DISPOSAL OF MUD ON BAGASSE

A VAN HENGEL[1] AND P VAN DER WAAL[2]

[1]*5 Bruce Crescent, Westville, 3630*
[2]*1 Roberts Place, Westville*

Abstract

The process of disposing of clarifier mud on bagasse in a milling train was practised with acceptable results by the (then) Java sugar industry well before the Second World War. Meadows *et al.* (1998) described the disposal of mud on bagasse in a diffuser but did not make reference to similar earlier experiences with milling tandems. This paper describes the personal experiences of the authors with the process and provides some of the data which could be traced. The authors suggest that the process would be equally useful on mills as diffusers.

Short historic review

In 1940 the Java sugar industry, under the guidance of the Proefstation Oost-Java (POJ), was technologically ahead of the rest of the world. This situation developed as all publications were in Dutch and were, as a matter of policy, not translated into English or Spanish. The results were therefore not or hardly available to the world, although Tromp (1936) made mention of the process. It is not surprising that modern sugar technologists are not aware that the disposal of mud on the extraction unit was in fact practised 70 years before the South African work on diffusers (Meadows *et al.*, 1998).

Description of the VOA process

The VOA (Vuilsap Op Ampas, meaning mud on bagasse) process was practised by a minority of sugar mills, although some records are available. It was not possible for the authors to find figures from before 1940, but the results of three mills during the 1940 season are shown hereunder, together with results of mills practising the process during the 1955, 1956 and 1957 seasons. During the war years (1941 onwards) records were not kept and only resumed in 1955, to be terminated again in 1958 when the Indonesian Government 'nationalised without compensation' the entire industry.

The mud from the clarifiers, nearly always float-type subsiders which were decanted (Tromp, 1936), was returned to the tandem and sprayed over the layer of bagasse, in the majority of cases on the bagasse from the first mill but also on the bagasse from intermediate mills.

It was generally accepted that 20-30% of the insoluble soils in mud were recycled to the mixed juice. That figure is probably not all that far from the percentage recycling of solids over vacuum filters.

Naturally the basic equation of the mill balance had to be amended to:

Mass of cane + mass of water = Mass of mixed juice + mass of bagasse
+ mass of mud + mass of solids in mud

The returned mud was weighed and analysed.

The extra addition of liquids to mills created increased risk of slip on the mills, which were not yet fitted with sophisticated feeding devices. As a result, in the majority of cases this was counteracted by by-passing mill juices, as shown in Figure 1. Here the imbibition pattern of a normal four-mill tandem, preceded by a two-roller Krajewski crusher , fitted with a Maxwell shredder, is compared with the imbibition configuration of a number of mills which applied the VOA process. For the sake of comparison, the quantities of mud and imbibition are taken to be equal in all configurations:

mud % cane = 20% and imbibition % cane = 20%

It is clear that already then the technologists were aware of the fact that:

(a) The mud should be returned as near as possible to the end of the tandem to reduce mud circulation to mixed juice.
(b) The mud should be returned to a point where the brix of the juice in mud should be as near as possible to the brix of the returned imbibition juice.

From Figure 1 it can be seen that some factories held that factor (a) was the more important, whereas other factories considered factor (b) of more importance. A single factory attempted to strike a balance by adding the mud to the

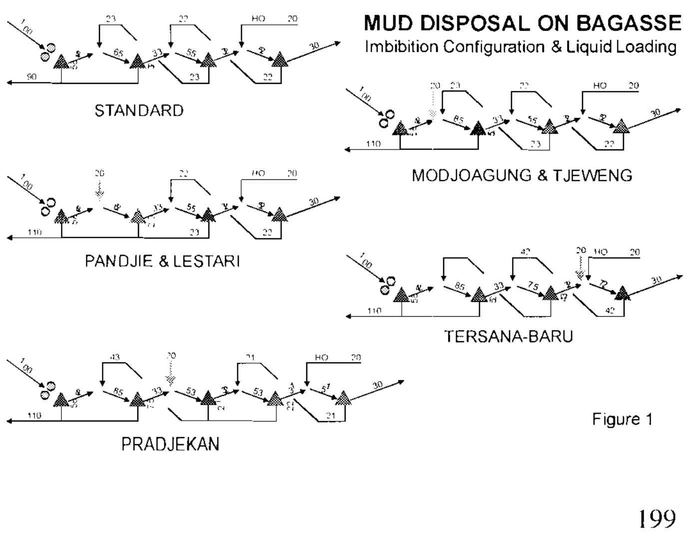

Figure 1

bagasse of the second mill. However, in that case, the tandem had five mills.

