SOME NOTES ON THE MELT CARBONATATION REFINERY OF REYNOLDS BROS. LTD. AT SEZELA

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Historical

Prior to 1953 the question of sugar quality was becoming more and more a serious problem. At that time mill white sugar was produced mainly by the C. G. Smith Group of factories. Refined sugar was produced by the Central Refinery, Illovo Sugar Estates and Natal Estates. Due to the varying qualities of the mill white, an effort was made to subdivide these various types of mill white into three groups namely: "Special", "Superfine" and plain "Mill White". To encourage the production of the best quality sugar, "Special" white was given the maximum price, whilst the other two grades were penalised to the extent of 3d. per 100 lbs. In spite of this the position was still not very satisfactory from a consumer's point of view, as even the "Specials" varied too widely in quality and appearance.

As a result of the position at that time, the directors of Reynolds Bros. decided to investigate the possibilities of refining sugar at the Sezela Factory, and in that event, to discontinue the manufacture of mill white sugar. Apart from the quality of sugar, the economies of refining sugar under the same roof as the raw sugar factory were economically attractive.

After preliminary investigations, it was decided to send two members of their technical staff overseas to study the question, both from the process and engineering aspects. Visits were made to the U.S.A., U.K. and Holland, and the principal processes in use in those countries were studied. These processes included the vegetable carbon, carbonatation and bone char.

As a result of the above investigation, a report was submitted in which it was recommended that, of all the processes studied, the carbonatation process was considered to be the most desirable. The reason this was recommended was:

1. The carbonatation process presented no serious *filtration problems*, which has always been the bug-bear as far as overseas refineries are concerned when dealing with our sugars.
2. *Economically*—undoubtedly the most economical.
3. Supply of raw materials viz: *Limestone*, which is obtainable in South Africa and at an economical landed cost at the factory.

In 1956 when the decision was made to proceed with the refining project, two members of the technical staff were sent to England, where by the courtesy of the British Sugar Corporation, they were allowed to spend sufficient time at the Kidderminster Factory in Worcestershire to obtain first hand practical experience in the running of the process which at that time was refining cane sugar raws. This visit confirmed that the recommendations made in the 1953 report were correct.

The Refinery has just completed its third refining season and the results obtained have more than justified the faith put into the adoption of this process.

Raw House

The sulphitation process is practised and all raw sugar produced, viz: "A" and "B" single-cured and "C" double cured, is refined. The sugar is weighed and analysed, before it is melted.

Refinery

A surge bin is installed before the automatic raw sugar scale from where the sugar is fed into a continuous melter. The melter has two compartments; each compartment has a stirrer.

Temperature of 150°F is maintained by injecting low pressure steam into each compartment. A constant Brix of melt of 53°–54° is aimed at.

The melt is pumped through a heater, heated to 160°F and stored in buffer tanks from which it flows by gravity into three batch system 1st Carbonatation tanks. Constant Be. milk of lime is added into each tank in five stages. Gassing with CO_2 takes place continuously to an end point of 8.1 pH. This procedure takes 12–15 minutes per tank. Carbonated liquor is discharged into a liquor mixing tank equipped with a slow stirrer, which acts as a buffer tank for the filters. The carbonated liquor temperature is corrected to 160°F and filtered in "Auto-Filters", which are precoated with "HYFLO" filter aid. The filtering cycle is 8 hours.

"Sweetening-off" is done in the filter and the sludge is passed through a "Dynocone" centrifuge which separates the carbonated lime from the sludge.

The refinery is equipped for the double carbonatation process but it has not been found necessary to bring the continuous, 2nd Carbonatation tank into use. First carb. filtrate is passed through the "Quarez" continuous sulphitation tank and gassed down with SO_2 to 6.8–7.0 pH.

Sulphured liquor is filtered in modern "Fas-Flo" filters (precoated), and heated to 215°F before

entering the sealed downtake triple effect evaporator. Vapour from the first vessel is bled off for all liquor heating.

Evaporator thick liquor of 65°–67° Brix is heated to 170°F and then follows the final filtration in "Fas-Flo" filters, (precoated), and pumped to pan supply tanks.

