CONTINUOUS CENTRIFUGAL SCREEN EVALUATION

By P. L. M. VERMEULEN, C. MACK and R. RAMPHAL

C.G. Smith Sugar Limited - Umzimkulu

Abstract

The performance of Western States continuous centrifugals using various open area screens on B and C massecuites has been monitored over five seasons at Umzimkulu Mill. Three different screens from three different manufacturers, with a 10 %, 12 % and 14 % open area were tested. Significant higher throughputs (up to 44 %) have been attained at similar machine settings. In general final molasses brix was higher and apparent purity lower with large open area screens. Screen life was between 6 and 10 weeks with no modifications to the backing screens.

Introduction

Historically, the conventional screen used on C centrifugals is the 0.06 mm, 7 % open area screen and the 0.09 mm, 10 % open area on B centrifugals.

The first 12 % open area screen was installed at Umzimkulu in July 1981, and since then numerous evaluations with other makes have been conducted. Because of the higher throughput it was decided in 1984 to fit 0.06 mm, 12 % open area screens in all B and C centrifugals. The specifications of the continuous centrifugals used at Umzimkulu are the Western State, 34° basket with 4 mesh, interwoven flat top, backing screen.

In 1977, at Empangeni Mill, Prince and Montocchio, testing a 14 % open area screen found similar increased throughputs, at generally higher molasses brixes and equal or lower molasses purities. To support the thinner screen, a woven 10 mesh, stainless steel screen was fitted in addition to the existing standard backing screen. It is interesting to note that the slot length of this 0,06 mm screen is 1.02 mm.

Large open area screens mentioned in this paper have slot lengths of up to 2.80 mm. The longer slots could be for reasons of screen material thickness or improved molasses drainage.

Method

The method adopted for the evaluation was by comparing the performance of two centrifugals, keeping all parameters similar except for the screen used. The performance of the centrifugal is evaluated from its capacity and by the quality of the molasses produced.

Massecuite flow rate was determined by pol balance from molasses flow rate, corrected for process water added. However no account could be taken of steam addition or evaporation.

$$M = (L - W)(Ps - Pc)/(Ps - Pm)$$

$$Pc = Pr/(1 - W/L)$$

Where:
- M = Massecuite flow rate Kg/h
- L = Molasses run off flow rate Kg/h
- W = Water flow rate Kg/h
- Ps = Pol % Sugar
- Pc = Corrected molasses pol
- Pr = Measured molasses pol
- Pm = Massecuite pol

To measure molasses flow rate, a receptacle of known volume (Figure 1) was inserted into the molasses outlet pipe, and the time taken to fill this was noted.

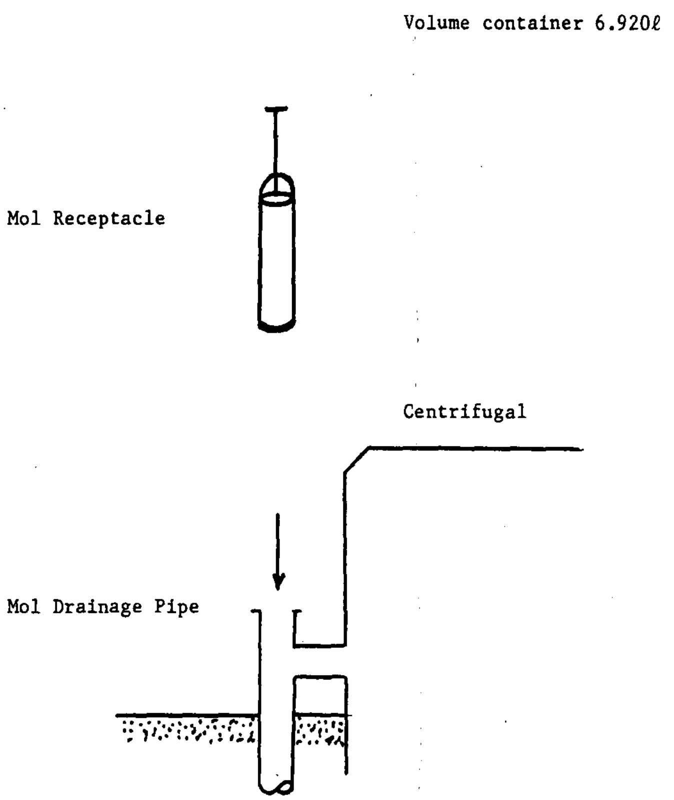

FIGURE 1 Receptacle of known volume inserted into molasses outlet pipe

Procedure

Before a series of test runs was started, the screens and the baskets were washed and inspected. After the basket had gained its maximum speed, the water rotometer was set at a predetermined setting. The water temperature ranged between 80 and 85°C. Steam valves were fully opened. The machines were then slowly fed with massecuite.

