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Since Circular AIC-63 entitled "Recovery and Utilization of Natural Apple Flavors" was published, in September 1944, additional information has been obtained pertinent to the design of equipment for the process.

To insure complete recovery of the aroma, the first step of the process necessitates the vaporization of 10 percent of the fresh juice. The heating and vaporization must be done rapidly enough to avoid modification of the fresh flavor. In the process described in the circular this was accomplished by superheating the juice to 320° F. in 3 seconds and then flashing to atmospheric pressure.

On pages 4, 8, and 10 of the circular it is suggested that a possible alternate method would be to heat and vaporize the juice by a single passage through a rapid evaporator. Recent experiments have indicated that for industrial application of the process a rapid evaporator is superior to a superheater. The most important advantages of the evaporator method are that the fouling of the heating surfaces by the juice is reduced to a small fraction of what occurs in the superheater and that steam pressures of only about 30 lbs. per sq. in. (gauge) are needed, whereas up to 120 lbs. per sq. in. (gauge) are required for the superheater. The evaporator method, as well as the superheater method, sterilizes the juice as well as the essence.

This information is based on pilot-plant experience with a mixture of McIntosh and Stayman "inesap" apples, fully ripe. Unfiltered juice was used because it represents the most unfavorable conditions that would be encountered in practice with respect to fouling of the tubes. The inside diameter of the evaporator tube was 0.62 inch; its heated length was 16-1/2 feet; and 30 lbs.
per sq. in. of steam was used in the steam chest. Under those conditions the juice could be heated for a total time of at least 15 seconds without modification of the fresh flavor, and the rate of processing the juice was 50 gallons per hour. The modification of flavor resulting from doubling this heating time would not be very significant. However, in general it is desirable to heat the juice for as short a time as possible, consistent with practical evaporator design.

Under certain conditions, as for example when the maximum steam pressure available is much less than 30 lbs. per sq. in., it may be desirable to employ a high velocity preheater. However, when such a preheater with a tube of 0.18 inch inside diameter was used ahead of the evaporator described above, the total permissible heating time without modification of fresh flavor was only 10 seconds when the time for preheating the juice to its boiling point was 2.0 seconds.

With the evaporator system, either alone or with a preheater, fouling is so slight that daily cleaning would probably be sufficient. Moreover, we have been able to remove in a few minutes the fouling deposit formed in a 3-hour run on the tubes of both the preheater and the evaporator. This is accomplished by shutting off the steam, pumping cold water through the heating tubes, then stopping the pumps and suddenly admitting steam to the steam chest. The boiling, that takes place inside the tubes shortly thereafter, removes the deposit.