Increased Sugar End Capacity at Betteravia Resulting from Changes in Equipment and Operation

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Jn 1950 Union Sugar decided to continue its program of expanding the factory capacity by taking steps to increase the efficiency and capacity of the sugar end production. Prior to this decision a new white pan and three new evaporator bodies had been installed to replace worn out equipment. A Silver continuous diffuser had been installed in 1947 which easily furnished enough slicing capacity to overcrowd the sugar end. After reaching this decision, the following steps were taken beginning in the early part of 1951:

1. The old, slow speed, belt-driven low raw centrifugals were replaced by seven new fluid drive 40 x 30 centrifugals built by the Western States Machine Company. At the same time, Blanchard-type cooling coils as used by the Utah-Idaho Sugar Company were installed in six of the old air-cooled crystallizers.

2. In 1952 the low side boiling system was supplemented with a new 1,300 cu. ft. calandria pan and four more Blanchard-type cooling coils were installed to bring the total number of water-cooled crystallizers to ten. The size of these crystallizers is such that each crystallizer will hold one-half the contents of a low raw pan (approximately 600 cu. ft.) .

After these two steps the practice of putting all the low raw sugar through the intermediate pan was discontinued (see Table 1) . The low raw sugar, after being washed to 97.5-99.0 purity" by a 60-second application of water at the end of the cycle, was introduced directly into the standard liquor, thence to the white pan.

This procedure, combined with the control of the wash water and green syrup purities gained by manipulating the syrup separators on the intermediate and white centrifugals, was used to produce uniformly controlled purity syrups going to the three stages of boiling. All our mixers are equipped with mingler coils to facilitate the handling of the massecuite and the action of the separators.

Thus, with a normal thick juice purity of 90 coming from the evaporators, the purity of the white massecuite is maintained uniformly from 93,[5] to 94 purity. The quality of the white sugar produced under these circumstances is of a high standard.

An additional advantage was encountered in this procedure, in that the reintroduction of large amounts of non-sugars into the process was avoided, the amount of white massecuite to boil for a given production of

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[2] The purities referred to in this paper are apparent purities only in the absence of raffinose, which is not encountered at Betteravia.

white sugar was materially reduced, and the total amount of all massecuites boiled per unit output of white sugar was reduced. This has meant a considerable saving in steam to the pan floor, greater production per man hour, and less loss of sugar through process losses and chemical changes. In terms of beet slicing capacity, which is critical in California factories where no piling is done, this change has resulted in a slicing increase of 200 to 400 tons capacity on the beet end.

The sending of melted raw sugar through the intermediate pans prior to introduction into the head of the process has been eliminated except under extraordinary circumstances.

Washing of the low raw sugar to high purities depends upon the maintenance of good grain characteristics in the low massecuites. As a result, the boiling procedures have been carefully scrutinized to insure the production of even grained, smear-free massecuites with good purging qualities. A minimum boiling time of eight hours or longer if possible is adhered to. The absence of unmelted grain in the syrups and the uniformity of the purities greatly facilitates this procedure.

As outlined in Table 1, the purity of the intermediate pan is carried at approximately 87 purity, which gives maximum crystallization under slow boiling procedures taking from 3 to $3^1/_2$ hours. The purity of the low-raw pan is regulated between 75.5 and 76.5, shooting for an average of 76 purity.

Table 1.

PRIOR PRACTICE (1950)	NEW PRACTICE (1953)
White Pan Boiling	
I. White Massecuite 92.5 to 93 Purity	I. W'hite Massecuite 94 Purity
Components:	Components:
a. Evaporator thick juice 90 Purity + High Raw Sugar 97 to 99 Purity	a. Exaporator thick juice 90 Purity
b. Wash water from White Centrifugals at 92-93 Purity	b. High Raw Sugar 99 Purity
d. Wash Water from White Centrifugals 94 Purity	c. Washed Low Raw Sugar 98 Purity
High Raw **Pan Boiling**	
I. High Raw Massecuite 87.1 Purity	I. High Raw Massecuite 86.8 Purity
Components:	Components:
a. High Green from White Centrifugals 86.5 Purity	a. High Green from White Centrifugals 87.5 Purity
b. Wash water from High Raw Centrifugals 84 Purity	b. Wash Water from High Raw Centrifugals 84 Purity
c. Unwashed Low Raw Sugar 92.8 Purity	
Low Raw Pan Boiling	
I. Low Raw Pan Crystallizer Mass. 75.7 Purity	**I.** Low Raw Pan Crystallizer Mass. 76.2 Purity
Components:	Components:
a. Low Green from High Raw Centrifugals -f Low Wash, if necessary	a. Low Green from High Raw Centrifugals 75.1 Purity
	b. Wash Water from Low Raw Centrifugals 70 Purity
	c. High Green from White Centrifugals, if necessary
Molasses Purity—56.1	Molasses Purity—56.4

