PRELIMINARY TESTS ON THE USE OF SMUTS AS FILTER AID FOR MUD FILTRATION

By N. KALIDASS
C. G. Smith Sugar Ltd., Sezela
and
S. S. MUNSAMY
Sugar Milling Research Institute

Abstract

The use of smuts as filter aid in clarifier mud filtration was investigated at SZ both on a pilot plant and on a full scale basis. The number and duration of the experimental runs were limited but the results show that filter performance was better with a smuts/bagacillo mixture than with bagacillo only. Sand in smuts caused problems at the filters.

Introduction

The use of smuts (boiler fly ash) as a filter aid for mud filtration was first reported by Marie-Jeanne[1] who gave the results of full scale operation at Highlands sugar factory in Mauritius. Laboratory scale trials were carried out by the SMRI in 1979 and 1980 to find out the effect of the use of smuts as filter aid on the sodium and potassium contents of the filtrate. These initial results[2] showed a higher concentration of the salts in filtrate using smuts which, it was concluded, could have a detrimental effect on final molasses exhaustion. Subsequent trials, following redesign of the Sezela smuts separation plant, revealed reduced and very variable levels of sodium and potassium which were sometimes lower than the concentration of these salts in filtrate obtained with bagacillo as filter aid. It was felt that the variations in quality of spot samples used for laboratory tests were such that reliable results could only be obtained from pilot plant runs.

At the beginning of the 1981 season, the piping to an 18,6 m² rotary vacuum filter at SZ was modified to enable the filter to run either on normal factory filter feed (using bagacillo as filter aid) or on batches of specially prepared feed. The results of these tests were encouraging and temporary conveyors were installed to carry smuts to the mud mixer and to enable the whole filter station to operate with bagacillo or smuts, or various mixtures of the two products as filter aid.

The objectives of the experimental work carried out by SZ were :

(a) To find out if mud filtration using smuts as filter aid was possible on an industrial scale.

(b) To assess the effect of the process on filtration, clarification and boiling house performance.

(c) To estimate the savings in fuel and transport costs which the process could generate.

Procedure

Pilot Plant Tests

Mud from the supply line to the mud mixer was piped to a separate tank below the 18,6 m² rotary vacuum filter where it was mixed with smuts (from the smuts filter). The size of the tank and the fact that the smuts had to be transported by wheelbarrows limited the duration of test runs to about one hour each. The weight of smuts was determined by weighing while the mud used was estimated from the volume of the tank. The performance of the pilot filter was compared to one of the other filters in the station which was running on the normal mud/bagacillo feed.

Full Scale Tests

Temporary belt conveyors were laid out to take all the smuts from the smuts filter to the factory mud mixer. The quantity of bagacillo was controlled at various levels during these tests. Test runs were carried out over a period of 4 weeks using decreasing proportions of bagacillo to smuts. The tests consisted of running the factory filter station continuously for varying lengths of time on smuts/bagacillo, followed by runs of approximately the same duration on bagacillo only. Details of the runs are discussed later. In all the smuts/bagacillo runs, the total weight of smuts produced by the factory, supplemented by varying amounts of bagacillo, was used.

Analyses

All analyses were carried out by the Sezela laboratory using the recommended methods[3], except for potassium and specific conductance which were determined by the SMRI.

Results

Pilot Plant Tests

The arithmetic averages of eight pilot plant runs are listed in Table 1. No experimental difficulties were experienced during these runs. The filter cake of the test filter was always thinner and easier to wash than bagacillo cake. The filtrate from the test filter was always darker but simple test tube clarification tests showed that it clarified faster than the reference filtrate.

TABLE 1

Average Results of the Pilot Scale Tests (8 runs)

Test Parameters	Pilot Filter (Smuts only)	Reference Filter (Bagacillo only)
No. of runs	8	8
Pol % filter cake	0,3	2,2
Moisture % filter cake	66	72
Filtrate Analysis:		
Brix	6,5	8,5
Purity	85,2	85,0
pH	7,2	6,7
Mud solids (%)	1,5	0,5
Specific conductance (mS)	2,9	3,2
Potassium concentration (ppm)	643	944
Potassium/Brix ratio	99	111
Filter Feed Analysis:		
Brix*	7,7	8,8
Mud solids (%)*	7,4	6,0
Temperature (°C)	63	75

* Average of 5 runs only

Full Scale Tests

During the first week of the trials the smuts mixture was used on a 12 hour on/12 hour off basis with smuts addition

taking place during the day and bagacillo only during the night. The day results were taken as the test results and the night values as the reference. The results are shown in Table 2.

