SEPARATE CLARIFICATION OF VACUUM-FILTER FILTRATE BY USING SEPARAN AP30 AT UMFOLOZI

By G. H. CONIJN

It is generally recognised in the sugar industry that the filtrate from the vacuum filters forms a problem. Usually it is returned to the mixed juice tank or to the liming station and reclarified. Not so long ago it was found that this mixing of two juices with such different characteristics is far from ideal and the idea of separate clarification was brought up. F. Gayle[1] did extensive tests in this direction at Valentine Sugar Factory, Lockport, Louisiana, and reported excellent results using lime and phosphoric acid as chemicals and a Graveret clarifier as settling equipment.

This seemed a good approach and we liked the idea of trying it at Umfolozi.

Phosphoric acid however is not a good proposition for Umfolozi, as in the past quantities of up to 400 and 500 p.p.m. of P_2O_5 have been found in the juice. So we had to look for a flocculating agent which would not unnecessarily increase the quantity of non-sugars. From a paper by M. M. Moron and Dr. A. G. Keller[2] we learned that they had selected Separan AP30 out of ten different coagulants to give the best results as a clarification adjunct in cane sugar production. Separan AP30 is one of the many polyelectrolytes that have been developed in the past few years. It dissociates in water to give negatively charged particles which activate flocculation.

After the type of flocculant was decided upon, we started a test on a laboratory scale to investigate what pH and quantity of Separan AP30 would give optimum results. The results of that test will be found in Table 1.

Table 1

pH	Separan AP30 p.p.m.						
	1	2	3	4	5	10	
7.0	— 5% 10%	10 5% 15%	11 5% 15%	12 5% 15%	18 5% 15%	18 5% 15%	Kopke Clear juice after 10 minutes settling Clear juice after 30 minutes settling
7.2	5 5% 15%	12 5% 15%	12 10% 15%	12 10% 20%	18 15% 20%	20 15% 20%	Kopke Clear juice after 10 minutes settling Clear juice after 30 minutes settling
7.3	5 10% 15%	12 10% 15%	12 10% 20%	15 15% 20%	20 15% 20%	20 20% 25%	Kopke Clear juice after 10 minutes settling Clear juice after 30 minutes settling
7.4	6 15% 20%	14 15% 25%	15 20% 30%	15 25% 30%	20 25% 30%	22 30% 40%	Kopke Clear juice after 10 minutes settling Clear juice after 30 minutes settling
7.5	8 15% 25%	16 20% 30%	20 30% 35%	20 30% 40%	20 35% 50%	22 40% 60%	Kopke Clear juice after 10 minutes settling Clear juice after 30 minutes settling
7.6	8 20% 25%	16 25% 30%	20 30% 40%	20 30% 40%	22 50% 60%	22 50% 60%	Kopke Clear juice after 10 minutes settling Clear juice after 30 minutes settling
7.7	10 20% 30%	18 20% 30%	22 25% 40%	23 30% 40%	23 40% 50%	24 50% 60%	Kopke Clear juice after 10 minutes settling Clear juice after 30 minutes settling
7.8	12 20% 30%	20 20% 30%	22 30% 40%	22 40% 60%	24 50% 75%	26 50% 75%	Kopke Clear juice after 10 minutes settling Clear juice after 30 minutes settling
7.9	10 20% 25%	16 20% 30%	20 30% 40%	20 40% 50%	22 50% 75%	23 50% 80%	Kopke Clear juice after 10 minutes settling Clear juice after 30 minutes settling
8.0	10 20% 25%	15 20% 25%	18 25% 30%	18 30% 50%	20 40% 50%	22 40% 60%	Kopke Clear juice after 10 minutes settling Clear juice after 30 minutes settling
8.2	8 10% 20%	14 15% 20%	16 20% 30%	20 20% 30%	20 20% 40%	20 20% 40%	Kopke Clear juice after 10 minutes settling Clear juice after 30 minutes settling

From this table it was clear that pH 7.8-7.9 and 10 p.p.m.. Separan AP30, gave us the best results. With the above in mind and the necessary alterations to the plant, we started a test-run on a factory scale which lasted a fortnight.

The object of the test was to investigate the effect of separate clarification of the filtrate of the vacuum filters by using lime and Separan AP30 as chemicals and a clarifier as settling equipment.

Procedure during the Test

Mixed Juice

The mixed juice was heated as follows:
Primary heating to 175°F.
Liming to pH 7.8.
Secondary heating to 220°F.