Four or more strkes, depending on colour, are boiled. Graining is done on melt and the intermediate strikes are a mixture of melt, "wash" and "greens". The final strike is boiled on "greens" only. Run-offs from the final boiling are analysed, quantity determined and returned to the raw house "A" boilings.

The pans are of modern "Centre Flow" design with a large discharge door. Each pan has receivers below them from where the massecuite is fed by gravity into the mixer of the centrifugal battery. The sugar is dried in a rotary drier and stored in a four-compartment blending bin of 120 ton capacity. Blending of the sugar is carried out to put as near as possible a constant quality of sugar on the market.

"Sezela" sugar is bagged either in 50 lb. "Valve Pack Multiwall" paper pockets or in 100 lb. Hessian pockets. The sugar moves in a closed circuit and is neither touched by hand nor exposed to surrounding atmosphere to obviate bacterial contamination.

The pockets of sugar from the bagging station are conveyed by means of conveyor belts into S.A.R. trucks which are consigned either direct to customers or to Durban for storage.

Lime Kiln

A "Cocksedge" kiln, as commonly operated successfully by the British Sugar Corporation provides burnt lime for both raw house and refinery processes. It is not automatic but produces burnt lime of excellent quality and has not given us any anxiety.

Boiler Plant

It was calculated that 240,000 lbs. of steam per hour would be required for the Raw House and to refine 100 per cent of the raw sugar output.

The boiler plant consisted of six *Stirling* type boilers of 30,000 lbs. per hour rating each, with the horse-shoe type of furnace.

To increase efficiency, the boilers were converted to "Spreader Stoker" system of firing to boost the output to 40,000 lbs. per hour each.

Two were equipped with coal feeding hoppers to be put on coal firing should bagasse be in short supply due to cane shortage, or similar difficulty.

Instrumentation installed at Carb. Station.

1. *Beckman pH Meter—recorders* for 1st Carb., 2nd Carb., and Sulphured liquors (Figs. 1 and 2).
2. Co_2 *Recorder* (Mono).
3. Co_2 *Temperature Recorder* (Thermograph).
4. *Rotameter Controller—Recorder* for milk of lime density control (Fig. 3).

Laboratory Control

By means of hourly sampling and compositing, purities, colour and other data of liquors, etc. in all stages of process are determined.

A "Beckman" colorimeter with a 10 cm. cell is used for colour determination and has proved itself a reliable and accurate instrument. It compares favourably with the S.M.R.I. instrument.

Sugars from each shift are composited. Colour index and conductivity ash, and specific grain size is determined and the results made available to shift staff who take a keen interest in their respective shifts analyses.

The "Greens" returned to the raw house are strictly controlled and results summarized for recovery calculations.

A careful check on drains, entrainment sampling devices and sweetening off of each individual carbonatation filter is maintained throughout to ensure that no sugar losses occur.

Daily Analysis Summary Sheet

The following is a summary of daily analyses:

