Report of Committee on Clarification and Filtration.

The following report on the above subject was read by Mr. J. Rault.

In continuation of the statistics and comments issued in 1927, the above Committee reports the following features as representing the latest innovations in the practice of Clarification and Filtration in South African Factories.

1. Peck strainers are now used in eight factories as against three in 1927.

2. Heating the raw juice to about 140° F. before treatment with chemicals is the accepted practice in the majority of the leading factories. This treatment is justified by a quicker settling, a brighter decanted juice, easier filtration and highre rise in purity from mixed juice to clear juice, and also improved boiling and curing.

3. The amount of chemicals used for tempering is increasing year by year as shown in the reports of three typical factories covering the past seven years.

Mill No.	lbs. Lime used per Ton of Cane. Year 1922.	1923.	1924.	1925.	1926.	1927.	1928.
4	4.5	5.2	5.8	6.4	9.8	8.5	9.5
7	4.0	5.0	5.7	8.2	8.5	8.8	9.4
12	3.2	—	—	5.2	4.2	6.9	8.3

The pounds of lime used per ton of cane varies on an average from 7 to 9 lbs. as against 3½ to 5 lbs. a few years ago.

The raw juice is sulphited to an average of 2 grams sulphur dioxide per litre of juice, with even a maximum of 3.35 grams in one mill reputed for its superior clarification.

Phosphoric acid, whether for raw or white sugar manufacture, is an indispensable chemical used to the extent of 0.8 to 2 lbs. per ton of cane.

Items Nos. 2 and 3 show a tendency for clarifying methods to follow along the lines of the very successful carbonatation process. They also indicate a general opinion that improvement in Uba juice treatment is to be realised by an energetic physical action at definite temperatures with excess of clarifying material.

4. Clarification by lime and phosphoric acid, with the exclusion of sulphur, has been found impracticable and has now been discontinued in the mills that tried the process in 1926.

5. As a method of clarification the Petree process is only used in so far as the separation of juices and continuous settling is concerned.

Elimination of the filter presses with return of muds on the mills is no longer the practice. Satisfactory determination of the sucrose in cane and increased reliability of chemical control have both benefitted by this modification of the process.

6. Contrary to the ideas of the Petree Process, more importance is being attached to the filtration department, as it is realised that over 2 per cent. of the sugar in the juice is lost in the cake.

Attempts are being made to reduce this loss as evidenced by the gradually diminishing sucrose content of the scum cake during the past two years.

	1926.	1927.	1928.
Sucrose % Cake	6.46	5.41	5.15

Higher dilutions of the muddy juice and double pressing are being attempted.

7. Self-discharging rotary vacuum filters are being tried with varying success on sulphitation scums.

The " Mauss " patented filter of the above type is very favourably reported on by the factory using the carbonatation process.

A battery of eight of these filters has been in constant use on the filtration of the first carbonatation muddy juice at this factory. The advantages claimed for the machine in comparison with the plate and frame filter are economy in labour and cloth, cleanliness and decreased sugar losses.

These filters work at their best on thickened sludge and should not be considered as filters of high juice capacity, but rather as sludge dryers and sugar recuperators.

8. The working qualities of the raw sugars sent to the refinery have improved to a marked extent in comparison with those of the 1926 and previous seasons.

In a report by Farnell, published in the "International Sugar Journal," the average recovery from sucrose in juice for the 1924 season was given as 78 for the white sugar mills of South Africa.

The average recovery figure of all the factories for the past two seasons has now gone up to 83.01 and 83.90 respectively.

Although a larger percentage of cargo sugars is now manufactured than was the case a few years ago, this reason cannot explain entirely the remarkable advance in the recovery figures of the industry. On the past season's output, this improvement corresponds to an additional 21,000 tons of sugar (in round figures) which would have been lost at the old efficiency, and which are now a profit to the industry, due to higher recovery from the same amount of sucrose in juice.

There is a general opinion that one of the principal factors contributing to this progress is improvement in clarification methods.

Improved clarification will diminish the unknown losses and also allow a systematic pan boiling to produce its maximum effect.

