SOME NOTES ON OBSERVED INFLUENCE OF WATER COOLING OF "B" MASSECUITES ON THE BOILING HOUSE RECOVERY

By T. COVAS

In Luabo Factory, for the past few years, we have been disappointed with the low Boiling House Recovery, which we have appreciated has been due primarily to the incomplete exhaustion of the final molasses. The reasons for this are as follows:

With exceptionally high initial mixed juice purities:
Insufficient pan capacity.
Insufficient centrifugal capacity.
No provision for watercooling of "C" massecuites.

Step by step, these have been eliminated, first, by installing two additional 911 cu. ft. capacity calandria pans, then replacing the old 1,000 r.p.m. 36 in. by 18 in. belt driven "C" centrifugals by modern electrically driven 1,800 r.p.m. 42 in. by 24 in. machines and finally providing water cooling facilities to all "C" crystallisers.

Crushing an average 125 metric tons of cane an hour, the Boiling House has now the following installation:

Pans

2 Calandria pans, 12 ft. dia., 911 cu. ft. capacity.
3 „ „ 11 ft. „ 900 „ „ „
1 Coil Pan, 11 ft. diameter, 900 „ „ „
1 Coil Pan, 10 ft. diameter, 600 „ „ „

Centrifugals

30—36 in. by 18 in. belt driven 1,000 r.p.m. centrifugals for single and double curing "A" massecuites.

16—36 in. by 18 in. belt driven 1,000 r.p.m. centrifugals for single and double curing "B" massecuites.

8—42 in. by 24 in. electrically driven 1,800 r.p.m. high speed, high gravity factor centrifugals.

Crystallisers

4—Strike receivers 900 cu. ft. capacity each, for "A" massecuites.

6—Crystallisers of 900 cu. ft. capacity, and one strike receiver of same size for "B" massecuites.

11—Crystallisers of 900 cu. ft. capacity each, equipped with Blanchard type water cooling and reheating elements, in addition to two strike receivers of the same size for "C" massecuites.

Table 1
Typical "B" Massecuite—(Crystalliser No. 12)
Brix: 94.5 Sucrose%: 64.2 Purity: 67.9

Hours after strike	Temperature of massecuite °C	Temperature of cooling water °C	Molassess		
			Brix	Sucrose	Purity
1	56	29	89.0	47.80	53.70
2	55	29	89.0	47.00	52.80
3	53	29	89.0	45.93	51.60
4	52	29	85.5	45.13	50.99
5	50	30	89.0	45.11	50.68
6	48	30	88.0	44.35	50.39
7	46.5	31	88.5	44.06	49.78
8	46	31	88.5	44.86	50.69
9	44.5	31	88.0	43.81	49.79
10	43	31	88.5	43.30	48.90
11	42.5	30	87.5	43.02	49.17
12	41	30	87.0	42.60	48.95
13	40	30	88.0	42.80	48.63
14	39	28	88.0	42.60	48.40
15	38	28	88.0	42.30	48.06
16	37	28	86.0	41.20	47.90
17	36	27	88.0	42.00	47.72
18	35.5	28	88.0	42.00	47.72
19	35	28	88.0	41.80	47.50
20	34	28	89.0	41.50	46.63
21	33	28	89.0	41.10	46.17
22	33	28	88.5	40.80	46.10
23	32.5	27	87.5	41.10	46.96
24	31.5	26	88.0	40.80	46.36
48	27.5	25	88.0	39.30	44.66
72	28	28	87.0	39.30	45.17

During crops 1959 and 1960 the mixed juice often reached, during the peak month, an unprecedented high purity of 90° and the sucrose per cent cane was constantly over 16 per cent—occasionally as much as 18 per cent. Under these conditions the normal three massecuite system of exhausting final molasses proved to be inadequate and considerable thought was given to the improvement of this and consequent improvement of the Boiling House Recovery.

As a start, an attempt was made to boil lower purity "C" massecuites, that is, to reduce its purity from the previous 60/62 to 58°. This proved to be only partially successful, as the purity of the "B" molasses, under normal conditions, could not be brought below 55/56°.

It became obvious that the correct way was to attempt to reduce this purity to a level round 50°, before we could hope for better exhaustion and recoveries.

As the frequency of "B" strikes was one in every 3/3½ hours, no massecuite could be left in a crystalliser for more than 12 hours, which was really not sufficient to achieve a satisfactory purity drop. The only rational way was to attempt water cooling the "B" massecuites and during the 1959 and 1960 crops limited experiments have been carried out in this direction with very encouraging results.

During crop 1961, due to climatic conditions, the production of sugar was considerably reduced (sucrose per cent cane only 12 per cent) and our 11 "C" crystallisers turned out to be more than we required. Provision was made, during the previous off-crop, to use 3 of the water cooled "C" crystallisers also for "B" massecuites, increasing thus the total available "B" crystallisers from six to nine.

