

THE MUTUAL CLARIFICATION PROJECT

PROGRESS REPORT No. 1

By E. J. BUCHANAN, W. S. GRAHAM*,

L. M. S. A. JULLIENNE and M. MATIC

Sugar Milling Research Institute

Summary

The Mutual Clarification Project was inaugurated at a meeting held at the S.M.R.I. in June last year which was attended by technical personnel from most of the milling companies.

This paper outlines the purpose of the project and the method of operation in sufficient detail to provide a basis for discussion.

Only three factories contributed significantly to the project during the 1968-9 trial season but in spite of the limited information, some interesting observations were possible. The information on starch and suspended matter clearly indicated the importance of impurity removal prior to the crystallisation process. By facilitating a comparison of process data among factories some sources of inefficiency were located. The potential value of the M.C.P. has been demonstrated.

Introduction

When the Mutual Milling Control Project which had achieved its objectives) was discontinued at the end of the 1967-8 season, the S.M.R.I. began preparing the basis for the Mutual Clarification Project. The process staff of all factories were invited to attend a meeting on 4th June 1968 for the purpose of considering the new project. At this meeting a procedure for submitting data on clarification was formulated and members from some fifteen factories agreed to submit data during a trial in 1968. It was also agreed that a preliminary clarification plant inventory should be completed for each factory and that provided the response warranted it the S.M.R.I. would submit weekly summaries and comments.

This report is intended to provide a basis for further discussion of the project. It outlines the method of approach, describes analytical techniques and discusses the results obtained during the trial period in 1968.

Purpose of the project

The importance to the South African sugar industry of its export markets may be gauged from the fact that during the 1967-8 season some 850,000 tons of crystal sugar were consumed locally while 1,030,000 tons were exported. Although the overseas market has been stabilised by the recent International Sugar Agreement, its competitive nature as well as some criticism of sugar quality by overseas buyers indicate that the level of sugar quality should be raised. The importance of good quality raws to the economy of our own refineries has also to be considered. Efficient clarification is not the only

requirement for the production of high quality sugar. However, since the clear juice is the starting material, its condition must have a marked influence on the sugar produced. Interesting results and improvements in sugar quality have been obtained by the introduction of new clarification processes and the addition of new chemicals to the process but the technological standard at clarification plants leaves room for improvement in many cases. It is in this direction that efficiencies can often be increased by the most economical means. The basic aim of the M.C.P. is to point out sources of inefficiency by comparing clarification data within and among factories and to provide the information necessary for effecting improvements.

Procedure

The following procedure was outlined at the meeting held to consider the new project:

As an introductory move the questionnaire on plant inventory will be sent to all factories for completion. These data will provide a useful basis for assessing the performance data. If the information returned is of sufficient general interest a report will be prepared for the purpose of showing general trends in clarification installations. The information will also be of use in future surveys.

Analyses and performance data on a mean weekly basis will be submitted to the S.M.R.I. on data sheets similar to that in Table 1. The following data will be tabulated:

- (a) **Mixed Juice** — *In order to have a measure of the flow rate for capacity calculations, both the mean tons juice/hr and tons Brix/hr will be recorded each week. Since it is the clear juice which has a direct bearing on the sugar quality only the phosphate and starch contents of mixed juice will be determined. Phosphate content is sometimes a useful guide to the ability of the juice to clarify and starch is required for comparison of various starch removal processes.*
- (b) **Clear Juice** — *Phosphate, calcium plus magnesium, starch, turbidity, bagacillo and suspended matter will be determined on 24-hourly composite samples and recorded as a weighted mean weekly figure. The latter applies also to the phosphate and starch in mixed juice.*
- (c) **pH** — *The pH of the limed juice, clear juice and syrup will be determined hourly at room*

*Present address The Tongaat Sugar Company Limited.

temperature and the results averaged over the week to give the mean weekly figure. The set point of the pH controller will also be tabulated.

- (d) **Control Data** — The stability of pH* and temperature control will be recorded with simple integrating devices which will be made available through the S.M.R.I. at a very low cost. The figure recorded each week will indicate the percentage of total actual operation time for which the value of the controlled variable deviates beyond a certain given range. These instruments will be extremely simple to install and will require no maintenance. They will require a 220V power supply. Operating instructions will be supplied with the instruments.

- (e) **Filter Performance** — Recirculation of mud solids in the filtrate can have an adverse effect on clarification. The filter performance will be assessed by the determination of suspended solids in mud which will also be reported. These analyses will be determined on the same time basis as for clear juice.

- (f) **Filtrate Rate** — This is generally regarded as an important figure especially with respect to mud recirculation. Since we are comparing factories with different dilution characteristics the figure will be reported as undiluted filtrate % mixed juice (i.e. at the concentration of the mud before dilution by wash water. The determination is described in the appendix.

