

MODIFICATIONS TO AND UPRATING OF CLARIFICATION STATION AT SIMUNYE

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Abstract

Over the years many attempts have been made to improve the performance of clarifiers, and filter stations not only to increase throughput, but also to improve the quality of clarification and reduce sucrose losses both chemical and physical. The Simunye modifications which are markedly different and have proved successful are presented.

History

Filter Station

Filter stations as supplied by the manufacturers are fitted with Reeves pulley variable speed drives and operate on the constant mud level overflow re-circulation concept.

The Reeves variable speeds proved very troublesome and were removed by some engineering/process staff and the filters run at one speed. The next generation of process staff re-installed them and had the same problems.

The mud overflows and return system tended to retain too much mud in re-circulation which cooled down, became contaminated and increased inversion losses as evidenced by pH and purity drops of the mud and filtrate. Most mills in Southern Africa have now installed level control on the mud mixer and filter troughs using one or other type of float control operating pneumatic valves. This is one of the rare occasions where there has been a change from continuous to batch operation and with very beneficial results.

Clarifiers

Very early models of the multitray clarifier had only one internal suction box in each tray (see Figure (1)). Later uprated to two, three or four diametrically opposite suction points (see Figure (2)). Most clarifiers in the industry were of this type.

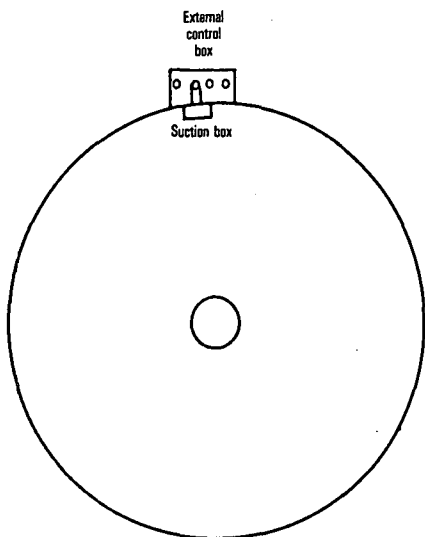


FIGURE 1 Original multitray clarifier

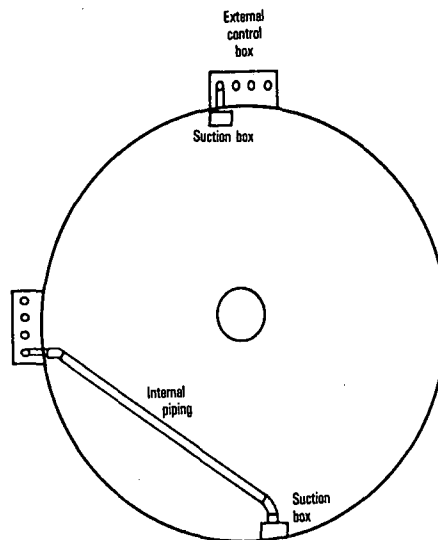


FIGURE 2 Early modification of multitray clarifier

A Hulett's modification about 12 to 13 years ago involved replacing the internal suction boxes with pipe horns, which took the form shown in Figure (3). The nozzles on the horns were sized and spaced to try and equalise the draw off. This system apparently works well until some nozzles become partially or totally blocked, which then necessitates liquidating the clarifier to clean the piping and nozzles.

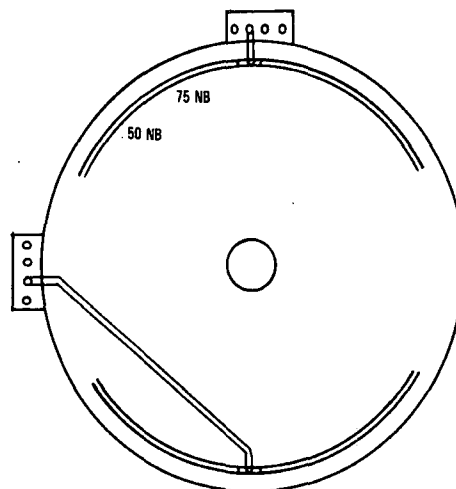


FIGURE 3 Current modification of multitray clarifier

Modifications at Simunye

Despite having two 9,8 metre Dorr 444 clarifiers and a conventional Oliver filter station consisting of three (10 × 16 ft) filters operating on the constant level overflow/return system, clarification results for the 1980–82 seasons at Simunye were disappointing, with a clear juice-filtrate purity drop of over 4 degrees see table 1.