TABLE 2
Average Results of 5 Runs of the Full Scale Trials (Week 1)

Test Parameter	Test (Smuts+Bagacillo)	Reference (Bagacillo only)
Bagacillo (th-1)	± 1,8	± 3,5
Smuts (th-1)	± 6,2	Nil
Total filter aid (th-1)	8,0	3,5
Filter Cake Analysis:		
Pol %	1,04	1,61
Moisture %	72,5	73
Filtrate Analysis:		
Brix	7,8	8,3
Purity	83,0	83,2
pH	6,8	6,5
R.S.R.	3,8	3,9
Specific conductance (mS)	2,95	2,56
Potassium concentration (ppm)	732	599
Potassium/Brix ratio	94	72

During the second week the smuts mixture was used from Tuesday to Thursday and bagacillo only from Friday to Sunday. The average results are shown in Table 3.

TABLE 3
Average Results of the Full Scale Tests (Week 2)

Test Parameters	Test* (Smuts+Bagacillo)	Reference† (Bagacillo only)
Bagacillo (th-1)	± 1,0	± 3,5
Smuts (th-1)	± 5,5	Nil
Total filter aid (th-1)	± 6,5	± 3,5
Filter cake Analysis:		
Pol %	1,09	1,82
Moisture %	69,4	73,4
Filtrate Analysis:		
Brix	7,5	7,6
Purity	82,3	83,2

* Test period — Tuesday to Thursday
† Reference — Friday to Sunday

During the third week the smuts mixture was used during the first half of the week and bagacillo only during the latter half of the week. The average results are shown in Table 4.

Discussion

Before discussing the results, it should be pointed out that the filter station at Sezela was due for modernisation and was not operating under optimum conditions during the 1981 season. Vacuum was low, bagacillo size distribution poor and the quantity of bagacillo was high. The results of the pilot runs can be considered to have been justification for further trials and will not be discussed here. Similarly, optimisation of the filters working with a smuts/bagacillo filter aid was continuously carried out during the full scale runs so that more attention will be paid to the results listed in Table 4 in this discussion.

Amount of Filter Aid

The weight of filter aid (both smuts and bagacillo) was estimated by weighing the flow at the mud mixer over a given time.

TABLE 4
Average Results of the Full Scale Trials (Week 3)

Test Parameters	Test† (Smuts+Bagacillo)	Reference‡ (Bagacillo only)
Cane crushed (tons)	20 249	20 248
Smuts produced (tons)*	485	485
FC+smuts despatched (tons)	1 103	1 525
Filter cake produced (tons)	1 063	1 040
Smuts not used (tons)	40	485
Bagacillo used (th-1)	± 1,0	± 3,8
Smuts used (th-1)	± 4,8	Nil
Total filter aid (th-1)	5,8	3,8
Filter cake % cane	5,3	5,1
FC+smuts cane	5,5	7,5
Pol lost in filter cake (tons)	13,92	17,99
Filter Cake Analysis:		
Pol %	1,31	1,73
Moisture %	68,1	74,2
Filtrate Analysis:		
Brix	7,3	7,8
Purity	79,93	81,86
pH	6,8	6,6
Suspended solids (%)	0,53	0,86

† Test period – Monday start-up to 6h00 Thursday.
‡ Reference period – 6h00 Thursday to Sunday shut-down.
* Smuts % cane = 2,4 (approximate value)

The results listed in Tables 2, 3 and 4 show that the total rate of smuts plus bagacillo addition was gradually reduced from 8,0 to 5,8 tons per hour without any apparent adverse effect on filtration. During the same period, bagacillo addition was at the rate of 3,5 to 3,8 tons per hour. The weight of filter cake was, therefore, higher with smuts but since smuts is mixed with filter cake for export from the factory, the effective weight of residue which had to be transported was reduced from 7,5% on cane to 5,5% when converting from bagacillo to smuts.

Pol in Filter Cake

Pol % cake was always lower with smuts probably because of a thinner cake and more efficient washing. The very low value listed in Table 1 (0,3%) was probably due to excessive washing, but during the last series of runs (Table 4), Pol % cake averaged 1,31 with smuts and 1,73 with bagacillo. The tonnage of pol lost in filter cake was 13,92 with smuts and 17,99 with bagacillo, a reduction of 22%. By coincidence the tonnage of cane was almost identical for the two periods shown in Table 4.

Moisture in Filter Cake

In all the runs the moisture content of filter cake was lower with smuts and a 6,1 points difference (68,1 to 74,2) is shown in Table 4.

Filtrate Quality

Except for pilot plant runs, purity of filtrate was slightly lower with smuts, typically 79,93 compared with 81,86 for the last series of runs (Table 4). The pH was about the same (6,8 and 6,6) while the percentage of suspended solids was lower with smuts (0,53% compared with 0,86%). Specific conductance and potassium concentration were measured during the pilot plant runs and during the second series of tests (Table 2). The higher values in the case of smuts may be misleading and are probably due to the lower brix of smuts filtrate. When expressed as a potassium/brix ratio, the values (Table 2) for smuts and bagacillo are respectively 94 and 72. The wide variations in results

of individual analyses which are shown in Table 5, indicate that other factors have influenced these results. The potassium content of wash water is suspected and a decrease in purity due to excess washing could also be a contributing factor.

