

EXPERIENCES WITH THE BMA G 1500 CENTRIFUGAL ON A-MASSECUITE

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Abstract

This paper describes the replacement of an existing out-of-date centrifugal station by two BMA G 1500 centrifugals. The development of a specification for the new centrifugals, based on the historical performance of the existing centrifugals and other process and engineering requirements is outlined. The reasons for choosing the BMA G 1500 machine from amongst those centrifugals offered, are given. The construction and features of the centrifugal as well as problems experienced and maintenance costs incurred during two seasons of operation are presented and discussed. The performance of these centrifugals in comparison to that of the old centrifugals and to the specification is also discussed.

Introduction

The 5 existing A-centrifugals at the Union Co-operative Limited (UCL) factory had been in operation since production commenced in 1965 and were of the semi-automatic type. During 1982 it became obvious that the mechanical condition of these centrifugals would preclude their continued operation unless a large amount of money was spent on refurbishing the centrifugals and even this would not be satisfactory since a labour intensive operation would still remain. This was not an acceptable solution to the problem and approval for the purchase of replacement centrifugals, to be phased in over the next few seasons, was obtained.

Discussion

As a result, a specification for the replacement centrifugals setting out process requirements and limited mechanical/electrical requirements was developed. From assessment work carried out on the existing centrifugals during November 1982, a purity rise of 2,2 units was determined and it was decided that any new centrifugal would have to be capable of working to this value. Two other features of the redundant machines which were considered for inclusion in the specification were:

- After ploughing the screens were left perfectly clean and free from residual sugar thus not requiring a prewash at the start of the next cycle.
- The screen life achieved by these centrifugals, using copper screens, was more than two seasons.

These standards were included in the specification as well as numerous other requirements. The final specification is given in Appendix 1. After consideration of these requirements, three different sizes of machines were offered by the manufacturers as detailed in Table 5 in Appendix 2. In Appendix 2, the number of each type of centrifugal required to process the 39 t massecuite produced per hour from crushing 150 tons cane per hour was calculated. From these results it became obvious that the BMA G 1500 option was the most economic, (at R14,29/kg massecuite cured per hour) and advantageous when coupled with some of the other features. The first centrifugal was commissioned for the 1984/85 season and operated in parallel with the old centrifugals

for the whole season while the second machine was commissioned for the 1985/86 season when the old centrifugals were finally phased out.

Features, Construction and Installation of Centrifugals

The BMA G 1500 series centrifugal had been well proven in the beet industry but this was the first occasion on which they were to be applied to process cane sugar A-masseccuites anywhere in the world. Some additional features of the centrifugals, apart from those mentioned in Appendix 1, are as follows:

- (i) All braking is done electrically through the DC drive and the emergency brake is a large disc brake.
- (ii) The construction of the plough has a "double" blade which means that the stroke length of the mechanism is only approximately half of the basket height. The tips of the plough are spring-loaded stainless steel which allows the plough to be set almost onto the screen in order to remove all of the sugar. The guide bushing of the plough mechanism is such that the plough tips remain at a constant setting in relation to the basket (normally this just touches the screen) preventing the plough from "digging-in" to the screen and tearing it.
- (iii) The massecuite feed-valve is a double-acting pneumatically operated slide valve mounted on the massecuite hopper. An enclosed chute connects the valve to the casing and at the entry point into the basket, the chute is sealed off by a small flap, also pneumatically activated which closes on a time delay after the feed valve closes and prevents the massecuite left in the chute from falling into the basket while the centrifugal is accelerating. The retained massecuite is fed into the basket on the next cycle.
- (iv) The water spray mechanism is partially retractable from the basket when not in use, the main reason for this is that, once ploughing commences, the wall of sugar on the bottom of the basket is so great that any fixed pipe protruding into the basket would be damaged.
- (v) The front panel mounted on the machine has a simple indication unit which shows what stage of the cycle the machine is in. All manual operation and feed valve regulation is set on this panel; also included are the stop/start station, emergency brake, ammeter and rev. counter.
- (vi) The process timer panel is very simple and easily accessible allowing process parameters to be varied according to prevailing conditions.
- (vii) The machine is constructed so that it arrives on site in two pieces which are
 - the motor
 - the remainder of the machine.

All ancillaries are wired and piped up on the machine during construction requiring only terminal point connections to be made on site. This "stand-alone" design although not new, disposes of overhead steelwork.

Actual mechanical installation time onto prepared staging and terminal points was approximately 18 hours while electrical installation, after the motor control centres were installed, involved connecting the multi-core cable from the panel to the terminal box on the centrifugal. This took approximately 30 hours.

The machines were supplied with standard BMA style backing screens of stainless steel with slotted stainless steel sugar screens as well. Exhaust steam at 70 kPa (gauge) and wash water at 400 kPa and 95°C were piped up to the centrifugals.

Problems Experienced and their Rectification

Operation

Only two problems were experienced, the first being that some residual sugar was left on the massecuite distribution cone after ploughing and was actually "retained" through each machine cycle. This has not proved to be troublesome although consideration is being given to using a compressed air jet to blow it off.

