

PRE-CLARIFICATION AND THE ION EXCHANGE PROCESS

By G. C. DYMOND.

The introduction of the ion exchange process into sugar manufacture brings with it many new problems and several interesting possibilities.

Pre-clarification methods, filtration problems, water requirements, chemicals and effluent disposal; manufacturing technique and recovery of by-products, constitute the major issues.

The following notes deal with pre-clarification and in particular describe a new method of cold mixed juice clarification, which is suitable both for ion exchange and for ordinary sugar manufacture.

General.

The best results from the ion-exchange process appear to be bound up with good pre-clarification methods, whereby the highest possible colloid, colour and non-sugar elimination have already been achieved. Thus carbonatation juices give high throughputs and brilliant syrups, whereas cloudy factory raw sugar juices yield syrups cloudy with colloids and colouring matter.

Where efficient pre-clarification is not used, filtration of the resulting syrups will be necessary. Owing to limited experimental facilities no final decision can be made at this stage as to which system, i.e. good pre-clarification or final filtration, is the more practical and economical.

During this investigation, however, on the ion exchange process only pre-clarification methods were considered. Many combinations of the usual heat, lime, phosphoric acid, sulphur dioxide and carbon dioxide treatments were tried out. Of these the standard method of heating to 50°C, liming to 9.6 pH, sulphiting to 8.4 pH and then correcting with lime and phosphoric acid to give a final clarified juice of 7.2 pH, appeared to give the best general results for all kinds of mixed juice.

Nevertheless the syrups from this treatment often contained colloidal matter and in particular colloidal silica.

Drastic changes in technique were then tried out with the object of eliminating as far as possible the "reversible" types of colloids in the variable types of cane juice.

The iso-electric theory of colloid behaviour teaches that different colloids are flocculated at varying reactions. In ordinary sugar practice only alkaline reactions are generally used, resulting in a low elimination of certain types of reversible colloids.

Obviously a number of reactions ranging from high acidity to alkalinity and the elimination of the

flocculated colloids at each point is impracticable. The iso-electric point for the apparent maximum elimination of the reversible colloids was therefore determined and found to be approximately 3.2 pH. The following technique was eventually developed with gratifying results.

New pre-clarification methods.

To the *cold mixed juice* a sufficient quantity of phosphoric acid is added to give a minimum of 0.03 per cent. of phosphoric acid in the juice.

Sulphur dioxide is then passed through until a reaction of 3.2 pH is reached. Liquid sulphur dioxide was used, there being no means of using the ordinary dilute gas employed in factory practice.

A quantity of puddled clay is now added, the amount varying according to the nature of the raw juice and the subsequent procedure. The amount used varied from 20 lbs. to 50 lbs. of dry clay per 1,000 gallons of juice, or from 3.5 to 8 lbs. per ton of cane.

After mixing, there is a variable but generally rapid precipitation of a black slimy precipitate consisting principally of cane wax, gums, pentosans, nitrogen compounds and silica.

The filtration or multiple compound precipitation and dilution of this precipitate constitutes a special problem of its own. Its importance, however, warrants intensive research, for whether the ion exchange process is employed or not, the elimination of these colloids *in the cold*, constitutes an important advance in sugar manufacture.

The supernatant liquid after the above treatment is cloudy with other types of colloids, their intensity depending on the quantity of the original juice and the amount of clay used. Too little clay yields results poor in clarity; too much gives too voluminous a precipitate.

