FLOCCULANT USAGE REDUCTION AT SEZELA

By T. J. BLOM and S. S. MUNSAMY

CG Smith Sugar Limited, Sezela

Abstract

A number of polyacrylamide flocculants for juice clarification have been tested at Sezela over the past ten years, some with a degree of hydrolysis between 27 and 33% working satisfactorily on diffuser juice. However, over a wide range of juice qualities, two brands of flocculant (A and B), produced good clear juice and easily filtered mud. Flocculant B has the potential to reduce Sezela's consumption from about 7 ppm to about 3 ppm. All tests were carried out on plant scale.

Introduction

Poor cane quality and the introduction of short residence time clarifiers have made the addition of polyacrylamide flocculant a necessity at Sezela. In 1982 the change to total diffusion for sucrose extraction also affected the quality and quantity of clarifier mud. The suspended solids content of mixed juice decreased from about 0,50% to about 0,05%, due mainly to reduction in sand content. Diffusers are operated at high temperatures (85°-98°C), and any lime addition results in calcium phosphate precipitation in the diffuser at the expense of natural flocculation at the clarification stage. Clarifier mud from a diffuser factory is very difficult to filter and may result in high filtercake pol and low filtrate purity. Flocculant assessments should therefore include filterability of the clarifier mud as well as juice quality.

Description of the clarification plant

Sezela sugar mill uses cane diffusion for juice extraction, and has two BMA-type diffusers with a total rated capacity of 450 tch. Mixed juice quantity is about 130% on cane and the juice can range from 9° to 13° brix. Sezela uses the hot liming method for juice clarification. Diffuser juice is heated to 105°C in a set of tubular heat exchangers. Calcium hydroxide solution (milk of lime) is directly dosed into the juice pipe about five metres from the flash tank by a variable speed positive displacement pump. Mixing the milk of lime and hot juice is done by a screw-type inline mixer. There are three short residence time clarifiers of the SRI design with a total capacity of 394 m^3. Two clarifiers only were used in the 1990/91 season. The Sezela clarifier station at present has the lowest installed clarifier capacity in the South African sugar industry (0,88 m^3/tch). Each clarifier has three juice inlet boxes, and flocculant is dosed into the bottom of each box. The mixed juice flow rate is measured by a magnetic flow meter and controlled by the mixed juice tank level. The speed of the flocculant dosage pump is controlled by the mixed juice flow rate via a ratio control station. In automatic mode of operation, flocculant is dosed in proportion to the mixed juice flow rate. Filtrate is returned to the mixed juice after the magnetic flow meter has been passed, and this instrument does therefore not take into account the filtrate flow rate when dosing flocculant.

Flocculant dosing system

The flocculant is prepared in an 18 m^3 tank fitted with a mechanical stirrer rotating at 25 rpm, and the dried powder is added to treated water of drinking quality by a vibratory feeder. The stock solution is then discharged into a holding tank with a capacity of 18 m^3. A positive displacement pump (Mono D62) is coupled directly to a DC motor capable of a speed range of 0-1500 rpm. The flocculant is pumped through nine manually controlled rotameters to the nine inlet boxes. The rotameters are adjusted to give an even flow of flocculant to the dosing points. When a clarifier is taken off range the manual valves at the rotameters are shut.

Flocculant usage

It has been found that flocculants affect both clarification and filtration. Monthly clarification and filtration data for the 1988-90 seasons are shown in Tables 1, 2 and 3. From these tables it can be seen that flocculant usage at Sezela is very high, and for this reason new products and application methods are continuously evaluated at Sezela. During the period 1983 to 1990 a large number of dry powder and liquid flocculants were tested. The high usage (about 17 tons per annum) caused various manufacturers to compete as suppliers of flocculant to Sezela. The Process department's 'open door' testing and evaluation policy resulted in all the major manufacturers carrying out tests at the mill. It was found that a number of brands with a degree of hydrolysis between 27 and 33% worked satisfactorily at Sezela. Flocculant testing and evaluation can be frustrating because a brand that works well on some juices can be unsatisfactory when juice quality changes. However, two brands were found to work well on all types of juice at Sezela.

Flocculant A, of French origin, worked exceptionally well over four seasons, during periods of drought and excessive rain. It produced clear juice and mud of good filterability.

Flocculant B, of British origin, was first introduced on a trial basis in 1989. It was used for most of the 1990 season and was found to be suitable for a wide range of juice qualities.

Flocculant A produced good juice and mud, and cost about 25% less than conventional brands. Unfortunately it did not markedly reduce the dosage rate, although a small reduction was noticed.

