SOME OBSERVATIONS MADE ON THE REHEATING OF MASSECUITE IN A CRYSTALLIZER

By W. F. DAVIES

The writer apologises for the scantiness of data contained in this paper. However, had more data been available it is unlikely that this article would have gone into print. At the outset let it be said that the object of this paper is not to show how a massecuite should be reheated, rather an attempt is made to point out the snags encountered when massecuite is heated in plant of inadequate design and more or less devoid of instruments.

In 1955 a new set of high speed centrifugals was put into operation at Felixton. It soon became evident that the massecuite reheater supplied with these machines was not satisfactory. The blowing of steam through a Blanchard type element resulted in poor heat distribution and local overheating of the massecuite. A temperature difference of 35°F (120–155°F) was found when taken at either end of the reheater mixer. Final molasses purities were always higher by 2–3° when the massecuite was reheated. Final molasses purities with no heat applied were 38–39 and 40–43 when the massecuite was heated. Minor alterations were made to the reheater but with little effect. Finally the use of the reheater was abandoned and only in cases of extreme urgency was its use permitted. The old method of diluting massecuite with water in the crystallizers and at the massecuite pump was again adopted.

During June and July 1959 great difficulty was experienced with the purging of C massecuites and the resulting recirculation of molasses caused the B massecuites to fall off in quality, to purge less freely and to increase in quantity.

At this stage the advice of the S.M.R.I. was sought. An officer of the S.M.R.I. and a technologist of the Huletts Group visited Felixton in regard to the foregoing, and the following points resulted from the discussion:

(*a*) It was considered good practice to change the method of graining for C massecuites. Whereas previously syrup grain was used as a footing for C massecuites, it was proposed to grain on A molasses with a view to improving grain regularity.

(*b*) Due to the sticky nature of C massecuites it was suggested to end the heavying up at about 97° brix and to consider this brix as acceptable, in light of the difficulties being encountered.

(*c*) It was stressed that the heating of final massecuite can contribute greatly to the ease of curing. However, as pointed out previously, the reheating device supplied with the centrifugals was not considered of adequate design, so other means of reheating were investigated.

As Felixton is fitted out with six 1,200 cu. ft. crystallizers with Blanchard cooling elements through which hot water can also be passed, it was attempted to heat massecuite in these crystallizers.

The necessary attention was given to the three above mentioned points. The results in practice were:

SUB. A

Unfortunately full advantage could not be made of this recommendation as Felixton was not equipped with a Cuitometer and it was felt that graining on A molasses, without the help of such an instrument would be rather risky. To achieve as much similarity to the proposal as possible, the following graining method was used. Instead of slurry graining on syrup, C massecuite footings were slurry grained on a 50/50 blend of syrup and A molasses giving a graining charge purity between 73°–75°. After establishing the grain it was worked up on A molasses to 900 cu. ft. and used as footings for two C massecuite strikes.

It must be said that hardly any improvement in grain regularity was noticed, but it should be taken into account that a large quantity of syrup was still used for graining.

SUB. B

During the period that the massecuites were being discharged at a lower brix than normal the massecuites were also being heated, so it is very difficult to say how this practice affected either curing or the final molasses purity.

SUB. C

First of all it should be stated that the application of heat to the massecuite in the crystallizer greatly contributed to easing the tension at the final massecuite station. The necessary amount of final molasses could be discarded from the factory and hence the crushing rate of the mill could be maintained. Also, due to less recirculation of non-sugars in final molasses an immediate improvement in the quality of the B massecuites was noticed. Before reheating of massecuites, magma purities were between 77° and 79° and after heating these rose to 83°–85°. However, the author feels that it should be investigated as to what costs are involved to gain the above advantages, which in nature, are only normal in a smooth running factory. (On the basis of Nutsch molasses obtained and assuming a final molasses of 37° at the machines, a rough estimate is that something in the range of £14,000 could be saved in the course of an 80,000 ton sugar crop).

We only became aware of the loss incurred after the position in the factory had eased up so much that this emergency way of heating could be discontinued and the normal way of dealing with the final massecuite, namely slight dilution at the pump and in the crystallizers was again practised.