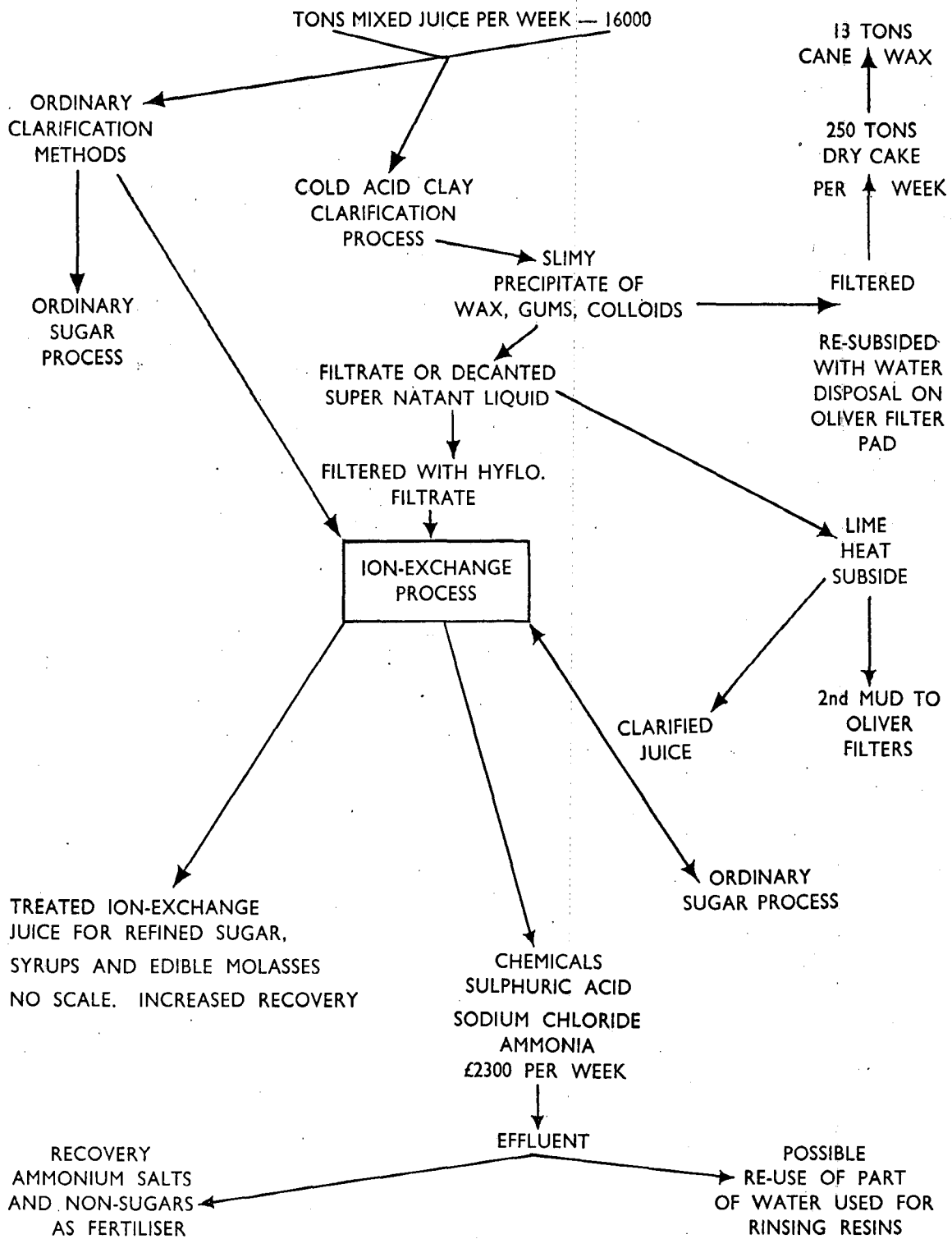
Having reached this point, the process may be continued in two ways. Both are suitable for the ion exchange, but only the second can be used for ordinary sugar practice.

Acid-clay process and the ion exchange.

With the ion exchange process in view, the clarity of the first precipitation is of importance, for this juice must be filtered.

Approximately 0.5 per cent. of the hyffosupercel is sufficient for ordinary plate and frame filtration.

ION-EXCHANGE AND BY-PRODUCTS POSSIBILITIES BASED ON DARNALL FIGURES



The juice is bright and clear, an essential condition for the ion exchange. Since this highly acid juice is cold, little inversion occurs. On passing through the resin beds, the final juices are alkaline. The analytical results are shown below.