The second and major problem experienced was that the sugar screen fractured in 5 places around the circumference at the top of the screen. This was unacceptable in terms of the specification and after two further occurrences it was found that the plough mechanism was not properly aligned causing excess plough pressure to the top of the screen resulting in stress cracking. This was rectified although the construction of the screen was not entirely satisfactory since it appeared that the backing screen did not adequately support the slotted screen and that this added to the problem. In order to counter this, a perforated screen of the same open area with 0,5 mm diameter holes was obtained and tested. After evaluation, one of the perforated screens having operated for the whole of the 1985/86 season, the slotted screens have been phased out.

Mechanical

The only mechanical problems experienced in addition to those described above were sticky feed-valves when they were new; and the plough mechanism centering bushes which wore out quickly. No further problems were experienced after the feed valves were well polished and the centering bushes were replaced with ones locally manufactured using a more suitable material.

Electrical

The only problem encountered here was on the D.C. drives where an electronic component failed repeatedly, probably due to high temperatures. This was countered by improving air circulation in the panels and panel room by changing the ambient air 37 times per hour. Thyristor banks on drives of this size are an enormous heat source, necessitating "cooling" the surrounding atmosphere.

Maintenance Cost

The total maintenance costs, including labour, for the past two seasons amount to R5 500,00 or 4c/t sugar produced. Obviously this figure will increase as the machines age, but at present this is, very low.

Evaluation and Results

In carrying out development work on the old centrifugals, a system of catch sampling the molasses every 10 seconds through the cycle after the feed gate closed was used, the samples being analysed for purity and the results being used to draw purity curves for the centrifugal cycle. The nutsch

molasses of the massecuite fed to the centrifugal was also analysed for purity and this was compared to the average of the molasses purities obtained. Eight runs were conducted during November 1982 with the results shown in Table 1.

TABLE 1

Old Centrifugals : Purity Rise

Nutsch purity	Molasses purity	Purity rise
64,3	66,5	2,2

It is from these results that the specification for purity rise was decided upon.

The next season the same technique was applied but with sampling at 15 second intervals to evaluate the purity rise on the new centrifugal and compared with that achieved on the old centrifugals. The results are shown in Table 2.

TABLE 2

Purity Rise : Comparison of Old and New Centrifugals

Centrifugal	Nutsch purity	Molasses purity	Purity rise
Old	63,7	65,3	1,6
New	63,5	65,7	2,2

As can be seen, the old machines outperformed the new one, although the purity rise was acceptable.

A further comparison during January 1985 yielded the results shown in Table 3. Purity rises were found to be extremely low; this having been achieved by being able to "process time" the machines very well. It must be noted that the slotted screen was still in use in the BMA centrifugal although the second machine had been ordered with a perforated screen.

TABLE 3

Purity Rise : Comparison - January 1985

Centrifugal	Nutsch purity	Molasses purity	Purity rise
Old	64,7	65,5	0,8
New	64,7	65,7	1,0

Improvement in comparison with earlier results can be seen although the old centrifugals were still slightly better on this basis.

At the start of the 1985/86 season the second BMA centrifugal was commissioned but with a perforated screen installed. A series of 5 evaluation tests gave the average results shown in Table 4.

TABLE 4

Purity Rise : Comparison of Screen Types

Screen type	Nutsch purity	Molasses purity	Purity rise
Perforated	68,0	69,0	1,0
Slotted	68,0	69,2	1,2

The slight reduction in purity rise, as well as the better strength of the screen led to the perforated screen being adopted for use on both machines in the latter part of the season. A comparison of the nutsch molasses purities achieved on a monthly basis, is illustrated in Figure 1.

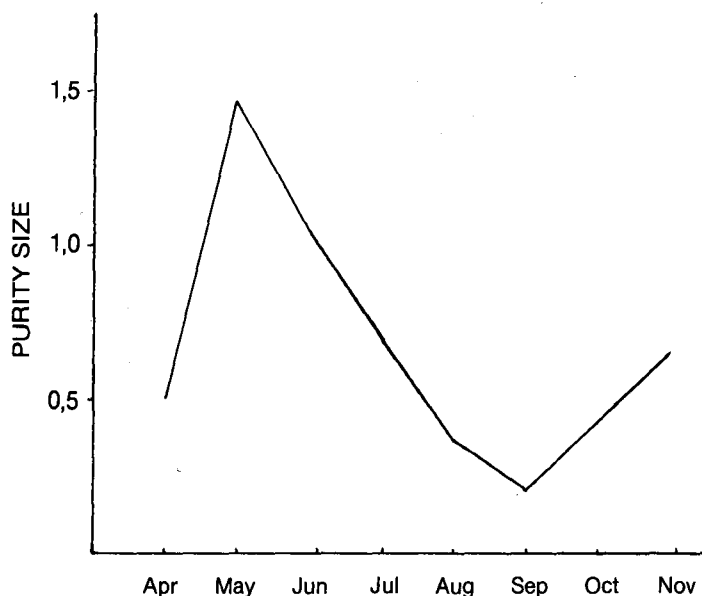


FIGURE 1 Purity rise: A-Centrifugals

These results show that since these centrifugals have been in use, improvements in purity rise have been achieved and that these machines achieve the specified level. It must be mentioned here that these results will obviously be affected by the grain size of the sugar and volume of wash water applied. The results reflected in Figure 1 are average values for the month showing that despite the variances which occur, excellent results are attainable. Furthermore, purity curves taken through the cycle of the centrifugal have been invaluable in optimising the operation of the centrifugals.

