

SUGAR LOSSES IN BEETS IN STORAGE

R. J. Smith  
Holly Sugar Corporation

I feel it is in order to make a few preliminary remarks regarding points in connection with the procedure and results of test work involved in determining sugar losses in storage beets.

There is a loss of sugar in beets during storage regardless of conditions under which they are stored, for during the life of the beet, its sugar is being used for respiration purposes.

Sugar losses are greater for longer periods of storage and where higher temperatures are encountered. According to experimental results by Dr. Classen, the temperature of beets in piles is higher than that of the surrounding air. This is one point on which we have no data on our test work. With the higher piles of the present, there should not be the radical temperature changes throughout the pile that would prevail in low piles.

In the earlier days of the Beet Sugar Industry, methods of storage consisted mostly of storing in beet sheds of large capacity or in low piles where, in the latter case, the area exposed to the elements was very great. Tests were made to determine the extent of the loss of sugar during the storage period, and reports of earlier tests, by others, show sugar loss of beets in sheds to be greater than in piles and as a result, shed storage is now usually kept at a minimum.

In more recent years there have been numerous developments and improvements in methods of harvesting, receiving, and storing. At the present time harvesting can be completed much more rapidly with facilities for receiving and storing being geared up to keep pace with faster deliveries.

The problem of storing is still a major one as larger tonnages are now in storage, part of which were formerly undelivered by the growers until a later date.

Handling equipment has been greatly improved so beets enter storage with much less foreign material, which is one cause of deterioration, and the surface exposure per ton in storage is greatly reduced because of the large increase in depth of pile.

Since under present conditions, harvest can be, and normally is, finished in a shorter period of time, it permits delay in start of deliveries with lengthening of the growing season tending to increase sugar content, and make a more mature beet that should hold up better in storage.

In order to determine sugar losses under present methods of storing it was decided to make tests using a rather simple system and one which it was believed would give fairly accurate and representative results. We are not aware of the previous use of this method of storing by means of "what may be termed the 'basket system'".

No attempt was made to choose samples for these tests but instead they were taken as they came from the general run of beets as delivered.

The procedure was as follows:

1. A sample of 100 beets was taken from a load delivered at the factory receiving station just before the load was dumped into the piler hopper.
2. This large sample was divided into two samples of 50 beets each by picking alternate beets, one lot to be placed in the storage pile, the other for immediate testing.
3. One sample was carefully cleaned, avoiding any damage to beets, then placed in a basket made of fine mesh wire. This permitted free circulation of air and lessened the chance for loss of small pieces of beets that might be broken off. The sample was then weighed and a tag was attached showing Sample Number, Date and Weight. The basket of beets was then located in the pile with a marker placed on top of the pile and above the sample.
4. Samples were located in the pile near the bottom, center, and top and so distributed as to represent average conditions throughout the pile as closely as possible.
5. The duplicate sample was at once taken to the laboratory where the beets were carefully cleaned, weighed, each beet quartered, one quarter of each beet saved and the quarters composited. This composite sample was then passed through a cossette grinder and the ground beets thoroly mixed. Determinations were made in duplicate for moisture, sugar content, and for purity. These results were for later comparison with those of the duplicate sample which had been placed in the storage pile.
6. As beets were being sliced from the storage pile, the sample baskets were removed as soon as exposed. They were taken at once to the laboratory, weighed, the beets quartered, ground and carefully mixed. Duplicate determinations were made for moisture, sugar content and purity for comparisons with the other half of the sample taken at the time the beets went into the pile.

Many baskets of beets were placed in storage piles that were damaged by shovels when beets were being removed for slicing. These were a total loss for test purposes and only results of tests of beets in undamaged baskets were used in compiling the data included in this paper.

Results of tests on Samples at Factories No. 2 and No. 5 show a substantial decrease in sugar content of samples of Beets Out of Pile from those Into Pile, also the higher Sugar Loss in samples at those two factories. In the case of both these factories, adverse weather conditions prevailed during a considerable part of both harvest and storage periods. There was greater variation in Sugar Loss between individual samples at these two factories than at any of the others involved in this test work.

"Moisture Loss % on Beets + Sugar Loss % on Beets" is a figure obtained from analytical results and was calculated for comparison with actual % Weight Shrink in these samples. The results check very closely.

Results of tests for the first year series show an average of .49 lbs. sugar lost per ton beets per storage day. For the second year series the average is .50 lbs. per ton per storage day.

### First Year Series

Factory 1. This was a shovel pile approximately 7 feet in depth. The samples went into and came out of the pile in fine condition and weather was good during the storage period. Samples averaged 42 days in this pile with a sugar loss of .25 lb. per ton beets per storage day.