- (g) **Chemical Consumption** — Consumption is frequently expressed as lb/ton cane and this is adequate for a purely monetary assessment. However, at the clarification stage fibre at least has no further bearing and hence the latter rate has no meaning. In order also to eliminate discrepancies arising from differing dilutions it is proposed that lb/ton cane and ppm on Brix in mixed juice be adopted, the former for economic calculations and the latter to provide an insight into the reaction characteristics.

As a further refinement in the case of lime, the quantity should be expressed as available CaO in ppm on Brix in mixed juice — see appendix.

- (h) **Analytical Procedures** — Details of analyses are given in the appendix.

Calculation sheets will be provided on the back of data sheets (Table 2) and these will assist chemists in calculating final data.

Weekly summaries of all data submitted to the S.M.R.I. will be sent to all participants in the project. When interesting conclusions appear these will be reported. The S.M.R.I. staff will be available for discussion in cases where results suggest potentials for improvement.

Data submitted for trial season

In keeping with the M.M.C.P. the trial year of the M.C.P. was by no means spectacular. If this heralds an ultimate accomplishment similar to the M.M.C.P. then pessimism at this stage would be premature. Of the fifteen factories which agreed to participate in the project the following submitted completed plant inventories:

Umfolozi
Amatikulu
Darnall
Glendale
Gledhow
Tonga

In spite of repeated reminders there was no further response and, owing to the information being incomplete, it was not published as had originally been intended.

Of the above six factories only three submitted a significant number of weekly data sheets:

Amatikulu	25	(from 4.8.68 to 18.1.69)
Darnall	32	(from 16.6.68 to 19.1.69)
Tonga	16	(from 14.8.68 to 11.1.69)
Gledhow	1	

and it is rather distressing to note that these included only three of the fourteen factories which manufactured sugar for the export market during the past season. However, the S.M.R.I. is indebted to the management and staff of the three factories who submitted data with admirable regularity and it is hoped that this example will give encouragement to the rest of the industry in the coming season.

Discussion of results

General

Being restricted to three factories the results and hence conclusions are rather limited. Furthermore, all three factories conducted intermittent tests on various methods of starch removal and as a result the clear juice and sugar quality fluctuated abnormally. This is shown clearly in Figure 1. For this reason the average results shown in Table 3 are not necessarily an indication of the normal average performance. Within one particular factory the analytical results were very consistent and it appears that (a) the mean operating conditions of the clarification plant at a factory can be established after several weeks of observation and tabulation of data over a whole season is unlikely to provide any additional information and (b) the exception to this is when changes are deliberately introduced to the process conditions or when cane quality changes. The latter aspects justify tabulation of data over extended periods.

Mixed juice and clear juice quality

From the aspect of starch and phosphate content the quality of mixed juice at all three factories was similar, as shown in table 3. In considering the data for starch in clear juice it must be borne in mind that many changes were made to the starch removal processes and that the clear juice analysis does not indicate the effect of enzyme addition to the evaporator liquors. The effect of the various treatments is shown in Figures 1 and 2. The chemical

*See amendment mentioned under "Control Performance".

dosage levels are indicated in Table 4. It is not considered necessary to comment in detail on this aspect as the subject will be dealt with in a separate paper to be presented at this congress. (See: Jennings, R. P. and Robinson, R. C. S., Clarification Trials at Darnall.) It would appear that the addition of enzymes to the last evaporator effect is an efficient and economic method for degrading starch and reduces the starch analysed in sugar.

It is interesting to note that about 32 per cent. of the starch in mixed juice was degraded after clarification at Amatikulu and this was achieved with no specific retention tanks. At Tongaat 61 per cent. was degraded after 10 min. retention at 65°C and this was reduced to 37 per cent. for a 3 min. retention. No information was available on the percentage degradation by enzymes added to the evaporators since syrup analyses were not tabulated. However the low starch content of corresponding sugars indicates that high efficiencies were attained. It would appear that for future investigation attention should be focused on syrup analysis rather than on clear juice.

The performance of flocculation and settling (flotation) as indicated by turbidity and suspended matter in clear juice is shown in Table 3. Unfortunately the turbidity measurement was not consistent but the suspended matter results showed a somewhat higher level at Darnall. It appears that the clarifier capacity at this factory is lower than that of the others, particularly when the flotation process is applied, since the small residual mud solids do not warrant higher retention. As a result of the higher suspended solids in juice the suspended matter in raw sugar from this factory was at times higher and the filterability lower than for the other two factories, in spite of a low starch and gum content — see Table 5. As this factory is a major producer of export sugar corrective action would appear to be necessary.

Control performance

This aspect was not investigated very thoroughly since a universally applicable pH stability monitor could not be made at a reasonable cost and only one temperature stability recorder was constructed for testing. The latter behaved adequately but due to the excellent control at Darnall showed a consistent 100 per cent stability. Owing to the importance of this variable, the temperature of treated juice before flashing, it is strongly suggested that all factories be equipped with these instruments.