Throughput capabilities have not been specifically evaluated although with both centrifugals operating at 50% load, the required curing rate is easily attained. As a result both machines are generally operated at about 30% of their maximum massecuite load which then permits continuous operation with less wash-water being used to achieve the required sugar quality since the thicker the massecuite layer, the more wash-water is needed to obtain uniform sugar quality. This, and the screen improvements have been the major factors in reducing the purity rise across the A centrifugals.

On one occasion during the season, one centrifugal was out of order for approximately 8 hours, but production was maintained by increasing the load on the remaining machine to its maximum. This means that if one machine is out of order it does not constitute a reduction of 50% in throughput.

It should be mentioned that during July 1985, when massecuite purities were high and viscosities low, the centrifugals were timed on one occasion at 2 minutes 45 seconds per cycle which is equivalent to 22 cycles per hour. An additional benefit has been the resulting reduction of 6 units of labour due to the fact that these centrifugals are fully automatic.

Conclusion

The installation of the two BMA G 1500 centrifugals on A-massecuite has resulted in cost and labour savings with improved massecuite exhaustion being achieved due to a significant reduction in purity rise. Also, for the most cost-effective installation, capacity to process the A-massecuite production for many seasons to come, has been installed and commissioned.

Acknowledgements

The author wishes to thank the staff of Union Co-operative Limited for their co-operation and assistance in producing this paper and the Board of the Union Co-operative Limited for their permission to publish this work.

APPENDIX 1

Process Specification

- (i) Number of cycles per hour: 18 MIN
20 NORMAL
23 MAX.
- (ii) The plough must be constructed such that all sugar is removed and the need for a screen pre-wash is negated; purity rise max. 2,2.
- (iii) Process times must be easily adjustable from the working platform.
- (iv) No syrup separation required.
- (v) Machine must be able to handle typical A-massecuites at up to 92,5 brix with varying viscosities.
- (vi) Screen open area to be 20% with a slot size of 4 mm × 0,35 mm.

Mechanical/Electrical Specifications

- (i) Basket to be fully perforated stainless steel, with stainless steel reinforcing rings.
- (ii) Backing and top screens to be of brass woven-mesh and copper or brass respectively.
- (iii) Sequence control between the machines to be supplied.
- (iv) Process and motor controls to be by microprocessor.
- (v) Drive to be D.C. in order to have smooth power demands and to be capable of cycle requirements as detailed in process specification above.
- (vi) Braking to be regenerative in order to reduce overall power consumption.

APPENDIX 2

Calculations

- 1. Given: (a) Mass of massecuite to be processed = 39 tons per hour.
(b) Massecuite brix = 91,0 to 92,5 (S.G. = 1,49)
(c) 20 cycles per hour to be achieved.
(d) 3 different types of centrifugals to be considered as shown in Table 5.
(e) Consider a massecuite load of 150 mm wall thickness.

TABLE 5
Details of Centrifugals Under Consideration

Type	Basket Dimensions (D × H)	Quoted Prices R
1	1372 × 1016	145 000
2	1320 × 1000	135 000
3	1600 × 1100	160 000

Note: TYPE 3 - BMA G 1500 CENTRIFUGAL
D = Basket diameter (mm)
H = Basket height (mm)

- 2. Mass massecuite per charge for each type of centrifugal.
From $V = \pi(R^2 - r^2)H$, where
V = Volume of massecuite/cycle (m³)
R = Radius of centrifugal basket (m)
r = radius of centrifugal basket with massecuite load (m)
H = height of basket (m)

TABLE 6
Calculated Mass of Massecuite per Cycle

Centrifugal Type	Massecuite Volume m ³	Massecuite Mass kg
1	0,585	872
2	0,522	823
3	0,752	1 120

3. Number of centrifugals required to process 39 tons massecuites h⁻¹

TABLE 7

Calculated Number of Centrifugals Required

Centrifugal Type	Mass Massc/ Cycle kg	Mass Massc/ Hour kg	No. of Centrifugals Req'd.	
			Calc.	Actual
1	872	17 440	2,24	3
2	823	16 460	2,37	3
3	1 120	22 400	1,74	2

4. Cost of centrifugals in terms of R/kg massecuite cured per hour.

TABLE 8

Cost of Centrifugals: R/kg Massecuite Processed Per Hour

Centrifugal Type	No. of Centr. Required	Total Cost R	Cost R/kg Massc/h
1	3	435 000	24,94
2	3	405 000	24,61
3	2	320 000	14,29