# Large Scale Supplemental Ventilation of Sugar Beets Stored for 106 Days[1]

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Supplemental ventilation was applied to 22,500 tons of beets stored for an average of 106 days during 1950-51. Beet piles were 22 feet high and 130 feet wide and sections of two piles were ventilated. Air ducts were made from used 55-gallon oil drums with the ends cut out and ducts were spaced 20 feet apart. The average amount of air supplied was 12.5 cubic feet per minute per ton of beets.

Analytical data on the effect of the ventilation was obtained from captive samples in wire baskets which were distributed throughout the two piles in a regular pattern. In each pile the 70 feet adjacent to the ventilated section was made the control or check section. At 10-foot intervals, as the pile was built, 6 captive samples were placed in a vertical plane as shown in Figure 1.

Thus there were 72 captive samples representing 140 feet (approximately 6,000 tons of beets) in the unventilated control sections. In the first 100 feet of each of the ventilated sections, 6 captive samples were similarly placed in a vertical plane every 10 feet. These were so placed that vertical planes representing 6 samples came alternately over a ventilating duct and between ducts. For the next 120 feet of ventilated pile 4 similar sets of samples were placed in planes at 30-foot intervals placing sets alternately over and between ducts with one duct separating sets. Thus a total of 156 captive samples was distributed throughout the ventilated sections of the two piles.

The beet samples were obtained as follows: From a single truckload of beets, 3 samples were selected so that each of the three consisted of the same number of beets of similar size, shape and weight. The beets were all brushed clean and one of the three samples was weighed and analyzed immediately for sugar. The second sample was weighed, placed in a wire basket and the basket placed in the proper place in the ventilated control section of the pile. The third sample was placed in a rubber bag and held until the piler had reached the section of the ventilated pile corresponding to the same place in the control section in which its mate, sample number 2, had been placed. At this time sample number 3 was removed from the rubber bag, weighed, placed in a wire basket and the basket placed in the pile according to plan. No sample was held more than 48 hours in the rubber bags.

To obtain an adequate record of temperatures in the interior of the pile, 3 tubes of different lengths were driven into the pile in each vertical plane formed by a set of 6 samples (see Figure 2) , and thermometers lowered to the bottom of these tubes. Thirty-six thermometers were in the control sections and 78 in the ventilated sections.

During most of the storage period fans were operated whenever the temperature of the ambient air was lower than that of the beets. Figure 3 is a composite graph showing for each day of storage the maximum and minimum temperatures of the ambient air, maximum, minimum and aver-

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FIGURE 1

Location of Coptive Samples and Ventilating Ducts

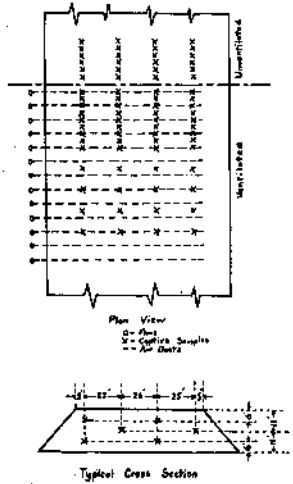



FIGURE 2

Location of Thermometers

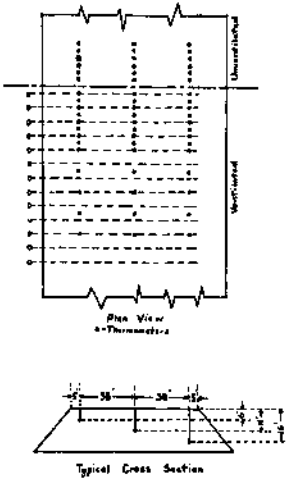
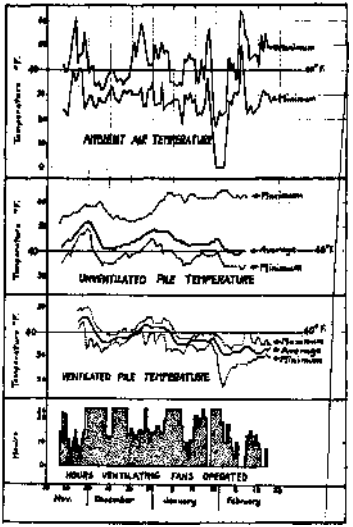



FIGURE 3



age temperatures of the unventilated and ventilated piles and the hours the ventilating fans operated.

To obtain some information on the probability of freezing beets in the interior of a pile by ventilating with low temperature air, continuous blowing was maintained for a 4-day period when the ambient air temperature was 23° F. maximum and 0° F. minimum (see Figure 3). All beets in the pile exposed to the prevailing winds were frozen for a distance of about 7 feet above the duct. Beets in the pile shielded from the prevailing winds were not frozen.

