

SOME FURTHER REMARKS ON RESULTS OBTAINED WITH THE DEFEICATION PROCESS IN NATAL

By C. VAN DER POL

In the past crushing season a further four mills (Amatikulu, Darnall, Felixton and Umfolozi) have followed Illovo and Tongaat in abandoning the use of sulphur for the production of raw sugars. Hence at the close of the 1955-56 crushing season, 42.48 per cent. of all government grade and raw sugars produced in Natal were obtained from juices clarified by the defecation process.

The advantages of the defecation process over the sulpho-defecation process are many and can briefly be enumerated as follows:

A. Lower production costs due to:

1. Saving in chemicals.
2. Saving in labour.
3. Saving on maintenance of equipment.
4. Increase in capacity of evaporators.

B. Simplicity of the process lending itself to automatic control.

It speaks for itself that, if the above advantages are accompanied by a reduction in efficiency, they will not compensate for a financial loss due to a lower recovery of sucrose from the juice. It is a comparatively simple matter to calculate the amount saved due to lower production costs, but to estimate the magnitude of a gain or loss in efficiency of sucrose recovery due to a change in clarification technique, is not so straight forward.

Factory Performance

The boiling house performance figure is undoubtedly the best figure on which to judge the effect of a change in clarification efficiency, if it can be assumed that the performance of the boiling house as such is only dependent on clarification efficiency. Unfortunately, this is not the case from week to

Factory		May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Final to Date 1955-1956	Final to Date 1953-1954	Final to Date 1954-1955	
		SULPHO-DEFEICATION					DEFEICATION								
AK ...	B.H.P.	98.3	100.1	100.9	99.5	98.0	98.5	98.2	99.1	99.0	—	99.4	97.7	98.7	
	Purity Final Molasses...	37.3	38.3	37.6	38.5	38.4	41.6	42.6	40.7	39.0	—	39.3	37.7	38.9	
	Brix Final Molasses ...	87.4	88.1	88.9	89.2	90.0	87.3	86.8	87.9	87.2	—	88.2	89.6	88.1	
DL ...	B.H.P.	97.2	99.8	98.8	98.5	97.3	96.5	98.5	99.6	99.6	100.4	98.5	96.8	97.3	
	Purity Final Molasses...	37.4	36.9	37.4	38.6	40.7	43.0	41.4	39.9	40.0	39.2	39.4	37.5	37.3	
	Brix Final Molasses ...	89.6	91.2	91.8	91.8	90.21	89.7	89.7	89.2	88.6	89.5	90.2	89.4	90.3	
FX ...	B.H.P.	96.9	98.2	98.7	98.7	99.4	98.9	97.7	97.6	98.1	97.5	98.3	97.9	98.2	
	Purity Final Molasses...	39.6	38.7	38.5	39.2	39.2	38.6	41.4	40.3	40.4	40.3	39.7	38.5	38.8	
	Brix Final Molasses ...	89.1	91.4	93.2	92.7	92.9	92.5	92.4	92.2	91.9	90.5	92.0	90.3	88.4	
UF ...	B.H.P.	—	97.1	99.0	96.8	98.0	97.6	97.4	96.4	95.1	—	97.2	96.9	97.1	
	Purity Final Molasses...	—	38.5	36.9	38.8	38.2	41.4	42.2	41.3	40.2	—	39.7	39.5	38.9	
	Brix Final Molasses ...	—	91.7	93.6	92.8	93.5	91.6	91.2	90.7	90.6	—	91.9	96.5	94.0	
		SULPHO-DEFEICATION													
ZM ...	B.H.P.	98.2	99.0	98.4	97.3	97.1	98.0	97.9	98.0	97.5	95.5	97.8	97.5	97.6	
	Purity Final Molasses...	36.6	37.4	37.5	39.1	38.3	38.8	39.0	37.9	38.5	39.8	38.2	37.1	37.8	
	Brix Final Molasses ...	94.1	94.5	94.7	93.3	93.2	93.8	93.3	94.0	93.7	92.0	93.7	93.8	95.0	
MV ...	B.H.P.	91.5	98.5	99.9	99.2	97.3	96.8	98.0	97.5	96.9	97.1	97.8	96.1	97.9	
	Purity Final Molasses...	40.5	38.5	37.5	38.0	41.3	43.3	41.2	40.7	40.2	40.6	40.2	42.0	39.7	
	Brix Final Molasses ...	87.7	87.2	87.6	88.0	85.9	85.4	86.8	87.0	86.9	87.9	86.9	85.5	88.2	
UK ...	B.H.P.	—	97.0	98.0	98.0	98.9	97.5	95.0	—	—	—	98.0	97.5	99.2	
	Purity Final Molasses...	—	38.0	37.3	36.0	38.1	41.1	41.2	—	—	—	38.3	40.2	38.5	
	Brix Final Molasses ...	—	92.1	91.0	92.1	91.4	89.9	90.3	—	—	—	91.1	91.2	92.7	