DAILY REFINERY LABORATORY REPORT

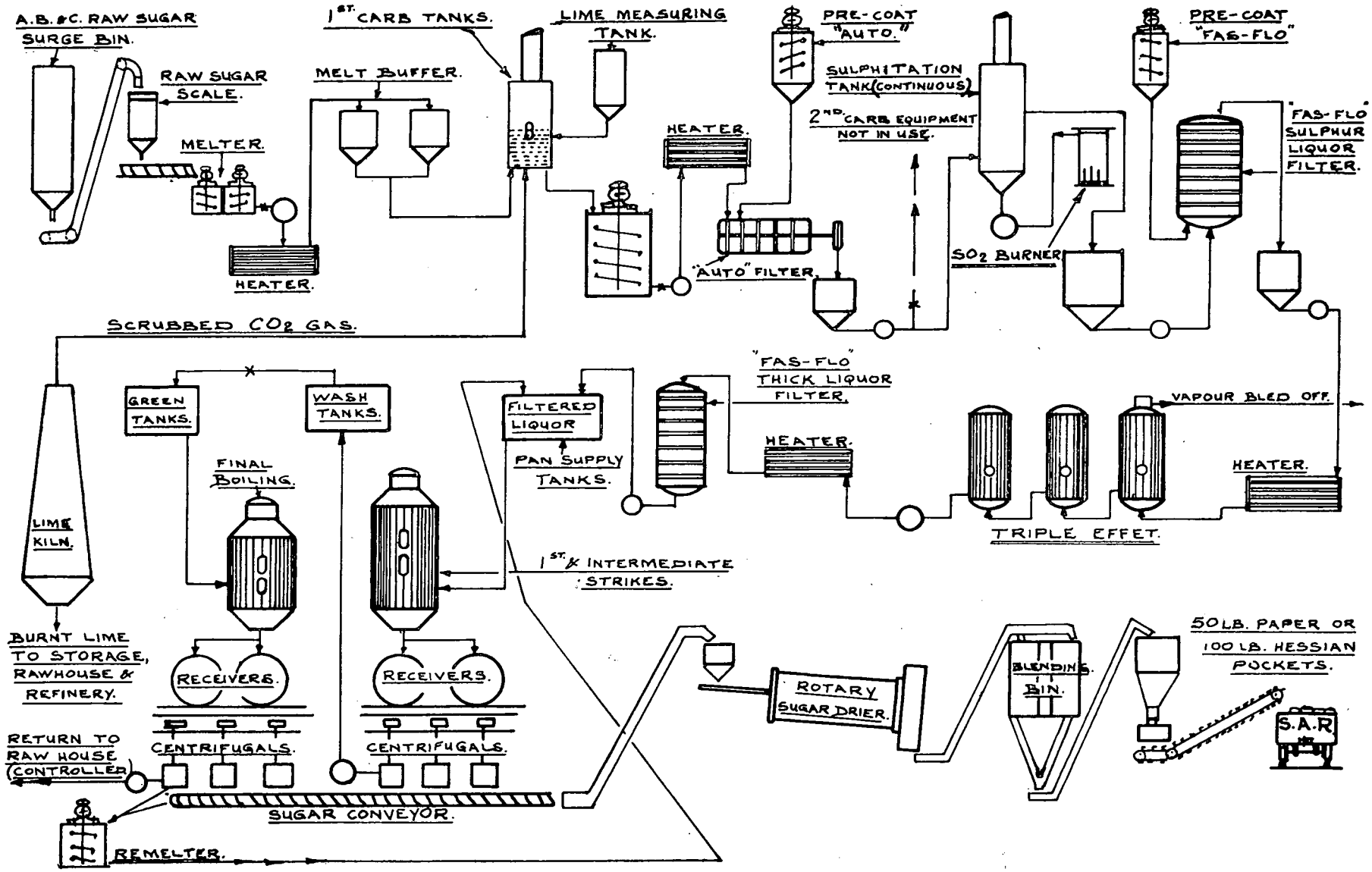
Day No. **86** Date: **11th August, 1959**

