THE PRACTICAL APPLICATION OF A STRAIGHT TWO-BOILING SYSTEM

By RENE NOEL

The practical possibility of using a straight two-boiling system was suggested to the author by the unexpected results obtained with a new battery of centrifugals during the 1957 grinding season.

The purity drop recorded between the first massecuite and its runnings was such that the success of a two-boiling system seemed certain if three conditions were fulfilled:

1. The boiling of a first massecuite pure enough to ensure the required crystal recovery.
2. A constantly large purity drop to give runnings of the same purity as that of the final massecuite.
3. Runnings of such quality that a massecuite of the same purity could be boiled direct from it.

In order to check the first of these conditions, the apparent purity of the first massecuite was raised to 84 by boiling with syrup and some A runnings on a C sugar footing; this massecuite, struck at 95 brix, was cooled in a Blanchard crystalliser and fugalled at 55°C in 40" x 30" x 1500 R.P.M. Roberts fluid-drive centrifugals at 22 operations/hr. Washing was effected for 4 seconds with superheated water at 115°C, and the following results were obtained:

Pol % sugar: 98.7

Runnings purity: 56.0

Brix in sugar recovered per cent brix in massecuite: 65.0.

Could runnings at 56 be boiled to a final massecuite of 56 purity? This could only be tried once before the end of the crop, but no major difficulties were encountered and the massecuite, fugalled at 42°C in 42" x 24" x 1500 R.P.M. Broadbent centrifugals gave molasses of 33 apparent purity.

These results were considered good enough to give a fair chance of success, and it was decided to try the system during the 1958 grinding season.

This has now been done successfully, and the purpose of the present paper is to record the results obtained and to discuss the practical significance of the process. Ways and means of improving on the results will also be considered.

TABLE I

	Brix	*Purity*
Syrup	62.6	85.7
A Massecuite ...	95.9	81.8
A Runnings ...	87.7	55.5
B Massecuite ...	99.1	58.0
Final Molasses ...	97.7	32.7 (apparent)
		36.7 (clerget)

A glance at these figures shows that reasonably well exhausted final molasses were obtained; in fact, as can be judged from Table II, the final molasses were more exhausted than in 1957 when using a standard three-boiling system.

TABLE II

	3-Boiling	*2-Boiling*
	1957	1958
Brix	96.6	97.7
Apparent Purity ...	33.6	32.7
Gravity Purity	36.7	36.7
Total Sugars % Brix...	49.2	48.6
Reducing Sugars/ Sucrose Ratio ...	34.1	32.6

As far as the total amount of massecuite is concerned, respective figures for 1957 and 1958 are 203 kg and 182 kg % kg of brix in the mixed juice.

How were these results obtained and what was the implication of the new process on the general work of the factory?

As already mentioned, an adequate purity drop between the first massecuite and its runnings was an essential condition; this being the case, the technical staff's chief worry was to keep the runnings purity at an acceptable figure. A first massecuite purity of 84 had been set as a target, but it soon appeared that the 28 point drop expected could not always be reached, although much higher drops were recorded occasionally.

The massecuite purity was then lowered to about 82, and this resulted in a runnings purity lower than that which had been set for the final massecuite, purities as low as 52 being reached on certain days.

Graining was done directly on first runnings when its purity was not too low, 56-57 being considered a minimum. Once purities of 53-55 were reached, it was found better to grain on a mixture of syrup and runnings at about 59, the purity of the massecuite being then brought to 56-57 with runnings.

Occasionally, graining was done directly at 56, the massecuite purity being brought to 54-55, but these were more difficult to fugal so that, on being heated or diluted, they gave no better molasses.

Whatever the purity of the graining mixture, graining was done by seeding with sugar dust in the form of a slurry in alcohol; there is, however, a suspicion that the pan boilers grained by shock when they were left on their own. In any case, graining

on these low purity mixtures offered no great difficulty, and the increase in time necessary was considerably shorter than expected since it amounted to only 15-20 per cent.

The crystal size was naturally somewhat smaller than with high purity graining mixtures, and although the grains were fairly regular, two definite sizes could be seen under the microscope; this certainly did not help fugalling, but this part of the process offered no more difficulty than in the previous years in spite of the absence of an adequate reheating system.

Apart from the good results already mentioned, a definite improvement was noted in the general conditions of work: less runnings and massecuites in circulation, a simpler working scheme more easily followed by the pan boilers, and a sugar more constant in quality. To these advantages may be added an important gain in the capacity of the 'A' centrifugals and of the vacuum-pans; this gain is in fact much more important than that suggested by comparing the total amount of massecuite obtained with the two systems, because of the ease of boiling and fugalling high purity massecuites.