Acid clay defecation process.

The following technique may also be used for preparing the juice for the ion exchange, but there appears little to warrant the extra manipulations. For ordinary sugar manufacture, the cloudy juice after the acid-clay treatment is limed to 7.6 pH, heated and settled and the resulting brilliant juice

freed from reversible colloids, is processed in the ordinary way.

No final conclusion has been made as to which is the most practical, economic and most efficient method of pre-clarification for the ionexchange (excluding carbonatation). The acid clay process has, however, many points in its favour, thus no lime is used and heat exchangers become unnecessary.

The following experiments show typical results achieved when using the two methods.

Analytical Results.

The acid clay ion-exchange process.

	Brix.	Pol.	Purity.	Reducing sugars.	Reducing sugars ratio.	pH.	Ash	Ash per cent. brix.
Mixed juice	14.8	12.36	83.5	0.61	4.94	4.9	0.52	3.34
Ion exchange juice	12.4	11.49	92.7	0.67	5.83	7.2	0.03	0.26

Non-sugar removal : 86.0 per cent. on mixed juice.

Ash removal : 94 per cent.

The acid clay defecation ion-exchange process.

	Brix.	Pol.	Purity.	Reducing sugars.	Reducing sugars ratio.	pH.	Ash	Ash per cent. brix.
Mixed juice	13.2	10.98	83.2	0.60	5.46	5.1	0.48	3.46
Clarified juice	13.7	11.37	83.0	0.69	6.07	6.4	0.49	3.39
Ion exchange juice	11.9	10.78	90.6	0.77	7.14	7.1	0.02	0.19

Non-sugar removal: 78.3 per cent. on mixed juice.

Ash removal: 96 per cent.

Remarks.—It will be noted that there is no rise in purity from mixed to clarified juice in the acid clay defecation process. This peculiarity was noted in every case. Mr. S. S. Peck observed the same condition in other clarification experiments, but was unable to give a reason for it. In these and in the general run of ion exchange tests, throughput has been only generally referred to, owing to the difficulty of determining the economic point in varying types of juices. In the case of the acid clay process there appeared to be a definite increase in throughput as compared with sulpho-defecation juices.

The Muds.

The acid clay mud after settling represents approximately 12 per cent. of the juice by volume. The dry solids per cent. cane are 0.42 per cent., or 0.84 per cent. at 50 per cent. moisture.

This means that on a weekly crush of 16,500 tons of cane there will be 69 tons of dry solids or 138 tons of filter cake. The wax content of this dry cake varies from 10 to 30 per cent. due no doubt to the type of cane being crushed. Under the conditions of cold clarification a high grade wax can be re-

covered on extraction with benzene and subsequent fractionation with acetone and alcohol. In the acid-clay defecation process, the second mud approximates in volume to the first mud, so that the total press cake per cent. cane, without reckoning any added bagacillio, would be approximately 1.6 per cent. on cane. It is interesting to note that this mud contains only 1 per cent. of wax, showing that a high percentage is removed by the first precipitate.

The third type of mud is that obtained when the supernatant liquid from the acid clay treatment is filtered with hyflosupercel. With a cloudy juice the percentage of wax in the dry cake is as high as 3.75 per cent. This amount decreased progressively with the clarity of the juice.

Disposal of Muds.

The key to the acid clay process lies in the disposal of the first precipitate. Owing to its valuable wax content, a straight filtration would be most suitable. Without excessive quantities of supercel this is difficult. High speed centrifugal filtration causes a portion of the wax to pass over into the

filtrate leaving only 5 to 6 per cent. in the cake. Progressive dilution and decantation is cumbersome, though this appears the only solution if filtration fails. Thus in the acid-clay defecation process, the second mud is mixed with bagacillio and filtered on the Oliver Campbell filters in the ordinary way. This pack can now be made to act as a filtering pad for the first precipitate by applying it half way around the drum.

