work of Kynochs. They fully appreciated all that had been done to help them in their problems connected with cane.

Mr. Blewett expressed his thanks for the complimentary remarks of the various speakers, and his pleasure that the Sugar Association had honoured them by spending the first day of their "Sugar Congress" at Umbogintwini.

A hearty vote of thanks to the Chairman (Mr. Johnson) then concluded the proceedings of the day, and the members returned to Durban by special train.

Second Day's Proceedings.

Thursday, March 26th, 1925.

Chairman of the day: Mr. D. L. Patrick.

For the second day at Mt. Edgecombe the conditions were more propitious. It had rained heavily the greater part of the night, and the fields and roads were very wet and muddy, but the weather remained fine all day. Unfortunately the programme had to be modified, the trip to Umhlanga Rocks having to be abandoned, as well as visits to the more distant parts of the Estate.

On arrival the guests were taken to the factory, where seating accommodation was provided in the newly erected commodious sugar store. After brief preliminaries Mr. Wm. Campbell delivered his paper on the carbonatation process which was especially interesting to everybody. Mr. Campbell had shorn it of all the technicalities so that it could be followed by the layman in sugar manufacture.

Tea and other refreshments were then served in the same building, after which the guests were taken on a tour of inspection of the factory and were then conveyed in motor cars to the Experimental plots, and afterwards to the Irrigation System, about a mile from the homestead.

WHY WE ADOPTED THE CARBONATATION PROCESS.

(Paper by W. A. CAMPBELL, Managing Director, Natal Estates, Ltd.)

I wish to take you back, ladies and gentlemen, to the early days when this factory was built by Mr. Alfred Dumat, a most eminent French Engineer, and the father of the present Doctor Dumat.

Alfred Dumat introduced a system of clarification, which though wasteful in steam, was to my mind, the simplest method for securing an even grade of white sugar in a Defecation mill, and strangely enough on my writing Home a few years ago for expert advice on the trouble we had in making white sugar by defecation, Doctor Schalk-Sommer advocated the method which Mr. Dumat had introduced, with open clarifiers, bac Portals and Taylor filters. This system was altered in 1909/10, when the factory was remodelled.

Mauritius is the Home of the making of defecation white sugar by sulphur, and this process was invented by Doctor Icery as far back as 1868.

Do what we could, and armed with the very best advice to be obtained from England, Mauritius and

Why We Adopted the Carbonatation Process.—Contd.

Java, our losses in the treatment of juice compared most unfavourably with the rest of the sugar countries of the world, and furthermore we found that in a large factory it was almost impossible to produce an uniform white sugar, which is so essential in the manufacture of sugar for domestic purposes.

This unsatisfactory state of affairs led us to seek other avenues of information, and it occurred to me that our Uba juice, because of its viscosity, was somewhat analogous to the beet juice. I thereupon wrote to Doctor Schalk-Sommer, and asked his advice about starting a carbonatation factory here, and his reply was such that we immediately decided to adopt the carbonatation process.

Our next difficulty was to find someone in the country who had a knowledge of carbonatation and limestone, and we opened up correspondence with Pretoria without result. Whilst we were considering the matter of sending Home to get someone suitable out here, Mr. Wuthrich, Consulting Sugar Chemist, and Mr. Mitchell, late of the Sugar Machinery Manufacturing Company of London, arrived on the scene.

Mr. Mitchell gave us his practical knowledge on how to start and equip the factory with the machinery we had at our disposal, and Mr. Wuthrich contributed his technical knowledge.

We are indebted to both these gentlemen.

I need hardly mention, as it is common knowledge to you all, the troubles we had in the introduction of this process. In the first place the lime kiln fire bricks which were supplied in the Union, fused, and ran out in a molten liquid; and secondly we were faced with the problem of the extraordinary viscosity of the Uba juice, which confounded the technical experts.

Credit is entirely due to the staff in overcoming these difficulties, and in this connection I would like to mention the names of Mr. Simpson our Chief Engineer, and Mr. Rault our Chief Chemist.

The patent tower which you see in the factory, and which utilizes the so-called exhaust gas, was one of the chief factors in overcoming our initial troubles.

I am dividing my Paper into the four following heads:—

(1) The reason for name, and basic principles of the process.
(2) Kiln work.
(3) Juice treatment.
(4) Results obtained and advantages.

I must say that but for the whole-hearted support of Mr. Harold Payne, who was then the Chairman of the Company, the introduction of the carbonatation process at Mount Edgecombe, would have been very seriously delayed.

Name, and Basic Principles of the Process.

In cane juice clarification, Lime is almost the universal clarifying agent, but for a thorough purification, a large excess must be used, and this excess has to be removed by a neutraliser.

Carbonic acid gas has been found to be the cheapest neutraliser of excessive quantities of lime, and the most economical way of making use of lime and carbonic acid gas is by burning limestone (lime carbonate) in a lime kiln where 100lbs. of limestone produces 56lbs. of quick lime and 44lbs. of carbonic acid gas.

As its name implies the Carbonatation process is essentially connected with the production and use of carbonic acid for juice treatment.