week due to varying undetermined losses, occasional mishaps, etc., but over a relatively long period of time the boiling house performance can be assumed to be a direct function of clarification efficiency.

The purity of final molasses, although being influenced by variables other than clarification efficiency to an even greater extent than the boiling house performance figure, is also a valuable guide to factory performance.

In the above table the boiling house performance, final molasses purity and brix of final molasses for the four "new" defecation factories as well as for the three remaining sulpho-defecation raw sugar factories, are collected. The monthly figures have been taken in an attempt to even out fluctuation due to factors not dependent on clarification efficiency and the sulpho-defecation factories have been included in case there is a natural seasonal variation in performance efficiency. The vertical dark lines separate the periods sulpho-defecation from defecation and in the case of the factories still on sulpho-defecation, are intended to indicate the approximate time at which the change from sulpho-defecation to defecation occurred at the other factories.

A statistical study of the boiling house performance data in the table above shows that there is no significant difference between values obtained before and after the change-over to the defecation process.

The molasses purity figures, on the other hand, do show a significant difference when comparing the periods before and after the change-over to defecation. However, the sulpho-defecation factories also show a small rise in final molasses purity over the latter part of the season and this rise can only be due to a seasonal variation independent of the nature of the clarification process.

Further, there is a significant drop in brix of the final molasses produced after the change-over to defecation in the factories concerned. This, naturally, has an important bearing on the purity of the final molasses. The brix of molasses produced by the sulpho-defecation process did not drop significantly.

Since the increase in defecation molasses purity was not accompanied by a drop in boiling house performance it must be assumed that either the quantity of molasses produced had decreased, due to a better removal of non-sugars from mixed juice, or the nature of the non-sugars in clarified juice changed, affecting the brix as determined by Brix spindle. There is no evidence for a suggestion that the defecation process removes more non-sugars than the sulpho-defecation process. However, there is evidence to show that, for the same dry substance, a sulphitation molasses has a higher brix than a defecation molasses, when measured with a Brix spindle at the same dilution.

This phenomenon has been observed repeatedly in our laboratories when analysing molasses produced by a factory just before and just after the change to the defecation process.

Hence for the same true purity (sucrose per cent. dry substance), a defecation molasses will have a higher gravity purity than a sulphitation molasses. Whereas this fact is somewhat confusing, it affords no evidence for any suggestion that a defecation molasses is less easily exhausted than a sulphitation molasses.

A complete survey of molasses produced by all factories is at present being carried out at the S.M.R.I., and it is hoped that some empirical formula can be established whereby the efficiency of exhaustion of a molasses can be judged, completely independently of its source.

There is hence no evidence to suggest that lower production costs with the defecation process are partly or wholly nullified by a decrease in sucrose recovery from the juices.

Quality of Raw Sugar

The question has been raised recently whether the quality of raw sugars produced by the defecation process is inferior to that produced by the sulphitation process. An answer to this question is somewhat dependent on how one defines the quality of a raw sugar. From the refiners' point of view the following criteria, not necessarily in order of merit, are usually considered to be of importance:

- (1) Keeping quality of the sugar on storage.
- (2) Average grain size and regularity of the grain.
- (3) Filterability of the affined sugar melt.
- (4) Colour of the affined sugar melt.
- (5) Composition of the sugar.

