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PACKINGHOUSE NEWSLETTER

W. Wardowski, Editor
CREC
700 Experiment Station Road
Lake Alfred, FL 33850
Phone (813) 956-1151

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DRYER FUNDAMENTALS

Heated air drying is implemented in Florida citrus packinghouses to vaporize residual moisture after water wax application. Also, drying is required prior to solvent wax application as a surface dry fruit is necessary for proper wax adherence.

A drying unit operation should be analyzed as a function within an integrated packingline. For example, excessive wax application will decrease the efficiency of heated-air drying, while dewatering can significantly reduce the dryer moisture load. Dryer capacity can be increased through pregrading and presizing. Also, allowing debris such as small twigs to reach a dewatering unit can cause excessive wear. Inadequate pregrading may allow split fruit to enter the waxer. Resultant acidity may break down certain wax emulsions thereby making the dryer operation more difficult.

In forthcoming Packinghouse Newsletters, surface drying fundamentals for citrus packing will be reviewed. Topics will include dewatering, energy sources, energy conservation techniques, and surface drying phenomena. In this first section, associated operations, specifically mechanical dewatering will be addressed.

Part A. - Dewatering

Dewatering is the process of removing free surface water. For fresh fruit and vegetables, this surface water is typically residual moisture from washing. Such water is eliminated to facilitate further packinghouse operations and to reduce energy costs for heated-air drying. Techniques that are currently employed include either rotary brushes and rollers (sponge, PVC, or metal) or aerodynamic removal with a high pressure blower. Another process that may be applicable is a vibrating conveyor; this system is used extensively in water removal from minerals but may be too mechanically abusive for fresh produce.

Sponge and brush rollers (Fig. 1) will be discussed in detail as they are the most common dewatering systems found in Florida citrus packinghouses. A flicker bar deflects the brush bristles so the water is directed downward into the drain pan. For secondary moisture elimination from sponge rollers, a PVC or metal wringer roller with a wiper blade arrangement is designed for water removal. Both flicker bars and wringer rollers should be vertically adjustable to control the deformation and pressure. Water removal from a wringer is accomplished with a wiper blade. New sponge rollers should be washed thoroughly with neutral cleaner before their initial use. Some houses prefer to "break-in" new brushes by placing fruit or a plywood sheet on a rotating brush bed for a sufficient period (normally 2 to 4 hours) to reduce the brush's rigidity and sharp edges.

Table 1. Comparison of test dewatering techniques with heated-air drying for fresh citrus.

Water removal technique	WRE[a] %	UEC[b] kJ/kg-H_2O	Total energy[c] kJ/kg-H_2O
Heated-air @ 50°C, (122°F)	100	5015	6270
Brush and adsorber roller	85	220	750
PVC roller with wiper blade	83	90	300
Air strip flow amplifier	58	2070	34770
Blow-off nozzles	72	945	15850
High pressure blower-air knife	54	220	1040

[a]Water Removal Effectiveness.

[b]Unit Energy Consumption

[c]Includes process efficiencies of dryer, power plant, electric motor, air compressor, blower, boiler, and heat transfer.

Brush or roller spacing is a nominal 5 inches with the brushes or rollers of approximately 4.75 inch diameter. Rotational speeds from 80 to 150 rpm are common. The initial design of a wide packingline is preferred, as linear advancement of the fruit can be kept low and then increased to accommodate plant expansion. Automatic clean-out and automatic shut-off procedures should be implemented to eliminate the chance for injury (brush burn) to the fruit. Also, fruit sensitivity should be considered. In Florida, brush damage to tangerines occurs most frequently.

