automatic Density Separation of Florida Citrus, by W. M. Miller. 1989 International Summer Meeting of the American Society of Agricultural Engineers. Paper No. 88-6020

Mechanical and Physical Properties for Postharvest Handling of Florida Citrus, by W. M. Miller. Proc. Fla. State Hort. Soc. 1986. 99: 122-127.

Methods for Reducing Acidity in Citrus Fruit, by W. C. Wilson. Proc. Fla. State Hort. Soc. 1988. 101: 157-161.

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Enzymes of Sugar and Acid Metabolism in Stored 'Valencia' Oranges, by E. Echeverria and J. Valich. J. Amer. soc. Hort. Sci. 1989. 114(3): 445-449.

Available from J. Whigham, Division of Fruit and Vegetable Inspection, P. O. Box 1072, Winter Haven, FL 33882-1072

1988-89 Season Annual Report (Citrus)

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