Whereas the above points are, to a certain extent, inter-related, this can be ignored when discussing the difference between sulphitation and defecation raws.

Both points (1) and (2) mentioned above are not dependent on the clarification process used to produce the sugar and will not be discussed further.

(3) Filterability

A number of filtration tests have recently been carried out in the S.M.R.I. laboratories on raw sugars produced by all the factories. Since these tests were not made for the purpose of detecting a possible change in filterability of sugars due to a change in clarification process, no evidence is available to suggest that defecation sugars have poorer filtration properties than sulphitation sugars of the same factory. It is a fact that of the samples

analysed, the defecation sugars did on the whole have a somewhat lower filtration rate than sulphitation sugars. Since this is not in agreement with previous results and also since very large variations in filtration rate of sulphitation sugars from the same factory have been observed for different samples, no conclusion can as yet be reached.

Factory experience at Illovo, when this factory was still refining, did not give any evidence for a deterioration in filtration rate after the change-over to defecation. Hulsar too, although upset by the change in colour of the defecation sugars, were not troubled by a decrease in filtration rate.

Good and bad filtering sugars can apparently result from both the sulpho-defecation process and the defecation process.

(4) Colour

On the whole the colour of raw sugars produced by the sulpho-defecation process is lighter than that

of affinated defecation sugars without any refining operation whatsoever. This affords considerable proof that the specific colouring matter harmful to the refining process is not necessarily present in defecation raws.

(5) Composition

Ash, and in particular calcium salts, are considered to be undesirable components of a raw sugar, since they affect the colour of refinery products and reduce the recovery of sucrose.

Starch, phosphates and silica are suspected of being responsible for at least part of poor filtration properties of some sugars.

The arithmetical averages of the analysis on raw sugars, as recorded monthly in the communications

Factory	Pol.	Moisture per cent.	S.F.	R.S.	Ash per cent.	CaO per cent. Ash	SO ₃ per cent. Ash	A _c * 505	A _c * 560	
<i>Defecation Raw Sugars</i>										
UF	...	98.7	0.468	0.36	0.240	0.438	9.8	21.0	753	524
FX	...	98.7	0.391	0.30	0.376	0.375	16.2	27.0	676	471
AK	...	98.8	0.336	0.29	0.307	0.326	15.2	29.1	879	636
DL	...	98.3	0.544	0.32	0.364	0.472	12.1	22.8	1,144	816
Average	...	98.6	0.439	0.32	0.365	0.396	13.7	25.5	877	623
<i>Sulphitation Raw Sugars</i>										
ZM	...	98.7	0.441	0.33	0.262	0.398	15.2	26.0	495	343
MV	...	98.2	0.626	0.33	0.566	0.445	18.2	28.9	609	459
UK	...	98.4	0.519	0.32	0.593	0.393	17.3	24.0	555	443
Average	...	98.4	0.528	0.33	0.474	0.412	16.9	26.3	553	415

of sugars produced by the defecation process, as is evident from the monthly analysis carried out on raw sugars by the S.M.R.I. This is as expected in view of the well-recognised inhibiting action of sulphur dioxide on colour formation in sugar products. However, the concentration of coloured substance in a refinery melt is of less importance than the presence of certain specific coloured compounds.

Illovo succeeded in producing a mill white sugar of quality better than average, by straight remelting

of the S.M.R.I., are recorded here for the months October to January inclusive for the factories indicated.

Whereas the average composition of the defecation sugars is better than the average composition of the sulphitation sugars considered, this has no statistical significance due to the relatively large variation in composition within the two groups. It can hence only be concluded that the composition (as analysed for) of defecation sugars is no different from sulphitation sugars, except for colouring matter.