The following flow chart illustrates the points outlined in the foregoing speculations. Speculations

that can only be turned into realities by adequate research facilities on a practical scale.

Summary.

A new process of pre-clarification whereby the reversible types of colloids are removed from the cold mixed juice is described.

This process can be combined with the ion exchange process of non-sugar removal or used in ordinary sugar manufacture.

APPENDIX.

The following are records of various clarification treatments on crusher juices. Owing to the volume of the work entailed, the work had to be done in the off-crop when no mixed juices was available.

The object was twofold. First an endeavour to improve upon our existing clarification methods and secondly, to find if possible a simple treatment suitable for the ion exchange process.

The investigation once again demonstrated the complexity of the subject, especially under conditions where it was impossible to obtain samples of a common quality. The results are tabled for record as a basis for future work.

Nos. 1 and 2. Experiment to show the effect if any of preheating green juice to 100°C. and then cooling to 50°C. before chemical treatment.

Juices limed to 9.6 pH. Phosphoric to 7.5 pH. Results inconclusive.

Nos. 3 and 4. Repeat with different chemical treatment. Limed to 9.6 followed by SO₂ to 7.8 in No. 3 and 7.3 in No. 4.

Heating to 50° only gave best result in No. 3 but not in No. 4.

Results inconclusive. Merely show the variations in juices.

No. 5. Juices treated cold and preheated to various temperatures. Lime and sulphur dioxide treatment. Heated to 85°C. only. Settling was very rapid specially with No. 4. No. 1 was cloudy, the others clear but with suspended matter. Purity rises low.

No. 6. This was a repeat of No. 5 with the exception that the juices were boiled. The rate of settling was not so rapid, but still very good.

No. 7. This experiment with immature Uba juice treated with lime, sulphur dioxide and phosphoric acid showed the marked effect of trash on the clarification. No purity rise in either case.

No. 8. This was carried out to find out at what point phosphoric acid should be added. The best results are obtained by adding all the phosphoric last.

No. 9. Replacing part of the SO₂ with CO₂ and without phosphoric acid was compared with the standard treatment of liming to 9.6 sulphiting to 8.4 and adding phosphoric acid to 7.4. The juice is first pre-heated to 50-55°C. and after chemical treatment boiled. In this case there was no rise in purity and while the settling was very rapid in No. 2, the juice was cloudy and the mud very fine in texture.

No. 10. A lime, CO₂ and phosphoric treatment was compared with the standard method. The juice while having slightly less mud and higher rise in purity, was darker than the standard.

No. 11. Various combinations of phosphoric, lime, CO₂ and SO₂ were tried out. No. 1 and 2 showed no appreciable rise in purity. No. 2 treated with CO₂ and SO₂ gave the lowest amount of mud and the best juice after 30 minutes, settling. No. 3 treated with CO₂ and phosphoric gave a higher rise in purity, but more mud and darker coloured juice.

No. 12. This was another series of combinations with the lime applied first. No. 1 with SO₂ only gave the best results with the highest purity and lowest percentage of mud.

No. 13. This experiment was carried out in order to determine the best point for CO₂. No. 1 with CO₂ to 8.3 gave no rise in purity and a cloudy juice. When this point was raised to 8.7 with consequent more SO₂, the juice was good and gave rise of 0.5.

No. 14. In this case the comparison lies in the replacement of phosphoric with CO₂. No. 1 with SO₂ and phosphoric gave rise of 1.3, whilst No. 2 with CO₂ and SO₂ showed no rise. Both juices were very clear.

No. 15. Decreasing amounts of lime with CO_2 and SO_2 showed No. 2 the best. pH with lime 9.6—10. No. 3 gave little mud after settling but the juice was cloudy and the mud fine.

No. 16. Various combinations of lime, SO_2 , CO_2 and phosphoric. All three gave good rises in purity. The ppt in No. 2 was finer than the others. No phosphoric was added in No. 2.