By burning the limestone in a lime-kiln, we separate it into its two constituent parts, that is, quick lime and carbonic acid gas. In the carbonatation of juice, we reserve the destructive work of the kiln, and combine again the carbonic acid gas to the lime in the presence of juice.

It is this formation of new soft powdered limestone in a dirty cane juice which constitutes the basic principle of the process. In doing this we charge a large excess of pure lime into carbonate of lime, and the French chemists have named the process "carbonatation," and this name has clung to it, although more correctly it ought to be "carbonation."

Kiln Work.

The kiln here is the standard Belgian type and burns 40 to 50 tons of limestone a day in a continuous operation. When lit, a few days previous to starting the mill, the fire is kept alive right through the crushing season.

It is fed with limestone broken to the size of a man's fist, and coke in the proportion of 9 per cent. coke to the weight of limestone. The coke is added to promote heat and also to produce an excess of CO_2 (carbonatation) gas.

A lift raises the stone and coke in wagon loads to the top of the kiln, and at regular intervals charges of the mixture are dropped in by special arrangement.

At regular intervals also the burnt lime is drawn away at the bottom of the kiln, so that the limestone and coke mixture is practically in a continuous slow descending motion in the kiln, whilst it is getting burnt to quick lime and ashes.

The heat of the kiln is maintained by the burning of coke, and also by the strong draught of a powerful gas pump, which regulates the burning of the kiln, and at the same time sucks the gas and delivers it to the juice side of the sugar house.

The presence of a pump intensifying the heat of a kiln and controlling its output of gas creates new conditions which do not exist in the usual lime kiln where the burning of lime is the only aim.

Why We Adopted the Carbonatation Process.—Contd.

In our case burning of lime and gas production are of equal importance, and has to synchronise with the juice production of the factory; on that account a carbonatation lime kiln demands technical ability, and a vigilant scientific control.

The burnt quick lime is slaked and diluted to a cream in a rotary drum, which is sieved to get rid of unburnt particles, or dirt, and after cooling is ready for the juice treatment.

The carbonic acid gas sucked from the top of the kiln is cooled and scrubbed before reaching the gas pump.

The lime kiln, lime slaking and lime storage is in a separate building from the rest of the factory, and together with the gas pump constitutes a department of vital importance to a Carbonatation Mill, as any defect there would eventually cause crushing operations to stop.

A well balanced kiln work, which means perfectly burnt lime, and a plentiful supply of gas, is conducive to a safe, easy running on the juice side to such an extent, that sugar-men experienced in the suphitation process with the vagaries of that craft called "juice tempering," no longer care for this old process, and quite paradoxically, and contrary to the outsider's general opinion, called the CO process the simplest in existence.

Juice Treatment.

The first step in juice treatment is heating raw juice from the mills to a temperature of about 140 deg. F. This temperature fulfils the best conditions for gassing, filtration and colour of juice.

The hot juice is sent to the gassing tanks where "carbonatation" is conducted.

Our practice is to fully open the valve connecting the gas pump to the carbonation tank, so that all the gas from the kiln is being blown into the juice, whilst a continuous stream of lime cream runs in the juice, mixes with it, and is carbonated.

The lime cream flow is regulated so that nearly all the lime is neutralised and only a small percentage left as free lime. This is checked by means of specially prepared test paper which turns pink or white according to the amount of lime neutralised.

The reason for continually neutralising the lime instead of letting the full quantity act on the juice, and then neutralising (as is done in beet root practice), is that with the new method the violent frothing common to juice full of free lime, is considerably diminished.

This frothing is particularly noticeable with Uba cane juice, and in our first trials we found that, as already mentioned, the viscosity of the Uba juice was such that for the first portion of gassing the juice would not absorb the gas, and because of this we pump the raw juice from the mill to the patent tower 30 feet high.

This juice meets the exhaust gas from the tanks and gives it a pre-gassing. It also acts as a save-all and foam breaker.

The addition of lime in the juice with its simultaneous carbonatation is continued until the operator judges that the juice is sufficiently treated for a quick filtration.

A sample of muddy juice taken from the tanks would then show in a test tube a quickly settling mud, with a clear yellow juice on top. The real test, however, is the spread of filtration when the juice is sent to the filter press.

An experienced carbonator adds a uniform quantity of lime in each tankful, and the safest method is to add a slight excess of lime in case juice from bad cane should have been treated. The average quantity of lime used for Uba juice is about 12 per cent. by volume at 15 deg. Beaume.

Other countries would naturally think this excessive, but we find by practice that it is the safest figure we can use; although I have known juices for short periods take only 8 per cent. of cream.

The action of lime on hot juice is to neutralise the natural acidity of the juice, kill the germs, and coagulate and bind various impurities inimical to sugar extraction, and this action is further helped by the formation of carbonate of lime in the juice. Added in large excesses to the viscous Uba juice, it really changes for the better the physical qualities of the refractory juice, especially by acting on the gummy substances which in other processes slime the presses, retard the boiling, and diminish the extraction of crystals.

The juice treated with the proper quantity of almost neutralised lime can now be easily filtered in filter presses, where the mud is kept as a solid cake. The lime cake contains nearly all the carbonate of lime (limestone) from the kiln together with the impurities removed from the juice, and constitutes a very valuable fertilizer.