Other conditions being equal, the recovery from juice varies as the difference between the initial purity of the juice and the final molasses purity. To increase this difference two methods are possible: (1) Raising the purity of the juice going to the boiling house, and (2) Lowering the purity of final molasses. Of the two methods the most promising is the first.

The first method is mainly a clarification technique which by removal of non-sugars may indirectly help to render the second method possible.

Examples taken from the yearly laboratory records will bear out our opinion in a clearer way.

Factory No. 1 by a superior clarification raises its purity of juice from 83.49 to 88.9 before it enters the boiling house, and consequently increases the availability (S.J.M. Formula) of the sugar dissolved in this juice from 84.11 to 89.97, i.e., 5.86 per cent. without in any way attempting to reduce further the purity of molasses.

On the other hand, had Factory No. 8, with the highest purity final molasses, succeeded in bringing down the purity of its final molasses to the low figure obtained by Factory No. 6 with the best record (42.3), this drop of purity in molasses would have raised the availability of the sugar dissolved in juice from 86.49 to 90.20, i.e., 3.71 per cent. if no improvement had been given to the initial juice purity.

We see from the above calculations that 1° purity improvement in juice is equivalent to 1.1% increase in possible recovery as against 0.6% for 1° improvement in final molasses.

This lengthy argument is to emphasize the importance of the purity rise obtained during clarification. This figure in the case of the sulphitation mills for the 1928 season has fluctuated from — .4 to + 4.0.

It is interesting to show in the following table of actual results obtained in a factory with comparative yearly statements how the purity of juice has a marked influence on molasses formation, sugar losses and recovery:—

Year	Mixed Juice Purity	Weight of Molasses per cent. Cane	Purity Molasses	Sugar in Molasses per cent. Sugar in Cane	Undetermined Losses per cent. Sugar in Cane	Sucrose Recovery from Juice
1925	85.01	2.46	40.97	7.12	4.67	86.29
1926	84.47	2.65	41.32	7.65	4.91	85.20
1927	84.00	2.83	43.56	8.04	5.43	84.80
1928	83.49	3.37	43.48	9.54	5.28	83.65

RECOMMENDATIONS.

The Committee records with satisfaction that the control of clarification by the hydrogen ion method is almost universally adopted in South African Sugar Factories.

As an increase in the lime salts during clarification is to be deprecated, the adoption of the soap test as carried out in beet factories is recommended as a general routine. The Committee also recommends the use of the Salinometer or other similar apparatus for ash determination by the electric conductivity method. (The two latter recommendations have also been embodied in the Chemical Control Committee Report.)

Although it was felt that a colloid determination apparatus would be highly desirable for clarification control, the Committee does not feel justified in adopting just yet the new apparatus placed on the market, both on account of cost and lack of local experience with same.

The same applies to instruments advertised in view of automatically controlling the hydrogen ion concentration of juices in the factory.

RESEARCH INVESTIGATION.

A certain amount of original research has been carried out by individual workers on the nature of the mineral matter in juice and its behaviour during clarification, but this work is not advanced far enough to form the subject of a paper.

As an interesting contribution on the causes of difficulties met with in the Uba juice treatment, Mr. Feuilherade is presenting a valuable paper on Starch in Uba juice.

Mr. Dymond in two papers is also bringing forward new ideas both on the cause and solution of the troubles encountered in Uba juice treatment.

Mr. Draeger, in his paper on Phosphoric Content and Clarification, is adding to the store of knowledge being gradually accumulated towards the final solution of the "Key Problem" of the South African Sugar Industry.

A Sub-Committee appointed to investigate on the sulphur dioxide content of sugars is publishing its findings in a separate report.

JOS. RAULT, Convenor.

Committee on Clarification and Filtration:—

W. H. FOSTER.
J. BIJOUX.
C. MARTINDALE.
M. VIGER.
J. RAULT.

Chairman: This is an excellent summary of recent progress in clarification work in factories, and opens up a great many interesting matters for comment and discussion.

Mr. Feuilherade: I would like to know how it is possible to lower the purity of the final molasses as mentioned.

Mr. Rault: It was inferred that the removal of non-sugars changes the physical nature of the juice, giving you a much better working quality and indirectly, therefore, helps you in the boiling to bring down your molasses to a lower purity.

Mr. Dymond: Have you examined the relationship between these rises in purity up to 4% with the amounts of chemicals used?

