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LIQUOR WASHING IN REFINERY CENTRIFUGALS

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Abstract

Liquor wash was used intermittently in 1989 and fully in 1990 to replace water wash in the refinery centrifugals at Noodsberg. The use of liquor washing resulted in appreciable increases in refinery sugar yields. In addition a 43% reduction in water consumption occurred, which resulted in a saving in steam use. The plant needed for liquor washing is simple and inexpensive. The main problem encountered was the blocking of piping used for liquor wash and this has been overcome by installing recirculation lines, flanges and steam lines.

Introduction

Work done by Lionnet (1989) has shown that when syrup was used as a partial replacement for water washing in A-centrifugals the purity rise, for equivalent sugar colour, was one point less than when water was used. The replacement of water by refinery liquor in refinery centrifugals, where up to 20% of the sugar can be dissolved by the use of water, could be more beneficial. Therefore work was done in the Noodsberg (NB) refinery to investigate liquor wash.

Test procedure

The centrifugal station in the NB refinery consists of 6 BMA Variant 1 250 centrifugals, each curing a 1 250 kg charge of massecuite. During June 1989 preliminary tests were done on the third and fourth massecuites. The steam addition facility in each machine, which consists of a single nozzle, was converted to dispense liquor at 0,9 kg/s. First refinery run-off at 70° brix and 55°C was used as the washing medium. A secondary water wash was also used immediately after the liquor wash. Wash % massecuite (w/w) for these preliminary tests were 1,5 and 0,8 for liquor and water respectively. A schematic diagram of the wash system is given in Figure 1.

Towards the end of 1989 the entire centrifugal station was modified so that liquor could be used to wash all grades of massecuite. The washing system was optimised and at the start of the 1990 season all grades of massecuite were washed with liquor.

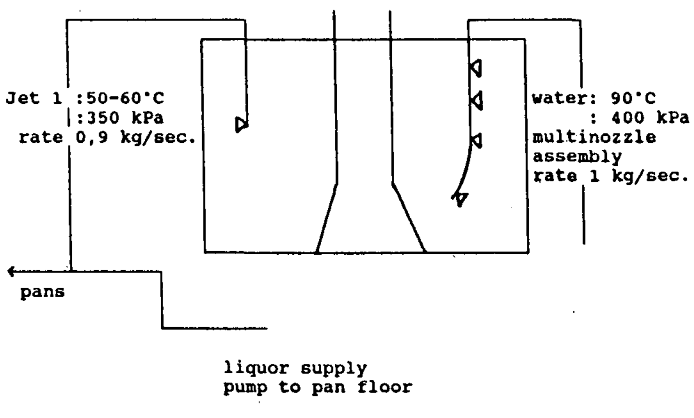

FIGURE 1 Schematic diagram of the wash system.

Due to the extreme difficulty in arriving at accurate sucrose balances in high purity refinery products, NB makes use of impurity (ash) balances and kg sugar/m3 of massecuite to assess performance. One yield parameter used is overall refinery yield (ORY), which is the mass of brix in sugar per cent the mass of brix in fine liquor, and is given by equation 1. Another yield parameter is pan yield, which is given by equation 2.

$$\text{ORY} = \frac{(\text{CA \% brix 4th run-off}) - (\text{CA \% brix fine liquor})}{(\text{CA \% brix 4th run-off} - (\text{CA \% brix sugar})} \times 100 \quad (1)$$

$$\text{Pan yield} = \frac{(\text{CA \% brix run-off}) - (\text{CA \% brix massecuite})}{(\text{CA \% brix run-off}) - (\text{CA \% brix in sugar})} \times 100 \quad (2)$$

where CA is the conductivity ash.

A third yield parameter is kg sugar/m^3 of massecuite which is calculated on a weekly basis.

Table 1

Optimisation of wash system

Massecuite	Water only (sec)	Jet 1 (sec)	plus water (Sec)	Sugar colour (ICUMSA 420)
1st	5	-	-	26
1st	-	5	2	29
		7	2	21
		15	2	24
		5	3	24
	7	3	3	26
		10	3	26
		15	3	24
2nd	5	-	-	33
2nd	-	5	2	51
		7	2	43
		10	2	45
		15	2	51
		5	3	48
		7	3	41
		10	3	51
		15	3	47
3rd	10	-	-	83
3rd	-	10	4	94
		15	4	117
		20	4	106
		10	5	83
		15	5	78
		20	5	71
4th	15	-	-	112
4th	-	15	7	143
		20	7	118
		25	7	107
		15	9	117
		20	9	119
		25	9	107

Table 2

Centrifugal settings which were used for full-scale tests

	Liquor		Final burst water	
	Time (sec)	Mass (kg)	Time (sec)	Mass (kg)
1st m/c	15	13,5	2	2
2nd m/c	15	13,5	3	3
3rd m/c	15	13,5	5	5
4th m/c	25	22,5	9	9

Results

Optimisation of the wash system

Various preliminary tests were done at NB whereby the amount of liquor and the final burst of water were varied so that the final sugar colour would be similar to that with water wash only. Some results are given in Table 1. These results confirm previous findings that firstly, 50% more liquor than water is needed to achieve similar sugar colours and secondly, a final burst of water is also needed. Table 1 results were then used to obtain settings for liquor washing over the entire centrifugal station. The settings are shown in Table 2.

