DECREASING SUCROSE LOSSES ACROSS THE CLARIFIER AND FILTER STATIONS AT SEZELA

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Abstract

Traditionally more emphasis has been placed on decreasing sucrose loss in filtercake than decreasing microbial activity, although the latter can account for higher losses. Sezela successfully reduced the clear juice-to-filtrate purity drop from about 4 to 1,7 units, by decreasing the residence time of clarifier mud and filtrate, and by increasing the filtrability of the filter feed. Some plant and process modifications, together with recommendations are presented.

Introduction

Pol % filtercake has traditionally been used in the sugar industry to measure the sucrose lost across the filter station. Very little emphasis has been placed on the sucrose lost by microbial activity. The difference in purity between the clear juice (CJ) and the filtrate is an indication of sucrose loss and the difference can range from 7,0 to 0,2 units[1] for the different factories in the industry. The differences in purity between clear juice and filtrate for Sezela and five other diffuser factories in the industry are shown in Table 1.

TABLE 1

Purity difference (CJ - filtrate) obtained at Sezela and 5 other diffuser factories in the industry

Season	Factory					
	1	2	3	4	5	SZ
81/82	4,67	3,55	2,78	3,94	2,82	3,17
82/83	4,57	4,07	2,62	5,31	3,80	3,44
83/84	7,22	3,12	3,03	1,36	3,37	3,51
84/85	5,22	1,05	1,03	1,48	2,20	1,70

Lionnet[2] has shown that one unit drop in filtrate purity is equivalent to approximately 0,2 unit drop in boiling house recovery. The pol lost in filtrate as a percentage of pol in mixed juice has been calculated using this value, and is shown in Table 2 for the same factories.

TABLE 2

Pol lost in filtrate and filtercake as a percentage of pol in mixed juice for the 1983/84 season

Parameters	Factory					
	1	2	3	4	5	SZ
Δ Pty (CJ-filtrate)	7,22	3,12	3,03	1,36	3,37	3,51
Pol lost in filtrate	1,44	0,62	0,61	0,27	0,67	0,70
Pol lost in filtercake	0,40	0,25	0,30	0,27	0,13	0,22

At the beginning of the 1984–85 season the Sezela process staff set itself a specific objective to decrease the pol lost in the filtrate. Lionnet[2] had reported that larger filtrate purity drops were associated with longer filtrate residence times and lower temperatures and that diffuser muds had a lower filtrability than muds from a milling factory. All modifications to plant and process were therefore aimed at rectifying the long residence time and low temperature of filtrate and increasing the filtrability of the clarifier mud.

Decreasing residence time and increasing temperature

Plant and process modification

Sezela is equipped with three SRI type clarifiers (two 7,3 m and one 7,9 m diameter vessels). The level of the mud in the mixer controls the mud withdrawal valves of the three clarifiers, while the level of conditioned mud in the filter troughs controls the filter feed valves at the mud mixer. The filtrate, after passing through the receivers was pumped into a transfer tank from which it was pumped to the mixed juice (MJ) tank situated about 300 m away. As part of the plant modifications, the transfer tank was by-passed by connecting the extraction and transfer pumps in series. This series arrangement also provided the necessary head to pump the filtrate straight into the mixed juice line just before the lime in-line mixer. The modified filtrate system is shown in Figure 1.

At the beginning of this project the filter station was the focal point because it was believed that the purity drop took place across it. Biocide was dosed into the mud mixer for a period of one week and no measurable improvement was noted. It became clear that a significant drop in purity had already occurred even before the mud reached the filter station. Our attention shifted upstream to the juice clarifiers and the residence time of mud in the clarifier was decreased by withdrawing mud at a lower solids concentration. Tracer tests were performed by the SMRI on one clarifier, and the effect of residence time on mud solids and purity drop was determined.

The temperature of the mud and filtrate was increased by injecting Vapour One into the mud line, the mud mixer and the filter boots. The steam addition points are shown in Figure 1.