Water cooling of "B" massecuites was then started in these crystallisers as a permanent feature. Cooling commenced immediately after discharging of the strike, and continued at a rate of approximately 1°C per hour. An average "B" massecuite purity of 70 was employed and a "B" molasses purity of 46/47° was obtained, or a purity drop of 23/24 points. Time required to achieve this was 16 hours. When cooling continued for a total of 48 hours, the purity dropped to 44°. (viz. Table 1 and Fig. 1).

It was very significant, that after one hour cooling, the purity of the mother liquor (molasses) was 54° and from then on, for every 1°C cooling (one hour cooling time) the drop in purity was 0.5°, until an equilibration was reached after 48 hours. This means that the required purity drop could be safely predicted and cooling discontinued at any practicable level.

In Luabo we discontinued cooling generally after 12 hours, obtaining a "B" molasses purity of about 48°, from which a "C" massecuite of 54/56° purity was boiled, yielding final molasses purities of 34/36° (Clerget).

"B" massecuites, which have been struck into uncooled crystallisers and had the same original purities, gave after the same period, a molasses purity of 52/54° only, or a total purity drop of 16/18° points only.

To verify the above results, several strikes have been divided into two parts; the first was water-cooled for 12 hours, the other half uncooled for the same period.

The average results received from 70° Purity "B" massecuites were as follows:

Table 2

	Temp. °C	Purity
(*a*) After 12 hours (uncooled)	58°C	54
(*b*) After 12 hours (watercooled)	43°C	48

Beside the purity drop, the total quantity of the "B" molasses has also decreased sharply and the frequency of "C" boiling was reduced accordingly.

The exhaustion of our molasses already at the "B" stage, had the following immediate results:

1. Better quality "B" sugar, as the heavier massecuite made the separation of molasses and crystals easier.
2. Reduced quantity and lower purity "B" molasses.
3. Less "C" massecuite boilings of a reduced purity.
4. Lower purity final molasses.
5. Reduced total loss of sucrose in final molasses as the direct result of the above two points.
6. Increased Boiling House Recovery, from 85.3 in 1958 to 89.8 in 1961.
7. Saving of fuel, as the total cubic feet of massecuite boiled per ton of Brix in the mixed juice dropped from 64.0 cu. ft. in 1958 to 55.2 cu. ft. in 1961. These last two points are more significant if we realize that 1961 was a year with extremely low purity mixed juice (83.1°).
8. Increased crystalliser capacity.

Conclusion

Introduction of watercooling of "B" massecuites will have a beneficial influence on the final exhaustion of the "C" molasses, reducing total sucrose losses and improving the Boiling House Recovery.