No. 17. This was a comparison between lime and SO_2 and lime and CO_2 . No. 1 gave a rise in purity while No. 2 gave no rise. Both juices were clear. The mud percentage in No. 2 was low.

Conclusions.

The standard treatment preheating to 50°C . then treating with lime to 9.6 pH, SO_2 to 8.4 pH, final tempering with phosphoric acid and boiling to give a clarified juice of 7.4, generally gave good results.

Lime with sulphur only and lime with CO_2 and SO_2 , with or without phosphoric acid also gave encouraging results. With CO_2 only, the muds were of a fine texture.

CLARIFICATION. ALL SMALL MILL CRUSHER SAMPLES. APRIL AND MAY.

Method of Treatment	Brix.	Sucrose	Purity	Quality	Time of settling	Per-centage of mud	pH	Brix.	Sucrose	Purity	Rise in purity											
1. Juice 1. Heated to 50°C. Lime 9.0 pH Phosphoric to 7.8 Boiled	18.0	15.67	87.0	Both clear	15 mins.	34	7.5	18.6	16.33	87.8	0.8											
						52	8.3	19.2	16.90	88.0	1.0											
Jioce 2. Preheated to 100°C. cooled to 50°C. then treated as No. 1 Boiled																						
2. Repeat of No. 2	18.2	15.83	87.0	Very clear	1 hour	72.7	7.3	18.3	16.05	87.7	0.7											
						74.4	7.2	20.2	17.61	87.2	0.2											
3. Juice 1. Heated to 50°C. Lime 9.0 pH, SO ₂ 1.04 pH 7.8. Boiled	16.5	13.96	84.6	Clear	15 mins.	45.4																
					30 mins.	37.5																
					2 hours	28.4	7.3	16.5	14.21	86.1	1.5											
					Rapid settlement	15 mins.	86.4															
					30 mins.	64.8																
					2 hours	36.4	7.9	17.7	15.08	85.2	0.6											
4. Juice 1. Cold. Lime 9.0 pH, SO ₂ to 7.4... ..	16.0	13.29	83.1	Cloudy	15 mins.	79.5																
					30 mins.	78.4																
					1 hour	46.6	7.3	15.9	13.11	82.4	-0.7											
					Clear	15 mins.	93.2															
					30 mins.	47.7																
					1 hour	33.0	7.3	17.0	14.07	82.8	-0.3											
5. Juice 1. Cold	16.3	14.02	86.0	Cloudy	15 mins.	35.2																
					Juice 2. Preheated to 40°C.	30 mins.	25.0															
						60 mins.	20.4	7.3	16.3	14.16	86.9	0.9										
					Juice 3. Preheated to 50°C.	Clear	15 mins.	47.7														
						30 mins.	30.7															
						60 mins.	26.1	7.4	16.3	14.17	86.9	0.9										
					Juice 4. Preheated to 60°C.	Cloudy	15 mins.	40.9														
						30 mins.	26.1															
						60 mins.	21.6	7.4	16.4	14.25	86.9	0.9										
					Lime 9.0 pH, SO ₂ to 7.5. Heated to 85°C. after treatment	Clear	15 mins.	29.5														
						30 mins.	21.6															
						60 mins.	17.0	7.5	16.7	14.41	86.3	0.3										
6. Repeat of No. 5	18.6	16.61	89.3	Settling not so rapid as in No. 5 but all results good.	15 mins.	90.9																
					Juice 1. Cold SO ₂ 1.16	30 mins.	68.2	7.4	18.4	16.58	90.1	0.3										
					Juice 2. Preheated to 50°C. 1.02	15 mins.	53.4															
					Juice 3. Preheated to 60°C. 1.18	30 mins.	40.9	7.4	18.8	16.97	90.3	1.0										
						15 mins.	61.4															
					Juices brought to boil.	30 mins.	40.9	7.5	18.9	17.06	90.3	1.0										
7. Immature Uba Cane	12.5	7.49	59.9	Brilliant	30 mins.	31.1	7.7	12.6	7.50	59.5	-0.4											
												Juice 1. Clean Cane	12.3	6.85	55.7	Cloudy	24.4	7.7	12.4	6.86	55.3	-0.4
												Juice 2. With trash										
Both raised to 55°C. Treated with lime SO ₂ and Phosphoric																						