A theoretical working diagram based on the 1957 juice characteristics had been drawn before the 1958 crop[1] to give an idea of the results which could be expected from the application of the two-boiling system. This is given in Appendix I together with the diagram drawn from the actual figures obtained in 1958. A study of these diagrams shows clearly how near the figures obtained stand to the ideal results, and thus makes it easier to look for any possible improvements.

It appears at once that the amount of A Massecuite is larger than it should be; the reason for this can be traced to the lowering of the massecuite purity which was necessary to reach the required runnings purity, and one may ask at this stage how to make sure of a 28 point drop from a massecuite at 84. In the author's opinion, this can only be achieved by paying constant attention to the brix of the massecuite and to the temperature at the time of fugalling; the influence of these two factors was carefully observed day after day and there is no doubt that one must aim at a brix of 96 and a temperature of 45-40°C. Needless to say, these conditions can only be achieved in factories having the necessary equipment.

As regards the purity of the B massecuite, it will be noted that this was *on the average* two points above the figure of 56 which had been chosen. There is there a definite ground for improvement, and in fact this improvement did take place in the last few weeks of the season; it was brought about when the pan-boilers finally realised that the process was an acceptable proposition and gave their wholehearted support to make a success of what they considered impossible.

The absence of any control instruments on the B pans was also a drawback, more so than with a 3-boiling system to which everybody was used.

The quality of the B sugar footing used for the A strikes was poorer than expected, but was about the same as that usually obtained at Saint Antoine when fugalling as cold as possible. Although it is felt that the purity of the magma is of less importance with a two-boiling system, modifications to the massecuite reheating gear will be carried out before the next season to improve on last year's conditions.

In conclusion, it can safely be said that, provided a factory is well equipped, a two-boiling system like the one described offers several advantages, and that the results obtained compare very well with those usually considered good, at least under the existing conditions in Mauritius.

It is the author's hope that the above remarks will prove of interest and that they will, in some small way, help towards the solution of that great problem: How to make more sugar from a given syrup.

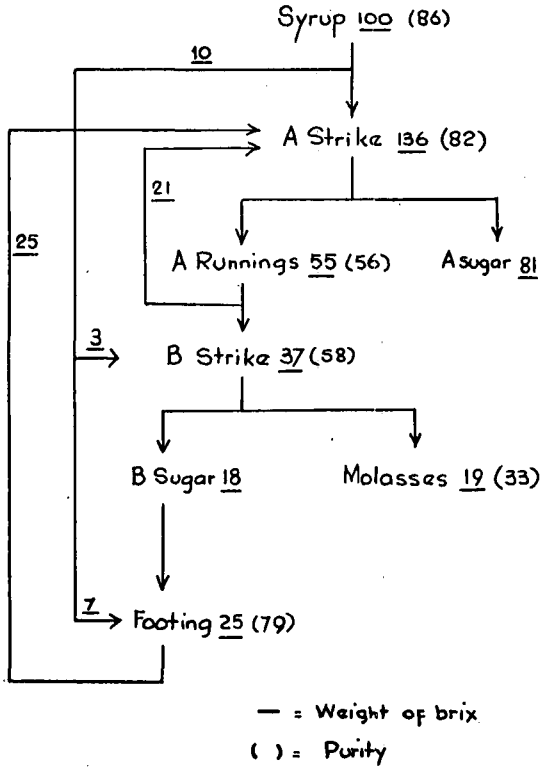
The author wishes to acknowledge the encouragement he received from the manager of Saint Antoine, as well as all the unselfish help provided by his assistants.

BIBLIOGRAPHY

[1] A straight two-boiling system. Rene Noël, Revue Agricole de l'ile Maurice, Nov-Dec. 1957.

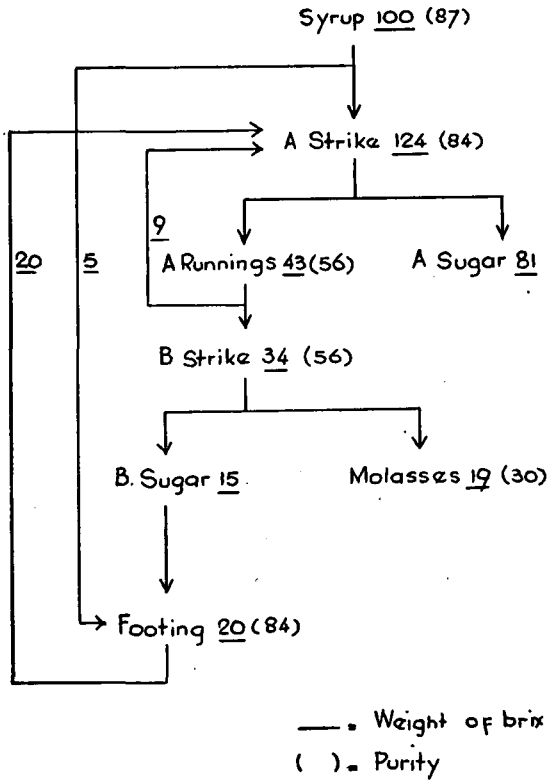
APPENDIX I

II. Actual 1958.



APPENDIX I.