Results of preliminary tests done on third and fourth massecuites

A comparison was made of the third massecuite pan yields (equation 2) for 1989, where liquor wash was introduced at week no. 13. Results are given in Figure 2. The graph shows a definite improvement in pan yields after week no. 13. Average yield for the third massecuite increased by 5%; during the same period the kg sugar/m^3 of massecuite also increased by 6%.

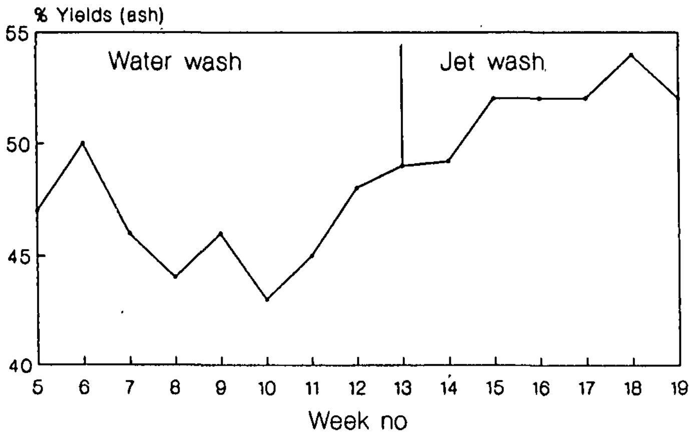

FIGURE 2 per cent yields plotted against week numbers, 1989 season.

Results of full-scale tests

Full-scale tests were begun over the entire centrifugal station at the start of the 1990 season using the settings described in Table 2. The results obtained from these tests were then compared with the results from the 1988 and 1989 seasons. Comparisons are given in Table 3.

There is every indication that significant increases in both overall refinery yield and kg sugar/m^3 of massecuite are achieved with liquor wash. To confirm the effect of liquor wash and to obtain results which would be directly comparable, a test programme was implemented from week no. 13, whereby two week periods of conventional water washing were alternated with two weeks of liquor washing. Results of these tests are given in Table 4 and are averaged in Table 5. These tables show that liquor wash gave generally better performance. Period by period comparison is somewhat complicated because the refinery had to stop on numerous occasions due to rain. The averaged results however (Table 5) show that liquor wash increases ORY by 0,6% and improves kg sugar/m3 of massecuite by 5%.

Table 3

Comparison of results for different wash conditions

Year	Wash condition	ORY	Kg sugar per m^3 massecuite	Jet 4 purity
1988	water only	92,4	698	91,3
wk 1-12	water only	93,5	706	90,4
wk 13-29	liquor plus water burst on 3rd and 4th massecuites	94,3	719	89,3
1990 wk 1-14	liquor plus water burst on all grades of massecuite	94,6	765	91,0

Table 4

Comparison of liquor and water wash

Period	Wash medium	ORY	Kg sugar per m^3 massecuite	Jet 4 purity	Sugar colour
1	Liquor	94,6	794	91,1	38
2	Water	92,6	743	92,4	39
3	Liquor	93,6	731	91,5	39
4	Water	94,0	675	89,0	39
5	Liquor	94,4	736	89,0	33
6	Water	94,1	713	89,9	37
7	Liquor	94,3	715	89,3	38

Table 5

Summary of comparisons between water and liquor wash

	Water wash	Liquor wash
ORY	93,6	94,2
Kg sugar per m^3 m/c	710	744
Run-off purity	90,4	90,2
Sugar colour	38	37

Savings in energy consumption

Using the settings in Tables 1 and 2 the wash % massecuite for the entire centrifugal station has been calculated and, with liquor wash, the water consumption at the centrifugals drops from 80 to 45,6 tons/week.

Discussion

The use of liquor wash at NB refinery resulted in definite advantages. Yield of sugar was increased without sacrificing quality. Using the kg sugar/m^3 of massecuite parameter, an increase of 34 kg sugar/m^3 of massecuite was achieved. Since NB boiled 228 064 m^3 of white massecuite in 1990, the increase of 34 kg sugar/m^3 of massecuite represents 7 754 tons of sugar that were not dissolved, and were thus recovered without recrystallisation. It is difficult to obtain accurate mass balance across a centrifugal under industrial conditions. If, however, a number of assumptions are made, it can be shown that crystal dissolution has been reduced by about 45% when Jet 1 is used. This agrees reasonably well with the yield calculations. This would have three advantages. Firstly an appreciable saving in energy has been achieved. With one ton of coal (R98) being needed to crystallise seven tons of sugar, about 1 108 tons of coal have been saved, which are equivalent to R108 556 per year. Secondly, the reduction in the amount of crystalline sugar being redissolved results in about a 3% increase in capacity for pans and centrifugals. Finally, the reduced dissolution should improve overall colour and losses since that sugar is not again subjected to the process.

Conclusions

It is evident that liquor wash has been applied successfully at NB with definite increases in sugar yield and savings in energy, without sacrificing sugar quality. Plant modifications are required to allow liquor wash, and the piping needs recirculation lines to prevent blockages. These are however minor problems.

Acknowledgements

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