On a continuous centrifugal the water percent massecuite decreases with increasing massecuite throughput. If the water is kept consistent and the massecuite throughput is increased, a point will be reached where the emerging sugar will be below standard. Maximum capacity was obtained by maintaining massecuite throughput as high as possible without reaching this condition.

It was imperative to keep the sugar quality the same for both test machines. (A 1,0 variation in sugar purity leads to a 0,1 difference in molasses purity). After the machines have been regulated to give similar sugar quality and are operating at optimum capacity, they are run for a further ten minutes. Thereafter sugar, massecuite and molasses were sampled and molasses flow rate measured. As far as possible sampling was done simultaneously on both machines.

After a series of tests was completed, the screens were interchanged between machines and further tests were run.

Results and Discussion

Test 1

12 % open area screen (0.06 mm) versus 7 % open area screen (0.06 mm)

Screen pattern (1 cm²)		Screen pattern (1 cm²)	
Open Area	12 %	Open Area	7 %
Number of slots:	77	Number of slots:	68
Length of slots:	2,60 mm	Length of slots:	1,70 mm
Width of slots:	0,06 mm	Width of slots:	0,06 mm
Distance between slots:		Distance between slots:	
Horizontal:	0,40 mm	Horizontal:	0,56 mm
Longitudinal:	0,30 mm	Longitudinal:	0,80 mm
Thickness of screen:	0,225 mm	Thickness of screen:	0,250 mm

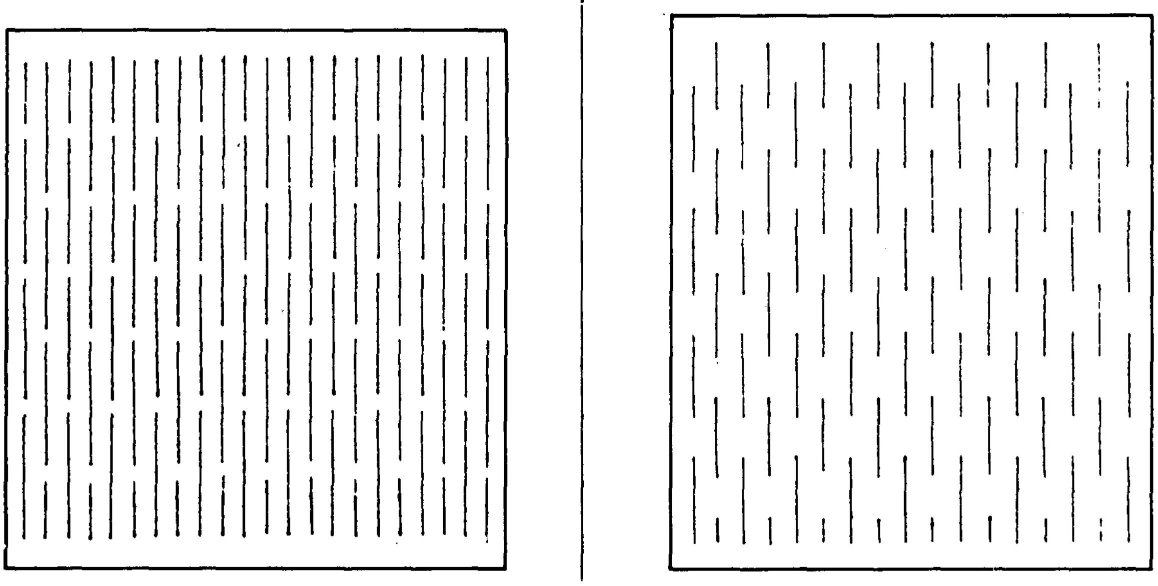

FIGURE 2 Screen data and slot arrangements for test 1

A summary of results from 35 pairs of test runs conducted in June 1982 and August 1983 is shown in Table 1.

