

# Factors Affecting Odor in Beet Sugar

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The quality of commercial beet sugar generally has improved during the past 25 years. The improvement is most marked in respect to color, solution color, and ash content. Many factors, no doubt, have contributed to this improvement but the most important one is, probably, the practice of boiling higher purity pans.

Undoubtedly the odor of beet sugar has also been reduced during the past 25 years but since we have no absolute measure of odor the degree of improvement can only be conjectured. One's memory of an odor is very unreliable.

During the 1954 campaign, a preliminary survey was made to get some "leads" on factors affecting odor in white sugar. The problem was found to be illusive. In some instances, treatment of centrifugal wash water appeared to cause improvement. In other cases water treatment was without effect. Similarly, such diverse factors as weed roots, excessive amount of beet tops, badly deteriorated beets the venting of evaporators, and the washing of high raw sugar were investigated. Conflicting evidence was obtained.

Perhaps the most definite information obtained in a 1954 survey was on the subject of lime addition. In most, but not all cases studied, the odor of sugar from Steffen factories was found to be lower than that of sugar from the non-Steffen factories. Inasmuch as the lime addition at the Steffen factories is nearly double that at the regular beet houses, this would appear to be evidence that higher lime addition is effective in reducing sugar odor.

During the 1955 campaign, a planned study of the more promising leads uncovered in the 1954 survey was made. In this study the following factors were studied:

1. Centrifugal wash water treatment.
  - (a) Untreated, (b) treated with ion exchange resin,
  - (c) treated with carbon.
2. Washing high raw sugar.
3. Washing low raw sugar.
  - (a) Return of low raw sugar to first carbonation.
  - (b) Return of low raw sugar to high raw pans.
  - (c) Return of low raw sugar to white pans.
4. High lime additions (at two Non-Steffen factories).
5. Higher purity pans.
6. Primary sources of factory water.
7. Miscellaneous sources of odors—dust boxes, sumps, etc.

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In order to compare sugar samples for odor it was necessary to set up standards. These were arbitrarily selected sugars believed to cover the range of odors which might be expected. The number of standards was subsequently reduced to two. A panel of testers from the research laboratory was able to differentiate between these standards. It was also able to score a large number of selected samples with reasonable agreement. Later all factory chief chemists were given an opportunity to test the procedure and to rate the same samples. Again, agreement was good. The procedure was simple. The samples were placed in clean, one-quart jars. Odor comparisons were made at about 30° C.

Treatment of centrifugal wash water with a cation exchanger resin or a mixed bed exchanger, followed by treatment with a granular carbon, usually caused a reduction in the odor of the water. This was particularly noticeable in the case of third and fourth evaporator body drips when the odor of the untreated water was distinct. In other cases the effect of treatment was less pronounced. Treatment of city water, which is commonly used for centrifugal wash, with mixed bed ion exchanger and granular carbon also reduced the odor but to a lesser degree.

In laboratory tests, factory massecuites were centrifuged and washed with treated and untreated water. In one series of tests the odor of the sugar was reduced by washing with treated water. In all other tests, the effects were too small to be measured with certainty.

Facilities for treating centrifugal wash water with cation exchange resin are available at three factories. At these factories the sources of the water are the third and fourth evaporator drips. Tests were made in which all the sugar produced during two consecutive days was washed with untreated water. Samples of sugar were taken during the second day of the test for comparison with sugars washed with treated water. Differences in odor of sugars washed with treated water and those washed with untreated water were too slight to measure.

In the preliminary survey of 1954, it was noted that high raw sugar carried a heavy odor and that this odor could be markedly reduced by adequate washing. Some work was done at the commencement of campaign in 1955 to determine the proper amount of wash water to use to reduce the odor to tolerable levels. It was found that, in general, about eight quarts of water are adequate. Actually the odor level of the high raw with this amount of wash water was only slightly higher than that of white sugar.

Similarly, the effect of washing low raw sugar on odor was determined. No attempt was made to reduce the odor of the low raw sugar to that of the washed high raw. About two quarts per machine were found sufficient to remove most of the molasses odor.

All of the washed high raw sugar was returned to standard liquor, that is to thick juice and melted sugar. Because of sulfate problems, it was found inexpedient to return all of the washed low raw sugar to standard liquor. During the two-week test period only about 35 percent was added to standard liquor, the remainder returning to first carbonation. Sugar produced during these test periods was compared with sugar produced

during periods in which the high and low raw sugars were not washed with optimal amounts of water. No measurable improvement in the odor of the sugar was obtained.

At two non-Steffen factories chosen because they represented two extremes of beet purities, the lime addition was varied over comparatively wide limits. At factory E which normally uses 1.5 to 1.7 percent CaO on beets, the lime addition was raised during two two-week periods to 2.17. At factory A which normally uses 1.35 to 1.4 percent lime on beets, the lime addition was increased to 1.80 percent. At neither factory was the odor of white sugar significantly improved by the larger lime addition.

An attempt was made at one factory to determine the effect of boiling higher purity white pans on the odor of the sugars. Because of the abnormally low purity beets encountered during this campaign, it was found impossible to maintain slicing capacity and hold white pans as high as was desired. However, during a brief period when the purities were held somewhat higher than normal, the sugar produced showed only trivial improvement.

Investigation of factory water supplies with respect to odor disclosed that at two factories the factory water supplies did, indeed, carry considerable odor. Odor of sugar produced at these factories was not higher than that of other comparable factories.

Other miscellaneous possible sources of odor were investigated. Sumps occasionally showed some odor. Dust boxes and melters were surprisingly free of odor this year.

The results of the special study appear to be essentially negative. A reason for this lies in the fact that the entire level of odor is lower in 1955 than it was in 1954 and probably lower than in several years. Table 1 shows a comparison between the odor in white sugar produced in 1954 and in those produced in 1955. The numerical values are arbitrary but should indicate factually the true difference.

Table 1.—Comparison of Odor in White Sugar Produced in 1954 and 1955.

Factory (non-Steffen)	Odor		Factory (Steffen)	Odor	
	1955	1954		1955	1954
A	0.7	3.0	J	0.6	2.0
B	0.7	4.0	K	0.9	1.3
C	0.5	1.0	L	1.4	5.0
D	0.6	2.3	M	1.3	2.0
E	0.3	2.0	N	1.0	1.3
F	0.6	2.0	Q	1.1	2.0
G	0.8	2.0			
H	0.7	3.3			
I	0.8	2.0			

It is difficult to account for the great differences in the odor level in the two years. Beet purities were generally lower in 1955 than in 1954. Sugar content was also lower in 1955. Topping of beets was probably neither better nor worse in 1955 than in 1954. There was little evidence of serious deterioration of beets in piles in either year. Because of the low purity of beets, more high purity sugar had to be introduced in white pans to maintain normal white pan purities. This may have had the effect of reducing the concentration of odor bearing substances in the white pans. One observation which is worthy of note is that in spite of generally low beet purities, sugar quality as measured by color and solution color seemed easier to maintain than usual.

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