In future it is suggested that all factories submit at least two pH control charts each week for inspection and visual grading. An absolute performance figure is not regarded as essential. The mean pH values for various process streams for the three reporting factories are shown in Table 6. The wide discrepancy between the treated juice and controller set point at Tongaat would appear to warrant investigation. The pH of the syrup at Tongaat seems rather low at 6.4 and this may be the cause of the increase in reducing sugar ratio from clear juice to syrup as shown in Table 7. However the magnitude is rather low and requires further investigation before any definite conclusion can be stated.

Performance of filters

Information on filter performance is presented in Table 8. Although all three factories showed good mud solids compaction the retention of the filters at Tongaat was rather low. An investigation was conducted by the S.M.R.I. and although several suggestions were made it was evident that corrective action would be required during the off crop period. The sucrose in cake was rather high at both Darnall and Tongaat. However, it must be borne in mind that repeated changes to the clarification process could have contributed to filtration difficulties.

Conclusions

Due to the limited response by factories during the initial trial season few conclusions could be drawn. However it has been amply demonstrated that the efficiency of clarification has an important bearing on sugar quality. Carry-over of suspended matter in the clear juice results in an increase in the suspended matter in sugar and some evidence has been presented to show that this can reduce the filterability of an otherwise good quality sugar. The reduction of starch in clear juice or syrup by various processes effects a definite reduction of this impurity in the sugar. The addition of certain enzymes to the evaporator liquor appears to be particularly effective in this respect. By facilitating comparison of results among a number of factories several technological inefficiencies have been pointed out. The value of conducting an investigation such as the M.C.P. on a more extensive basis has been borne out and it is hoped that all factories will submit data during the coming season.

Acknowledgements

Thanks are due to the personnel of the factories discussed in this paper for their co-operation and to the management of these factories for permission to publish data.

Appendix

Sampling and frequency of analysis

Daily composite samples of mixed juice, clarified juice, mud and filtrate may be prepared using mercuric chloride as preservative. These daily samples are analysed for:

- Bagacillo (in clarified juice)
- Suspended matter (clarified juice)
- Phosphate (mixed and clarified juice)
- Starch (mixed and clarified juice)
- Calcium and magnesium (in clarified juice)
- Suspended matter (in mud)
- Retention by rotary filters.

Turbidity of clarified juice is measured on catch samples taken once every four hours. pH shall be determined hourly on catch samples of limed juice, clarified juice and syrup.

Turbidity of clarified juice

The absorption of the clarified juice is measured in a 1 cm cell in a spectrophotometer or absorptiometer at 700 mμ. If the instrument has not got a wavelength selector the appropriate filter should be used. Instead of reading against water the blank

cell should be filled with a sample of the clarified juice which has been filtered over kieselguhr. This allows the reading to be corrected for colour present in the juice.

The result is given as the absorptiometer reading.

Suspended matter in clarified juice

Weigh 100 g of the clarified juice into centrifuge cups and spin for 30 minutes at about 1,500 g. Decant the supernatant juice and redisperse the solids in a volume of distilled water approximately equal to the original volume of juice. Centrifuge again as above. Decant the supernatant. Dry and weigh the residue.

Weight of residue in grams = Suspended matter % juice.

Bagacillo in clarified juice

Pour 1,000 g of well mixed clarified juice through a 200 mesh tared screen. Wash the bagacillo particles retained on the screen with water. Dry the screen + bagacillo, cool in a desiccator and weigh.

Bagacillo % clarified juice = Wt. dried bagacillo/10

Calcium and Magnesium in clarified juice

Calcium and magnesium together are determined by the method given in the Laboratory Manual for South African Sugar Factories, Chapter VII, 9.

pH of limed juice, clarified juice and syrup

Hourly catch samples of the limed juice, clarified juice and syrup should be taken to the laboratory and cooled to room temperature before measuring the pH. The syrup sample is not diluted. The electrodes should remain in the syrup until a constant reading is obtained, usually at least 15 minutes.

Ortho phosphate in mixed or clarified juice

The method for analysis of ortho phosphate in mixed or clarified juice involves reaction of the phosphate with ammonium molybdate to form phosphomolybdic acid which is then reduced to molybdenum blue. From the intensity of the blue colour of the solution the quantity of phosphate present is determined.

Details of the method are given in the Laboratory Manual for S.A. Sugar Factories (pages 46 and 65). Since the reducing solution recommended in the Manual must be stored under refrigeration it may be necessary in some laboratories to use a reducing agent which may be stored at room temperature. In this event we should suggest using stannous chloride.

Preparation of Stannous Chloride solution

Dissolve 5.26 gm pure tin in 25 ml concentrated HCl and store in a stoppered dark bottle. Solution of tin in HCl is rather slow and should be left for several hours. This solution may be kept up to six weeks.

For use dilute 1 ml of the concentrated stannous chloride solution in 332 ml water and use immediately.