Throughput increased by 44,5 %, while the molasses produced by the larger open area screen was a better quality than that produced by the conventional screen (Brix is higher and purity is lower).

A summary of routine product analysis of the test centrifugals indicated a similar trend, higher brix (1.12) and lower molasses purity (0.60) in favour of the larger open area screen.

Table 1

Open area comparison: June 1982 to August 1983

Open Area	7 %	12 %
Water flow rate (l/h)	160	160
Massecuite purity	51,3	51,2
Sugar purity	81,2	81,4
Massecuite temperature (°C)	60–62	60–62
Molasses temperature (°C)	40–42	40–42
Molasses brix	81,90	84,25
Purity rise across centrifugal	1,25	0,61
Molasses purity	34,3	33,6
Throughput (t/h)	1,348	1,948
Water % massecuite	11,87	8,21

Test 2

12 % open area screen (0.06 mm) versus 10 % open area screen (0.06 mm)

Screen pattern (1 cm²)		Screen pattern (1 cm²)	
Open Area	12 %	Open Area	10 %
Number of slots:	77	Number of slots:	57
Length of slots:	2,60 mm	Length of slots:	2,80 mm
Width of slots:	0,06 mm	Width of slots:	0,06 mm
Distance between slots:		Distance between slots:	
Horizontal:	0,40 mm	Horizontal:	0,50 mm
Longitudinal:	0,30 mm	Longitudinal:	0,50 mm
Thickness of screen:	0,225 mm	Thickness of screen:	0,250 mm

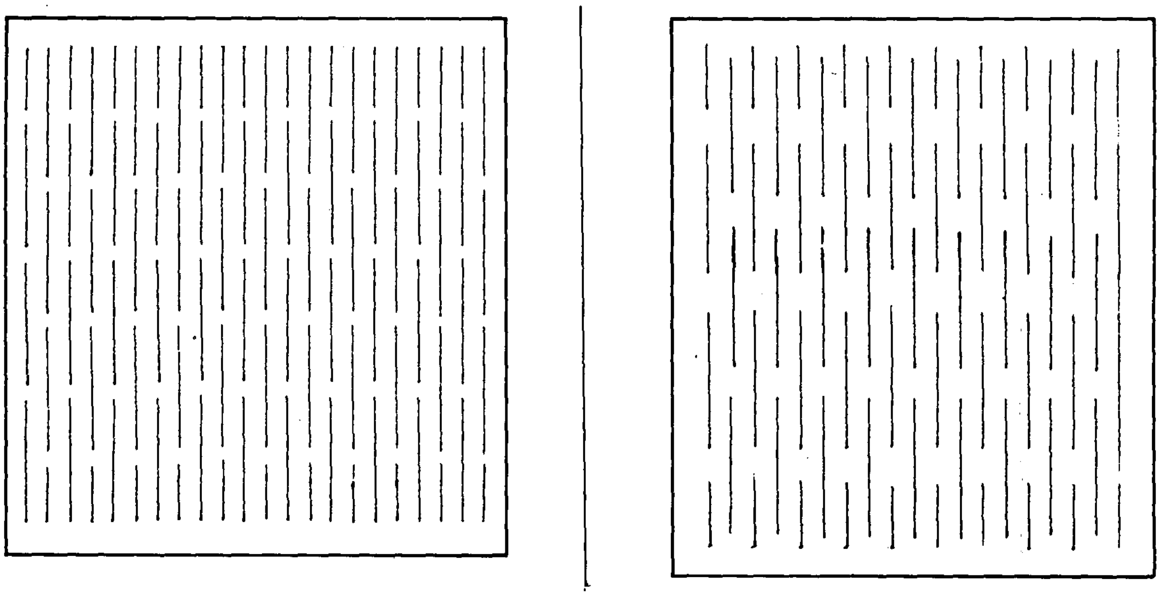

FIGURE 3 Screen data and slot arrangements for test 2

It was noted that the slots on the 10% screen extended into the unperforated band at the lower portion of the screen as shown in Figure 4 thus weakening the area of screen, which is held by the clamp ring.