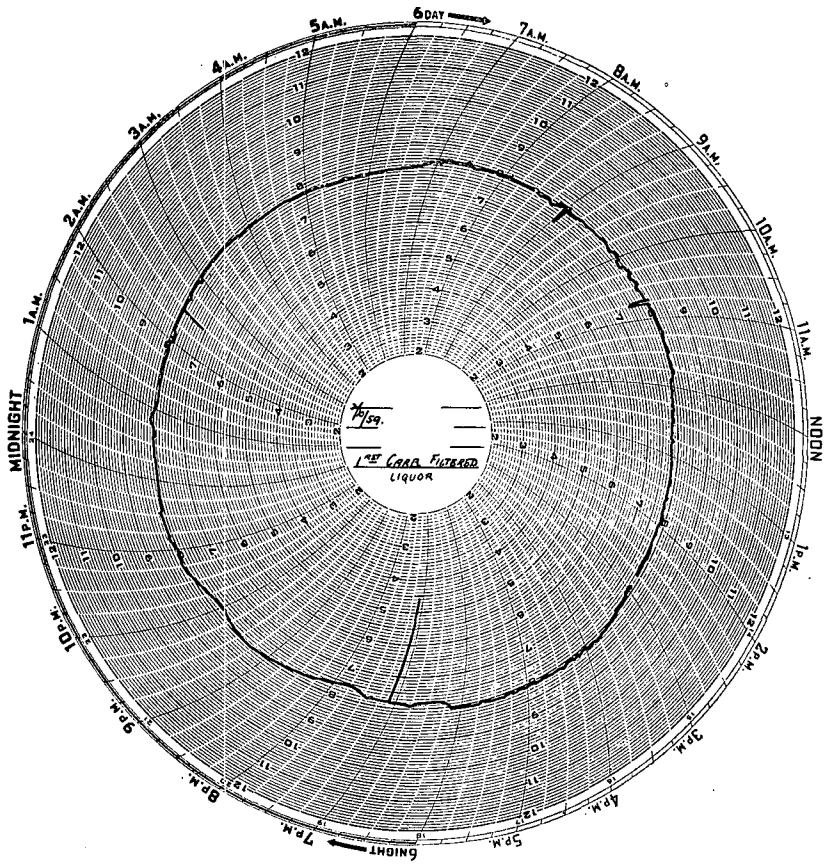
	Brix	*Sucrose*	*Purity*	*Glucose per cent*	*pH*	*Colour*	*Colour removed*
Raw Melt	53.51	52.36	97.85	.172	7.12	418	—
1st Carbonated Liquor	49.93	48.56	97.25	.127	7.99	117	72.0%
Sulphited Liquor	50.40	48.95	97.12	.118	6.83	79	32.5%
Evaporated Thick Liquor	66.50	65.20	98.04	.205	6.75	75	5.1%
"A" Refined Massecuites	90.63	87.79	96.86	—	—	285	—
1st Greens	69.59	66.50	95.56	—	6.02	588	—
"B" Refined Massecuites	91.05	87.21	95.78	—	—	1114	—
2nd Greens	—	—	—	—	—	—	—

		Maximum allowed	*Remarks*	*CaO*	*100% Brix*
Number of Tanks Carbonated	71	—			
Tons Melt to Refinery	493.250	—			
Tons Sucrose to Refinery	486.000	—	Raw Melt	0.031	0.058
Tons Refined sugar bagged	420.000	—	1st Carbonated	0.014	0.028
Refined Sugar: Colour Index	14	50.0	Sulphured	0.014	0.028
,, ,, Per cent Moisture	0.04	0.06%	Thick Liquor	0.019	0.029
,, ,, Per cent Ash	0.009	0.03%			
,, ,, So_2 ppm.	1.9	25 ppm.	S.G.S. Refined 0.49 mm.		
,, ,, Per cent Reducing Sugars	—	0.02%			
Sludge: Per cent Sucrose	0.04	—			
Pol. Raw Sugar	98.67	—	Total colour removed 82.1%		
Returned to Raws	2151 cub. ft.	—			

REYNOLDS BROS. LTD. SEZELA.

REFINERY FLOW SHEET.