Flashed and fed into three clarifiers of the following capacities:

Rapi-Dorr	24 ft. of 69,400 gallons.
Bach	22 ft. of 36,300 gallons.
Bach	20 ft. of 26,900 gallons.

The clear juice was sent direct to the evaporators and the mud to the vacuum filters.

Filtrate

The filtrate from the vacuum filters was pumped by the filtrate extraction pumps into a clarifier of the Bach type of 15 ft. diameter and a capacity of 14,680 gallons, through a juice heater, which heated the filtrate to 220°F. In the pipe leading from the flash-tank to the clarifier we fitted a funnel for the dosing of the Separan AP30.

The clear juice from this clarifier was sent to the evaporators and the mud was mixed with the mud from the mixed juice clarifiers and sent to the vacuum filters. The filtrate was found to average a pH of 7.6 instead of 7-8-7.9 as intended, and as predetermined in the laboratory scale test (see Table 1). This was due to the liming which was done manually and which made control to the correct pH rather difficult.

Juice Quality

Filtrate clarification

Table 2

Filtrate analyses before and after clarification.

	Filtrate to clarifier	Juice leaving clarifier
Brix	9.55	8.95*
Sucrose	6.75	7.26
Purity	70.7	81.1
% Reducing Sugars ..	0.337	0.240
R.S.R.	4.99	3.31

*Number of analyses done was insufficient to establish a fully reliable average.

From Table 2 we see that 60 per cent of the non-sugars present in the filtrate before clarification were removed. The colour of the juice was light yellow but hazy, but acceptable however for sending it straight to the evaporators.

Mixed Juice Clarification

The clear juice that was sent to the evaporators was a mixture of clear juice from the mixed juice clarifiers and clear juice from the filtrate clarifier. This mixture had a lower kopke (16.6) than the average clear juice during the season without the separate filtrate clarification (18.7) or the week before the test (19.4). There was slightly more haze during the test, which must have caused the drop in Kopke. This would confirm the findings of Dr. W. S. Graham and L. C. G. Douwes Dekker[3], where they describe the effect of adding vacuum filter filtrate, and state as one of their observations that a clearer clarified juice was obtained when filtrate was added to the mixed juice. We are however not so sure that the diluting effect of adding filtrate is not one of the reasons for this improved clarity. Once during the test we increased the imbibition to see whether there was any effect and found that after a couple of hours the clarity improved, indeed while the brix came down in the mixed juice clarifiers. We have therefore come to the conclusion, while studying the results, that it would be worth while trying to add the once-clarified filtrate to the mixed juice liming station and so reclarify the juice from the filtrate clarification in the mixed juice clarification. This would mean a kind of compound clarification with "primary" and "secondary" process juices and it must have several advantages, such as:

(*a*) The first clarification of the filtrate would still receive the treatment as required for its specific settling characteristics.

(*b*) Adding the clear juice from the filtrate clarification to the mixed juice would dilute the mixed juice and so improve the settling rate in the mixed juice clarification.

(*c*) Further non-sugar removal may be expected from a secondary liming and clarification.

From the foregoing a scheme would result as drawn up in Figure 1, which is intended to be worked to in the coming season for a further trial.