Table 1 gives final molasses purities when massecuites were heated and Table II when the heating was stopped.

The brix figures in the table are inclined to be misleading. During October the brix of final molasses was actually higher than that shown in the table, due to the fact that dilution was necessary in order to be able to pump the molasses to the scale tank where sampling takes place. Quite confidently it can be said that the actual brix of the final molasses must have been about 96°.

In an endeavour to find out what happens when massecuite is heated in this type of crystallizer under the existing set-up, Nutsch tests were carried out and Table III shows that at a brix of 95–96° molasses purities of 35–36° regularly occur.

Hence it can be said that heating the massecuite caused a molasses purity rise of approximately 5–6° whilst feeding with water caused only a 3–4° rise.

As such, it is clear that unless better means of heating are available than those which exist at Felixton, preference should be given to diluting with water.

Let it be pointed out, however, that the above is certainly not an answer to the question of whether reheating should be applied or not. Figures in Table I and II merely indicate that if reheating is seen as a simple process that can be done by any available type of heater, disappointment can be expected.

It is worthwhile to take into account that the "better" method of feeding with water still causes a loss of sucrose due to the purity rise of 3–4°.

Conclusion

The author feels that it must be profitable to see reheating as a potential means of reducing the losses in final molasses, only if suitable plant is available to do this job. The advantages will not only be a better purging of the massecuite and a lower purity of the final molasses but an increase in C sugar purity and a resulting decrease of non-sugar recirculation.

To achieve the above advantages it would seem that a plant of the following characteristics should be available:

1. A heat exchanger of the continuous flow type where heating and the heating medium are run counter-currently.
2. A heat exchanger which has a large heating surface ratio to volume of massecuite.
3. A mixer above the centrifugals with a small heating element to maintain the temperature of the massecuite.
4. The centrifugal baskets should be covered and conditioned air should be blown in to prevent cooling of the massecuite during purging.

Additionally, the laboratory should be sufficiently staffed and well equipped to be able to maintain a continuous control on the saturation temperature of each boiling, this again to prevent undue resolution of sucrose.

TABLE 1

OCTOBER *Heating in crystallizer* *Week No.*	*Massecuite* *brix*	*Massecuite* *purity*	*Molasses* *brix*	*Molasses* *purity*	*Mixed Juice* *purity*	*Sucrose lost in Molasses per cent Sucrose in Mixed Juice*	*Undetermined per cent Sucrose in Mixed Juice*	*Boiling house performance*
1.	98.54	59.00	91.84	41.24	85.14	9.05	0.70	97.21
2.	99.26	59.20	93.38	41.51	85.47	8.99	1.95	95.61
3.	98.51	59.02	92.05	41.39	84.86	9.01	0.36	97.75
4.	97.92	58.11	92.46	41.17	84.70	9.29	0.81	97.17
5.	97.98	58.46	92.58	41.15	84.40	9.08	0.86	97.74
Average	98.44	58.76	92.46	41.29	84.91	9.08	0.94	97.10

TABLE 2

NOVEMBER *Diluting with water* *Week No.*	*Massecuite* *brix*	*Massecuite* *purity*	*Molasses* *brix*	*Molasses* *purity*	*Mixed Juice* *purity*	*Sucrose lost in Molasses per cent Sucrose in Mixed Juice*	*Undetermined per cent Sucrose in Mixed Juice*	*Boiling house performance*
1.	98.38	58.67	90.47	39.14	84.30	8.50	0.43	98.87
2.	98.18	57.88	90.48	39.12	84.14	8.38	0.56	98.92
3.	98.79	57.52	90.84	38.24	84.44	8.02	0.46	99.34
4.	98.67	56.93	91.37	38.07	84.36	8.03	0.44	99.39
Average	98.50	57.75	90.79	38.64	84.31	8.23	0.47	99.13

TABLE 3

MASSECUITE A

Temperature	*Massecuite* *brix*	*Massecuite* *purity*	*Nutsch* *brix*	*Molasses* *purity*		
143 Deg. F.	98.10	59.8	97.10	45.3		
105 Deg. F.	97.60	59.1	96.60	36.3	Cooling time	43 hours
115 Deg. F.	98.45	59.6	96.95	34.9	Heating time	4½ hours
120 Deg. F.	98.10	58.8	96.00	37.4	Water inlet	165 Deg. F.
130 Deg. F.	—	—	96.80	38.0	Water outlet	153 Deg. F.
130 Deg. F.	—	—	96.30	38.6		