To check on the possibility of a significant effect of the change in clarification technique on the quality of the sugars for individual factories, the data on ash per cent. sugar, CaO per cent. ash and SO₃ per cent. ash were analysed for the period before and after the change in clarification process. In the following table the results are summarised for the factories indicated. The data listed under the sulpho-defecation factories pertain to the

Unfortunately, neither starch, phosphate nor silica were part of the routine analysis of raw sugars during the past season. A number of sugar samples have lately been analysed for these constituents at the S.M.R.I., in connection with filtration work. Results obtained so far do not indicate that either the starch content or the silica content of defecation sugars is necessarily higher than that of sulphitation sugars. There is a tendency for the phosphate

Factories	UF	DEFECATION				SULPHO-DEFECATION		
		DL	FX	AK	ZM	MV	UK	
<i>Average Ash per cent. Sugar</i>								
Before Change	...	0.523	0.402	0.383	0.363	0.433	0.395	0.339
After Change	...	0.438	0.467	0.348	0.326	0.429	0.428	0.355
Difference	...	+0.085	-0.065	+0.035	+0.037	+0.004	-0.033	+0.016
<i>Average CaO per cent. Ash</i>								
Before Change	...	10.8	16.9	21.3	17.5	13.0	14.0	15.8
After Change	...	9.8	12.4	15.9	15.2	14.2	17.7	16.5
Difference	...	+1.0	+4.5	+5.4	+2.3	-1.2	-3.7	-0.7
<i>Average SO₃ per cent. Ash</i>								
Before Change	...	16.9	27.1	33.3	26.5	24.2	26.3	23.7
After Change	...	21.0	22.2	27.8	29.1	24.3	27.7	24.2
Difference	...	-4.1	+4.9	+5.5	-2.6	-0.1	-1.4	-0.5

periods before and after the end of September and are included to check on seasonal variations.

A statistical analysis of the significance of the difference showed that the change in ash per cent. sugar is in all cases not significant for the factories that changed to the defecation process.

The reduction in CaO per cent. ash is significant for DL and FX, and the increase in CaO per cent. ash for MV during the period in question is also significant. If one can conclude from the data on the sulpho-defecation factories that there is a tendency for the CaO per cent. ash to increase in the latter half of the season, the decrease in CaO per cent. ash as observed after the change-over to the defecation process becomes even more significant.

Both the increase in SO₃ per cent. ash at UF and the decrease in SO₃ per cent. ash at DL are statistically significant. Since no additional SO₃ could have been introduced in juices at UF during the defecation period, the increase in SO₃ per cent. ash in their defecation sugars is difficult to explain, and is most probably due to factors not associated with the clarification process.

content to be higher, i.e. 20 ppm. for defecation sugars and 5 ppm. for sulphitation sugars are average values obtained for the samples analysed.

Particular attention has been given to starch in sugars since South African sugars contain such a high proportion of this impurity. Laboratory investigations have shown a somewhat better removal of starch from mixed juice by the defecation process. Factory investigations have shown that 80 per cent. of the starch in mixed juice enters the clarified juice with the sulpho-defecation process. Unfortunately similar results are not available for the defecation process, but it is clear that if the defecation process permitted even more starch to enter the clarified juice (for which no theoretical or practical evidence exists) that this could have but little effect on the starch content of sugar.

Some idea of the large variation in starch content of the different raw sugars from various factories can be obtained from the following table in which the average starch content, as well as the upper and lower limit between which the average occurred, are collected for the 1954-55 season.

Starch Content of 1954-55 Raw Sugars

Factory	Average	Upper Limit	Lower Limit
UF ...	457 ppm.	570 ppm.	330 ppm.
ZM ...	386 "	790 "	230 "
FX ...	274 "	390 "	190 "
EN ...	819 "	1,100 "	540 "
AK ...	361 "	490 "	230 "
DK ...	420 "	520 "	370 "
DL ...	364 "	480 "	230 "
GL ...	632 "	850 "	480 "
MV ...	414 "	590 "	190 "
CK ...	440 "	One Sample Only	
TS ...	755 "	1,050 ppm.	300 ppm.
NE ...	390 "	One Sample Only	
IL ...	378 "	580 ppm.	290 ppm.
RN ...	641 "	740 "	540 "
SZ ...	560 "	700 "	440 "
UK ...	450 "	600 "	260 "

It can hence be concluded that, from the point of view of raw sugar quality also, there is little difference between the two clarification processes, except for the colour of the raw sugars. It must, however, be remembered that the sulpho-defecation process is essentially a white sugar process, in which the colour of the product is of greater importance than in the production of raw sugars.