TABLE 5

Variations in Potassium and Specific Conductance in Filtrates (Full Scale Test — Week 1)

Run No.	Sample	Specific Cond (mS)	Potassium (ppm)	Filtrate Brix	K^+/Brix
1	Test*	3,01	694	6,98	99
	Refer.†	1,82	358	8,44	42
2	Test	3,03	952	7,21	132
	Refer.	2,66	705	8,76	81
3	Test	2,76	564	7,11	79
	Refer.	2,87	810	6,81	119
4	Test	2,88	490	7,56	65
	Refer.	2,79	500	7,69	65
5	Test	3,09	962	8,04	120
	Refer.	2,66	620	8,98	69
Average	Test	2,95	732	7,38	99
	Refer.	2,56	599	8,14	74

* Test — Smuts/bagacillo mixture.
† Refer. — Bagacillo only.

Effect on Factory Operation

The full scale tests have shown that operation of the filter station is easier with smuts than with bagacillo. The cake is more porous and easily washed and discharged.

No appreciable effect was noted on juice heating and clarification and the dark smuts filtrate yielded a clarified juice which was not higher in colour than the normal clarified juice at Sezela. The tests were not long enough to assess any effect which the process may have had on boiling house work.

On the debit side, sand from the smuts accumulated in the filter sumps and piping and could have caused blockages in a continuous run.

Approximate Cost Advantages

Extrapolating the results of Table 4 to the whole of the 1981 season at SZ, it is possible to estimate the savings which the smuts process could have achieved. They are calculated in Appendix A and are listed in Table 6 below.

TABLE 6

Estimated Gains if the Smuts Process had been used during the 1981/82 Season

	Tons	Rands
Pol in filter cake saved	330	—
Pol recovered	280	100 000
Reduction in FC+smuts transported	43 000	43 000
Reduction in bagacillo used	26 000	—
Equivalent coal value	5 200	180 000
	—	323 000

Conclusion

Preliminary results of factory scale trials at Sezela indicate that the use of a smuts/bagacillo mixture as filter aid offers definite operational advantages when compared to bagacillo only. No harmful effect was observed in the filtration, juice heating and clarification stations but the tests were not carried out over a long enough period to assess any influence on the boiling house.

Pol and moisture % cake were lower with smuts and pol losses were reduced in spite of a higher weight of filter cake due to the fact that a higher proportion of smuts/bagacillo than of pure bagacillo had to be used as filter aid.

Filtrate quality was poorer with smuts and the average potassium content of smuts filtrate was higher than with bagacillo. The lower brix of smuts filtrate, which indicates better washing on the filter, may be responsible for the poorer filtrate quality.

Accumulation of sand from smuts in the filters and piping is a definite disadvantage which may well limit industrial application of the process.

The preliminary results obtained indicate that the use of smuts would result in appreciable saving in bagacillo and in transport cost of filter cake and smuts for disposal.

Acknowledgements

The authors would like to thank the management of the Sezela mill for permission to publish this paper. Thanks are also due to Messrs. G. F. Mann anr T. J. Blom of Sezela, J. P. Lamusse of the SMRI and the SMRI Analytical Services Division for the potassium and specific conductance analysis.

APPENDIX A

CALCULATION OF POSSIBLE SAVINGS BY THE SEZELA MILL IF IT HAD USED SMUTS AS FILTER AID FOR THE WHOLE SEASON

Tons cane crushed	= 1 894 083
Filter cake % cane	= 5,57
Tons filter cake .... (a)	= 105 500
Pol % filter cake	= 1,38
Pol lost in filter cake .... (b)	= 1 456
Smuts % cane (approximate value)	= 2,4
Tons smuts produce ... (c)	= 45 458
Tons FC + smuts disposed ((a) + (c)) = (d)	= 150 958
If smuts were used (a) would be 2,2%* more .... (e)	= 107 821
Savings in FC + smuts disposal ((d) - (e))	= 43 137 tons
The pol lost would be 23% less if smuts were used .... (f)	= 1 129 tons
Pol saved ((b) - (f)) (tons)	= 327
Final molasses purity	= 37,59
SJM recovery (%)	= 85
Tons pol recovered	= 278
For every 4,75 t smuts 1 t of bagacillo was used*	
Bagacillo used (tons) .... (g)	= 9 570
The above value is 73%* less than normally used.	
Normal tons bagacillo used ....(h)	= 35 444
Tons bagacillo saved ((h) - (g))	= 25 874

* Values from Table 4.

REFERENCES

1. Marie-Jeanne, J. L. S. (1979). Les escarbilles de sucreries en remplacement de la bagacillo pour la filtration des boues de cannes. *Revue Agric et Suc. de l'ile Maurice.* **58** (1), 19–24.
2. Lamusse, J. P. and Vanis, M. (1979). The effect of using smuts as a filter aid in mud filtration on the ash content of the filtrate. *SMRI Technical Report No.* 1199, 8th October, 1979.
3. Laboratory Manual of South African Sugar Factories (1977). *South African Sugar Technologists Association.*