PROBLEMS AND POSSIBILITIES WITH PARALLEL-FLOW PRUNE DEHYDRATION

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Prior to 1918 nearly all prunes were sun dried. Early rains in California in 1918 and again in 1919 caused considerable damage to the prune crops. As a result of this damage, research was started to investigate mechanical dehydration of prunes. Professors Cruess, Christie, and Ridley developed the design characteristics used in building the early mechanical prune dehydrators. The percentage of the prune crop dehydrated in mechanical dehydrators grew considerably during the 1920's and 1930's. By 1948 Dr. Mrak estimated that over 80% of the prune crop was mechanically dehydrated. Today there is very little sun drying of prunes.

About three and a half years ago work directed toward improving prune dehydrator performance was undertaken at the University. The Department of Food Science and Technology, the Department of Pomology, and the Department of Agricultural Engineering, cooperated on this project. Prior to this time, the dehydrators used to dry prunes were tunnel dehydrators operated in a counter-flow method. In counter-flow operation the drying air is introduced into one end of the tunnel and moves in a direction opposite to that of car progression. The driest fruit comes into contact with the warmest air. The maximum safe temperature that can be used in counter-flow operation is 165°F.

Our investigations were directed toward parallel-flow dehydration. In parallel-flow operation fruit and air pass through the dehydrator in the same direction. Parallel-flow operation is characterized by very fast drying conditions in the portion of the tunnel where the fruit to be dried is still very wet. The results of this investigation look very promising, and a few commercial dehydrators were converted to parallel-flow operation during the 1964 season. These few dehydrators dried approximately 6,000 tons of prunes. The results of this trial run look so encouraging that in 1965 approximately 200 prune dehydration tunnels were operated in a parallel-flow manner.

In converting to parallel-flow operation the first problem encountered is reversing the flow of either the air or the fruit. In some operations it has been simpler to reverse the flow of fruit, and in other operations it has been easier to reverse the flow of air. Both methods have worked satisfactorily.

Another problem in parallel-flow operation is keeping enough fruit on trays to keep the tunnels going. It is important that the tunnel be kept full of cars and that a new car is inserted at each of the predetermined time intervals. This often requires additional trays and a scheduling of the spreading operation.

Burning or caramelizing of fruit on the top trays is a serious problem in parallel-flow operation. This burning is caused by too much space between the top tray and the ceiling of the dehydrator. Air velocities of twice those through the center of the car have been measured above the top tray in many dehydrators. It should be possible to baffle this space, but because of variation in car height (up to 2 inches) an effective system of baffles has not yet been designed. Two methods used to overcome this burning problem have been (1) to not put fruit on the top tray, and (2) to reduce the temperature on the hot end from the recommended 195°F to 185°F. Reducing the temperature increased drying time about 10 percent.

Fuel availability has been a problem at some dehydrators. Fuel should be available at a rate of approximately 40-50 percent faster than with counter-flow operation. Fuel and burner problems can be solved by consulting the fuel supplier and burner manufacturers.

Among the possibilities and advantages with parallel-flow operation are increased dehydrator capacity and a more uniform product with less heat damage. Dehydrator capacities have reportedly been increased from 30 to 100 percent. For the most part growers, dehydrator managers, and tunnel men like parallel-flow operation. Growers like parallel-flow because there is less tendency to over dry and therefore less tendency for heat damage. Dehydrator managers, after they have established drying times, like parallel-flow because they know exactly how many tons of prunes they can dry in any given day. Tunnel men, after they have become trained, like parallel-flow because it is a time clock operation, and they do not have to make any decisions.

Because parallel-flow dehydration is a time clock operation, it makes possible automation of prune dehydrators. An electronic operator for a prune dehydrator has been designed and built. After a time period, that is adjustable to one-minute intervals, this operator stops the dehydrator fan. Then after a 10-second delay the door opens, a car of dried fruit is removed from the tunnel, a car of fresh fruit is put in the tunnel, and all the cars in the tunnel are advanced one position. The door is then closed, the timer reset, and the fan starts. The cars of fresh fruit on the outside slab are then advanced until there is a car in ready position. This automatic operator is considered too expensive for commercial application, but a manually controlled version that would permit one man to operate a 30 to 40 tunnel plant is being designed.

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