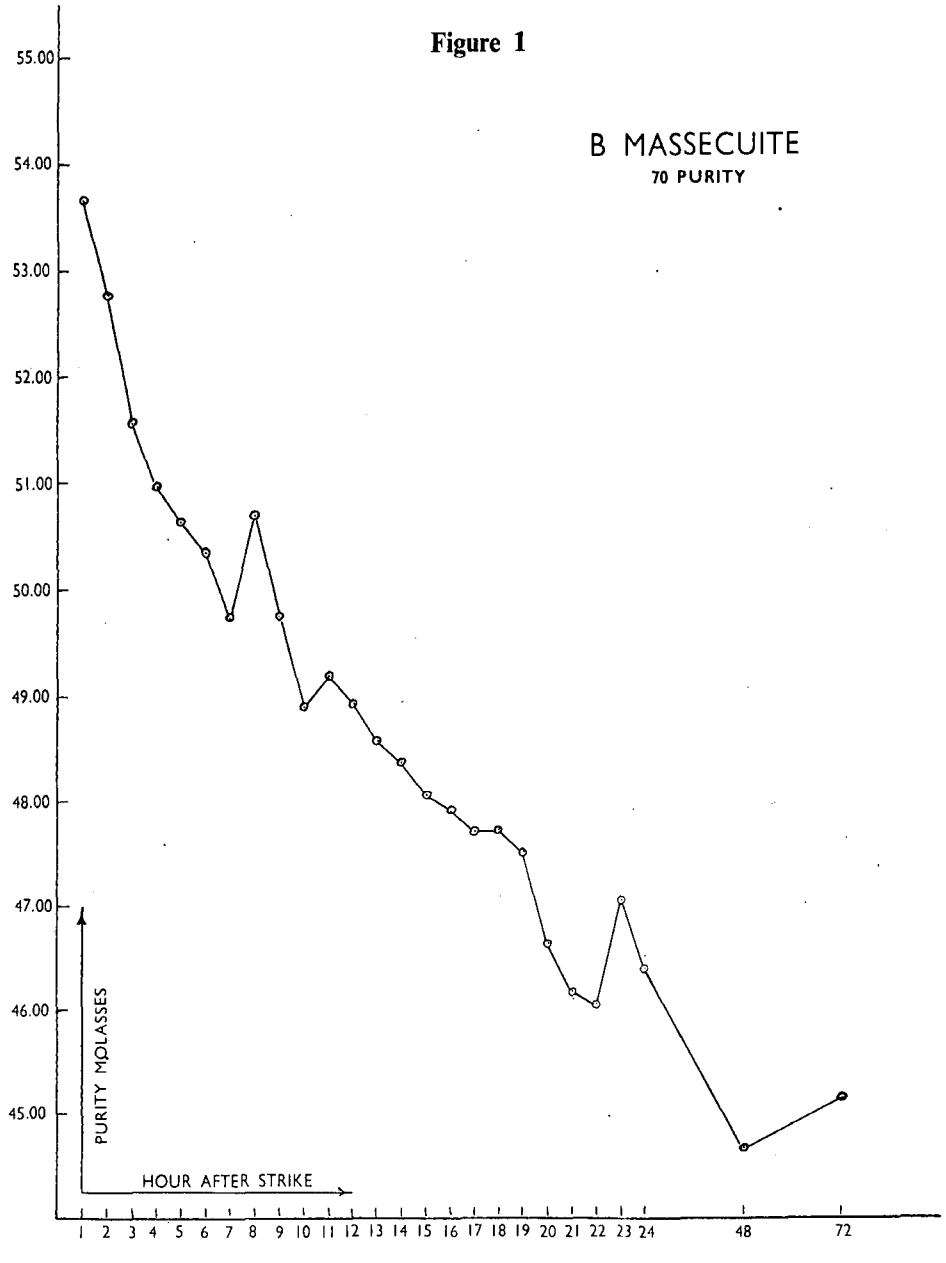
Table 3

Crop	Mixed Juice Purity	Final Molasses		Lost per 100 Sucrose in Cane				Total Loss %	Boiling House Recovery	Overall Recovery	Boiling House Performance	Cu. ft. of Mas. per ton Brix in M.J.
		Purity	% on Cane	In Bag	In Mud	In Molasses	Undet.					
1958	84.2	43.6	4.23	8.22	0.79	12.24	0.45	21.70	85.3	78.3	93.4	64.0
1959	86.7	41.5	3.82	7.56	0.56	9.56	0.53	18.21	88.5	80.8	95.4	57.2
1960	86.3	38.7	3.52	8.67	0.43	8.37	0.50	17.17	89.8	82.0	97.2	56.8
1961	83.1	36.8	3.14	7.12	0.60	8.51	0.34	16.37	89.8	83.4	98.6	55.2

Table 4

	A Massecuite			B Massecuite			C Massecuite		
	Masc.	Molasses	Drop in Purity	Masc.	Molasses	Drop in Purity	Masc.	Molasses (Apparent)	Drop in Purity
1958	85.4	69.0	16 4	73.5	59.2	13.8	62.9	39.9	23.0
1959	85.1	68.8	16.3	72.6	55.1	17.5	60.2	37.3	22.9
1960	85.2	68.4	16.8	71.4	54.1	17.3	58.3	36.3	22.0
1961	83.9	64.9	19.0	69.9	49.3	20.6	54.9	33.6	21.3

Figure 1



Mr. J. L. du Toit, in the chair, said this was another example of free interchange of information in the Sugar Industry. Mr. Covas had given a complete explanation of the excellent boiling house performance in his factory in Mocambique.

Mr. Rault stated that the paper was especially valuable in that it gave details of the factory plant. He remembered that years ago it was said in Java that cooling massecuites to 40°C was a waste of time, but Mr. Covas had shown that cooling to 40° after 13 hours gave a molasses of 48.6°C, and this then came down to 44° after the temperature was reduced to 27.5°C. The author could be proud of the fact that he had reduced the number of massecuites. We had often been given processes which by the returning of molasses gave a good sugar but increased the number of massecuites. If one could reduce this number, from the point of view of steam economy and other considerations, one had made progress.

At Natal Estates Ltd., they had very good results from the cooling of massecuites and had even gone to the extreme of cooling very high purity first massecuites with good results.

Mr. Covas said it was intended next season to carry the experiment further by cooling "A" massecuites with a view to boiling only two massecuites, especially at the beginning of the crop when purities were low.