Procedure

Filter the clarified or mixed juice prior to carrying out the determination. The volume of juice taken for colour development must be such that a suitable colour intensity is obtained. The required aliquot of juice is pipetted into a 100 ml volumetric flask,

the solution diluted to approximately 60 ml with distilled water and then 20 ml of ammonium molybdate solution pipetted into the flask followed by 10 ml of the reducing solution recommended in the Laboratory Manual, or 5 ml of the diluted stannous chloride solution, after which it is made to volume.

When using stannous chloride the colour intensity should be read between 4 and 20 minutes after addition of the reducing solution, but it must be read after exactly 15 minutes when 1-amino-2-naphthol-4-sulphonic acid is used.

A blank determination should be carried out under conditions similar to those used for development of the colour but excluding the ammonium molybdate. The concentration of P_2O_5 corresponding to this reading is subtracted from that obtained in the determination.

Attention is drawn to the fact that the intensity of colour produced is dependent on the reducing agent employed. Care should be taken that analyses are carried out under conditions identical to those used when preparing the calibration curve.

Express the result as mg P_2O_5 per litre juice.

Determination of retention by rotary filters and suspended solids in mud

The following analyses are required:

Brix % filtrate

Brix % filter feed

Mud solids % filtrate

Mud solids % filter feed.

Centrifuge a portion of the filter feed (mud before bagacillo addition) and filtrate and determine the brix on the clear supernatant.

100 g filtrate is placed in a tared centrifuge bottle and centrifuged. The supernatant is discarded and the residue redispersed twice with water. The residue is dried and weighed.

The weight of residue in grams is equal to the percentage of mud solids in filtrate.

The sample of filter feed should be taken preferably before the point of addition of the bagacillo used as a filter aid. If, however, this is not possible the bagacillo must be removed by wet screening prior to carrying out the determination:

100 g of sample are taken and washed on a 100 mesh screen until no trace of mud is left in the bagacillo. The washings are made up to 2,000 grams and a 250 g aliquot is transferred to a weighed centrifuge bottle and the mud washed as described above.

% mud solids in filter feed = (wt of residue x 8)

% retention =

$$100 - \left(\frac{\text{mud solids \% filtrate}}{\text{mud solids \% filter feed}} \times \frac{\text{brix filter feed}}{\text{brix filtrate}} \times 100 \right)$$

N.B. To obtain reliable data it is essential that the samples are continuously and effectively agitated when subsampling.

The determination of starch in juice

Reagents

ethyl alcohol (absolute)

kieselguhr (filter aid — acid washed white)

35% aqueous solution of $CaCl_2$ (flakes used)

2N acetic acid solution

10% potassium iodide solution (freshly prepared)

0.01N potassium iodate solution (0.3567 g/litre)

80% alcohol prepared by dilution of 95% alcohol with water.

The starch must firstly be precipitated by the addition of alcohol. After filtering and washing the precipitate, the starch is re-dissolved by boiling with calcium chloride solution.

Procedure

Determine and record the brix of the juice.

Shake well and quickly weigh out 25 g of juice into a 250 ml beaker, add 100 ml alcohol, 2 g kieselguhr and stir. Allow to stand for one hour. Filter through a No. 5 Whatman filter paper previously prepared with 2 g kieselguhr. Wash with 80% alcohol followed by absolute alcohol. The absolute alcohol dissolves out co-precipitated wax which, if not removed, will often result in turbid liquors when colour is developed.

Transfer the filter cake to the beaker, discard the filter paper and add 40 ml calcium chloride solution. Cover with a watch glass and boil gently for 15 minutes to dissolve the starch. Cool and transfer to a 100 ml volumetric flask. After making to volume, add a further 1.7 ml water to correct for the volume of kieselguhr. Separate the kieselguhr by centrifuging.

Pipette 10 ml of the clear supernatant liquid into a 50 ml volumetric flask. Add about 10 ml water, 2.5 ml of 2N acetic acid, 0.5 ml 10% potassium iodide solution and 5 ml 0.01N potassium iodate. Make to volume with water and measure the colour intensity within 2 minutes at 600m μ in a 1 cm cell. It is necessary to run a blank if the solution used for colour development appears turbid. The concentration of starch is found by comparing the spectrophotometer reading with the calibration curve obtained using pure starch. Express the final result in ppm starch on brix.

The result obtained is affected by variations in the amylose-amylopectin ratio in the starch sample used for the calibration curve. The calibration graph should be drawn using Baker's soluble starch.

Available CaO in lime

Reagents

7.5 Brix aqueous refined sugar solution made just alkaline to phenolphthalein with calcium saccharate

N/10 hydrochloric acid

Phenolphthalein solution.

The subsample of lime for analysis should be ground in an agate mortar so that it will pass a 200 mesh Tyler sieve. Weigh out 2.00 grams lime sample and agitate in a sealed container with 1 litre of the 7.5 Brix sugar solution for 4 hours at room temperature. The volume of the container should be only slightly more than 1 litre and agitation should be effected by end over end shaking.