General

It is indeed very gratifying that the results obtained after a very short experience with the defecation process already compare favourably with the results obtained by the sulpho-defecation process, which has been in use in Natal for many years.

It would be erroneous to conclude from this that there is no room for improvements in the defecation process as applied in many factories. pH control in particular is open to serious criticism in a number of cases. It has been noticed by a number of factories that a serious discrepancy exists between the pH of the various juices as measured by the glass electrode pH meter and by a certain brand of indicator paper. The paper reading is invariably lower than the meter reading, the difference sometimes being as much as one pH unit. Since this difference is not constant, it becomes rather a difficult task for the juice preparer to know to which colour he has to lime to obtain the desired pH value. There is no

doubt that continuous operation with automatic liming by electrometric pH control is a far more satisfactory way of controlling the clarification process.

Liming of the muds before filtration has found favour in a number of factories. Since the chemical reactions involved in the precipitation of calcium phosphate are not instantaneous, the pH of juices containing the phosphate precipitate, i.e. the muds, will drop when such juices are kept in contact with the precipitate for a prolonged time at an elevated temperature. On further liming of the muds it is quite possible that further non-sugars can be precipitated. Provided the liming of muds is not carried to above pH8, little harm can be done. However, if the pH is allowed to reach values of 9 or higher, two very undesirable reactions take place:

- (1) Destruction of reducing sugars.
- (2) Irreversible re-solution of some precipitated non-sugars.

Although maximum removal of non-sugars at the filters is of great importance in efficient clarification, it is extremely doubtful whether the supposed small advantage gained by liming muds is balanced by the above-mentioned serious disadvantages.

In conclusion it may be mentioned that one factory in particular, i.e. Darnall, has benefited considerably from the defecation process in an indirect way. Increased capacity of the evaporator station, due to reduced scaling of evaporator tubes, has enabled Darnall to increase the maceration from about 200 per cent. on fibre to nearly 300 per cent. on fibre. Whereas it is not suggested that this is the only factor responsible for raising its extraction from being one of the lowest in the industry to one of the highest, it cannot be denied that the benefits of the defecation process have been exploited to the full at this factory.

Summary

Results obtained by the factories that changed from the sulpho-defecation process to the defecation process during the past season, have been studied from two aspects:

- (1) Sucrose recovery.
- (2) Quality of raw sugar.

It is concluded that sucrose recovery did not suffer by the change and that the quality of defecation raw sugars is comparable to sulphitation raws.

Acknowledgment

The author wishes to express his gratitude to Mr. J. B. Alexander of the S.M.R.I., for permitting him to quote freely from his unpublished work on factors influencing the quality of raw sugars.

Mr. J. Rault, in the Chair, stated that Mr. Boyes was Research Chemist to the Tongaat Sugar Co., a new position marking a progressive step in the appreciation of technical control in our leading sugar firms.

The works chemist fully engaged in the day to day production control could hardly spare the time and the staff for research. He was now being helped by a very precious collaborator, with more leisure and training to solve on the spot local problems, more slowly investigated by research stations.

The paper referred to a very topical subject, i.e. the successful working of the simple defecation process adapted to our South African conditions and at one specific factory.

Dr. van der Pol's contribution on the same subject, covered more ground, and was a study of the average results of six factories, lately gone over to the simple and more economical liming process, after years of previous experience with the more exacting sulphitation process. One notable improvement was claimed for the defecation treatment, namely the decrease of evaporation scaling—a feature which should allow for heavier water application at the mills and the filters, with a consequent rise in overall recovery.