Method of Treatment	Brix.	Sucrose	Purity	Quality	Time of settling	Per-centage of mud	pH	Brix.	Sucrose	Purity	Rise in purity
8. Juice 1. Lime, SO ₂ , Phosphoric	15.7	12.73	81.1	Very bright	30 mins.	54.4	7.6	15.4	12.77	82.9	1.8
Juice 2. Lime, Phosphoric SO ₂				Clear		71.1	7.6	15.4	12.74	82.7	1.6
Juice 3. Lime Phosphoric SO ₂ Phosphoric				Bright		61.1	7.5	15.6	12.76	81.8	0.7
Lime 9.6 pH No. 3, half Phosphoric at beginning and end (No. 1 now termed standard treatment)											
9. Juice 1. Standard lime SO ₂ Phosphoric as in No. 8... ..	19.6	17.60	89.8	Clear	30 mins.	75	7.5	20.0	17.94	89.7	No rise
Juice 2. Lime CO ₂ to 8.3 SO ₂ to 7.5				Cloudy mud very fine		10	7.5	19.9	17.85	89.7	No rise
10. Juice 1. Standard treatment	17.3	14.69	84.9	Bright	30 mins.	62.2	7.5	17.6	15.01	85.3	0.4
Juice 2. Lime and CO ₂ to 8.3. Phosphoric to 7.5				Darker		53.3	7.6	17.3	14.79	85.5	0.6
11. Juice 1. Phosphoric Lime SO ₂ to 7.5	17.5	15.37	87.8	Clear	30 mins.	57.8	7.1	17.6	15.48	88.0	0.2
Juice 2. Phosphoric Lime CO ₂ and SO ₂ to 7.5				Very bright		38.9	7.1	17.6	15.48	88.0	0.2
Juice 3. Phosphoric Lime CO ₂ Phosphoric to 7.5... ..				Clear		61.1	7.7	17.5	15.51	88.6	0.8
12. Juice 1. Lime and SO ₂ to 7.4	16.1	13.26	82.4	Bright best result	30 mins.	31.1	7.4	16.0	13.42	83.9	1.5
Juice 2. Lime Phosphoric SO ₂ and Phosphoric to 7.4... ..				Bright		47.8	7.4	16.1	13.43	83.4	1.0
Juice 3. Lime, Phosphoric CO ₂ , SO ₂ and Phosphoric to 7.4				Bright		60.0	7.4	16.0	13.40	83.8	1.4
13. Juice 1. Lime CO ₂ to 8.3, SO ₂ to 7.4	20.1	18.50	92.0	Dark cloudy	30 mins.	27.3	7.4	20.6	19.14	91.8	-0.2
Juice 2. Lime CO ₂ to 8.6 SO ₂ to 7.4				Bright		31.8	7.4	20.7	18.91	92.5	0.5
14. Juice 1. Lime SO ₂ and Phosphoric to 7.3	16.1	13.51	83.9	Very clear juice	30 mins.	44.4	7.3	16.1	13.71	85.2	1.3
Juice 2. Lime CO ₂ and SO ₂ to 7.3				Very clear juice		44.4	7.3	16.4	13.75	83.8	-0.1
15. Decreasing amounts of Lime with CO ₂ and SO ₂											
Juice 1. 30cc 11 Be Lime	16.5	13.97	84.7	Clear	30 mins.	40.0	7.2	17.0	14.31	84.2	-0.5
Juice 2. 20cc 11 Be Lime				Clear		31.1	7.1	17.0	14.37	84.5	-0.2
Juice 3. 15cc 11 Be Lime				Not so clear very fine ppt.		13.3	7.0	17.6	14.78	84.0	-0.7
16. Juice 1. Lime SO ₂ 7.5 Phosphoric 7.2	15.7	12.79	81.5	Clear	30 mins.	46.7	7.0	16.0	13.27	82.9	1.4
Juice 2. Lime CO ₂ 8.4 SO ₂ 7.2				Clear		44.4	7.2	15.9	13.22	83.1	1.6
Juice 3. Lime CO ₂ 8.4 SO ₂ 7.5 Phosphoric 7.2				Clear		45.3	7.1	16.0	13.32	83.2	1.7
17. Juice 1. Phosphoric Lime and SO ₂ to 7.2	18.5	16.88	91.2	Clear	30 mins.	44.4	7.0	19.0	17.39	91.5	0.3
Juice 2. Phosphoric Lime and CO ₂ to 8.3 SO ₂ to 7.2				Clear		26.7	7.1	19.1	17.38	91.0	-0.2