Also, the necessity of reducing the liquid loading on the mills was not fully agreed upon. Pandjie, the factory where the authors' personal experience was gained, and Lestari made a full compensation (bypassing of imbibition juice). Modjoagung and Tersana-Baru made none and Pradjekan made partial compensation. It is obvious that the quantity of mixed juice became much larger.

Operational results

Table 1 shows the results achieved by the mills applying the 'mud on bagasse' process during four different years.

Table 1. Factories applying the 'mud on bagasse' process.

Factory	Pol % cane	Fibre % cane	Imbibition % fibre	% Pol in cane lost in			LUJ % F	Corr. red extr.
				Bagasse	Cake	Combin		
YEAR 1940								
Pandjie	13,22	13,7	127	6,75	-	6,75	47	92,12
Modjoagung	14,92	13,8	140	7,74	-	7,74	50	90,36
Tjeweng	13,98	13,7	164	5,21	-	5,21	34	93,71
Industry	14,59	13,7	140	5,25	0,53	5,78	35	93,49
YEAR 1955								
Pandjie	11,92	16,1	131	7,97	-	7,97	50	92,76
Industry	12,26	13,7	128	7,51	0,76	8,27	48	91,62
YEAR 1956								
Pandjie	12,57	17,1	123	8,43	-	8,43	47	92,65
Tersana-B	14,98	14,9	128	9,01	-	9,01	55	89,72
Industry	13,73	13,9	133	7,11	1,01	8,12	48	91,65
YEAR 1957								
Pandjie	11,54	17,8	109	9,35	-	9,35	48	92,62
Lestari	13,66	14,4	129	6,22	-	6,22	54	93,01
Tersana-B	14,89	14,9	129	8,13	-	8,13	48	90,76
Pradjekan	14,92	12,1	156	7,31	-	7,31	54	89,42
Industry	13,68	13,6	132	7,23	0,95	8,18	49	91,31

All milling tandems consisted of four three-roller mills, except Pradjekan which had five mills. All tandems were preceded by a two-roller Krajewski crusher, fitted with a Maxwell shredder, rotating at 450 rpm.

The cane quality, the level of imbibition and the losses sustained in bagasse and mud, both separately and combined, are shown. As extraction is very much dependent on fibre % cane, (varying between 13,6 and 17,8%), the figures for lost undiluted juice % fibre (LUJ%F) and corrected reduced extraction are also quoted.

In the year 1940 (Marchés, 1941), two of the three VOA mills recorded a lower corrected reduced extraction than the industrial average, whereas Tjeweng was on a par. Tjeweng's combined losses in bagasse and filtercake were also lower than the industrial combined losses. However, Tjeweng applied considerably more imibibition.

In the years after the war (Anon, 1955; Anon, 1956; Yap Kie and van Zanten, 1957), the picture is even less clear. Cane quality deteriorated and the losses in bagasse were difficult to compare. But on the bases of Lost Absolute Juice (LAJ%F) and corrected reduced extraction, Pandjie and Lestari managed to better or equal the industrial level of extraction. Pradjekan, with the best cane, longest tandem and highest imbibition, fared worst.

It is the opinion of the authors that the operational results are such that they warrant an attempt to investigate how this process would work when:

- the tandems are longer
- the cane preparation is better
- the imbibition is much higher.

Model for an average modern milling tandem

A model for a standard six-mill tandem is given in Table 2.

Table 2. Normal extraction pattern of a six-mill tandem (imbibition 50% on cane).