In evaluating the data from the captive samples, the 72 samples in the unventilated control section may be compared with either the 156 samples in the entire ventilated section or with only those 72 samples in the ventilated section which are corresponding duplicates of those in the unventilated. Both calculations were made and the pounds of sugar lost per ton of beets per day differed by only .01 pound. However, it is believed that the most scientific basis for evaluation is to compare those samples which are duplicates. This camparison is shown in Table 1.

Table I.

| | Unventilated | Ventilated |
|---|---|---|
| Average days storage | 99.000 | 105.833 |
| Average weight, pounds, going into storage | 24.167 | 23.915 |
| Average weight, pounds, out of storage | 22.692 | 22.719 |
| Average weight loss, % | 6.103 | 5.001 |
| Average % sugar going into storage | 15.119 | 15.119 |
| Average % sugar out of storage | 13.850 | 14.187 |
| Average pounds of sugar lost | .511 | .393 |
| Average pounds sugar lost per ton beets per day | .427 | .311 |
| Difference—pounds sugar saved per ton beets per day | .116 | |

On the 22,500 tons of beets ventilated this savings amounts to 2,762 bags of sugar, which is all recoverable at practically no operating cost.

The cost of supplemental ventilation of beets at Toppenish is shown in Table 2.

The savings due to ventilation at Toppenish during 1950 are perhaps less than might possibly be obtained on a similar storage period under average conditions in the Yakima valley. Storage conditions during the 1950-51 season approached the ideal and while the beets were placed in the pile in fairly muddy condition due to considerable rain during harvest, the generally cold storage temperatures resulted in the unventilated piles keeping in better than average condition.

### West Jordan, Utah, 1950 Crop

The experiment at West Jordan is reported to show the marked effect ventilation has on processing quality of certain beets. Many years of past history have demonstrated that Taylorsville beets under the best of storage conditions spoil very rapidly in the pile, so 5,000 tons of these beets were ventilated. The ventilation was carried out in a manner similar to that used at Toppenish and with duplicate captive samples to obtain the analytical data. The average storage time of the unventilated check sections was 57 days; of the ventilated sections 62 days. The sugar saved per ton day of storage by the supplemental ventilation was 0.201 pounds.

The most striking results from ventilating Taylorsville beets were obtained in factory operations. The usual poor storage character of these beets

Table 2.

Capital Costs

| | Labor | Material |
|---|---|---|
| 17 Ventilating fans | $ | $4,415.48 |
| Switches, coils, heaters, etc. | 443.89 | 261.18 |
| Bearings for 9 fans | 83.43 | 103.82 |
| Electric cable | 604.35 | 1,296.10 |
| 1,160 drums | | 2,604.29 |
| Preparing drums | 919.90 | 802.41 |
| Miscellaneous | | 53.77 |
| | $2,087.57 | $9,537.05 |
| Total | | $11,624.62 |
| Capital Cost per Ton Beets | | $ .52 |

Operating Costs

| | | |
|---|---|---|
| Hauling and placing drums | $ 641.15 | $ 92-42 |
| Reclaiming drums | 464.16 | 134.61 |
| Placing and removing fans | 302.26 | 25.28 |
| Power | | 2,777.22 |
| Drum replacements, 10% | | 260.43 |
| Depreciation, maintenance and repair, 10% | | 1,162.46 |
| Miscellaneous | | 152.42 |
| | $1,407.67 | $4,604.84 |
| Total | | $6,012.51 |
| Operating cost per ton beets | | $ .27 |
| Operating cost per ton beets per day storage | | $ .00252 |

was evident again this year in the unventilated sections of the pile, and was marked not only by spoilage areas but by the difficulty with which these beets were processed. Juice colors were very dark, purities low and lime salts high. White pans required 3 to 4 hours to boil compared to a normal time of one and three quarter hours. Losses were high and sugar quality suffered. These conditions were completely reversed when the ventilated beets were processd (the last beets to be sliced). Juice and massecuite colors were excellent, purities increased and lime salts decreased. Table 3 illustrates this by showing a comparison of some of the factory operating data.

Table 3.

| | % Sugar Beets | Purity Diffusion Juice | Purity Thin Juice | Lime Salts Thin Juice |
|---|---|---|---|---|
| Unventilated | 15.64 | 82.3 | 88.8 | 192 |
| Ventilated | 16.63 | 84.3 | 89.8 | .111 |

cessed the last five days of campaign, to sweeten off the factory 36 hours after the last beet was sliced. This is compared to the usual time of 72 hours.

The marked contrast in the ease with which the beets were processed from these two storage piles seems perhaps extreme. However, we have noted in most of our factory districts that beets from some areas store better than those from adjacent areas. We believe that supplemental ventilation of those beets which are known to have poor keeping qualities is particularly efficacious.