Factory 2. This was a Piler pile and most samples placed in the pile were in good condition. About one half were removed in good shape with part of the balance being fair and the remainder badly decomposed. There was considerable snow fall after the middle of October and generally very low temperatures from November 15th to the close of run on the first of the year.

Average number of days samples were in storage was 38, with a sugar loss per ton per day of .76 lbs.

Factory 3. The samples were planted in good condition in a Piler pile but came out with some slight mold and rot after being in storage an average of 25 days. The loss of sugar per ton per day averaged .24 lbs. with fair dry weather prevailing during the period of storage.

Factory 4. Samples were placed in both Piler and Shovel piles, the beets in good condition. Weather was good during the storage period. Approximately 50% of the samples were removed from storage in good condition with the remainder showing slight mold. Samples averaged 38 days in the piles with a sugar loss of .29 lbs. per ton per day.

Factory 5. The samples into Piler storage were good while some to the Shovel pile were good and some frosted. There was intermittent rain and snow after the middle of October for the balance of the harvest period. Temperatures after November 15th were generally low, freezing the beets badly, this continuing up to the close of slicing in January.

Average time samples were in storage was 51 days with a sugar loss of .66 lb. per day.

Factory 6. The beet samples went into the Piler storage in good condition. Coming out of storage most were good with the balance showing some rot and mold and partly soft. The sugar loss per ton per day was .42 lbs., with average time in storage of 26 days.

Samples for the first year series average 16.40 percent Sugar and 85.3 Purity. For the series of the second year the sugar content is 16.25 with 85.3 Purity; therefore the beets for the two year's series are almost identical.

There are several important points which, if adhered to, should aid materially in reducing sugar losses.

1. Frosted or diseased beets should be kept out of storage piles.
2. Only clean, trash-free and mature beets should be stored.
3. Reduce the time in storage to the minimum.
4. Development of some means of lowering temperature of beets in piles that will be practical from the standpoint of large scale operation.

A tabulation of average results for each factory, as well as the averages for each series is incorporated in this paper.

SUGAR LOSSES IN BEETS IN STORAGE

F A C T O R Y

							1932 GEOM. AVGS.				1936 GEOM. AVGS.
	1	2	3	4	5	6	1	2	3		
Number of samples	7	15	10	24	17	16	89	10	8	7	25
Avg. No. of Days in Pile	41.5	37.7	25.0	38.0	51.0	25.9	36.5	29	46	43	39
<u>Beets, % Moisture</u>											
Into Pile	76.26	77.46	80.16	78.02	76.03	75.12	77.15	75.36	77.70	77.95	76.59
Out of Pile	74.79	77.24	79.15	76.74	76.69	75.25	76.83	74.38	77.00	77.94	75.93
Difference	-1.47	-.22	-1.01	-1.28	+.66	+.13	-.32	-.98	-.70	-.01	-.66
<u>Beets, % Sugar</u>											
Into Pile	17.52	16.77	14.14	15.40	17.38	17.40	16.40	16.95	15.45	15.86	16.25
Out of Pile	18.39	16.28	14.99	16.25	16.76	17.23	16.55	16.85	15.52	15.29	16.11
Difference	.87	-.49	.85	.85	-.62	-.17	+.15	-.10	+.07	-.57	-.14
<u>Beets, Purity</u>											
Into Pile	87.3	86.1	82.6	83.9	86.3	85.3	85.3	86.4	84.3	84.4	85.3
Out of Pile	86.5	83.8	82.5	82.9	85.2	85.2	84.4	85.6	82.8	82.4	84.1
Difference	-0.8	-2.3	-0.1	-1.0	-1.1	-0.1	-0.9	-0.8	-1.5	-2.0	-1.2
Moisture Loss, % on Beets	7.11	5.10	7.04	7.90	3.56	1.27	5.17	5.37	3.87	3.80	4.58
Sugar Loss, % on Sugar	2.95	8.60	2.09	3.59	9.64	3.16	5.46	6.53	3.68	8.27	5.96
Sugar Loss, % on Beets	.52	1.44	.30	.55	1.68	.55	.90	1.10	.57	1.31	.97
% Weight Shrink	7.54	6.29	7.63	8.63	6.27	1.86	6.31	5.97	4.11	4.86	5.15
Moisture + Sugar Loss, % on Beets	7.63	6.54	7.34	8.45	5.24	1.82	6.07	6.47	4.44	5.11	5.55
Lbs. Sugar Lost per ton Beets per Storage Day	.25	.76	.24	.29	.66	.42	.49	.76	.25	.61	.50

All moisture, sugar, and purity determinations in duplicate.