Results

The purity difference (CJ - filtrate) for the first four weeks ranged from 3,36 to 2,04. This dropped to between 1,33 and 1,01 at the end of the fifth week after the filtrate system was modified.

During the first four weeks of the 1984/85 season the temperature of the filtrate at the point of addition to the mixed juice was about 40°C. After the filtrate system was modified, the temperature at the point of addition ranged from 70 to 75°C.

The effect of mud residence time on purity drop is shown in Table 3.

TABLE 3

The effect of residence time on clarifier mud solids concentration and purity (SMRI results)

Test no	Mud solids %	Residence time (min)	ppm Lactic acid on brix			Δ Pty (CJ - Mud)
			Limed juice	Clear juice	Mud	
1	3.7	69	390	390	335	0.9
2	5.8	154	435	430	500	1.6

The residence time of mud in the clarifiers was determined by the use of a lithium tracer. The residence time distribution is shown in Figure 2.

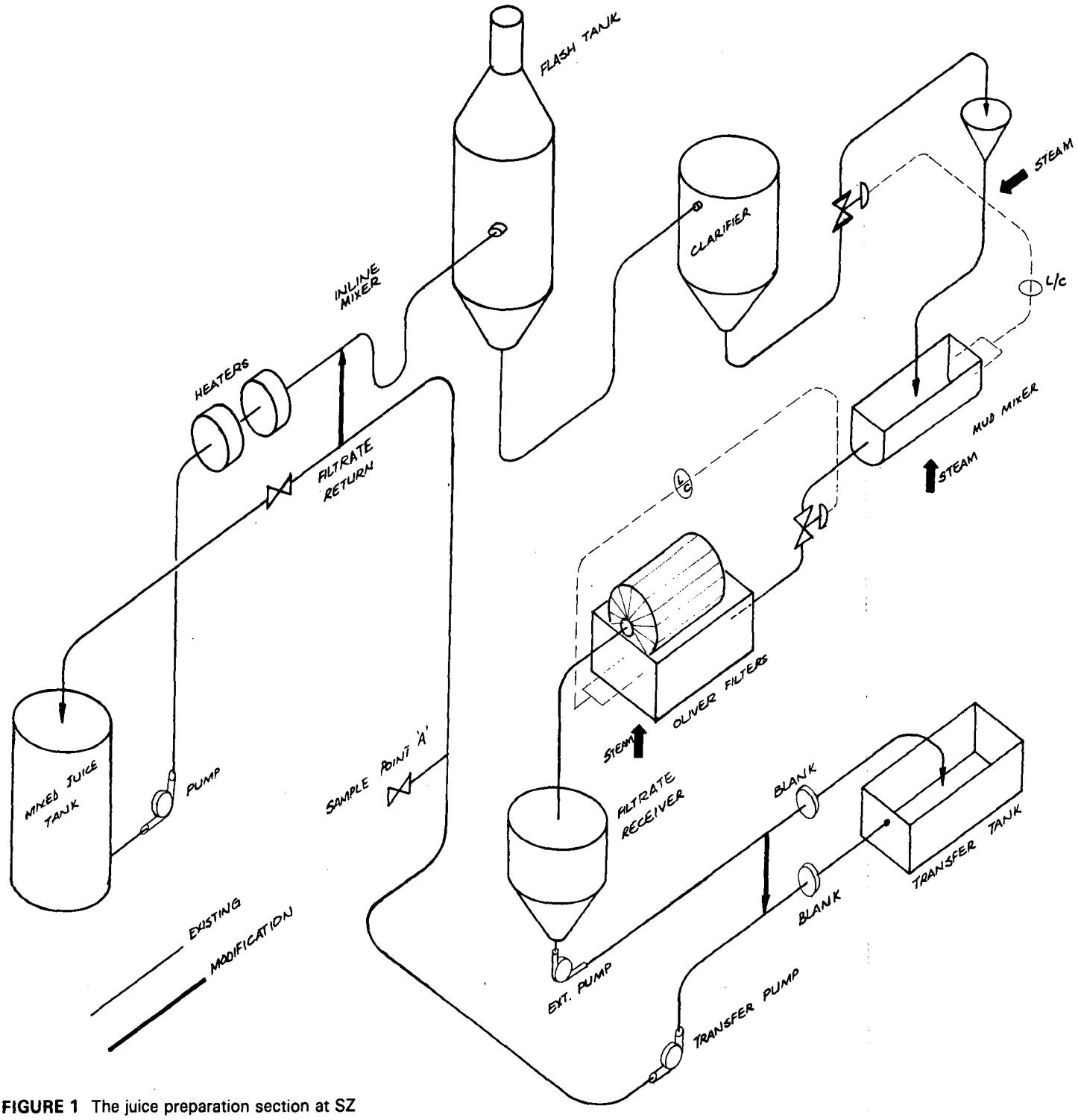

FIGURE 1 The juice preparation section at SZ

The difference in purity (MJ - filtrate) also appeared to be related to the daily factory diffusion rate. This is shown graphically in Figure 3, and is another possible indication of the effect of residence time on purity drop.

The effect of adding filtrate of a lower temperature to the mixed juice after the heaters was investigated. A Fletcher and Stewart settling kit was used to determine the settling rate of the flocculated particles in the limed juice. The results, which are the average of five pairs of tests are shown in Table 4.

TABLE 4

The effect of point of addition of filtrate on juice settling rates

Addition point	Settling rate (cm min^{-1})
MJ tank	16
After heaters	20

Increasing Mud Filtrability

Process modification

Lionnet[2] has shown that Sezela mud had the highest resistance to filtration in the industry. The specific cake resistance of the mud is shown in Table 5 for Sezela and two other mills.

TABLE 5

Specific cake resistance of filter feed

Factory	Ave. specific cake resistance ($m.kg^{-1}$)
SZ	$5{,}4 \times 10^{11}$
UK	$0{,}5 \times 10^{11}$
NB	$0{,}5 \times 10^{11}$