Table 1

	1980	1981	1982	1983	1984	1985
Crushing rate TCH	209,7	233,4	248,3	251,6	259,9	258,4
Mixed Juice % Cane	111,8	116,4	113,6	121,1	121,0	123,5
Residence Time (hrs)	3,68	3,05	2,98	1,37	1,32	1,28
F Cake Loss % Pol Cane	1,10	0,38	0,30	0,30	0,24	0,09
Flocculant ppm on MJ	-	0,27	0,28	0,60	0,88	1,05
Lime (g/t Cane)	620	660	800*	760	650	710
Purities						
Mixed Juice	82,60	83,43	82,47	83,66	85,60	83,33
Clear Juice	81,82	82,39	81,88	83,11	85,10	82,67
Filtrate	77,46	77,56	78,79	80,94	83,91	82,30
CJ - Filtrate	4,36	4,83	3,09	2,17	1,19	0,37
Filter Cake						
Pol %	4,49	1,38	1,03	1,10	0,92	0,39
Moisture %	67,09	74,65	71,62	72,95	72,38	74,00
Filter Cake % Cane	3,01	3,21	3,52	3,35	3,23	3,02
Loss % Pol in Cane	1,10	0,38	0,30	0,30	0,24	0,09
Filter Wash Index	98,1	102,0	102,6	102,0	101,8	102,6
Non-pol Ratio	1,00	1,00	0,98	0,97	0,91	0,96
RS/Pol in MJ	6,20	6,31	6,71	6,40	5,61	7,66
RS/Pol in CJ	6,81	6,49	6,82	6,46	4,67	7,32
Difference MJ - CJ	-0,61	-0,18	-0,19	-0,06	0,94	0,34
pH						
Mixed Juice	5,2	5,28	5,27	5,20	5,41	5,42
Limed Juice	-	8,10	7,82	7,75	7,76	7,88
L Juice - C Juice	-	0,97	0,87	0,73	0,70	0,69
Clear Juice - Filtrate	-	0,70	0,67	0,24	0,42	0,41
Clear Juice - Mud	-	0,28	0,17	0,02	0,21	0,07
Colour/Turbidity						
Clear Juice turbidity	-	0,19	0,14	0,14	0,10	0,17
Clear Juice Colour	-	20,72	24,26	20,78	23,89	14,24
Sugar Colour @ 560	-	0,20	0,25	0,27	0,20	0,44
Sugar Colour @ 420	-	0,80	1,00	1,11	0,84	0,66
BHR	82,33	87,71	88,80	89,74	91,96	90,57
Under Loss	3,38	1,06	0,90	0,39	0,37	1,04

* Change in hydrated lime supply, and although it was claimed to be of equal quality our experiences proved otherwise. It contained a large amount of grit and literally eroded the pumps away.

The clarity of the clear juice was also mostly not as one would expect even accepting that we had and still have the lowest mixed juice purities in the industry.

The poor clarification was initially attributed to the poor quality filtrate being returned to the clarifier as even at higher flocculant dosages very little improvement was observed, so during the 1982 off crop filter station was modified, doing away with the overflow system and installing level control but using Electromatic high/low conductivity probes which were far cheaper than float switches. The probes and mud chambers, similar to the floats need to be flushed out once a shift to maintain good operation.