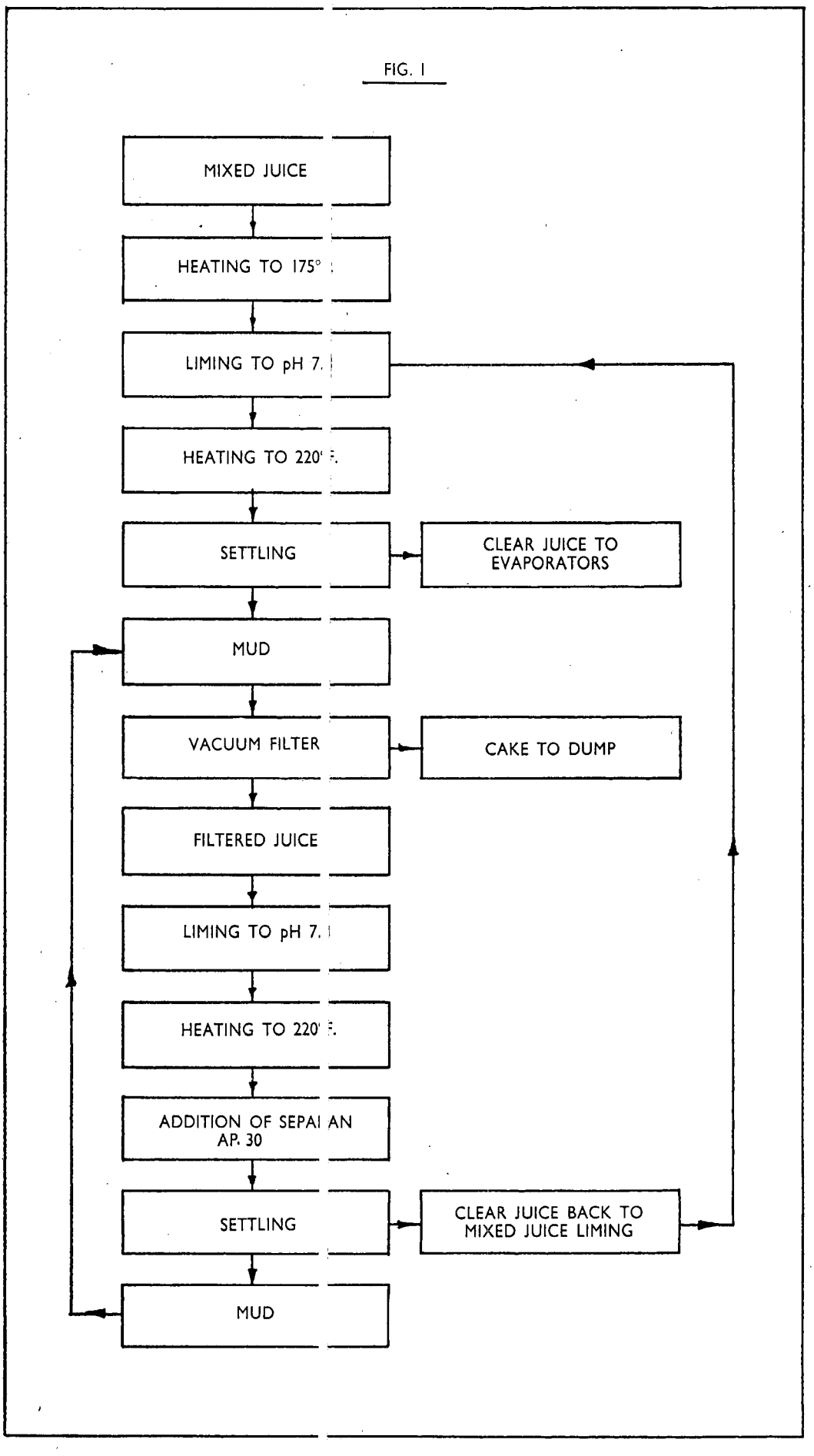
Mud Quality

The consistency of the mud of the mixed juice clarifiers improved very much during the test and was at times so thick that water had to be added in order to feed the mud into the mud-mixer. The mud levels were very low and we took one mud-valve out on each side of the mud-pumps of the Dorr clarifier in order to be able to keep a certain mud-level while the pumps were on automatic procedure. The filter-cake seemed to be more porous and consequently better washable. This resulted in a 0.4 per cent drop in sucrose of the filter-cake. During the test the average sucrose was 2.6 per cent, while the average for the season was 3 per cent with 3.3 per cent and 3 per cent respectively during the week before, and the week after the test.

Quantity of Separan AP30 Used

During the two week test a quantity of 225 lbs. of Separan AP30 was used. This came to 0.04 lb. per

FIG. 1


MIXED JUICE
HEATING TO 175°
LIMING TO pH 7.
HEATING TO 220°F.
SETTLING
CLEAR JUICE TO EVAPORATORS
MUD
VACUUM FILTER
CAKE TO DUMP
FILTERED JUICE
LIMING TO pH 7.
HEATING TO 220°F.
ADDITION OF SEPAI AN AP. 30
SETTLING
CLEAR JUICE BACK TO MIXED JUICE LIMING
MUD

ton of sugar. We are however quite sure that this quantity can be reduced further by having better apparatus for handling and dosing the Separan AP30. This was all done by hand in our case, e.g., we did not reduce the dosing during the test in case of mill stops, because it made things too complicated for the labour.

Conclusion

To conclude we would like to stress the fact that, as you will have recognised, there are still many "white spots" in the project, which need further to be investigated and analysed.

Acknowledgment

We wish to thank all those who assisted during the preparations and the actual running of the test for their pleasant and useful co-operation.

References.

[1]Gayle, F. Separate Treatment of Flitrate Juice from Rotary Vacuum Filters. Sugar Journal, Vol. 18, No. 12, May. 1956.