Mr. Fourmond stated that as a rule in Mauritius they cooled 1st and 2nd massecuites and thus managed to boil only two massecuites. To make sure of the efficiency of cooling it was decided that three factories should cure their massecuites without cooling for three months. It was found that in the 1st massecuite there was an increase in the drop in purity of 6° in molasses in favour of cooling and in the 2nd massecuite it was 4½°. This corresponded to an extra exhaustion of 7 and 5 per cent respectively.

Mr. Covas said a drop of 6° would not be significant in his case as "A" molasses would still have to be about the 72-74° purity mark. One could not boil "B" massecuites from 66° purity molasses and still obtain a final molasses at an economical level of purity. If molasses were used say, for producing alcohol, a higher purity would perhaps be economical, but at Luabo he had to throw away the final molasses and therefore had to exhaust it as much as possible.

Dr. Douwes Dekker queried the figures showing the amount of final molasses obtained, as shown in Table 3, which varied from 4.2 to 3.1 per cent on cane, which was a big drop. Comparing 1959 with 1961 the mixed juice purities were 86.7 and 83.1° respectively so there were some 8 per cent more impurities in 1961 than in 1959, yet the molasses produced was about 20 per cent less.

Mr. Covas said that the apparent discrepancy was due to the fact that the molasses was weighed in 1961 but previously it was calculated.

Mr. van Hengel considered there was a lot to be said for the cooling of "A" massecuites. He had had experience of cooling "A" massecuites of 84° purity which yielded molasses of 66° purity with very little residue, in a "Werkspoor" crystalliser. Moreover he considered that whatever was gained in the "A" massecuite was also gained in the "B" massecuite.

In this country where so many factories were refining their "A" sugars, the first aim should be to get as much sugar as possible from the "A" massecuite. Such extra gain from the "A" massecuite reduced the total amount of massecuite to be boiled.

Mr. Davies said that further to Mr. Fourmond's remarks, he had been told that in Mauritius the drop in purity between massecuite and molasses, was, in the case of the "A" massecuite, about 28°. Thus from an "A" massecuite of 84° purity the molasses was about 56° purity. It was this that enabled them to boil only two massecuites.

Mr. Covas stated that in Luabo white sugar for direct consumption was made but also he had to make a very high quality raw sugar of 98.9 to 99° Pol for the refinery in Lisbon. If he had a very low purity "B" massecuite he might not be able to produce a very high quality raw sugar except by washing.

Mr. Ashe asked if the cooling was based on temperature or were the massecuites merely cooled for a certain time. On the other hand, was a purity aimed at. Furthermore he wanted to know if the massecuite was reheated, and if so, what temperature was reached before centrifuging.

Mr. Covas replied that the massecuite was cooled to a temperature corresponding to the time available. This was generally 12 hours. Re-heating was not required, although better results might be obtained if this were done. With the installation of new high-speed centrifugals for the "B" massecuites, which would be fitted with re-heating elements, this would be carried out.

Mr. Perk had experience of cooling "A", "B" and "C" massecuites in Lafeuille crystallizers.

An "A" strike could be cooled in 2 to 3 hours to a temperature of 45°C. However, certain measures had to be taken. It appeared to be necessary to put beforehand 30 per cent highly concentrated "A" molasses in the Lafeuille for "lubrication", otherwise the cooled massecuite would become so stiff (as a result of the high crystal content) that it could not be moved. As a result of this high crystal content, all the water present in the strike when struck was now concentrated into a much smaller volume of molasses than in the case of a not-cooled "A" massecuite. As a result of this, the brix of the mother liquor was lower than usual and spun off in the centrifugals very easily, notwithstanding the lower temperature. As each drop of water was detrimental to crystallization, *concentrated* instead of ordinary "A" molasses was added to the strike as a lubrication medium.

Nearly the same could be said about cooling of a "B" massecuite. However, here the Lafeuille cooled faster than the crystallization rate could keep up with, resulting in a massecuite with a highly super-saturated mother liquor, which did not cure well. The cooled "B" massecuite was therefore put away for a couple of hours in an ordinary crystallizer till the super-saturation and been reduced to a normal value. After this "ripening" process, the "B" strikes cured very well.

Regarding curing of "C" massecuites, these could not be cured faster than in 8 hours time, and even then the massecuite had to be kept for a number of hours at the final temperature in order that the crystallization could make up its back-log. Only after the super-suration was reduced to a more normal value, the reheating before curing could be commenced.

Mr. Rault asked how it could be that heavier massecuites cured more easily and Mr. Covas replied that curing was more easy after cooling.

Mr. Cargill said that in an experiment at Mount Edgecombe factory massecuite dropped from the same pan was dropped into two crystallizers. One was water cooled and the other was not, but there was not any significant gain from cooling.

The Chairman said the amount of discussion which had followed Mr. Covas' paper showed how much it was appreciated. This type of contribution made the Congress really worth while.