Cane or mill	Purity of mill juice	Bagasse					Brix of juice in bagasse	LUJ % fibre	Extract of undil. juice
		% pol	% water	% brix	% fibre	% juice			
Cane	88,00	13,50	69,26	15,34	15,40	80,75	19,00	524	-
I	88,00	10,01	58,00	11,83	30,17	62,28	19,00	206	61
II	86,00	7,70	55,00	8,95	36,05	54,94	16,29	131	36
III	80,00	5,00	54,00	6,25	39,75	50,31	12,42	83	37
IV	70,00	3,00	53,00	4,28	42,71	46,61	9,18	53	36
V	60,00	1,75	52,00	2,91	44,08	44,89	6,48	35	34
VI	55,00	1,10	51,00	2,00	47,00	41,25	4,85	22	37

This table represents: Pol extraction of 97,33%
Brix extraction of 95,72%
UJ extraction of 95,80%

The figures in the table are assumed and form the basis of a calculation of the brix differences between the juice, added as imbibition, and the juices left in the bagasse after each mill. These juices will be mixed and extracted in each subsequent mill. The levels of these brixes are shown in Figure 2.

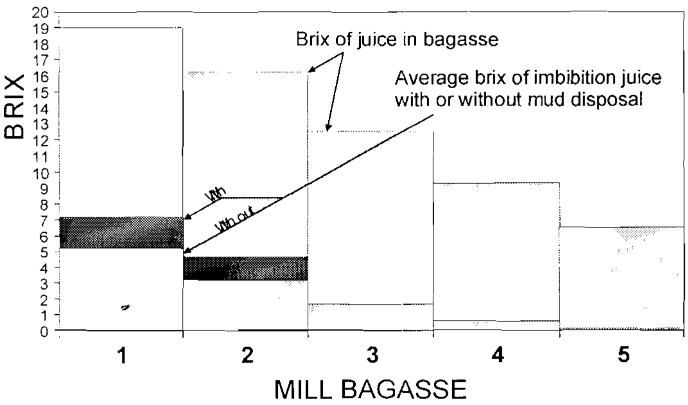

Figure 2.

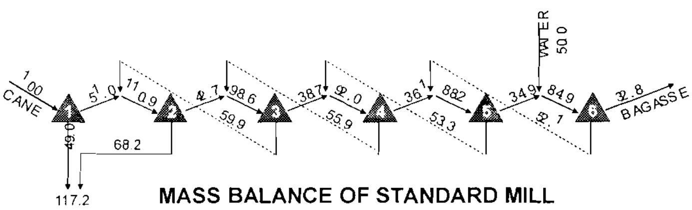

Figure 3.

(In Figure 3 the mass balance around each mill is shown. The quantities are based on the figures of Table 2 and 50% imbibition on cane (325% imbibition on fibre) is assumed.

The quantities of bagasse are known and the quantity of brix remaining is known. Knowing the quantity of juice from each mill and the quantity of brix extracted by each mill, the brix of the imbibition liquid is easily calculated. These brixes are also shown in Figure 2. The difference in level of brix between the brix in bagasse and brix in imbibition liquid is a measure for the efficiency of imbibition.

If now, in the first two mills, large quantities of mud are added, the question arises whether the mills can take the additional liquid loading. This may be possible, but it is safer to assume that an equivalent quantity of liquid has to by-pass the preceding mill. Then the following flow patterns will result as shown in Figure 4. The brixes of the imbibition liquid can again be calculated. The increased level of brix is shown in Figure 2 as a shaded area. The brix content of the mud is assumed as follows.

The brix of clean juice and mixed juice are taken as equal as there is no dilution over the filters and the addition of milk of lime is more or less compensated by flash. In our example 20 tons of mud with 18 tons of juice will contain:

18 x 16,94 / 135,2 = 2,26 tons brix (see Figure 4)

or 1,31 tons to each of the two first mills.

If the muds are split over the first two mills, receiving 9% each, the last four mills are unaffected. This assumption is not quite true, as the efficiency of the first two mills is reduced to some extent. However, any other assumption is still just that.