[2]Moron, M. M. and Keller, A. G. New Flocculating Agents to Improve Clarification. Presented at American Society of Sugar Cane Technologists' Meeting, February, 1959.

[3]Graham, W. S. and Douwes Dekker L. C. G. Some Notes on the Settling of Juices. S.M.R.I. Quarterly Bulletin, No. 13, January, 1960.

Mr. Hulett, in the chair, said the filter station was one which had been largely neglected in the past in that little work had been done on it. The experiment carried out at Umfolozi might therefore provide useful results. He asked the author if adding the clarified juice from the filtrate clarifier to the clear juice from the main clarifier, did not lead to a formation of floc, due to difference in pH.

Mr. Conijn replied that while the juice from the filtrate clarifier was not as good as he would like to see it there was no sign of floc being formed in the mixture.

Mr. Boyes said similar experiments had been made at Tongaat and he commented that with this system, one had to make sure that the filter station could handle the extra amount of mud obtained by adding extra lime. At Tongaat they had not yet been able to obtain a juice from the filtrate clarification good enough to send to the evaporators. The pH was kept at 7.3 for mixing with the main mixed juice. This might have been a mistake, as Mr. Conijn had shown a better result at a pH of 7.8.

Mr. Conijn had only taken his settling rate to 30 minutes. That was the initial settling rate, and he had observed with natural mixed juice, the addition of the polyelectrolyte led to a much more rapid initial settling, but after 2½ hours the mud volume was such the same as that of the juice which had not had the polyelectrolyte added.

The Kopke instrument was not very reliable but at Tongaat the reading on clear juice was 28 to 30, but when the settled filtrate was added it gave a reading of only 13 to 14. The filtrate was therefore passed back to the mixed juice and allowed to go through a second clarification but even then the clarity dropped to 24° Kopke.

He felt that if money was to be spent on using Separan clarification should be achieved in one stage and one could not afford to pass the filtrate back for a second clarification.

Mr. Conijn said that his experience was that when filtrate clarification was used, the mud volume was decreased, only 3 out of the 5 filters being needed. He agreed that one should aim at clarification being effected in one stage but now higher quality of our export sugar was demanded, and better clarification would assist in producing the better quality of sugar required.

Mr. Boyes asked for comment on the fact that after clarifying the filtrate and returning it to the mixed juice at Tongaat they did not get better results.

Mr. Conijn replied that the Figure 1 in the paper showed what it was intended to try out in the future, and as yet the "compound clarification" process had not been worked.

Mr. Hulett asked if any work had been done by Mr. Conijn on the best point at which the polyelectrolyte should be added. He asked this because of what he had seen in America. There, large amounts of soil were sent into the factories due to mechanical harvesting and frosted cane had to be processed at times. Factories had as a consequence to stop to allow settling in the clarifiers. A substance called "Lyton" which gave wonderful results in a test tube failed to reproduce these results in the factory although its addition at various points had been tried. One factory however which had open batch type clarifiers did get the expected results. He did not know why this should be, and he now asked if various points of application had been tried at Umfolozi.

Mr. Conijn stated that at the factory in which he worked prior to going to Umfolozi, Separan was used freely, and there it was also added in the flash-tank. He had not tested other points of application.

Mr. Rault asked the reason for the reducing sugar ratio being lowered from 4.99 in the filtrate going to the clarifier to 3.31 in the juice leaving the clarifier. Was this destruction of reducing sugars due to the lime added?

Mr. Conijn replied that he did not think the extra alkalinity was the cause, but as he had pointed out, insufficient tests were done to enable one to come to a reliable average and speak with certainty upon this point. He hoped to get more tests done during the coming season.

Dr. Graham said he had been informed that the best point of application was the pipe leading to the clarifier, but baffles should be fitted to ensure adequate mixing of the Separan with the juice.

Mr. van Hengel suggested that the filtrate from the filters might be treated by passing through a continuous centrifuge of the type now being tested for starch removal. This would remove the mud without the use of any chemicals.

Mr. J. B. Alexander said that some years ago a de-sludging centrifuge had been used in an endeavour to do what Mr. van Hengel had suggested. A small amount of mud was removed from the filtrate but after passing through the de-sludger it could not be centrifuged in an ordinary laboratory centrifuge, which, before the filtrate had gone through the machine, had clarified the filtrate fairly well. The action of the machine had apparently broken up any floc present and dispersed it very effectively.

Mr. Hulett said he was worried about the floc being broken up. Once this was done one would have trouble in re-settling the juice in the ordinary way.