Mr. Rault: On examining the figures of all sulphitation mills there does not seem to be a strict correlation; I think the factory that had the greatest rise is not the factory that used the highest amount of chemical, but if we compare different processes such as the carbonatation factory with the factories which use the sulphitation process and the smallest amount of chemical we certainly did think that by using a high amount of chemicals we would have a bigger rise in purity.

Dr. Hedley: We don't hear anything about the Oliver filter. Are you in a position to say anything about it? The Mauss has been tried only at No. 1 Factory. Has it been tried in sulphitation so that you can compare the results as against the Oliver?

Mr. Rault: I understand it has been tried in Sezela Sugar Factory but I am not in a position to give any results. There may be somebody here who can give you that information. The Mauss filter was tried at the Ottawa Factory about three years ago ,also at Chaka's Kraal, so that there are three factories using the sulphitation process which have used the Mauss filter.

Mr. Pougnet: It has been tried at Sezela and seems to be quite satisfactory, but I can't give any definite figures.

Mr. Bechard: Is this rise a consequence of having shortened the period of sampling?

Mr. Rault: We take for granted that all the analyses are done in the correct way and that careless work is not practiced.

Mr. Moberly: This paper has an extraordinary amount of useful work in it. We ought to express our thanks to the Committee for the work put in as it does cover a tremendous amount of ground. I move a vote of thanks to the Committee.—(Hear, hear, and applause.)

Discussion on the papers read earlier in the day on "Fibre Percentage on Extraction," and "Determination of Fibre in Cane."

Dr. Hedley: Is there any reason why in place of the three apparati that have been chosen for this extraction of fibre that you don't use a Soxhlet?

Mr. Bechard: A Soxhlet would probably do it very well. We came to the conclusion that we should use cold water and not hot water so as not to extract the gums.

Chairman: The ordinary Soxhlet apparatus is only suitable for use with volatile solvents, and even where extracting with alcohol it presents certain difficulties and has to be lagged to guard against air condensation. But it might be possible to use some form of percolator.

Mr. Moberly: There is a particular point to be considered here; in a Soxhlet you are trying to get all that you extract into a small volume, as it is the extract you are after. In this case we are trying to clear a very bulky substance of slight traces of certain other matter and a large quantity of solvent is required, which involves the main difficulty. The conditions are not exactly the same.

Dr. Hedley: My reason for suggesting a Soxhlet device was previous experience in the extraction of wattle. Certainly there the extract was required, but we also wanted to know the fibre. We used a litre of water in the boiling vessel and we kept returning this over the wattle bark. We wanted to know more or less the fibre content of the bark from various plantations; also we lagged our soxhlets, which did not present very great difficulty.

Mr. Dymond: Surely this is a step backward to have all these apparati described here. There is no necessity for doing this at all. We have Mr. Bechard's and I have done some as well. I can guarantee you can do a fibre under ten minutes. Why all this discussion? We have sufficient proof that you can do it. There is another point in this paper on the Determination of Fibre. It says on page 1 that sixteen sticks should be taken at random. I consider the sampling of cane is a very specialised sort of job. (Hear, hear.) It is not a random job. There is another point on page 2, "Method of applying Results." Where do you get that Java ratio?

Mr. Moberly: That is found according to the method described. (Refers to paper.) I may say that with regard to taking 16 sticks at random what I meant was that the sixteen sticks taken should not be selected,and to work this method out and get a larger sample and consequently sub-sample gives you a proportion of each of those sticks which have been selected. The sticks should be taken all along the carrier

Mr. Rault: Don't you fear that all this question of fibre testing will always meet against a brick wall, in this way? In a truck of cane which weighs 25 tons say, you know that a cane stick may weigh one pound. You have say 50,000 sticks of cane in the truck; what number are you going to take which you will be sure will be an average sample of the 50,000. It will be very difficult. There will be a lot of different opinions as to the representative nature of the sample you take.

