DOUBLE CURING OF C-SUGAR: WHY NOT?

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Abstract

Up to the late sixties when batch centrifugals were used for curing C-massecuites, double curing of C-sugar was common practice in the South African industry. However, with the introduction of continuous centrifugals in the early 70's, this practice has been progressively discontinued and has now disappeared completely. Paradoxically, several other processes have in the meantime been proposed and tried with a view to improving the quality of the VHP sugar, particularly its colour.

This paper questions the wisdom of these developments in raw sugar processing. The merits of double curing relative to the other newly proposed processes are discussed and its contribution to a better sugar quality under the present industrial conditions is supported.

Introduction

Since the introduction of VHP sugar in 1970, South African export sugar has been considered one of the best in the world. However, because of a number of adverse factors such as cane quality, eldana borer infestation, extraction levels and diffusion, among others, some mills have experienced in the last few years increasing difficulty in maintaining the required colour level without resorting to processing changes. The commitment of the industry to improve, or at least maintain the excellent standard of our sugar is reflected in the many papers presented at recent SASTA congresses dealing with sugar quality improvement. In 1983 and 1984 two papers dealt with a new boiling scheme proposed by Van Hengel[7,1]. In 1987 Mann[5] discussed the production of a smaller crystal size at SZ and Rein *et al*[6] discussed the advantages of syrup clarification in the Tongaat-Hulett mills.

Paradoxically, while all this effort was being spent on the development of new processing methods, the practice of double curing the C-sugar was being abandoned by the industry, Darnall being the last mill to use it in the 1985 season. Two main reasons can be put forward to explain the lack of popularity of double curing in the past: firstly, with the VHP process the colour specifications can be met easily at most mills and, secondly, double curing has a tendency to raise the minimum C-massecuite purity attainable. In 1976, the author himself (Jullienne[2]) stated that "elimination of any non-essential practices (double curing of C-sugars being an obvious one in many cases) which have a tendency to raise the minimum C-massecuite purity attainable, ought to be considered".

Because of the relative difficulty experienced by some mills intermittently to maintain the excellent colour standards of the past, is it not time to re-consider double-curing? Is this process not better justified now than it was in the early 70's? The author believes that the present understanding of sugar colour makes it possible to quantify with greater confidence, the influence double curing could have on the raw sugar colour.

Basic Approach to Sugar Colour

The raw A-sugar manufactured by the partial remelt system is made up of three distinct parts:

(i) The B-sugar nucleus, with a colour contribution of 5 to 10%

(ii) The 'A-crystal' around the B-nucleus (about 45% of the total colour)

(iii) The A-molasses film adhering to the crystal (about 45% of the total colour)

Based on the above, four different approaches can be adopted, individually or together, to improve the raw sugar colour, namely:

(i) The elimination of the B-nucleus from the A-crystal

(ii) The improvement in the quality of the medium from which the sugar is crystallised. This would improve the colour of both the crystal and the molasses film

(iii) The improvement in crystallisation technique which would reduce the crystal colour

(iv) The removal of the maximum quantity of molasses around the crystal (compatible with other performance parameters e.g. exhaustion) and/or its replacement by a film of lower colour (e.g. affination, decolouration).

Double curing of C-sugar fits in the second category above. It reduces considerably the recycling of low purity, high colour, final molasses to the syrup stage and improves the quality of the medium from which the sugar is crystallised. In general, without double curing, about 15% of the total final molasses is returned to the syrup stage. This recycle could be reduced to 5% or less with double curing. Double curing has a "double effect" on raw sugar quality in improving both the crystal and molasses film colour.

Effect on Sugar Colour

An estimation of the beneficial effect of double curing can be obtained using the assumption, generally valid, that the colour of raw sugar is directly dependent on the colour of the medium from which it is crystallised.

On average, the composition of the A-pan feed, with and without double curing, would be as shown in Table 1. The material balances for the two schemes are shown in Appendices 1 and 2.

Table 1

Percentage composition of A-feed (Brix basis)

	Single Curing	Double Curing
Syrup	75	75
B-sugar	15	18
C-sugar	10	7

Realistic colour data for single and double curing situations, starting with syrup at a colour of 25 000 ICUMSA units would be as shown in Table 2 (all colour data expressed in ICUMSA units).

Table 2
Colour and purity data for single and double curing schemes

	Single Curing	Double Curing
Syrup colour	25 000	25 000
B-Sugar colour	20 000	20 000
C_1-Sugar purity	82,0	82,0
C_1-Sugar colour	44 000	44 000
C_2-Sugar purity	—	91,0
C_2-Sugar colour	—	20 000
A-Pan Feed colour	26 150	23 750

The improvement in the pan feed colour is about 10% with double curing and the colour of the A-sugar can be expected to improve by 10% as well, everything else staying the same. In practice the improvement may be higher because the reduction in colour is in the form of colour from final molasses, with a high proportion of process-formed components which are generally believed to have a greater affinity for the crystal.