Mr. DYMOND had prefaced his reading of the paper by remarking that all the work done at Darnall on ion-exchange and pre-clarification had been carried out in an ordinary factory laboratory without a great deal of facilities or time available. The ordinary work had to go on and frequently interrupted the experiments.

The PRESIDENT said that papers of this description, controversial though they might be, brought an opportunity for criticism and discussion. Criticism, as he had pointed out in his presidential address, he considered to be not only the right, but the duty of the Association. He therefore thanked Mr. Dymond for providing the material for discussion, as he had so often done before, and which ultimately resulted in progress.

He thought we were indebted to Mr. Dymond for his coining of new words. We had here another new word, "Pre-clarification." He was not very clear as to where clarification began or ended in the Sugar industry, but in this case he considered the word very useful to describe what had been done.

He asked Mr. Duchenne to give some account of his experiments in which he had obtained very big increases in purity from mixed juice to syrup by using a modification of the sulphitation process.

Mr. Duchenne regretted that he was unfortunately not allowed at this stage to say much about his experiments at Umfolozi. They had, however, obtained a purity rise over a period of three months of 3.7 degrees. This was accompanied by less scaling of heating surfaces, the sugar crystallised more easily and the curing was quicker, thus confirming that a lot of non-sugars had been removed in the process.

Mr. Dymond had stated at the end of his paper that the standard treatment of pre-heating to 50°C, treating with lime to 9.6 pH then with sulphur dioxide to 8.4 pH to give a final clarified juice of 7.4 pH, generally gave good results. It appeared then that the old method used in Natal gave the better results in that series of clarification tests.

Mr. DYMOND said the conclusions referred to the appendix and not to the old method.

The PRESIDENT informed the meeting that whereas the paper mentioned sulphiting to 8.4 pH, the juice issuing from the sulphur tower at Empangeni averaged 6.55 pH. It appeared therefore that more phosphoric acid had to be used with this 8.4 pH juice, than was necessary at Empangeni.

Mr. DYMOND referred to the findings of the 1928 Commission which went into the question of sulphur dioxide in sugar. One of the points emphasised

was the necessity of discharging the juice from the sulphur tower somewhat alkaline and not acid. If it were acid bisulphites were formed; and these persisted through to the sugar.

He wished to refer to some of the samples mentioned in the paper. One was a very fine carbonation syrup supplied by Mr. Rault. He had another equally as good from the acid-clay process. This process removed a colloidal, black, slimy substance and all the silica. The next one was a similar product, except that it was inverted and had been clarified according to the second process and passed through the ion-exchange system. In this case there was a certain amount of silica still left in the liquor. This it was impossible to get rid of without filtration. All the juices were boiled to syrup in an open pan after clarification, first by what he called the standard process, after which they were passed through the ion exchange system. There was, in these cases, a precipitate of silica. Another sample showed a precipitate consisting mostly of silica, but also containing some of the other impurities mentioned by Mr. du Toit in the Report of the Committee on Ion Exchange. This precipitate resulted when pre-clarification of the juice passed through the exchangers was not well conducted. The final molasses had been diluted to 20° Brix, treated as indicated, and brought to about 74° Brix in an open pan.