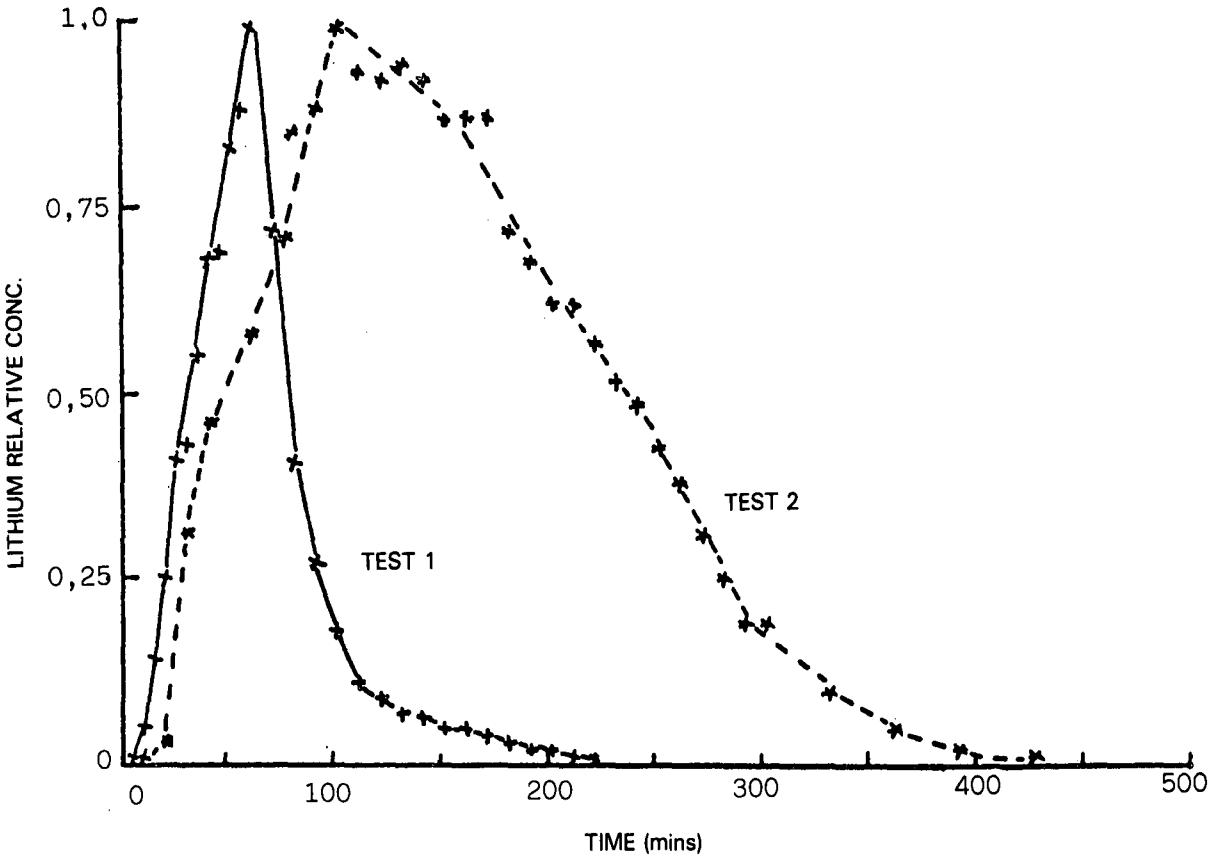

FIGURE 2 Residence time of mud in No 2 clarifier

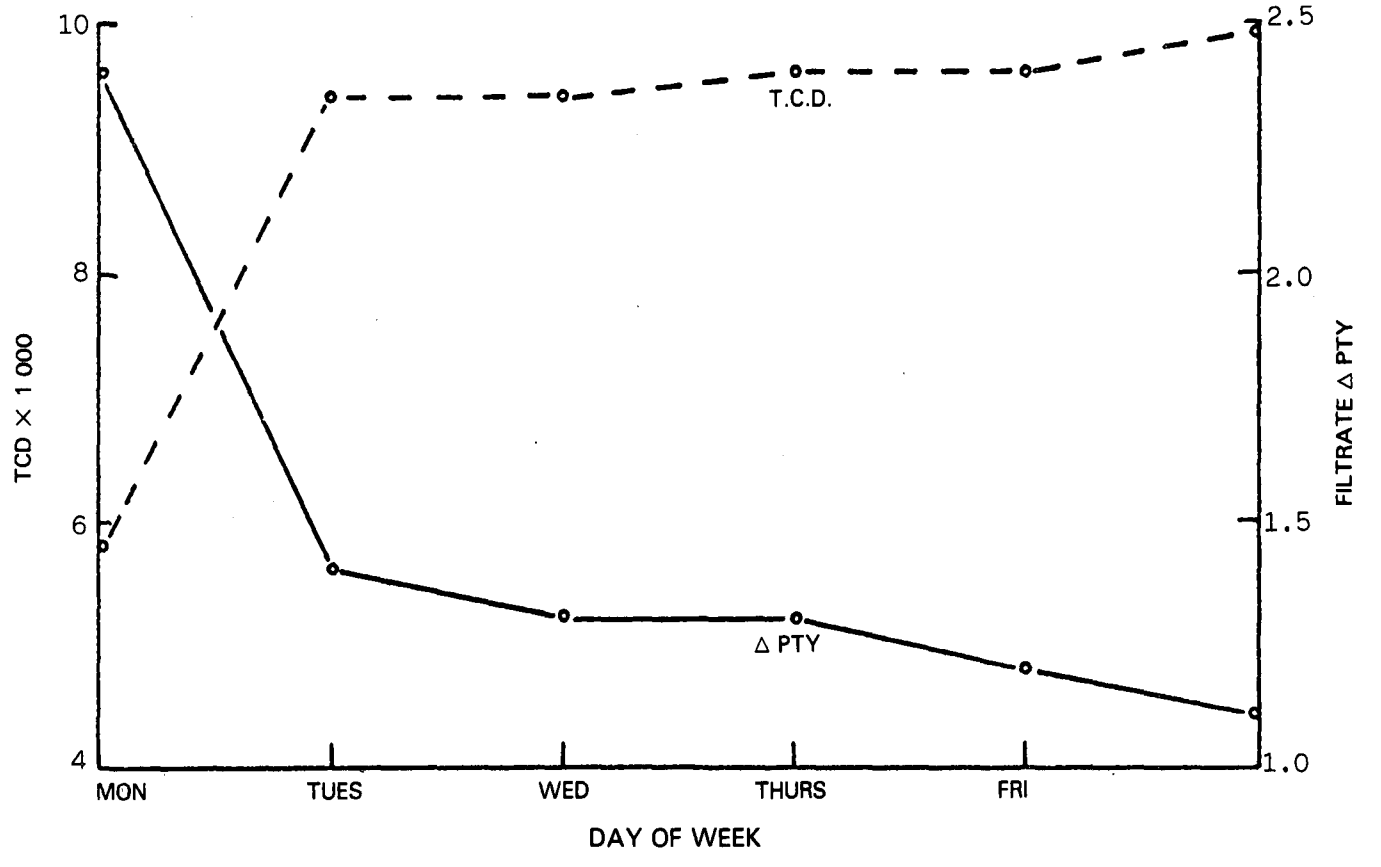

FIGURE 3 The effect of throughput on filtrate purity

The filtrability of the Sezela mud was improved by the addition of milk of lime, by decreasing the mud solids of filter feed, by improving the bagacillo quality and the mixing of mud and bagacillo and by the addition of flocculant to the filter feed.

Results

The effect of the filter feed solids concentration on the filtrate quality is shown in Figure 4. These data were collected over the first half of the season and no attempt was made to keep the other parameters constant. Some abnormal values have been discarded. The addition of milk of lime to the mud was also beneficial, but flocculant addition did not produce any visual or measurable improvement.

During the 1983–84 season no additional conditioning of mud, apart from bagacillo addition, had been practised and the results of that season are shown in Table 6 together with the results of the 1984–85 season.

TABLE 6

Filtration data for the 1983/84 and 1984/85 seasons

Season	Mud solids % Feed	Suspended solids % Filt.	Filtrate pH	Retention %
1983/84	5,0	1,07	6,6	67
1984/85	3,0	0,37	7,5	82

Discussion and Recommendations

Residence time

The modifications to the filtrate system to decrease the residence time had a marked effect on the purity drop. The addition of filtrate after the heaters did not affect the settling rate of juice in the clarifiers as shown by the results in Table 4. For the same plant conditions, the solids content of mud is directly related to the thickening or residence time and it can be seen from Table 3 that long residence times are associated with lactic acid production which is an indicator of sucrose loss.[3,4]

The data plotted in Figure 3 indicate that the low throughputs are associated with high purity drops and vice versa. The low throughput on Mondays was due to the fact that one diffuser was always off range for maintenance.

The residence time of mud and filtrate must be kept as short as possible. For a given throughput, the least number of clarifiers should be used to decrease the residence time of juice and mud. A flocculant that produces a fast settling and a short thickening time must be selected to increase the mud solids concentration of the underflow at the shortest residence time.