MASSECUITE B

Temperature	*Massecuite* *brix*	*Massecuite* *purity*	*Nutsch* *brix*	*Molasses* *purity*		
145 Deg. F.	98.50	57.5	96.30	44.7		
95 Deg. F.	98.30	57.8	95.00	36.0	Cooling time	27 hours
110 Deg. F.	97.90	57.4	96.10	35.5	Heating time	7 hours
125 Deg. F.	—	—	95.71	37.1	Water inlet	163 Deg. F.
130 Deg. F.	—	—	96.30	38.3	Water outlet	150 Deg. F.
130 Deg. F.	—	—	96.50	38.7		

The President, Mr. Bentley (in the Chair) said Mr. Davies' paper threw a lot of light on some of the difficulties experienced in sugar factories. Operators cannot get the equipment they want when they want it and they always have to try and make do with what is available and try to get the best results from that.

Mr. Turner asked Mr. Davies when he attempted to reheat the massecuite in the crystallizer, to what temperature did he manage to reheat the massecuite?

Mr. Davies said that they aimed to heat the massecuite to a temperature of 125°F. One interesting point was that they found that in a Blanchard type of crystallizer they were getting a temperature of 114° on one side and 127° to 128° on the other side, which seemed to indicate that they were getting little or no circulation whatever in places. Temperatures were all taken at the surface of the massecuite.

Dr. Graham drew attention to the point made in the paper that £14,000 could be saved. This should provide the necessary equipment.

Mr. Carter asked the author what was the purity of the 1st molasses when he attempted to grain on first molasses only, and at what purity it was brought up to when he mixed it with syrup.

Mr. Davies said that purity of the first molasses varied between 65° and 68° and the blend of syrup and molasses was about 75° purity. It was slurry grained first of all without the use of a cuitometer. Now that they had a cuitometer they had better control.

Mr. Thumann asked about the Brix of the 3rd massecuite at 97°. He said that would mean a rather low crystal content of massecuite. He would like to enquire the capacity of the Blanchard crystallizers and the capacity of the 3rd massecuite centrifugals. He also asked if Felixton had tried to grain on A molasses. He thought that the tendency nowadays was to bring the purity of the third massecuite down by lowering the purity of the blend used for graining. He had found at times it was possible to grain on 66° purity whereas on other occasions it was difficult to grain on 70°. Through the low reducing sugar ratio in Natal it was difficult to grain on low purity molasses. He also wanted to know if the material was very viscous. He thought that Felixton might have been more successful had they used hot water instead of steam for reheating the massecuites. This might account for why they found differences in temperature in the crystallizer.

Mr. Davies said that he could see the point that while the massecuite Brix was 98° the Nutsch Brix was only 97° it would indicate a low crystal content. As far as centrifugal capacity was concerned at 150 tons per hour they had six 24 x 42 in. machines.

With regard to graining on A molasses they found at Felixton that they had not been successful in graining on A molasses although this has been done in other countries.

The viscosity of the molasses was very high indeed. He did not think this was due solely to the low crystal content of the massecuite. He said that water was used instead of steam through the heater and in the crystallizers. The temperature of the water was too high, but if the temperature was lowered one would not have enough crystallizers for they were used as heaters as well as crystallizing machines.

Mr. Thumann asked if there was a long time-lag between the massecuite leaving the crystallizer and entering the centrifugal mixer. If this was the case the heating effect might be lost.

Mr. Davies said the massecuite had to be pumped about 40 ft. from the crystallizer to the mixer. He had pointed out in the conclusion that the mixer above the centrifugals is with a small heating element which was used to maintain the temperature of the massecuite.

Mr. Beesley congratulated the author for pointing out so clearly that the correct treatment for C massecuites prior to centrifuging was re-heating in a specially designed piece of plant, and if such plant was not available, it was preferable to dilute the massecuite rather than re-heat in the crystallizers.