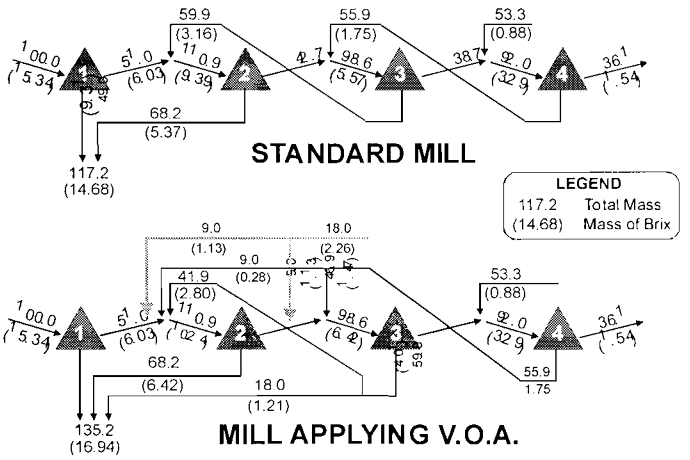

Figure 4.

The 'enrichment' of the imbibition liquid on the first two mills can now easily be calculated using Table 3:

Table 3. The 'enrichment' of the imbibition liquid on the first two mills.

Tons brix in:	Mill I	Mill II
Mud	1,13	1,13
Juice IV	0,28	1,47
Juice III	2,80	
Total	4,21	2,60
Mass total	59,9	55,9
% brix	7,02	4,65

The level of the brixes are shown in Table 4.

Table 4. Brix levels in bagasse.

% brix of juice in bagasse		Mill	
		I	II
Bagasse I	Standard	19,0	
Bagasse II	Standard		16,29
% brix in imbibition liquid			
Standard		5,37	3,16
VOA		7,02	4,65

These differences, as previously depicted in Figure 2, are not large when applying high imbibition and may even be insignificant.

Discussion

Generally speaking, the fibre content of cane in African countries is higher than it was in Java. The possibility of mud particles adhering to bagasse is therefore greater. However, of more importance is the better preparation of cane. The surface area exposed in reasonably prepared cane compared to cane prepared by a Krajewski crusher plus Maxwell shredder is very much larger.

All factors would point to a better operation of the VOA process under African conditions than under conditions in Java. It is not recommended that the three milling tandems in South Africa are converted as they already have filter stations, although a trial to evaluate the process could be advisable. The authors are fully aware of the absence of any operational data in South Africa that may or may not confirm the Java experiences and the authors' assumptions.

Conclusions

There is a trend of South African companies taking over ownership or management of mills in less developed counties in Africa. In fact there may be cases where mills have to be totally rehabilitated. Under those circumstances, applying mud to bagasse in order to avoid the cost and time of rehabilitating the filter station, may be considered when more is known about the process.

The following advantages and disadvantages would have to be considered:

Advantages:

- No filters or mud mixers, capital and maintenance savings
- Savings of 0,8% pol in cane as cake loss, probably more than off-setting an increased loss in bagasse

- No dust through bagacillo collectors
- 3% more fuel available
- Less dilution of juice
- No cake disposal problems.

Disadvantages:
- Larger juice scale required
- Extra mud scale to be installed
- More complicated milling control
- More ash to boilers
- No cake for agricultural use.

Acknowledgements

This paper, its graphs, tables and slides for presentation, could not have been produced without the valuable assistance of the Experiment Station, notably by Mrs Patricia Dunlop and Mr Sagie Doorsamy. The authors express their gratitude.

REFERENCES

Anon (1955). Overzicht van de bedrijfsresultaten betreffende Campagne. Proefstation Oost-Java.

Anon (1956). Overzicht van de bedrijfsresultaten betreffende Campagne. Proefstation Oost-Java.

Marchés, J (1941). Overzicht van de bedrijfsresultaten betreffende Campagne 1940. Proefstation Oost-Java.

Meadows, DM, Schumann, GF and Soji, C (1998). Farewell to filters: the recycle of clarifier mud to the diffuser. *Proc S Afr Sug Technol Ass* 72: 198-203.

Tromp, LA (1936). *Machinery and Equipment of the Cane Sugar Factory*. Norman Rodger, London.

Yap Kie, T and van Zanten, GM (1957). Synopsis of the production data and chemical laboratory reports of the Java sugar factories in the 1957 milling season. Proefstation Oost-Java.