A "blank" sample in which sugar solution without lime added is also run.

After the shaking is complete the sample is allowed to stand, overnight if necessary, to obtain a clear supernatant. 50 ml of supernatant is titrated vs 0.1N HCl using phenolphthalein as indicator and with a minimum of shaking. The "blank" titration should not exceed 5 ml 0.1N HCl per litre of sugar solution.

% available CaO in lime = $\frac{(\text{Titre} - \text{blank titre}) \times 2.804}{\text{ml 0.1N HCl required for 50 ml sugar solution}}$

Undiluted filtrate % mixed juice

The amount of filtrate should be determined by direct measurement. If this is not immediately possible data may be obtained in the interim by determining a pol balance over the mixed juice, filtrate and (mixed juice + filtrate) streams.

These analyses should be carried out once every shift on catch samples (not on the 24 hours composite samples).

From the pol analyses:

$$\text{Filtrate \% mixed juice} = \frac{100(\text{Pol \% m.j.} - \text{Pol \% (m.j. + filtr.)})}{\text{Pol \% (m.j. + filtr.)} - \text{Pol \% filtr.}}$$

$$\text{Undiluted filtrate \% mixed juice} = \frac{\text{Filtr. \% m.j.} \times \text{Bx \% filtr.}}{\text{Brix \% filter feed}}$$

TABLE 1
Specimen data sheet to be completed for each factory
SUGAR MILLING RESEARCH INSTITUTE
WEEKLY DATA SHEET
MUTUAL CLARIFICATION PROJECT

Week ending	Factory
Mixed Juice	
1. Tons juice/hr .. .. .	.....
2. Tons Brix/hr .. .. .	.....
3. P ₂ O ₅ ppm on juice .. .. .	.....
4. Starch ppm on Brix .. .. .	.....
Clear Juice	
4. P ₂ O ₅ ppm on juice .. .. .	.....
5. Ca (+ Mg) ppm on juice .. .. .	.....
6. Starch ppm on Bx .. .. .	.....
7. Turbidity .. .. .	.....
8. Suspended matter % clear juice .. .. .	.....
9. Bagacillo % clear juice .. .. .	.....
pH at Room Temperature	
10. Treated juice ex last control .. .. .	.....
11. Set point of last control .. .. .	.....
12. Clear juice .. .. .	.....
13. Syrup (undiluted) .. .. .	.....
Control Efficiency	
14. Temp. stability efficiency % .. .. .	.....
15. pH stability efficiency % .. .. .	.....
Filters	
16. % susp. solids in mud .. .. .	.....
17. Retention of filters .. .. .	.....
18. Undiluted filtrate % mixed juice .. .. .	.....
Chemical Consumption	
19. lb lime/ton cane .. .. .	.....
20. ppm available CaO on Bx in m.j. .. .. .	.....
21. lb phosphate/ton cane .. .. .	.....
22. ppm phosphate on Bx in m.j. and type chemical .. .. .	.....
23. lb sulphur/ton cane .. .. .	.....
24. ppm S on Bx in m.j. .. .. .	.....
25. ppm flocculant in m.j. .. .. .	.....
26. ppm flocculant on Bx in m.j. .. .. .	.....
27. Type of polyelectrolyte .. .. .	.....
Remarks—(Note changes to data in preliminary survey, etc.)	

TABLE 2

Guide to calculations for data submitted weekly

CALCULATIONS

Stability Recorders: (Insert instrument readings to 0.01 hours)

Time	Total Running	Temp. Stable	pH Stable
New reading			
— Previous reading ..	—	—	—
Week (difference) ..			

a b c

$$\begin{aligned} \% \text{ temperature stability} &= 100 \text{ b/a} = \% \\ \% \text{ pH stability} &= 100 \text{ c/a} = \% \end{aligned}$$

Retention:

*Insert lab. figures

$$\begin{aligned} \text{Mud solids \% filtrate} &= \text{a}^* \\ \text{Mud solids \% filter feed} &= \text{b}^* \\ &= \text{c} \\ \text{Brix filter feed} &= \text{d}^* \\ \text{Brix filtrate} &= \text{e}^* \\ &\text{d/e} = \text{f} \\ 100 \times \text{c} \times \text{f} &= \text{g} \\ \text{Retention} = 100 - \text{g} &= \% \end{aligned}$$

Undiluted Filtrate % Mixed Juice:

*Insert lab. figures

$$\begin{aligned} \text{Pol \% mixed juice} &= \text{a}^* \\ \text{Pol \% mixed juice + filtrate (mixed)} &= \text{b}^* \\ \text{Pol \% filtrate} &= \text{c}^* \\ &\text{a} - \text{b} = \text{d} \\ &\text{b} - \text{c} = \text{e} \\ \text{Filtrate \% mixed juice, 100 d/e} &= \text{f} \\ \text{Brix \% filtrate} &= \text{g} \\ \text{Brix \% filter feed} &= \text{h} \\ &\text{f} \times \text{g} = \text{i} \\ \text{Undiluted filtrate \% mixed juice, i/h} &= \% \end{aligned}$$

