

B-CRYSTALLISERS: ARE THEY JUSTIFIED?

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Abstract

A comparison of the beneficial effects of A- and B-crystallisers is presented. The effect of B-crystallisers on different aspects of process operation is discussed and their cost effectiveness is evaluated. It is concluded that the installation of B-crystallisers cannot be financially justified.

Introduction

The trend in local industry is to install relatively large crystalliser stations for all three grades of massecuite, with the object of achieving maximum crystallisation. An average mill would have a total crystalliser capacity of 5 m³ per ton cane per hour (TCH), of which about 30% is used on B-massecuite. This is equivalent to 5 000 m³ of B-crystallisers (including strike receivers) for the whole industry, with an estimated replacement value of R20 000 000. It should be asked whether an improvement in B-exhaustion is worth this investment, to which must be added the associated capital cost at the B-centrifugal station (especially in our partial remelt system, in which the B-sugar is only an intermediate product, a large part of which will be redissolved to process). The aim of this paper is to provide an answer to these questions.

Comparison between A- and B-crystallisers

Typical data on the capacity and performance of A- and B-crystalliser stations, as per the standards of CG Smith Sugar Limited (CGSS), are given in Table 1.

Table 1

Average A- and B-crystalliser station in CGSS (includes strike receivers)

	A-Massecuite	B-Massecuite
m ³ /TCH	1,8	1,5
Retention time (h)	11	24
Temperature drop (°C)	14	20
Reduction in molasses purity	4	5
Change in exhaustion	62 to 68	56 to 64

Under average conditions a drop in A-molasses purity of four units raises the overall A-exhaustion from 62 to 68. Similarly, an improvement of 5 units in B-molasses purity across the B-crystallisers increases the overall B-exhaustion from 56 to 64.

The positive effect of additional crystallisation is shown mainly in two forms, a reduction in massecuite quantity and a saving in steam consumption on the pan floor. Based on these parameters, the benefits of A- and B-crystallisers for average South African conditions, as determined by computer modelling, are summarised in Table 2.

Table 2

Reduction in massecuite volumes and steam consumption effected by A- and B-crystallisers

	A-Crystallisers	B-Crystallisers
Massecuite volume		
A	9%	0%
B	50%	12%
C	0%	0%
Total	15%	2%
Steam % pan floor	14%	2%

It is evident that the A-crystallisers, with only 20% more capacity than the Bs (1,8 m³ vs 1,5 m³/TCH) are about seven times more "effective". This important difference in the practical value of exhaustion gain between the two grades of massecuite is a clear indication that valid justification for the As might not necessarily hold true for the Bs.

Advantages and disadvantages of B-crystallisers

The advantages and disadvantages associated with B-crystallisers are listed in Table 3.

Table 3

Advantages and disadvantages of B-Crystallisers

Advantages	Disadvantages
Lower B-Molasses Purity	Higher Capital Costs
Lower B-Massecuite Volume	Additional B-Centrifugal Capacity
Lower Steam Consumption on Pan Floor	Difficulty in Eliminating B-Crystal Breakage
	Higher Running Costs
	Higher Sucrose Degradation

Advantages

B-molasses purity

The incentive to lower the purity of B-molasses, by the use of crystallisers is only valid if it is the limiting factor in meeting target C-massecuite purity. This is seldom the case locally, despite production of the lowest C-massecuite purities in the sugar world. For example, in the 1989/90 season, average industrial purities for B-molasses and C-massecuite were 44,1 and 52,5 respectively. It should be noted that, without B-crystallisers, the increase in B-molasses purity will

not be the full five points shown in Table 1, because one to two points will be recovered through crystallisation in the strike receiver. Furthermore, it is stressed that the most effective way of achieving low B-molasses purity is by maximising the A-masseccuite exhaustion, and this is the area which ought to receive top priority. In the exceptional instances when B-molasses purity may become too high to accommodate the target C-masseccuite purity, some recycling of B-molasses on the B-masseccuite could be considered.

B-masseccuite volumes

With B-crystallisers the relatively small reduction in B-masseccuite quantity (12%) corresponds to a drop of 2% in the total quantity of masseccuite.

Steam consumption

The effect of the B-crystalliser station is to reduce steam consumption on the pan floor by less than 2%, corresponding to about 0,4% of the total process steam consumption. This small saving is of benefit only to mills making use of supplementary fuel. For a 300 TCH mill the coal saving would be worth about R40 000 per annum. However, it will be shown (see 'Breakage of crystals in B-centrifugals') that the elimination of B-crystallisers opens the way to more than recovering this amount.

Disadvantages

Capital costs

Based on CGSS standards, a 300 TCH mill would have a B-station made up of a 150 m³ strike receiver plus three vertical crystallisers of 100 m³ each. Assuming that the strike receiver (which is essential in the case of batch pans) remains, elimination of the B-crystallisers would result in a capital saving of R1 200 000 (3 x R400 000).

Running costs

Based on mill data, it is estimated that the running costs of three crystallisers amount to R10 000 per annum.

Sucrose degradation

There is a great deal of awareness nowadays about sucrose degradation and colour formation (Smith, 1990) taking place in back-end products, and the SMRI is actively investigating this problem. Using the latest available information based on work by Schaffler (1990) it is calculated, using a computer model, that in a 300 TCH mill about 100 tons of commercial sugar worth R90 000 are lost through inversion in the B-crystallisers per season.

B-centrifugal capacity

Cooling the masseccuite in the B-crystallisers has the effect of increasing its viscosity which reduces the curing capacity of the centrifugals. As a rule the molasses viscosity doubles for each 7-8°C drop in temperature and consequently curing the hot B-masseccuites at about 65°C instead of about 48°C would, in theory, reduce the required centrifugal capacity by a factor of at least four. For a 300 TCH mill a B-centrifugal station, which would normally consist of four machines of 1 100 mm each, could easily be reduced to two at an estimated capital saving of R500 000. The saving in running costs would amount to R20 000 per annum (2 x R10 000).

Breakage of crystals in B-centrifugals

Elimination of the B-crystallisers would offer interesting prospects for an existing B-centrifugal station. A reduction in the number of centrifugals, as outlined above, would facilitate and reduce the cost of installing 'big' casings around the few remaining ('big' casings are difficult to install in most existing stations as space is limited due to the large number of machines). The saving in steam from the elimination of B-crystal breakage has been discussed by Jullienne (1990) and would more than counter the estimated 0,4% steam saving from B-crystallisers.

Economic appraisal of a B-crystalliser station (300 TCH mill)

Capital costs

3 crystallisers each 100 m ³	(R1 200 000)
2 centrifugals each 1 100 mm	(R 500 000)

Less

12% B-pan capacity saving	R 200 000
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Net capital investment	(R1 500 000)
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Running costs

Repairs and maintenance	
3 crystallisers	(R 10 000)
2 centrifugals	(R 20 000)
Sucrose degradation losses	(R 90 000)

Less

Steam saving (coal equivalent) (only applicable to mills using supplementary fuel)	R 40 000
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Net increase in annual running costs	(R 80 000)
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Conclusions

It is clear that investment in B-crystallisers is unjustified in the case of a new mill. In a mill already fitted with B-crystallisers a number of options exist, one of which would be to consider using the B-crystallisers, or part of them, to extend the A-station with a view to improving A-exhaustion. In addition, the feasibility of eliminating some of the centrifugals should be considered to facilitate the installation of 'big' casings at the B-centrifugal station.

In a case of mill expansion it would make economic sense not to expand the B-station but to use the existing B-crystallisers to increase the capacity of the A- and C-stations.

REFERENCES

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