Mr. Moberly: That difficulty has certainly been before our minds very strongly; for that reason we did not decide definitely upon the sampling of cane, and the sampling of bagasse may be done as an alternative method so that both could be experimented on. We considered 16 sticks as about the largest sample that could be conveniently handled. If it was possible to take 30 or 40 and make your subsample from that it would be better probably, but it would be rather bulky. We took 16 as being more easily subdivisable, and you could carry out the sampling with greater accuracy. The fibre adjustments finally are made on the weekly returns, and therefore you have several samples representing your fibre percentage of cane at the end of the week. Except in a few cases where a man sends in only one sample a week he is not dependent on the test.

Mr. Rault: We suggest a number of tests to be carried during the next season, and to have several tests on one truck to test if there is any variation.

Mr. Moberly: I think that is a very good idea and should be carried out.

Mr. Dymond: In Australia they do fibre determination but they don't burn cane. The burning of cane in this country is the trouble in sampling cane. In Australia when a certain block is going to be cut they go through that field before it is cut and determine the fibre of that block. Out here you could do the same if you did not burn it. You cannot go to a field of any particular planter and determine the fibre in the field because of the fire factor which causes such big variations in fibre.

Mr. Bechard: We quite expected a lot of criticism on the question of sampling of cane. We knew we were tackling a very big problem. At the same time I don't agree that cane cannot be sampled for fibre. It is possible with sufficient experience to sample cane satisfactorily. There is one problem, however, which is baulking us, that is how to represent the quantity of adhering trash.

Chairman: The difficulty in sampling cane is admittedly so great that it seems to me that the other alternative mentioned by the Committee is the lesser of the two evils, that is sampling the last of the bagasse. With regard to the determination of fibre I would like to know whether the committee have any information regarding the methods used in other countries. As Mr. Dymond points out the determination of fibre by sampling and pressing a portion of the cane is so easy compared with any lixiviation method, that it leaves one to wonder why it has not been adopted in countries like Hawaii and Australia where they apparently still use the lixiviator.

Mr. Moberly: I don't think I know of any methods in actual use other than the lixiviation method as mentioned by both Spencer and Deerr in their analytical methods.

Mr. McRae: I would like to say something in support of Mr. Rault's contention. At the Experiment Station we have had rather a wide experience in sampling cane. In all our experiments it has been necessary to take hand samples of cane and do our analyses on the hand samples. In the burning versus trashing experiments it has been necessary to take a small portion of burnt standing cane and sample that every two days. The great variations we found in the fibre content in the one small field section were remarkable. Then regarding these lixiviation apparati I should like to know whether any of these have been actually tried by the committee.

Mr. Moberly: No, they have not.

Mr. McRae: At the Experiment Station we had occasion to try compressing bagasse with a view to lixiviation and we found both in the case of the pressure from a small press to bigger pressures with a lever, that the bagasse remained at a reduced volume after relieving the pressure; it did not go back to its original volume. In any apparatus like this there ought to be some arrangement for teasing it out again to get proper circulation. The third apparatus which Mr. Moberly has suggested seems really the most feasible.

Dr. Hedley: I would give Mr. Bechard a chance this year to show how easy it is to sample cane. I have done mill tests and have done two samples side by side and they have varied up to 5% in indicating the work the mills have done, that is, by taking the sucrose. I was hoping to-morrow night Mr. Moberly might be able to tell us something about sampling cane. I am rather in a quandary because we want to do these tests this year.

Mr. Bechard: Perhaps Mr. Booth can tell us a little about cane sampling, he has had very wide experience of that.

Chairman: With regard to what Mr. McRae has just mentioned, during last year's proceedings Mr. Booth inquired why, in the series of experiments of cane burning, on the first day the fibre % was 19.2, and on the fourth day it was 15.9 from the same field of cane; and we had to admit that although we had taken the best care in sampling it was an experimental error that we could not account for. It illustrates the difficulty in sampling, especially for fibre.

Mr. Moberly: The Committee is not at all satisfied that cane can be adequately sampled for fibre determination, but it outlines a way in which sampling can be conducted for trial. It is true that the determination in Australia is not done on separate consignments but on the fields, and uniform fibres are taken to represent certain ages of certain fields, but the method is still based on the selection of sticks from the larger whole. We hope to find out this year whether that is anywhere close enough.

Chairman: I think we ought to accord our hearty thanks to Mr. Bechard and the Fibre Committee for the work that has been done. (Loud applause.)