Effect on Final Molasses

The important reduction in the recycling of final molasses to the syrup with double curing allows for more flexibility on the C-sugar purity level. Under average South African conditions a reduction in the C-sugar purity of 2 to 3 points becomes feasible, which could lead to an improvement in final molasses purity of 0,2 to 0,3 points (Jullienne[3]). In addition, the reduction in final molasses recycling should improve the processing characteristics in both the A- and B-stations. However, the necessary precaution must be taken to ensure that excessive recycling of final molasses to the C-massecuite does not negate the positive effects mentioned above.

Comparison with other processes

As mentioned previously a number of "new" processes have been proposed in the last few years by local technologists for sugar quality improvements.

The main ones deserving consideration are:

(i) AvH system (van Hengel,[7] De Robilland and van Hengel[1])

(ii) Reduction in crystal size (Sezela investigations, Mann[5])

(iii) Syrup clarification (Rein, *et al*[6]).

AvH System

The AvH process involves B-boilings from C-magma with the A-sugar being grained on slurry. This system possesses, partly, the advantage of double curing in reducing the recycling of final molasses, associated with the C-sugar, to the syrup. Double curing is however superior in this sphere because it returns the molasses to the C-massecuite instead of to the B-massecuite in the AvH system. In the AvH system the slurry graining of A-massecuite is an integral part of the system. In double curing, slurry graining is optional, which is advantageous. There is no centrifugal capacity advantage with the AvH system since the C-sugar is effectively double cured through the B-sugar. Based on factory trials at Illovo and Sezela, it is considered that the increase in B-massecuite volume and purity would be more pronounced with the AvH system than with double curing.

Crystal Size Reduction

Recent pilot pan studies at SMRI (Lionnet[4]) and factory investigations at Sezela have confirmed the positive influence a reduction in crystal size could have on the crystal colour. However, based on the present crystal size in the industry it is unlikely that much more than 10% improvement in crystal colour could be expected from this method. This method, of course, does not change the quality of the molasses film, which represents about 50% of the total raw sugar colour; that is, the overall improvement in raw sugar colour would be limited to about 5%. This technique has the advantage of requiring no additional equipment, it is totally compatible with double curing and a combination of both processes would be advantageous.

Syrup Clarification

Much has been written in the last few years about syrup clarification and sugar quality and many favourable reports have been presented both locally and overseas. Unfortunately, the experience with syrup clarification in CG Smith Sugar Limited, based on the performance of a syrup clarifier at Gledhow in the 1987 and 1988 seasons, has been disappointing. Apart from a significant reduction in the turbidity of the syrup it had no positive effect on all the parameters investigated, namely syrup colour, sugar quality, massecuite exhaustion and final molasses purity. It is felt that under average conditions (e.g. Gledhow over the last two seasons) double curing would be more beneficial than syrup clarification for sugar colour improvement (and final molasses purity). However the fact is not disputed that under certain specific conditions syrup clarification could be of benefit. Double curing is cheaper in capital and running costs and easier to run. Double curing and syrup clarification are, in any case, compatible and could be used simultaneously if considered financially profitable.

Discussion

In the seventies the South African mills could afford to return up to 15% or more final molasses to the syrup through the C-sugar and still produce an A-sugar well within specifications. This favourable situation no longer exists and it is considered illogical that all mills, irrespective of their colour situation, have deliberately adopted a system in which A-sugar is produced from a medium which is made up of final molasses. Double curing of C-sugar would greatly help in eliminating this anomaly. It is a system which is cheap and easy to run e.g. a 250 TCH mill would require only three continuous centrifugals and a magma mingler as major additional equipment. Many local mills could possibly practice double curing with less additional centrifugals by making use of the existing surplus capacity at the centrifugal station.

However double curing is not a "miracle cure" and it is estimated that it could improve the sugar colour by about 10% under average conditions. It is felt that this would compare favourably with processes like the AvH system and syrup clarification. In addition, double curing possesses an advantage regarding the final molasses purity. It is worth noting that double curing could be carried out simultaneously with processes such as syrup clarification and smaller crystal size, in which case the combined colour improvement effect could well reach the 20% level.