The Electromatic probe on the mud trough operates, via a pneumatic solenoid, a modified diaphragm valve on the mud feed to the filter, while the level probe in the mud-bagacillo mixer operates the clarifier mud pumps which can be pre-selected by the operator, depending on mud levels etc. The same probe also opens and closes the pneumatically operated bagacillo screens simultaneously to the mud pump operation.

The results of this change, while an improvement (C.J. - Filtrate drop in 1982 was 3 degrees) was still not acceptable, but clarity did improve. The variable speed Reeves pulleys which were very troublesome and maintenance intensive were replaced with a Baier Cyclo-variator drive which was supplied with an adaptor to directly couple the existing drive

motors. These give a wider variation in speed both slower and faster and have to date proved trouble-free DC drives were considered but were far more expensive.

The next step in the quest for better clarification was to look at and modify the clarifiers.

With single control boxes, the internal piping configuration was as shown in figure 4.

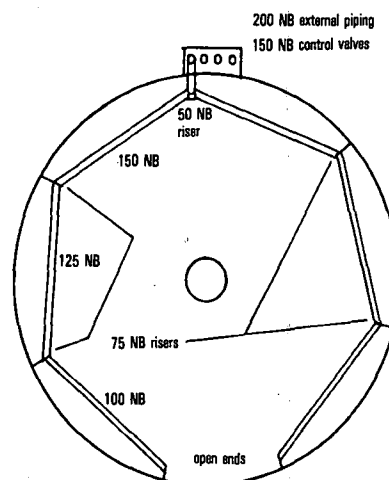


FIGURE 4 Dorr 444 as originally installed at Simunye

The suction points in each tray consisted of two open-ended 100 N.B. pipes, four 75 N.B. risers, and one 50 N.B. riser. It is easy to see why this system, while much improved on the earlier boxes, was still prone to biasing.

The external piping was 200 N.B. with 150 N.B. pipe control valves.

The modifications made in 1983 to these clarifiers were an attempt to equalise the hydraulic gradient from all suction points; and also to improve the throughflow capacity by adding to and increasing the size of the suction points.

All the internal and external juice piping was discarded. The new design as shown in section (Figure 5) and plan (Figure 6) consists of the following in each tray:

- Twelve 100 N.B. radial pipes to the outer shell of the vessel, each with an equal tee on the end, giving 24 suction points. These lead into:
- An annular collection box 350 mm deep × 300 wide around the central mud tray of the upper level.
- Two × 200 N.B. pipes feeding off this annular ring to one outside point via:
- A single 300 N.B. external pipe rising to the control box above, in which the control valve size was increased to 250 N.B. No modifications were made to the mud piping.

It should be noted that in the annular box there are horizontal baffles to prevent the flow from biasing to the inlet pipes closest to the draw off pipes. Figure 7 shows these baffles in the annular box when viewed linearly.

By doing the major portion of the modifications internally, very thin walled piping and plate can be used as corrosion in clear juice is almost nil, in fact the tendency is more to scaling. The first clarifier modification was mostly done with pipes re-claimed from the scrap yard and completed at new materials cost of approximately R2 000. The second clarifier cost approximately R6 000 to modify (materials).