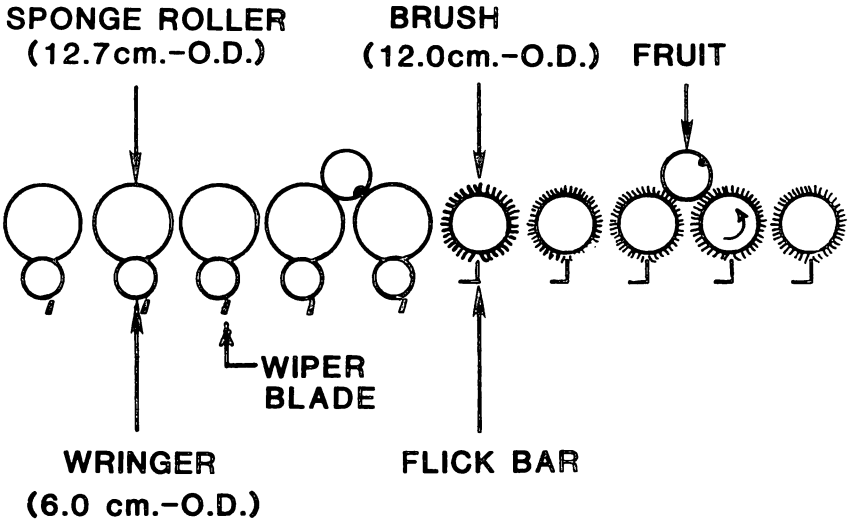

Fig. 1. Sponge and brush roller arrangement for dewatering fresh citrus.

Mechanical dewatering units, properly installed and maintained, will remove 70 to 90% of the residual surface water after washing (Table 1). Expected efficiencies for various units are cited in Table 1 based on water removal effectiveness (WRE) and unit energy consumption (UEC). After dewatering, the remaining water will be distributed equally, facilitating water wax distribution and water vaporization. The low efficiencies of associated equipment, such as electric motors, blowers, and compressors, negated any benefits of the aerodynamic techniques. Note that contact-type water removal required significantly less energy than heated-air.

The benefits in mechanical dewatering are important in that: energy required for surface drying can be reduced and limited dryer capacity may be overcome thereby increasing the overall packingline capacity.

Bill Miller
CREC, Lake Alfred

You may wish to join me in congratulating Dr. Miller on his well-deserved recent promotion to Professor.

Editor

AVAILABLE PUBLICATIONS

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

Packinghouse Newsletter Index for Issues 1-144.

"Decision model for computer-based grade separation of fresh produce" by W. M. Miller. Amer. Soc. Ag. Eng. 28(4):1341-1345. 1985.

"Non-parametric estimation of automated weight-filling machinery for fresh citrus" by W. M. Miller. J. Food Eng. 5:95-107. 1986.

"Prediction of energy requirements and drying times for surface drying fresh produce" by W. M. Miller. Trans. ASAE 1(2):87-90. 1985.

"Diagnostico y tratamiento de los envenenamientos con plaguicidas" by Donald P. Morgan, M.D. U.S. EPA Publication. 122 pp. 1982. (Spanish).

Available from Ing. Agr. Beatriz Stein, Estation Experimental Agro-Industrial Obispo Colombres, Casilla de Correo 71, 4000 S.M. de Tuchman, El Colmenar, Tuchman, Argentina

"Control de podredumbre amarga en limones" (Sour rot control in lemon fruits) by Beatriz Stein and J. L. Foguet. Nota Tecnica 44. Rev. Ind. y Agricola de Tuchman. 61(2):153-157. 1984. (Spanish with English summary.)

Available from Dr. R. Casamayor, Estacion Experimental de Citricos, Jaguey Grande, Matanzas, Cuba

"Paclobutrazol in citrus under tropical conditions: effects on vegetative growth and yield components" by R. Delgado, R. Casamayor, J. L. Rodriguez, P. Cruz, and R. Fajardo. 1984. (17 pages typed manuscript in English.)

Available from IFAS Software Communication and Distribution, G022 McCarty Hall, University of Florida, Gainesville, Florida 32611

"IFAS Grove Records System for the IBM Personal Computer," Price $27.

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Will Wardowski
Extension Service
Lake Alfred