For every ton of sugar produced, one ton of this fertilizer is sent to the fields.

Due to its porous nature this cake is easily washed free of the sugar it contains, so that in spite of the heavier quantity of cake manufactured in the CO_2 process, the sugar losses in scum cake are smaller than those of any sulphitation mill. The cake is washed until it contains but ½ per cent of sugar by weight of the cake. The defecation process gave us 8 to 11 per cent. by weight.

The clear filtered juice containing a small amount of free lime in solution is sent to a second series of carbonatation tanks where the final neutralisation is carried out.

Carbonatation, carried out in two stages that is, double carbonatation, is safer than the single process, as it allows of rectification of mistakes at the first stage.

Why We Adopted the Carbonatation Process.—Contd.

Whereas the 1st, Carbonatation takes an average of 10 minutes, the 2nd one is carried out in about 1 minute, but demands a finer adjustment, as it is the final gassing.

The 2nd CO_2 juice after neutralisation is heated to 165 deg. F. and sent to another series of filter presses where the small residue of lime carbonate in suspension is removed.

The clear filtered neutral juice is then slightly sulphured to a quantity equivalent to a tenth of that used in sulphitation mills, when juice becomes slightly bleached, a favourable condition for white sugar. It is then heated to boiling point and filtered again.

From there it is concentrated and another filtration given, after which it is boiled to grain.

Results obtained and advantages.

1. All juice from the Mills reach the Evaporator in 30 minutes. Probably 4 or 5 hours were required with the former process.
2. The Mills have an uninterrupted run.
3. Due to pure juice obtained, the capacity of our boiling house and centrifugal department has increased at least 30 per cent.
4. An increased recovery of sugar. Better quality of sugar.

Comparative Figures of Sulphitation and Carbonatation Mills in White Sugar Manufacture.

1. Rise in purity from raw juice to syrup: Sulphitation, .5 to 1.5. Carbonatation, 4 to 6.

2. Gallons of molasses per ton of Cane: Sulphitation, 6 to 7. Carbonatation, 4 to 5.

3. Sugar lost in molasses per cent of the sugar in the juice: 13 per cent. to 14 per cent. sulphitation; 8 per cent. to 11 per cent. carbonatation.

4. Weight of scum cake per cent cane, 3.5 to 4 sulphitation; 10 carbonatation.

5. Loss of sugar in cake per cent sugar in the juice, 3.5 per cent sulphitation; 0.5 per cent carbonatation.

6. Recovery of pure sugar in bags, per cent of the sugar in the juice, 73 per cent. to 77 per cent. sulphitation; 83 per cent to 84 per cent. carbonatation.

AN EXPLANATION.

At the conclusion of his address Mr. Campbell stated that guides were present to conduct members through the factory. He was sorry to say that owing to the heavy rains they had experienced it was impossible to get anywhere near the main green manuring fields but they would be able to see one of the smaller fields near the factory. The plot he had intended to show them however, was one giving about nine or ten tons of Mauritius beans to the acre, and he regretted very much that it could not be reached.

The Chairman in thanking Mr. Campbell for his address stated that they were under a very great debt to him. It may seem a very easy thing to some people to read a paper in simple language so that non-technical people could understand it, but he could assure them that it was a most difficult thing to handle a technical subject in a non-technical way. Mr. Campbell had explained to them how much had been spent to get an extra 7 to 10 per cent. improvement. It was those 7 and 10, and even 5 per cent. improvements which were going to put them in a position in the future to be able to compete with the whole world (hear, hear).

They could also see that it was not only one section of the industry that had its problems to deal with—the millers as well as the planters had their problems to deal with, and it was only by understanding each other's problems that they were going to get down to real work and co-operation together (hear, hear). The millers had just as many problems as the planters, if not more. They were also dependent to a certain extent on the planters problems and the manner in which the planters solved them. Later on he hoped to refer to the way in which Natal Estates Limited had helped the planters to solve their problems.

He then asked the members to join him in a hearty vote of thanks to Mr. Campbell, which was enthusiastically accorded.

Mr. Campbell expressed his appreciation of the remarks made and the reception accorded him.

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THE QUEENSLAND CANES.

Owing to the excessive rains of the previous few days, and particularly the heavy downfall of the previous night some of the field demonstrations had to be abandoned. At the Experiment plots, there are being grown in a quarantine area the canes introduced from Australia by Natal Estates, Ltd., about two years ago.

The chief object of these plots is to endeavour to discover a substitute for Uba, but great care has to be taken to prevent the introduction of Mosaic disease, to which the majority of these canes are subject.

These canes were examined with great interest by the majority of the planters present, but it seemed to be the general impression that they would have been more valuable from a planters point of view had they been some months older. Their qualities will certainly be more pronounced when they are more mature.

Mr. Storey, the Government mycologist through the loud speaker, explained the special points of the canes, which very briefly are as follows:—

Badila, a deep rooting purple cane, giving a very high sucrose content when mature. This cane which originated in New Guinea, has a very high reputation in Queensland.