TABLE 3

Average Analysis of Mixed and Clear Juices
(Up to 31.12.68)

	Amatikulu	Darnall	Tongaat
Mixed Juice:			
P ₂ O ₅ ppm	174	202	220
Starch ppm/brix	2043	1872	1922
Purity	83.8	83.5	83.5
Clear Juice:			
Purity	85.5	86.4	85.0
Starch ppm/brix	1383	701	997
P ₂ O ₅ ppm/juice	37	25	32
Ca(+Mg) ppm	655	570	677
Turbidity	0.235†	0.294†	73.2%*
Suspended Matter % ..	0.019	0.041	0.017

*Kopke.

†Photometer.

TABLE 4

Average Amounts of Chemicals Consumed

	Amatikulu	Darnall	Tongaat
Chemical Consumption:			
Lb lime/ton cane	0.95	1.31	1.11
Ppm flocculant on mixed juice	None	6.0	None
Lb phosphate/ton cane ..	None	0.50	None
		Rabe	
		0.14	
		S.S.P.*	
Ppm enzyme on mixed juice†	4.8	4.1	4.4

*Split stream process.

†Mean dosage for test periods.

TABLE 5

Effect of Suspended Matter on Filterability of Sugar

	AK		DL		TS	
	U	A	U	A	U	A
Starch, ppm ..	365	270	205	120	200	135
Gums, ppm ..	—	1600	—	950	—	1000
Suspended matter, % ..	0.010	—	0.045	—	0.030	—
Filterability, C.S.R. % ..	20.4	37.3	10.5	32.0	16.4	38.5

U=unaffinated.

A=affinated.

TABLE 6

Data on Mean pH Control

	AK	DL	ST
Treated juice ex last controller	8.17	8.10	7.91
Set point of last controller	—	8.10	7.10
Clear juice	7.43	7.44	7.30
Syrup	6.62	6.73	6.41

TABLE 7

Mean Reducing Sugar Content of Juices

	AK	DL	TS
Reducing sugar % sucrose, mixed juice	3.59	3.85	4.83
Reducing sugar % sucrose, clear juice	3.28	3.69	4.49
Reducing sugar % sucrose, syrup ..	2.93	3.62	4.53
Difference from clear juice to syrup	-0.35	-0.07	+0.04

TABLE 8

Filter Station Performance (Average figures 1968)

	Amatikulu	Darnall	Tongaat
% suspended solids in muds	5.00	4.95	5.60
Retention	72.7	89.3	53.5
Undiluted filtrate % mixed juice	25.5	20.9	17.2
Filter cake % cane	5.02	5.24	4.20
Sucrose % filter cake ..	1.42	2.03	2.16