The filters must be run at maximum practical speeds to shorten the residence time of mud in the mud boots. Filter speeds of up to one revolution in 3,75 minutes were used satisfactorily at Sezela. The filtrate should take the shortest route from the extraction pump to the mixed juice. Filtrate transfer tanks are not essential and are therefore not recommended. It

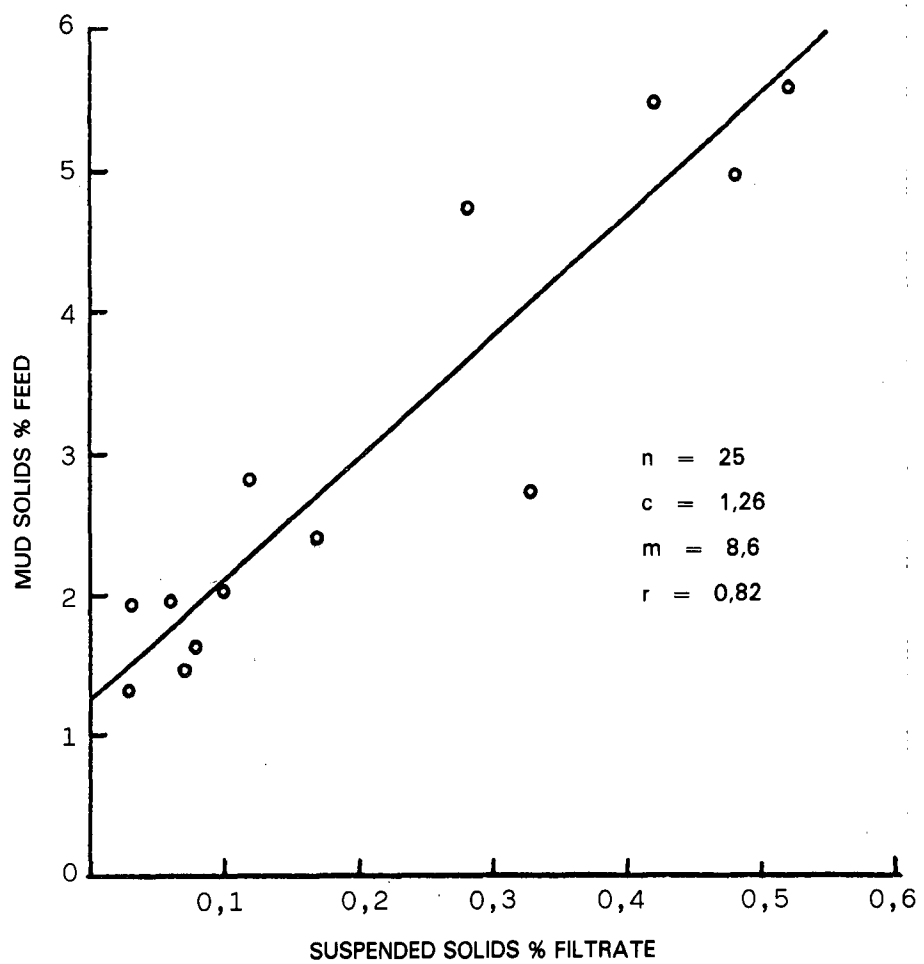

FIGURE 4 The effect of mud solids % feed on suspended solids % filtrate

is not necessary to add the filtrate into the mixed juice tank and it can be introduced at any point before the mixed juice liming point.

Increasing filtrability of mud

The information in Figure 4 shows the relation between mud solids % feed and suspended solids in filtrate. The correlation coefficient was 0,82. Low suspended solids in filtrate can be taken as an indicator of good filtrability and hence it can be seen that the lower the mud solids in feed, the higher the filtrability. The average mud solids % filter feed for the 1984–85 season was 3,0 at Sezela and the filtrate pH was 7,5. However, it must be borne in mind that the withdrawal of clarifier mud of very low solids content increases the filtrate volume and can be detrimental to overall performance.

It can therefore be concluded that the residence time of clarifier mud and filtrate is one of the most important factors affecting the purity of filtrate.

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