Conclusion

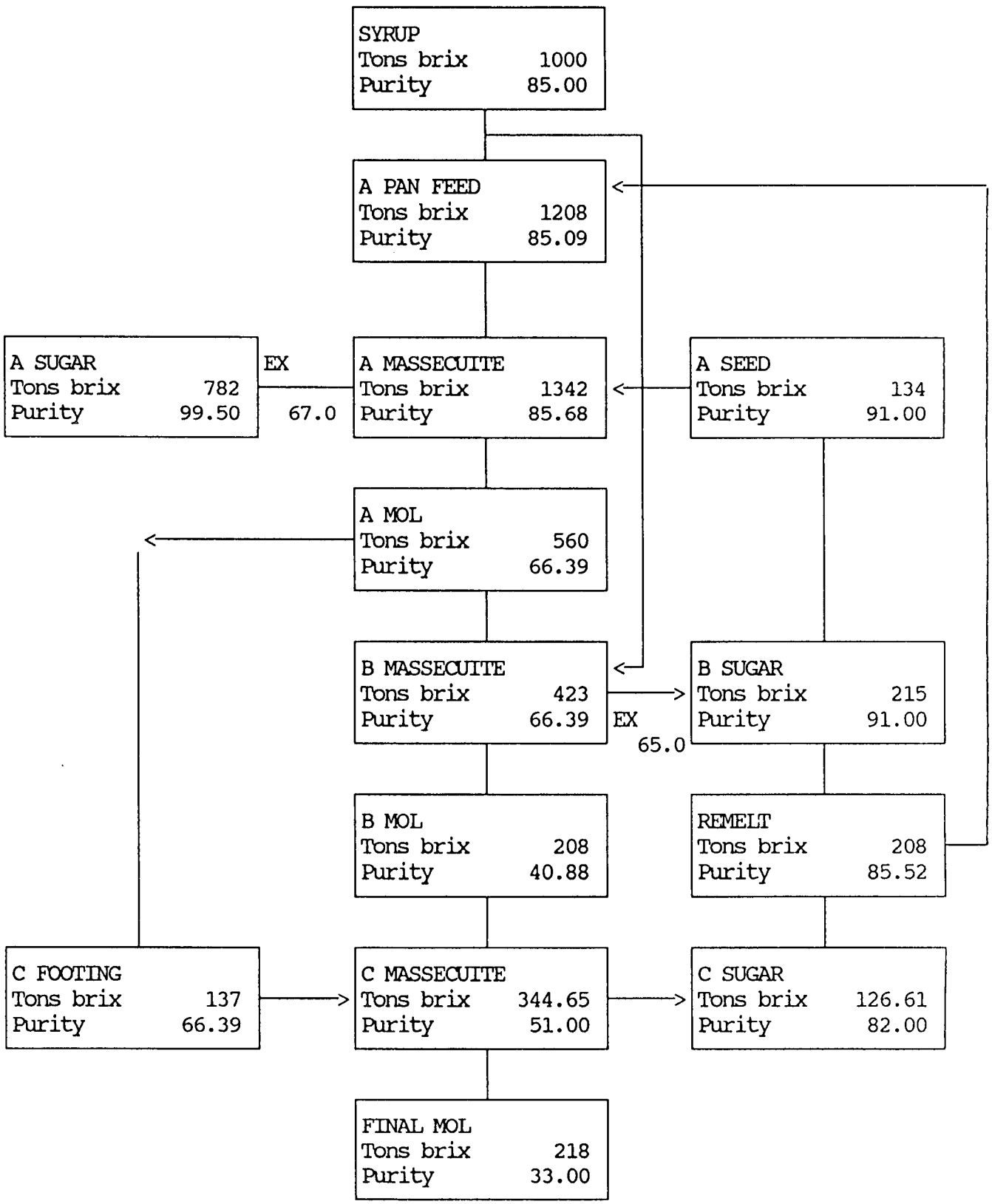
Although the industry may have been justified in abandoning the double curing of C-sugar in the past, it is suggested that many mills, under the present circumstances, would benefit from its re-introduction. It is cheap and easy to operate and in the author's opinion should be given top priority on the list of options for colour improvement. In general, the improvement in sugar colour that it would bring, although limited to 10 to 15%, could be increased substantially by running it in association with other processes if and when required.

REFERENCES

1. De Robillard, JPM and Van Hengel, A (1984). Preliminary results of a modified boiling system at Illovo factory, *Proc S Afr Sug Technol Ass*, 58: 47-50.
2. Jullienne, LMSA (1976). A-massecuite exhaustion and low purity C-massecuite at Melville, *Proc S Afr Sug Technol Ass*, 50: 194-197.
3. Jullienne, LMSA (1982). The operation and performance of continuous C-centrifugals, *Proc S Afr Sug Technol Ass*, 56: 37-40.
4. Lionnet, GRE (1988). The effect of some operational factors on colour transfer during pan boiling, *Proc S Afr Sug Technol Ass*, 62: 39-41.
5. Mann, GF (1987). Modifications to the boiling procedures at Sezela in an attempt to reduce VHP sugar colour, *Proc S Afr Sug Technol Ass*, 61: 83-85.
6. Rein, PW; Cox, MGS and Montocchio, G (1987). Syrup clarification in raw sugar mills, *Proc S Afr Sug Technol Ass*, 61: 22-31.
7. Van Hengel, A (1983). Modified boiling system for better sugar quality, *Proc S Afr Sug Technol Ass*, 57: 38-41.

APPENDIX 1

Partial remelt system (single curing)



APPENDIX 2

Partial remelt system (double curing)