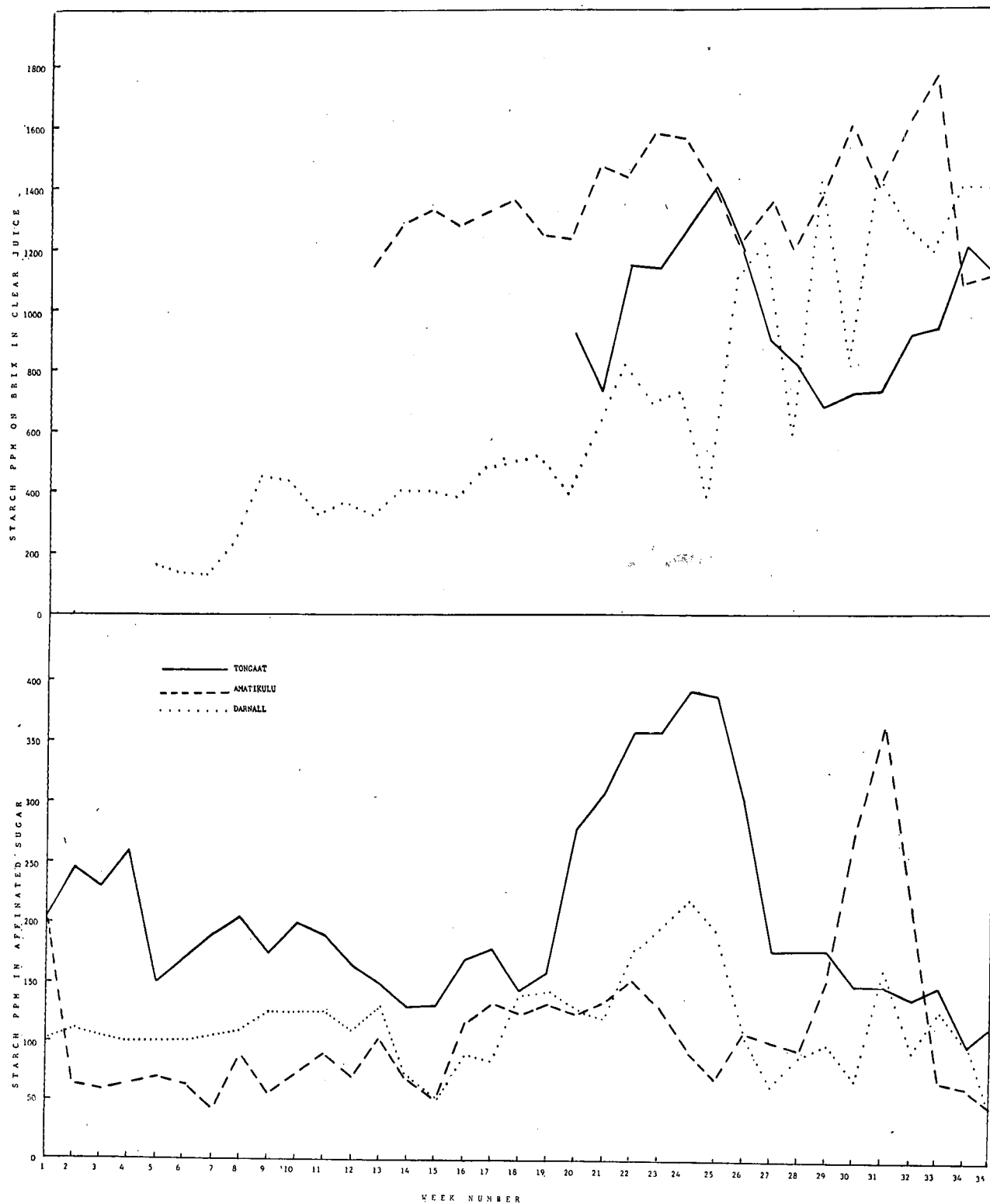


FIGURE 1: Starch content of affinated sugar and clear juice at Tongaat, Amatikulu and Darnall.