Table 1

Clarification and filtration data for the 1988 season

Month	Clear juice colour (420 nm)	Pol % filtercake	Purity difference (MJ-filtrate)	Flocculant dosage (ppm on mixed juice)	Flocculant type
April	25 300	0,88	1,21	7,97	A
May	21 800	0,76	0,82	7,39	A
June	21 200	0,78	0,81	6,57	A
July	17 700	0,78	0,84	5,30	A
August	18 500	0,79	0,76	5,26	A
September	19 400	0,82	0,86	6,81	A
October	20 600	0,71	0,73	8,10	A
November	21 100	0,75	0,61	7,78	A
December	21 700	0,75	0,88	7,96	A
Average	20 800	0,76	0,84	6,93	–

Table 2

Clarification and filtration data for the 1989 season

Month	Clear juice colour (420 nm)	Pol % filtercake	Purity difference (MJ-filtrate)	Flocculant dosage (ppm on mixed juice)	Flocculant type
April	26 800	0,80	0,83	8,46	A
May	27 400	0,72	0,71	5,80	A
June	26 400	0,61	0,54	7,26	A
July	25 200	0,69	0,69	8,32	A
August	21 200	0,77	0,75	6,33	A
September	23 600	0,84	0,76	6,30	A
October	23 100	0,78	0,82	5,46	A
November	26 200	0,81	0,54	5,71	A
December	27 800	0,84	0,89	7,11	A
Average	25 300	0,84	0,73	6,48	—

Table 3

Clarification and filtration data for the 1990 season

Month	Clear juice colour (420 nm)	Pol % filtercake	Purity difference (MJ-filtrate)	Flocculant dosage (ppm on mixed juice)	Flocculant type
May	27 200	0,72	1,01	6,05	A
June	22 200	0,67	0,77	3,45	B
July	20 900	0,67	0,96	3,24	B
August	20 800	0,84	1,01	4,27	A & B
September	22 800	0,70	0,61	3,28	B
October	24 500	0,67	0,51	2,58	B
November	28 300	0,69	0,34	3,80	A & B

Flocculant B produced juice similar to and sometimes better than the quality obtained with flocculant A. Mud quality was satisfactory, although tending to form balls. It is interesting that flocculant B had a greater affinity with bagacillo than flocculant A. When using flocculant B the filters were able to run for long periods without the addition of bagacillo. This means that the clarifier mud had sufficient bagacillo to filter well.

Most significant of flocculant B was that it produced good results at relatively low dosage rates, as shown in Table 4. At high dosage rates this flocculant produced mud that was very difficult to filter, and high dosages should therefore be avoided. The cost of flocculant B was about 70% of conventional brands.

Technical data on the flocculants were difficult to obtain from the manufacturers due to market competition; limited data available are shown in Table 5. It should be noted that the solution viscosity is an indication of molecular weight, and high viscosities are normally associated with high molecular weight. Smaller particle sizes facilitate better solution preparations.

Table 4

Clarification and filtration data for parts of the 1990 season

Week Number	Clear juice colour (420 nm)	Pol % filtercake	Purity difference (MJ-filtrate)	Flocculant dosage (ppm on mixed juice)	Flocculant type
1	24 300	0,83	0,79	7,92	A
2	28 800	0,78	0,85	6,73	A
3	28 100	0,60	0,79	6,82	A
5	24 400	0,65	0,93	3,36	B
6	23 600	0,70	0,87	3,28	B
7	22 900	0,71	0,66	3,46	B
18	21 000	0,75	1,24	6,13	A
19	22 600	0,78	0,74	3,28	B
20	23 000	0,74	0,68	3,73	A & B
21	23 300	0,68	0,68	2,92	B
25	24 800	0,63	0,74	2,55	B
26	24 900	0,65	0,12	2,59	B
27	26 600	0,61	0,24	2,70	B

Table 5

Technical information on flocculants A and B

Technical data	Flocculant A	Flocculant B
Ionic charge	anionic	anionic
Degree of hydrolysis (%)	30	33
Particle size (microns)	1 250	750
Apparent density	0,8	0,8
pH of 1% solution	8,4	7,5
Dissolution time (min)	60	120
Viscosity (Pa.s $\times 10^{-3}$)		
0,1% solution	90	200
0,5% solution	650	700

Conclusions

Flocculant B was used for most of the 1990 season and produced satisfactory juice and mud products. The dosage was decreased from about 7,0 to 3,0 ppm. Flocculant B was obtained at a low price and, if this price is maintained, the flocculant cost at Sezela will be reduced by about R100 000 per annum. Although the new product was only tested for one season, indications are that it would work satisfactorily with a wide range of juice qualities. The potential saving shows the importance of testing and evaluating chemicals to reduce the cost of sugar extraction.

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