I. Theoretical 1957.



The Chairman (Mr. du Toit) said this paper was written by Mr. Rene Noel and read by Mr. Baissac. He was pleased that we were able to welcome people from Mauritius—it was of great assistance to us and it enhanced the value of our Proceedings to get papers from other countries and to have the opportunity of discussing problems with people from outside countries. He said that one thing that seemed strange to him was the very high brix of molasses obtained in Mauritius. He wanted to know how the brix of molasses was determined. Another point of interest was the large increase between the apparent purity and the clerget purity of 3°.

Mr. Baissac said that the only reason he could see for this high brix was the high brix used in boiling the "C" massecuite. The brix was determined on a 10 per cent solution. The massecuite was boiled to a high brix, cooled in the Blanchard crystallizers and re-heated as little as possible.

Mr. Rault said that as far as he could remember from his early days of Mauritius experience, they never got such high purity drops between first massecuite and first molasses. He did not know of any South African factories that ever had such good results, as most of the first boilings were insufficiently cooled. Could this be due to the composition of the juice in Mauritius, i.e. the nature of the non-sugars, or was it just the high concentration of the massecuite? The objection many of us had to graining on low purity liquors, was that although one did form a very regular crystal, the time taken for crystal growth to a reasonable size for free purging, was unduly long. He wanted to know the size of the grain produced and particularly that of the "C" sugar crystal. It would be interesting to compare these sizes with that of the grain obtained here, where the "C" sugar had sometimes to be bagged as a 98° pol sugar.

Mr. Baissac in replying to Mr. du Toit said that he assumed that it was the amount of reducing sugars which enabled them to get such a big difference in purity between apparent and clerget sucrose of molasses. He thought that the big drop in purity between "A" massecuite and molasses was due to the high brix reached and also the temperature at which the massecuite was cured. When the massecuite was cured at low temperature one would expect to get a high purity drop. In actual practice the purity had to be reduced to 82 and lead to a 26°, or so, drop. He said the time used in obtaining such a high brix was adequately covered by the fact that less time was involved in boiling the two massecuite system rather than the 3 massecuite cycle. As far as the size of crystal was concerned he thought that

in the case of "A" massecuite this was not less than .25 millimeters and often .3 millimeters.

Mr. Johnston asked what temperature was used in the boiling. If the temperature was high during the graining period would it then be reduced or was it maintained at a constant figure throughout? Another point he inquired about was the "C" massecuite purity of 54°.

Mr. Baissac said that he could not quote actual temperatures but the vacuum had to be increased, and the temperature after graining would be reduced. As far as dilution of massecuites was concerned if the massecuite was very tight some water had to be added. The crystallizers were situated above the centrifugals and no pumping was required.

Mr. Perk said that he had applied the same system with the aid of rapid-cooling Lafeuille crystallizers. As the high degree of exhaustion leads to a very high crystal content of the massecuite, the massecuite has to be "lubricated" in order to maintain the required fluidity. This was accomplished by filling the Lafeuilles in advance with molasses in a concentrated form; about 20 per cent of the volume of massecuite. In the case of such high degrees of exhaustion the mother liquor becomes very thin, very watery and any drop of water added would decrease the exhaustion. Hence, concentrated molasses is added for "lubrication".

Mr. Hendry stated that thirty years ago in Brazil, white and brown sugar had been made by the two massecuite system. There were large purity drops and final molasses of 30-32 per cent apparent purity. The reasons for these figures were the low mixed juice purity, and glucose ratios of 8 and 9 degrees.

Mr. Beesley said that he wished to congratulate Mr. Noel on his "A" massecuite boiling technique. At Illovo, the aim was to boil a final massecuite of 54° apparent purity (only two units lower than Mr. Noel's aiming point). However, to do this it was essential to use more than two steps, i.e. "A" and "B" massecuites. The fact that all massecuites had to be pumped to the centrifugals at Illovo was a great limitation to exhaustion.

Mr. Rouillard said that the 28° purity drop could be explained by the fact that in the Robertson centrifuge super-heated water was used at about 150°C. which meant that very little water was used.

Mr. Rault inquired if the curing was single curing.

Mr. Rouillard said that this was single curing and that no separation of molasses was attempted.

Mr. Beesley said that his impression was that the rich runnings only were returned to "A" massecuite and the molasses went into the "C" massecuite, but apparently that was not the case. Apparently, however, "A" molasses was returned to the first massecuite.