He had managed to obtain a very good sugar in an experimental vacuum pan at Darnall.

One of the analyses was of the effluent obtained during regeneration of the resins, and consisting of ammonium sulphate and the non-sugars. This he thought would provide a key to the economics of the process. The last two samples were cane-wax precipitated by the acid-clay process from four mixed juices.

Mr. DU TOIT drew attention to a process which had been patented in connection with the ion exchange process. In this patent, part of the juice coming from the cation resin is diverted to the mixed juice before this enters the process. This cation juice has a pH of about 2.5, and when mixed with the incoming juice, gives it a very acid reaction, and it is claimed that efficient clarification results. If this were obtained it would mean that no chemicals were introduced.

Referring to Mr. Dymond's description of the standard method of clarification, he thought it would be useful to have descriptions from other factory operatives present. The variation at Empangeni where the juice issued from the sulphur tower at a pH as low as 6.5 would necessitate the use of more lime for correction.

Mr. GALBRAITH said that at Esperanza the sulphur dioxide content of the sugars was low. He ascribed this to treatment by dilution of molasses in the blow-ups and subsequent settlement, whereby much of the sulphites were eliminated. The juice issuing from the sulphur tower was as near neutral as possible—about 7.1 pH.

The PRESIDENT endorsed what Mr. Galbraith had said, remarking that any sulphitation syrup boiled and allowed to settle, would precipitate a sediment extremely high in sulphur dioxide, so that the process worked by Mr. Galbraith at Esperanza was bound to have a marked effect in eliminating sulphites. Sulphur dioxide content of sugars was now much less than in 1928.

He wondered if silica could not be considered a reversible colloid. It is not ionised to any great extent, but having been flocculated in an acid solution, it might be possible to remove it from the cold juice.

Mr. DYMOND said that he had observed only two ways of getting rid of silicic acid. Firstly by carbonatation, when it was removed as colloidal silica, and secondly when the juice from the acid-clay process was filtered with hyflosupercel. In all cases in which subsidation alone was used, silica persisted in the clarified juice. Filtration, therefore, was necessary to remove silica.

Mr. DUCHENNE said that, similarly to what occurs in water purification, silica and magnesia were probably adsorbed by the precipitate. It appeared that magnesia was absorbed on the carbonatation precipitate and silica might also be similarly removed.

Mr. DYMOND felt that it was somewhat depressing to find so few had attended the meeting. He would have liked to go further with the experiments on clarification and ion exchange, but he and his Committee had not got the necessary facilities and suffi-

cient assistance from the Sugar Association or the Millers' Association. The whole subject had been passed on to a new research organisation which would operate some day; but he felt that while the work he and the Committee had done might be useful to some other body, they had reached a point at which they could go no further.

Mr. BOOTH said he was glad to have had the opportunity of being associated with the ion exchange investigation. He wished to pay tribute to Mr. Dymond and his staff at Darnall for the immense amount of work they had undertaken.

In Mr. Dymond's practical work and in Mr. du Toit's paper it had been emphasized that the value of the resins was largely determined by the work they had to do to remove the non-sugars in the juice. This brought us to consider more closely methods of clarification and especially the elimination of silica. Further attention must be paid to clarification either by mechanical separation, by centrifugal or perhaps the superheating of raw juice or the use of liquid SO_2 . Mr. Dymond's acid-clay process had been developed as a result of his search for good clarified juice, suitable for ion exchange and the improvements on his ideas should be watched with great interest. Unfortunately, however, the investigation had come to a standstill pending a lead from higher quarters.

All who had been interested in the study would be anxious to see the newly formed Research Institute take up the work at an early date as its potentialities were great, not only in the sugar industry but in other industries.

The PRESIDENT agreed that a great deal of encouragement should be given to work of this nature, and could see no reason why it should not be continued until the Research Institute could take it over. That time was, in any case, unlikely to be in the near future.