Mr. Boyes having been asked to explain the meaning of fractional liming double heating, said that this was a technique first introduced in 1936 by Mr. J. Davies, then a lecturer at the Imperial College of Tropical Agriculture. The idea was to add an initial dose of lime to the cold mixed juice to give a pH of about 6.2. This was sufficient to prevent inversion and also near to the isoelectric point of the juice facilitating colloid removal. The juice was then heated to 200° F followed by the addition of the balance of the lime. A second heating was necessary to bring the temperature to 220° F. Thus the lime was added in two fractions and the heating carried out in two stages.

Mr. A. D. Elysee said that changing from sulphitation to simple defecation led to no decrease in boiling house recovery, although the juice looked very poor. There was a considerable amount of work still to be done to improve results obtained from simple defecation. The colour of the juice was not satisfactory. Amatikulu factory had just started, and he had never seen such dirty looking juice come out of clarification.

Mr. Boyes stated that he had visited 15 overseas factories recently and in every case they used the simple defecation process. The processes used were either cold liming or double liming with single heating. The juices obtained in these factories were brilliant, and probably better than sulphitation juices in South Africa. He considered one reason for their getting such satisfactory juices was the

cleanliness of the cane. These overseas factories seemed to have to deal with much less mud than we did in South Africa. He said that overseas they had made a study of the subject and took into account all departments of the clarification process. It took a long time to develop the sulpho-defecation process in South Africa, and he considered we still had a lot to learn about the defecation process. Possibly, when we knew more about this process, we might one day be able to produce juices comparable with those obtained overseas.

Mr. Elysee said that here quite a lot of work was done on the quantity and quality of bagacillo used in the filters, but he thought that if one could get 90 per cent retention of mud we would get clear juices. In his opinion, the Oliver filter was a machine which took in thick mud and finally delivered thin mud.

Mr. Alexander said that he was not quite sure what Davies meant by "organic silica" but that at the S.M.R.I. they had been unable to find evidence of silica organically combined. The silica in a clear clarified juice was entirely of a soluble form originating from three sources namely: that from chemicals used (i.e. lime), that silica which was originally insoluble in the mixed juice and that which was soluble in the mixed juice. The mixed juice was usually nearly saturated with respect to soluble silica but with increase of temperature and pH silica deposited as silic acid on cell walls etc. was made soluble.

Mr. Thumann said that in past years he obtained, as a general rule, very good juice with the sulpho-defecation process. At the beginning of the last season they had experienced difficulty, presumably due to the mud on the cane, and also to lack of bagacillo available.

With extensive experimentation as far as temperatures were concerned, no improvement was found.

With the change-over to simple defecation, there appeared to be no difference in clarity of juice.

He thought that as far as Umfolozi factory was concerned, until they got a normal season, it would be difficult to reach any conclusion as to the best method of treating juice.

Mr. Boyes considered that by studying the best methods of applying simple defecation in this country, a big improvement in the clarity of the juices would be obtained, although they would not probably be equal to those in other countries. He thought we should follow the basic principles of the processes used elsewhere.

Mr. Thumann said that in India, when they crushed one variety of cane, Co.419, and used simple defecation, the clarity of the juice there was as good as that obtained with sulpho-defecation in South

Africa. At one factory in India, however, very dark clarified juices were obtained in the 1950 Season. He considered that this was due to very high pH of juice following liming and prior to sulphitation. By reducing the high pH at this stage, an immediate improvement in clarity of juice was observed. He found that testing the pH by means of colour paper was not at all reliable when preliminary to a high pH. The reason for production of the poor juice at that factory, therefore, would appear to be too high an alkalinity and too high temperatures for too long a time.

Mr. Phipson said that on comparing colour papers with the pH meter, he found that in the case of sulphitation test papers gave a much better comparable figure than they did with simple defecation. He found big differences between the pH shown by the test papers and the pH meter and he also found similar differences on water.

Mr. Antonowitz was of the opinion that if one wanted to get good results from test papers, one would have to make sure that they were treated at the particular pH range required.