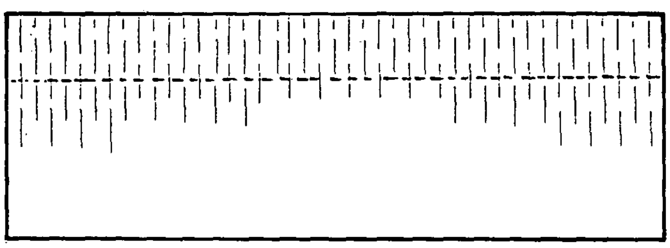

FIGURE 4 Lower Section of Screen

The first 10% open area screen was installed in January 1985, at which time a preliminary test was conducted. A summary of results of 32 pairs of test runs conducted between 10/9/85 and 19/9/85 is shown in Table 2.

Table 2

Open area comparison: 10/9/85 to 19/9/85

Open Area	10%	12%
Water flow rate (l/h)	160	160
Massecuite purity	51,6	51,6
Sugar purity	81,8	81,8
Massecuite temperature (°C)	60	60
Molasses temperature (°C)	46	46
Molasses brix	87,23	85,25
Purity rise across centrifugals	1.21	1.70
Molasses purity	35,2	35,5
Throughput (t/h)	1,933	2,109
Water % massecuite	8,28	7,59

The molasses produced by the 10% screen was of a better quality, with a higher brix and a lower purity.

An interesting feature of this 10% open area screen is that a reason for the improved molasses brix (drainage) could not be found, except that the slots are 0.2 mm longer than the 12% open area (1.1 mm longer than the 7% open area screen).

Under a microscope the 12% open area screen showed a more regular slot opening. Both screens had very few cracks in the chrome layer and were very well polished.

A summary of daily routine analysis also showed a higher brix (2.20) and lower molasses purity (0.60) for the 10% open area screen.

The throughput was marginally lower than the 12% open area screen. However, at the present high cost of screens, the advantage of a thicker screen with potentially longer life, together with apparent superior molasses drainage qualities, justifies further investigations.

Test 3

14% open area screen (0,06 mm) versus 7% open area screen (0.06 mm)

The 14% open area screen was installed at Umzimkulu in January 1983. A summary of trials conducted over this period initially produced the results shown in Table 3.

Table 3

Open area comparison: January 1983

Open Area	7%	14%
Molasses brix	81,45	81,75
Molasses purity	37,18	37,32
Throughput (t/h)	1,332	1,556

However the latter portion of these same trials showed a completely different picture. Results show a marked decrease in throughput, this was evident in Tests 6, 7 and 8. (See Figure 5).

The 14% screen blinds up after approximately 4 weeks continuous use. The other test screen did not blind up. Whenever there was a slack C Massecuite feed, the 14% screen tended to blind up after only 6 to 8 hours of continuous use.

Earlier tests with a 7% open area screen from the same manufacturer showed a similar problem.

Table 4

Open area comparison after blinding of 14% open area screen.

Open Area	7%	14%
Molasses brix	83,68	82,15
Molasses purity	34,86	35,07
Throughput (t/h)	1,815	1,444

It appears, that blinding of the screen occurs where the screen touches the backing screen, being worse at the lower part of the screen. This could have been caused by the constituents of the molasses and could differ from mill to mill.

The results shown in Table 5 were recorded after the screen was cleaned with caustic soda. To exclude the machine effect screens were exchanged.

Table 5

Open area comparison after cleaning 14% open area screen

Open Area	7%	14%
Molasses brix	80,62	79,80
Molasses purity	40,92	40,95
Throughput (t/h)	1,440	1,800

Results show again a higher throughput of 25% for the 14% open area screen, after the screen was cleaned with caustic soda, this was evident in Tests 9, 10 and 11. (See Figure 5).