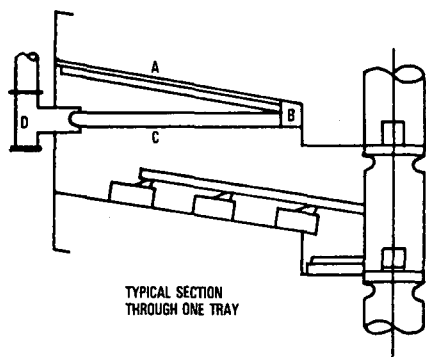


FIGURE 5 Present Simunye modification

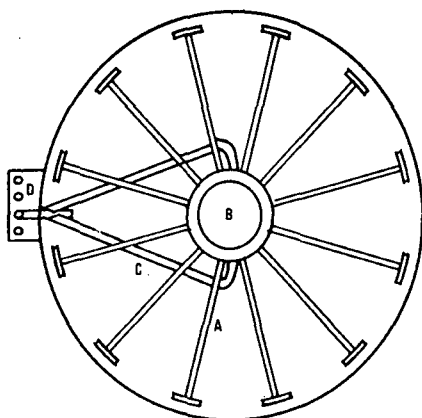


FIGURE 6 Present Simunye modification

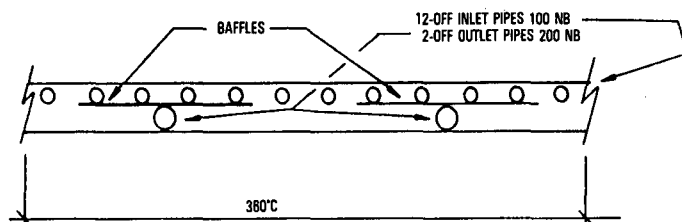


FIGURE 7 Central annular collection box

Discussion of Results Achieved

In Table 1, most pertinent results are tabulated covering the years 1980 (first year of operating) to 1985.

The 1980 season being Simunye's first year of operation was short and beset by numerous teething problems and staff training but it did highlight clarification station problems. Since inception the milling rate has steadily increased up to the present seasonal average of 259 tons per hour (inclusive of extended periods in excess of 300 tons per hour) as did the imbibition rate as indicated by the increased mixed juice per cent cane, but the very long retention times in the clarifiers of 3 hours for juice and much longer for the mud during the 1981/82 seasons resulted in the high inversion losses as indicated by the clear juice, filtrate, purity and pH.

In 1982 the replacing of the mud re-circulation system with the level control gave an immediate and marked improvement of over 1,5 degrees purity and a corresponding boiling house recovery improvement from the lowest mixed juice purity experienced to date.

During the 1982 season, on two occasions one of the conventional Dorr 444 clarifiers broke down and required liquidation and repair and during these periods the maximum crushing rate that could be maintained on one clarifier was approximately 170 tons cane/hour after which the clarifier physically overflowed.

One of the clarifiers was converted during the 1982/83 off crop and operated totally on its own during the 1983 season with results that met all expectations and it only overflowed at more than 300 tons cane per hour and this was overcome by raising the overflow gutter by 50 mm.

The second clarifier modifications were completed during the 1984 crop but it has not been necessary to run both simultaneously.

As can be seen from the table the average residence time is 1,3 hours, flocculant usage is lower than most mills operating conventional clarifiers. There has been a steady but moderate rise in the flocculant dosage to the clarifier as we have endeavoured to reduce filter cake losses as well as the clear juice/filtrate purity and pH with success and has been reflected in the BHR results as well.

Clear Juice Colour and Turbidity

These are more difficult factors to compare year by year as a number of outside factors can have a major influence on them, such as cane quality, climatic conditions, area from which the cane comes etc, but there does appear to have been a marked drop in clear juice turbidity corresponding to the filter change and colour drop due to the corresponding clarifier change although it does not appear to carry through to the sugar figures read on the same machine by the same staff.

Conclusion

The modification to the clarification station have proved so successful that for the last three seasons it has not been necessary to operate more than one clarifier at a time. Quality of clarification is significantly better than before, even at higher milling rates (up to 300 tonnes cane per hectare). All of which tend to prove that we have achieved our goal of reducing if not eliminating the short circuiting effect in conventional multi tray clarifiers, reducing the residence time of both juice and more importantly the mud with the corresponding beneficial results all at the very moderate materials cost of less than R6 000 per clarifier.

Possible Improvement

The modification could be improved by reducing the tee-pipes to 75 N.B., and using swept bends instead of fabricated t-sections. Thin wall stainless steel with its very smooth internal surface would result in less pipe friction and also less tendency to scale, and easier to clean. The annular box was made wide (300 mm) to ensure ease of cleaning in off crop. It is felt that this could be reduced to 150 or 200 mm to maintain flow velocities.