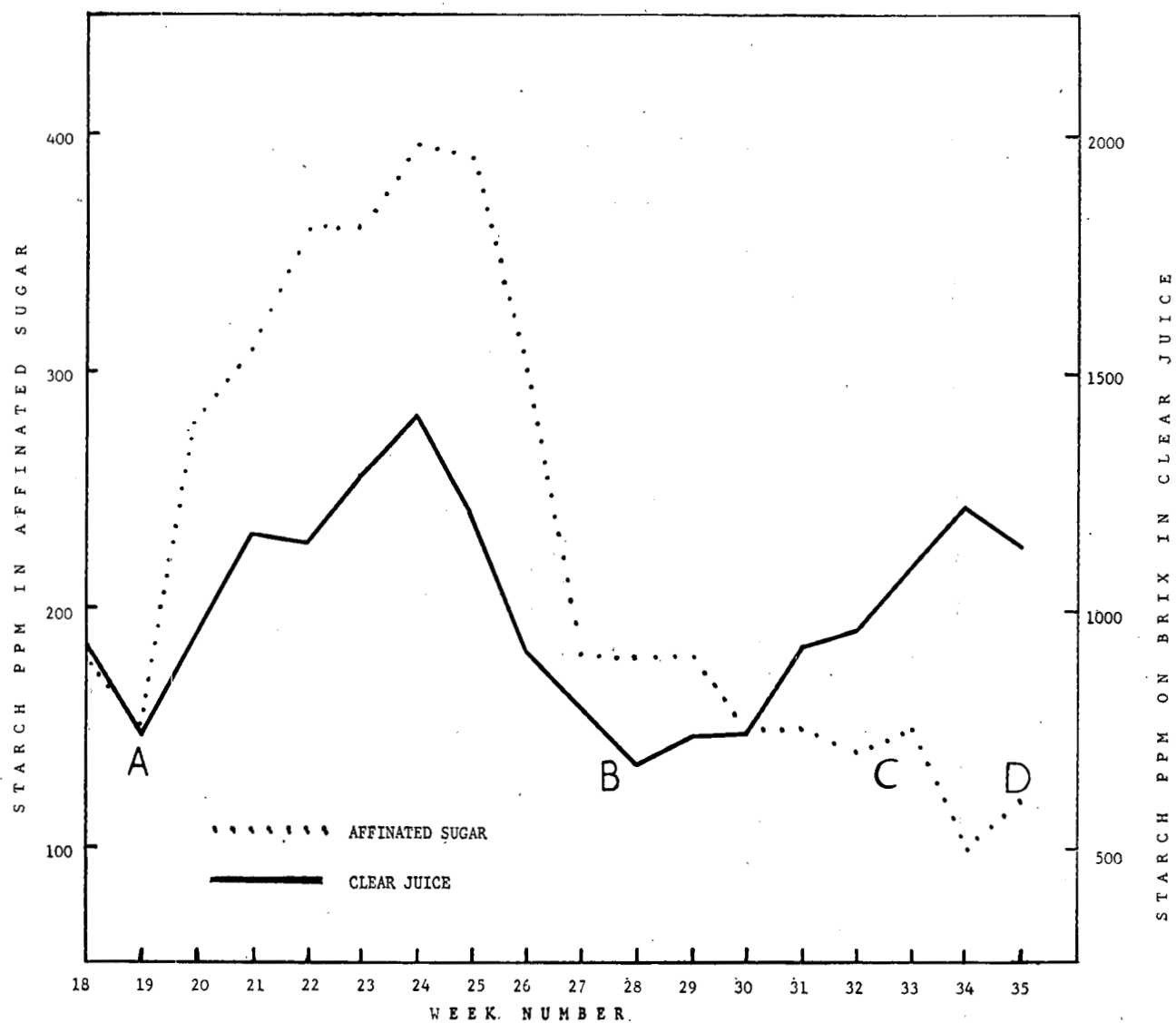


FIGURE 2: Starch content of clear juice and affinated sugar at Tongaat.

Starch removal processes: AB — Natural enzyme process — 3-minute retention time.

BC — Natural enzyme process — 10-minute retention time.

CD — Bactamyl added to evaporators.

Discussion

Mr. Gunn (in the chair): The inventory given to the S.M.R.I. by Tongaat for this project is already out of date and I suggest a member of the S.M.R.I. staff visit all factories in order to obtain new inventories.

Mr. Alexander: I think I can say that next season all the Hulett mills will participate in this project.

Mr. Robinson: When Darnall was using the same process as Amatikulu for starch reduction our starch reduction across the clarifiers was 29%.

In Table 8 the filter retention for Darnall is shown as 89.3%. With the Rabe process it was 93 but with simple defecation it dropped to about 75.

We are not sure why the former retention was so high although we think that last year it was due to the coagulant added to stabilise the Rabe mud.

Dr. Preen: I think averaging of data, as we did with the Mutual Diffusion Project, limits its effectiveness. Our computer analysis of the Mutual Diffusion project data was not successful.

Mr. Buchanan: You should not have attempted to apply sophisticated techniques for analysing Mutual Diffusion Data.

The earlier M.M.C.P. data had insufficient spread to give a sensible statistical analysis and in view of this experience the clarification project is not intended to be a particularly sophisticated operation.

Dr. Matic: Despite the meagre results we had it was decided to present this paper because it was possible to pinpoint a few mistakes in factories. We thought that by disclosing this at a meeting of technologists the value of the project could be demonstrated and more factories would contribute.

We are not looking for sophisticated answers but are trying to uncover gross errors in factories.

Dr. Preen: I agree that factories can be compared with each other and that gross errors will be disclosed. But by using the same data and recording it differently more sophisticated information can be obtained.

Mr. Buchanan: If we analysed less frequently on a routine basis and factory laboratories were organised on more sophisticated lines, more information would be readily available to us.

It is difficult enough to persuade a factory chemist to carry out one more analysis and still more difficult to get him to change his processes also.

The problem is not insurmountable and Dr. Preen's approach would give us more information, but I think in trying to do too much too soon we would have received even less support than we have in just trying to scratch the surface.

If Dr. Preen has some practical ideas to overcome our difficulties we will be very pleased to hear them.

Mr. Jennings: I appreciate the problems of collecting information but I think Dr. Preen's suggestions are sound. They have the further merit that if you are getting data from two factories only, there are only two possibilities. Either one factory is compared with the other or with itself. If you have data that is averaged too much then you cannot compare a factory with itself, but if the figures are obtained from controlled runs then the comparison can be made.

Mr. Robinson: Figures are available for week to week comparisons of clarification operations. There are also daily records kept which would provide a certain amount of information.

Dr. Matic: We had ambitious ideas for this project but when it was discussed with factory representatives we realised that we would have to moderate our demands.

One object of presenting this paper was to get new ideas which could be incorporated in the project. Dr. Preen's suggestions will certainly be considered.

Mr. Buchanan: We are not trying to resist a sophisticated investigation, but as is pointed out in the paper, this project is a means of pinpointing gross anomalies in the operation of clarification stations.

For example, in Table I, we find that the suspended matter at Darnall is .04 and is less than .02 at Amatikulu and Tongaat. The matter can be investigated by a team on the spot and then a more sophisticated type of investigation can be conducted. But the S.M.R.I. simply does not have the staff to carry out a sophisticated investigation simultaneously.

This project is only a forerunner for selecting factories where further work will be carried out.

Mr. Gunn: By having our congress so late this year the factories that are now operating have the opportunity to observe changes already in some of the parameters presented here for last season.

Although Mr. Buchanan thinks too many analyses are being done in factories, we have recently considerably increased our analyses at Tongaat, so it should be easier for us to supply the information required for this project.

By supplying information the factories can see their own mistakes without having them pointed out by the S.M.R.I.

Mr. Buchanan: I was referring more to the fact that we need more 'in line' control and not so much running to the laboratory with samples.