6 DAY
7 A.M.
8 A.M.
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10 A.M.
11 A.M.
NOON
1 P.M.
2 P.M.
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6 NIGHT
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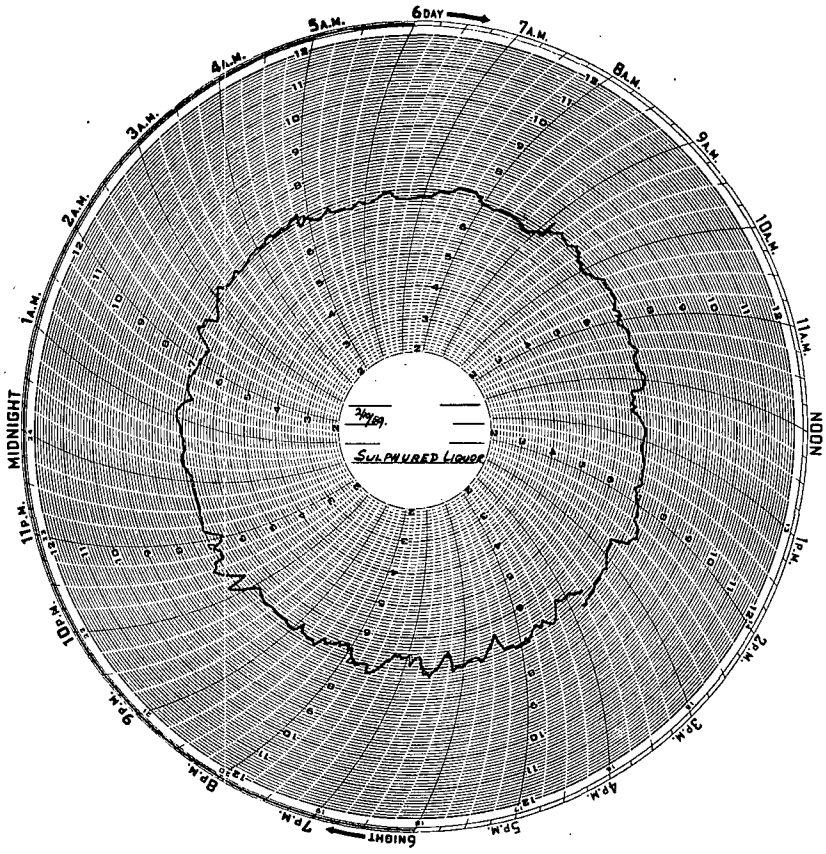
8 P.M.
9 P.M.
10 P.M.
11 P.M.
MIDNIGHT
1 A.M.
2 A.M.
3 A.M.
4 A.M.
5 A.M.
1st Carb. Filtered
Liquor

Fig. 1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MIDNIGHT
1 A.M.
2 A.M.
3 A.M.
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5 A.M.
Sulphured Liquor

Fig. 2

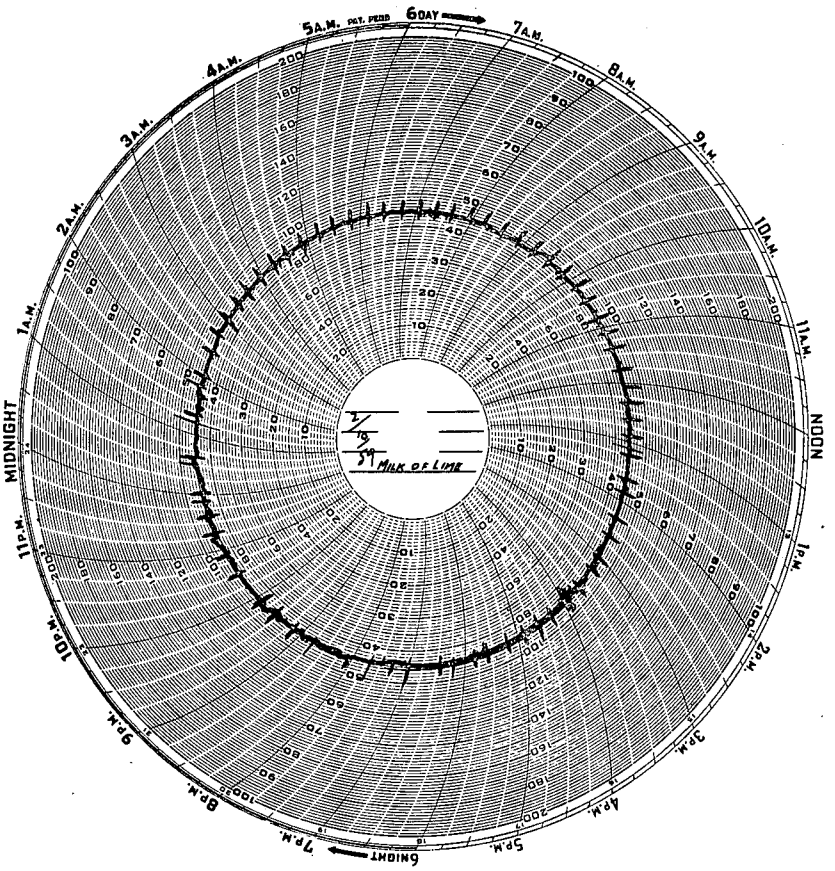

Fig. 3

For discussion on this paper see page 125