Mr. Elysee said that the performance of the test papers in sulpho-defecation and simple defecation was different, due to the different buffer action in the juice itself.

As far as P_2O_5 tests were concerned, he found a big difference between results obtained on hourly tests, as compared with eight-hourly periods. He found that if the solution was left for a long time before testing, a very much higher figure for P_2O_5 resulted. He wondered if there should be a specified time limit for these tests.

Mr. Boyes replied that he had found a very great variation in P_2O_5 content hour by hour. This he attributed to variation in the cane. He quoted figures from his paper to illustrate this. He had not found that on standing, juice P_2O_5 tests changed. He had noticed however that the diluted stannous chloride reducing agent was only stable for four hours and wondered if this was causing the trouble.

Dr. van der Pol said that as far as test papers were concerned, he thought that colloidal matter might affect the pH indicated. It had been suggested that the colour of the juice might affect the colour given by the paper.

He asked Mr. Boyes if, from his experience overseas, he would tell the Meeting the method of determining pH and to what extent automatic pH control was used.

Mr. Boyes replied that he had observed pH control in a number of factories. In two factories, one using a Kent pH recorder-controller, the other a Bristol, very fluctuating results were being obtained. Both these factories were cold liming and attempted to control the pH at about 8.6. In the first it fluctuated

8.0 and 9.5 and in the second between 6.0 and 9.0. These unsatisfactory results may not have been due to the pH meters concerned and may have been the result of a faulty hook-up. In a third factory a pH recorder was working very satisfactorily. This was a Beckman pH meter with Foxboro recorder, recording the pH of limed juice prior to entering the subsiders. Special glass electrodes recording at a temperature of 100° C and giving three months' service were being used. The chart showed a straight line.

The Chairman asked what was the experience at Illovo with automatic liming by pH control for the defecation process.

Mr. C. L. Wagner stated that, provided the flow of juice remained constant, one could get good results, working to 8.5 pH.

Mr. Rault stated that with reference to scaling and the rate of heat transmission, he considered that very useful data could be published in the Annual Summary by the S.M.R.I., i.e. "the lbs. of water evaporated per sq. ft. per hr."

He wondered why so few factories brought the thick syrup to a Brix density of 60° and over, specially after being told of the improvement in incrustation through the defecation process.

In his factory working with the carbonation process and realising an evaporative rate of 8.2 to 8.5 lbs. per sq. ft. per hr., the least amount of cloudy liquor from the filters going to the evaporator caused an immediate drop in evaporation rate, prejudicial to the subsequent rate of pan boiling speed—a department which was always overloaded by remelting and refining operations.

Dr. van der Pol considered that the figure suggested by Mr. Rault was not a very useful one, as evaporation depended upon a number of factors, such as Brix of the syrup, etc.

As far as scaling of evaporators was concerned, he said that Dr. Honig had found that the suspended matter in the juice had led to cleaner evaporators. Apart from this, the big reason why one could expect less scaling when using simple defecation was because there were fewer lime salts in the clarified juice.

As far as the dirtiness of the juice was concerned, he was careful to avoid saying that a dirty juice could produce a very good sugar.

Tests done at the S.M.R.I., removing starch and silica, had indicated that quite a lot of the silica was bound up with the fine particles of fibre and also as the starch in the mixed juice was insoluble, they had found that by centrifuging juices prior to clarification they obtained clearer juices.

He also remarked upon the fact that even in the past, using sulpho-defecation, when the appearance

of the juice was very good as compared with simple defecation, the filter-ability of the sugar was not necessarily of a high standard. Indeed, there appeared to have been no deterioration by using simple defecation.

Mr. D. C. Ross remarked that experience in the West Indies showed that when clarification was poor, overall recovery was not appreciably effected, and raw sugars polarised at about 97.5°. However, after these sugars had been stored in the sugar store for about two months, and then shipped to the U.K., test results received back, showed a fall in polarisation to somewhere in the region of 93.5°-94°. Could, therefore this be traced back to bad clarification?

Mr. Antonowitz said that in East Africa there were periods where the sugar was of very poor quality due to poor clarification and this sugar deteriorated readily.

