EVALUATION OF HIGH CAPACITY CONTINUOUS CENTRIFUGALS

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Abstract

Two Broadbent SP1220 centrifugals have been installed at Amatikulu and two at Maidstone. A BMA K1301 has also been installed at Maidstone. Over the past two seasons considerable effort has gone into evaluating the performance of these machines and modifying them to suit local conditions. The results of these tests on capacity and performance are presented together with a history of the changes made to optimise performance. Currently throughputs of 8 to 9 tons per hour of C-massecuite can be achieved with purity rises between 3 and 4 units.

Introduction

Two seasons ago it became necessary to refurbish the B- and C- centrifugal stations at some of the Tongaat-Hulett mills, the reason being that the majority of the machines were reaching the end of their useful life (approximately 20 years) and the baskets were developing fatigue cracks.

At that stage, with the exception of Felixton, the most widely used centrifugal on B- and C-massecuite was the BMA K850 which, on average, handles C-massecuite throughputs of 1200 kg/h with molasses purity rises ranging from 2 to 5 units. This necessitated the use of a large number of machines with the resultant need for more floor space and higher maintenance and operator costs. To refurbish the BMA K850, the replacement cost/basket was in the order of R52 000.

On this basis, capacity and performance tests were done to determine the feasibility of using centrifugals with large diameter baskets for B and C curing with a view to selection of replacement machines for BMA K850's. The first of the high capacity machines to be installed was a Broadbent SP1220 at Amatikulu (AK) in the 1990/91 season. A second Broadbent SP1220 at AK as well as two at Maidstone (MS) were installed in the 1991/92 season. In addition, a prototype BMA K1301 was installed and commissioned by BMA for evaluation purposes at MS. This paper deals mainly with the initial trials on the first Broadbent to be installed at AK. The machine was positioned so that it could be evaluated for either B- or C- massecuite.

Subsequent trials on the other machines will be briefly discussed. The fabrication and installation costs have not been included.

Materials and methods

Details of the Broadbent SP1220 and BMA K1301 are listed in Table 1.

The evaluation tests consisted of:

(a) Determining whether the machine could perform to within 90% of the manufacturer's specifications for B- and C-massecuite as shown in Table 2; and

(b) deriving characteristic curves by keeping the steam and sugar purity constant while varying the massecuite throughput and water flow, the purpose being to determine the optimum throughput.

Table 1

Specifications of Broadbent 1220 and BMA K1301 centrifugals

Centrifugal	Broadbent	BMA
ID of basket	1 220 mm	1 301 mm
Basket angle	30°	30°
Nominal basket speed	2 000 rpm	2 000 rpm
Motor size	55 kW	75 kW
ID of feed valve	Iris 250 mm	Iris 200 mm
Drive	V-Belt	V-Belt
Suspension (mounting)	3 point external	4 point internal
Screen configuration	0,06 x 2,2 mm	0,06 x 2,2 mm
Open area	6,5%	10%
Machine landed cost	± R200 000	± R250 000
Screen area	1,7 m²	1,8 m²
Mean "G" factor	1 897	2 289
Electric power @ full load	40 kW	51 kW
Energy consumption @ full load	5,0 kWh/ton Mcte @ 8 t/h	5,7 kWh/ton Mcte @ 9 t/h

Table 2

Broadbent SP 1220 (design and measured data) - 1990/91 season

Variable	B-Massecuite		C-Massecuite	
	Specified	Measured	Specified	Measured
Throughput (kg/h)	15 000		5 000	
90% of throughput	13 500	11 800	4 950	6 450
Massecuite brix	94	94,2	96	95,7
Massecuite temp (°C)	-	58	55	62
Molasses purity rise	<2,5	1,5	<2,5	2,0
Sugar purity	>90	93	>82	82
Molasses brix	>76	85	> 81	83

Procedure

The test procedure consisted of setting a constant steam flow and progressively increasing the massecuite throughput while varying the water flow to obtain an acceptable sugar purity for the product under test (⩾90 for B-sugar and ⩾80 for C-sugar).

The massecuite throughput was increased until either the maximum motor loading was reached or an acceptable sugar purity could no longer be obtained. Molasses flow was determined by pail and stopwatch in the 1990/91 season and thereafter on the Servo-Balans scales used to monitor the normal molasses flow from the factory.

Massecuite flow, sugar flow and steam and water flows were determined by mass balance.