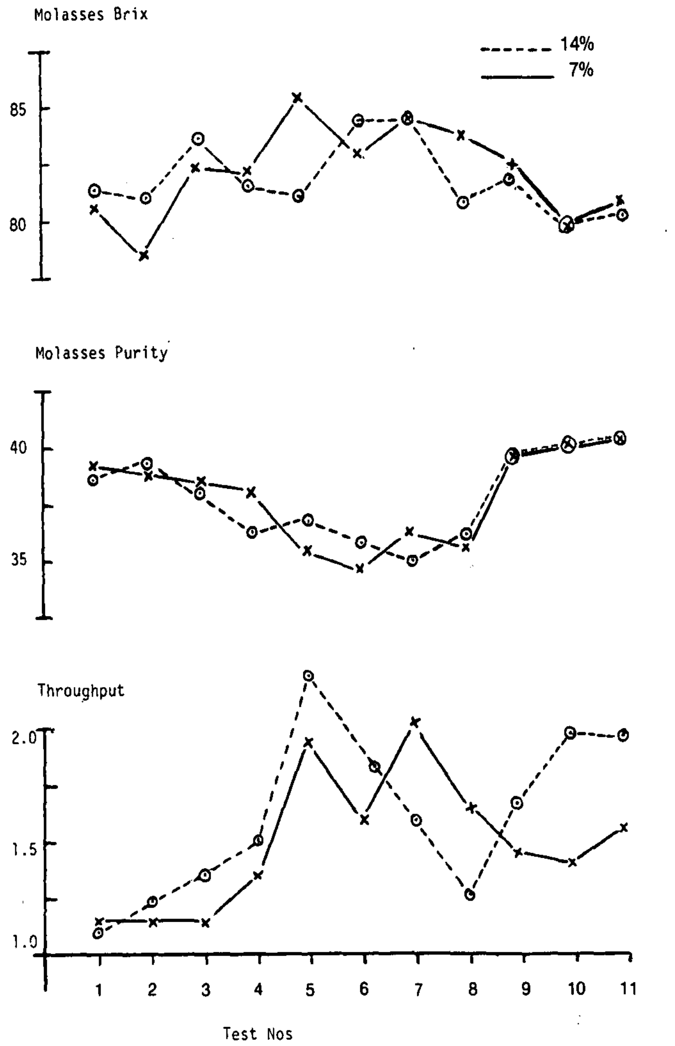

FIGURE 5 Results after the screen was cleaned with caustic soda

12% open area screens (0,06 mm) have been used on the "B" Centrifugals at Umzimkulu since the 1983/84 season. A summary of results of 16 pairs of test runs conducted between 4/7/85 and 11/7/85 is shown in Table 6.

Table 6

Open area comparison between 0.09 mm and 0.06 mm screen

Open Area	10%	12%
Slow Width	0,09	0,06
Water flow rate (l/h)	260	260
Massecuite purity	67,1	67,2
Sugar purity	89,8	89,6
Massecuite temperature (°C)	40	40
Molasses temperature (°C)	43	43
Molasses brix	77,23	77,14
Molasses purity	42,2	41,5
Throughput (t/h)	3,464	3,964
Water % massecuite	7,50	6,56

These results show a 12,61% increase in throughput and a lower molasses purity for the 12% open area screen. The brix figures remained constant between the two machines, despite a lower water % massecuite for the 12% open area screen.

A summary of routine analysis of the test centrifugals over this period showed a similar trend, of a slightly lower brix (0.11) and lower purity molasses (0,51) for the 12% open area (0.06 mm).

Inspection of the test screens after ten weeks continuous use, showed a slight wear on the 12% open area 0.06 mm screen and no wear on the conventional 10% open area 0.09 mm screen.

Discussion

Because of the thinner screen it is essential that large open area screens are fitted very carefully, by selected well trained fitters, who have a working knowledge of the machine and are aware of the importance of careful fitting of these screens.

Backing screens and distribution cones should be inspected each time a screen is changed. The standard 4 mesh backing screen should be interwoven and have a flat top, to give the thinner open area screen better support. Large open area screens are easily damaged by foreign objects. To overcome this, a rigid housekeeping programme must be adhered to.

Because centrifugal screens tend to blind, especially when curing viscous massecuites, a stringent washing program, preferably with high pressure cleaning equipment, should be carried out at least twice a shift.

Conclusion

These tests have verified that increased open area on centrifugal screens will increase machine capacity. As the water % massecuite decreases with increased open area the molasses quality improves in each case.