Mr. Carter enquired as to what type of pump was used overseas in handling treated juice so as to preserve the floc.

Mr. Boyes said that in the procedure of double liming single heating, the juice first received the initial lime and was then pumped by a centrifugal pump through the heaters and into the flash tank. The flash tank was so situated above the subsidisers that the juice was able to gravitate through the liming device, fluctuating tanks and into the subsidisers.

In one factory a reciprocating pump was used. This was of such a capacity as to give a very slow operating speed. The juice was pumped slowly through the heaters and only heated to 212° F so that little turbulence occurred in the flash tank. In this way floc break-up was reduced.

Mr. Hardy enquired what efforts were made overseas to avoid choking the filter screens when liming muds.

Mr. Boyes replied that he found overseas that liming was very common practice. Towards the end of last Season they did find a falling off in filtration at Tongaat. On opening up the screens he found a white deposit which could have been lime. However a black deposit, which he took to be wax, was far more predominant. A modification of practice might avoid this.

Mr. du Toit asked what was the P_2O_5 content of mixed juice overseas, and how it compared with ours here.

Mr. Boyes stated that he considered the figures here to be higher than those he had seen overseas.

The Chairman asked Mr. Perk or Dr. van der Pol for the reason why factories on going over to simple defecation shewed a higher purity of final molasses. Could this be an indication of inability to exhaust

through the presence of some refractory non-sugar, and was this a real increase of sucrose lost in molasses?

He considered that the sucrose lost per cent of the sucrose in juice, was more important than the mere expression of the degree of purity of molasses, a figure affected by the influence of certain non-sugars on the Brix hydrometer, as well as the method of dilution for analysis.

The loss in molasses was as much affected by the quantity of molasses produced.

Dr. van der Pol said that every Chemist, where simple defecation had been introduced, was worried about the purity of molasses, for otherwise the only method of judging the loss was to wait until the end of the week.

Mr. Antonowitz said that he had tested Brix by distillation and he found a big difference as compared with the Brix hydrometer. He had tried this out with both sulphitation molasses and simple defecation molasses and he found the same results in each case.

Dr. van der Pol said that similar tests had been carried out at the S.M.R.I., where it was found that the difference in purity between true purity and apparent purity was less in the case of simple defecation molasses.

Mr. Thumann enquired that since the purity of simple defecation molasses was apparently higher, what would be the effect on the boiling house performance? Was the value of the boiling house performance figure affected by the higher purities found?

Mr. Perk replying to the query by Mr. Thumann about the effect of the final molasses purity on the boiling house performance figure, said that the molasses purity only affected the calculation of the crystal content of the sugar. In the case of white sugar the influence was therefore negligible. The same could be said in the case of raw sugar when the difference in purity of the final molasses was small. For example, in the case of a raw sugar of 98.50° (Safety Factor 0.25) the crystal content would be 97.90, when the molasses purity was 40.0 and 97.92 when the purity is 39.0. The B.H.P. changed proportionally to the crystal percentage or as 97.90 to 97.92 which was not significant.

Mr. Alexander asked Mr. Boyes if he had actually analysed the deposit on the screens or if he had just assumed it was wax.

Mr. Boyes replied that no analysis was made.

Mr. Hardy said he had tried to steam the screens, without success.

Mr. Elysee said that for years they had found that when the reducing sugars in the juice rose, the quantity of molasses increased, and, at the same time, the purity of the molasses decreased.

He remarked that if there were a higher amount of salts in the molasses, they would increase the Brix unduly. With simple defecation and less salts being present, the Brix spindle gave a nearer assessment of the total solids.

Dr. van der Pol agreed with Mr. Elysee's point.

The Chairman stated that with further study of the various impurities in the juice, a great advance in clarification could be expected.

Visual judgment of the quality of the juice was obviously not an infallible criterion. He however admitted that the raw juice of much cleaner appearance that he had observed in other countries, and even in South Africa, when cleaner canes were sent to the factories, did give a superior clarified juice, easier to process in the factory.