Results and discussion

This section has been divided in two, viz. 1990/91 and 1991/92 season's work. Evaluation tests with B-massecuite were only done in the 1990/91 season at AK.

1990/91 season's work - Broadbent SP1220

(a) B-Massecuite

The initial tests were conducted with the machine consisting of a 55 kW motor and a nominal basket speed of 2 000 rpm. The steam flow to the mixing cup was via a 12 mm pipe. The maximum throughput obtained with this configuration without exceeding the motor loading was 9,25 t/h with a molasses purity rise of 2,1.

Attempts to lower the motor loading by fitting a pulley to give a speed of 1 735 rpm were unsuccessful and a reduction in centrifugal speed resulted in higher molasses purity rise for similar massecuite throughputs. This is illustrated in Figure 1.

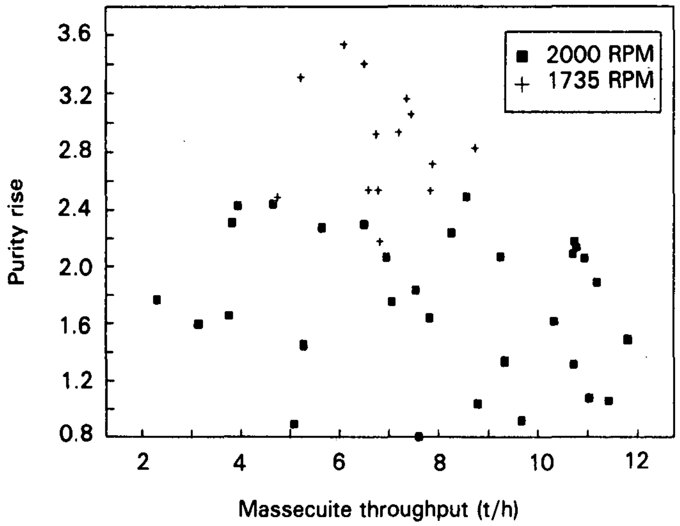

FIGURE 1 Effect of speed

Returning to a speed of 2 000 rpm and installing a 75 kW motor also proved disappointing as only a slight improvement in throughput occurred. The reason for this was thought to be the low massecuite temperatures (approximately 45°C) and hence the 12 mm steam pipe was replaced by a 25 mm pipe. With this configuration, a maximum rate of 11,8 t/h with a purity rise of 1,5 was achieved which was still lower than the specification of 13,5 t/h.

The steam and water to massecuite ratio for this throughput was 4% which is significantly lower than 8% assumed for BMA K1100 machines (Rein, 1983) and higher throughputs are anticipated if this ratio is improved.

(b) C-Massecuite

Initial rates achieved were 2,90 t/h. These low rates were entirely due to insufficient feed caused by poor siting of the machine at the end of the massecuite feed manifold. This problem was partially overcome by removing a butterfly type isolating valve which caused a restriction in the feed line, switching off up to 12 BMA K850's and ensuring sufficient head in the crystallisers.

After the above modifications, throughputs up to 6,45 t/h with a purity rise of 2,0 were obtained. All the C-massecuite tests were with a 12 mm steam pipe as the modification to 25 mm was done after the C-massecuite test work was completed. The steam and water to massecuite ratio was 7%.

Observation of the basket under a stroboscopic light showed the "fingering" phenomenon common to most centrifugals.

(c) Design and measured data

Table 2 summarises the results obtained from the tests in comparison with the design data. With the exception of B-massecuite throughput, all the specifications were easily met.

1991/92 season's work

(a) Amatikulu tests - Broadbent SP1220

After carrying out the recommendations from the 1990/91 season's work (Sahadeo, 1990), viz. relocating the machine to obtain a better feed, bigger steam lines and additional wash water, C-massecuite throughputs of up to 8,8 t/h with molasses purity rises of 3-4 units were obtained.

(b) Maidstone tests - Broadbent SP1220

At Maidstone, once again the problem was insufficient feed and wash water to the centrifugals. Feed was restricted by the 200 mm butterfly feed valves. Removing the feed valves so that the feed could be controlled by the knife type isolating valves and adding extra wash water gave a maximum rate of 8,2 t/h. The molasses purity rise was 3-4 units.