However, in the case of the 14% open area screen, a marked decrease in throughput was noticed after a period of time. The cause of this was severe blinding of the screen. The reason for this is not known but deserves further investigation.

Trials with large open area screens (0.06 mm) on B curing also showed an increased throughput and lower molasses purity. Trials with the 10%, 0.06 mm large open area screen, *Test 4*

12 % open area screen (0,06 mm) versus 10 % open area screen (0,09 mm)

Screen pattern (1 cm²)		Screen pattern (1 cm²)	
Open Area	12 %	Open Area	10 %
Number of slots:	77	Number of slots:	68
Length of slots:	2,60 mm	Length of slots:	1,70 mm
Width of slots:	0,06 mm	Width of slots:	0,09 mm
Distance between slots:		Distance between slots:	
Horizontal:	0,40 mm	Horizontal:	0,53 mm
Longitudinal:	0,30 mm	Longitudinal:	0,80 mm
Thickness of screen:	0,225 mm	Thickness of screen:	0,250 mm

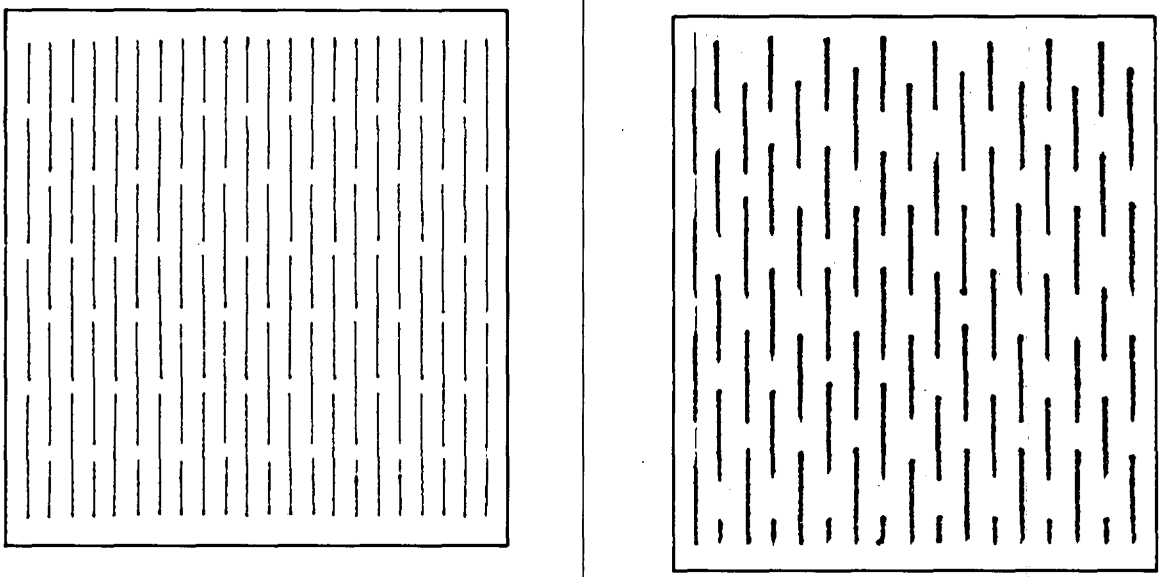

FIGURE 6 Screen data and slot arrangements for test 4

showed a superior molasses drainage (higher brix), for which no explanation can be given except for the longer slots. Tests with this thicker large open area screen will continue.

No modification of the 4 mesh backing screen was found necessary. With the same screens used on B and C centrifugals, inventory costs are lower, with only 0.06 mm continuous centrifugal screens kept in stock.

The average screen life of 12 % open area screens during the 1985 crushing season was ten weeks on C massecuites and 6 weeks on B massecuites.

Acknowledgement

The authors thank the management of C.G. Smith Sugar Limited for permission to publish this paper. A special word of thanks to the process team at Umzimkulu Mill for the contribution which made this paper possible.

REFERENCE

1. Prince PA and Montocchio MRG (1977). Evaluation of screen modifications on a continuous centrifugal. *Proc S Afr Sug Technol Ass* 51: 101-106.