This pan purity range has proven in our experience to give the best results, judging from the standpoint of purging qualities of the massecuite and purity of the final molasses. In the event the low green syrup purity drops below 75.5, owing to increased crystallization in the intermediate pan, the low raw pan charges are spiked with high green syrup to increase the pan purity and give a good grain foundation. This procedure is not difficult to control, due to the uniformity of the purities, and the information is easily recorded and transferred between the shifts.

Centrifugal Operation

Superheated water at 110° C. is used on the white machines together with the double washing system. This combination not only produces a better grade of sugar with less water and sugar loss, but also permits a sharp separation to be made between the wash and green syrups.

The intermediate and low raw massecuites are washed with water at 90° C. Double washing is used *on* the intermediate centrifugals and a single spray is applied on the low raw centrifugals approximately a minute and a half before the end of the cycle. The wash waters are returned to the pans as indicated in Table 1.

The time of application of the second wash water on the white and high raw machines is regulated according to the purities of the green syrups. In the case of low purities the separators are tripped five to ten seconds after the water is applied, which introduces the higher purity wash water into the green syrup. With high purity syrups resulting from fresh beets, the separators are tripped as the second wash is applied.

In the washing of the low raw centrifugals the separators are tripped when the wash water is applied, at which time approximately 95 percent of the impurities *in* the centrifugal charge has been eliminated. Thus the possibility of introducing sugar into the molasses by the wash water is avoided. The average purity of the low raw wash water at Betteravia is 70.

The low raw cycles are kept as long as possible, starting at approximately 25 minutes at the beginning of the run, and leveling off at approximately 15 minutes during peak operations. During the Imperial Valley season, with an extremely heavy burden on the low side resulting from spoiled beets, 98 purity sugar has been obtained with the cycles as short as $11\frac{1}{2}$ minutes.

Tablc 2.—Comparative Operating Figures for Past Five Years (Coastal).

Average Daily Slice Percent Sugar in	2.206	2.243	2.790	2.635	3.097
Beets Average Diff. Juice Purity	17.02	16.03	15.90	15.51	16.01
Average Sugar Production Percent	85.5	86.3	85.5	85.7	86.5
Molasses on Beets Sugar in Molasses	6.191	5.906	7.303	6.826	8.451
Percent on Beets Apparent Purity of	5.16	4.69	4.68	3.98	3.75
Molasses Net Extraction	2.42	2.19	2.22	2.03	1.90
(Percent of sugar entering factory)	56.3	56.2	57.0	56.5	56.2

The acceleration of the low raw centrifugals from loading until top speed has remained between four and five minutes. It has not been necessary to vary this acceleration time to produce good sugar.

Steam is carried on all of the centrifugals to keep the separators free and each centrifugal is steamed out thoroughly once a shift.

A partial summary of the operating results is given for the past five years in Table 2 for comparison of factory performance.

In summarizing the figures shown in Table 2, there is a decided increase in sugar end efficiency as evidenced by the reduction of the sugar going to the molasses, and in the decided increase in the volume of the average sugar bagged per day. The factory extraction has steadily improved and an increase in slicing rate has accompanied the change of equipment paralleled by the ability of the general personnel to make use of these changes. In 1952 the slicing rate was slowed clown owing to harvest difficulties, but the overall efficiency of the sugar end did not drop.

The net effect of these changes is to speed up the entire factory operation, both in respect to handling an increased quantity of beets sliced and to efficiency increase the sugar end output.