(c) Maidstone tests - BMA K1301

This was a prototype machine commissioned by BMA and evaluated in conjunction with Tongaat-Hulett Sugar Technology Division. Since the BMA K1301 was a new design not previously tried on low purity cane massecuites and this being the first time it was introduced to the cane sugar industry, no specifications were available for cane massecuite. However, two obvious differences between the Broadbent and the BMA were the even larger diameter basket (1 301 mm) and the presence of a stationary steam hood over the acceleration cone in the latter. Details of the BMA K1301 are listed in Table 1

The maximum throughput achieved on the BMA was 9,4 t/h. The molasses purity rise and steam and water to massecuite ratio were 1,6 and 8,2% respectively. Unfortunately, further tests to confirm these high rates were halted when the acceleration cone distorted. This was observed when no curing took place in two sections of the basket. Measurements confirmed the cone to be 2,3 mm oval and 0,7 mm

Table 3

Broadbent and BMA results - 1991/92 Season

Mill	Machine	Feed range t/h	Massecuite temperature °C	Averaged results			
				Feed t/h	Steam & water to massecuite ratio	Sugar purity	Purity rise
MS	Broadbent	5,0-6,5	57-62	5,6	9,1	85,3	3,4
		6,5-8,0	57-62	7,1	11,4	84,7	4,1
MS	BMA	5,0-6,5	57-62	6,0	8,3	84,2	2,9
		6,5-9,0	57-62	8,3	8,3	83,8	2,5
AK	Broadbent	5,0-6,5	58-60	5,6	8,1	83,5	3,4
		6,5-8,0	58-60	7,6	10,7	83,3	3,4

off-centre. The probable cause for this occurrence was that the cone was designed for beet conditions, i.e. lower viscosities and crystal contents. This aspect of the machine will have to be modified to suit cane conditions. A summary of the results from the two mills is shown in Table 3.

The results indicate that both types of machines are capable of high throughputs with reasonable purity rises and similar steam and water to massecuite ratios for the 5-6,5 t/h feed range. For higher throughputs, the steam and water to massecuite ratio increased for the Broadbent with no similar effect with the BMA. These preliminary findings on the BMA K1301 still need to be confirmed.

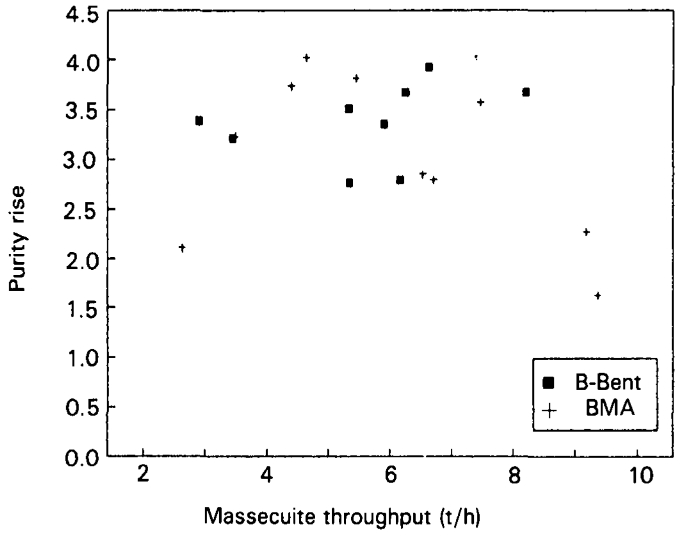

FIGURE 2 Characteristic curve test, Broadbent and BMA K1301

Characteristic curves

Characteristic curves derived for the Broadbent and BMA K1301 do not appear to show similar trends to those obtained on BMA K850 and BMA K1100 machines (Sahadeo, 1990), viz. for a constant sugar purity, increasing the massecuite throughput did not result in an increase in the molasses purity rise on the larger machines (see Figure 2).

Conclusions

The evaluation tests have indicated that it is feasible to use high capacity centrifugals on B- and C-massecuites. The Broadbent centrifugals are capable of higher massecuite throughputs than the specified rates. Molasses purity rises obtained from these machines are similar to those obtained on the BMA K850's. The capacity of one large centrifugal is equivalent to about four to five of the existing machines and hence potential savings exist in maintenance and operating labour as well as possible performance advantages. Adequate feed arrangements must be taken into consideration on installation of these large centrifugals.

REFERENCES

Rein, PW (1983). Sizing of water and steam lines to BMA K1100 centrifugals. Tongaat-Hulett Sugar Internal Memo 05/83.

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