

IMPROVEMENTS IN RAW SUGAR QUALITY

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Introduction

A few years ago there was little doubt that the refining quality of Natal raw sugars ranked among the worst in the world. Exported raws, generally representing the cream of the sugar produced in Natal, were the subject of numerous complaints from overseas refiners.

These storms of criticism precipitated a welcome reaction among Natal millers, who began to realise the "refining quality" was a worthwhile attainment and not just the pet aversion of the local Refinery. This awareness prompted various actions which have brought about considerable advances in the quality of sugar produced.

This paper deals with the improvement in quality of sugars sent to the Rosburgh Refinery. Since production for our Refinery very often represents those sugars which are not good enough for anywhere else, it follows that overall improvement in the quality of sugars produced in Natal will be manifested in exaggerated form in raw sugars sent to the Refinery. Thus, although this paper indicates a very real advancement in the quality of raw sugars received at the Refinery, the overall improvement is unlikely to have been as great.

Bases for Comparison

The refining quality of a raw sugar is not easily defined in strict analytical terms. Obviously the polarisation, and therefore the quantity of impurity in the sugar is a criterion of quality. More important to the refiner, however, is the quantity of impurity present in the crystal, though it must be remembered that impurities removed by a simple affination process are not lost to the refiner but may well cause a loading on the recovery station, especially in a refinery geared for higher polarising sugars.

It is not only the quantity but the nature of impurities which affect raw sugar quality. Certain impurities notably starch, have a far more severe effect on refining quality than, for instance, reducing sugars.

Grain size is another aspect of raw sugar quality of importance to the refiner. Raw sugar which has a small, conglomerated or mixed grain will place an unnecessary load on the affination station. The optimum is a grain size between 0.60 and 0.80 mm. containing as little fine grain (defined as grain passing a Tyler 28 sieve) and conglomerate, as possible.

If raw sugar is to be stored, safety factor is of considerable importance.

In recent years filterability has become widely accepted as a major criterion of refining quality. Since the filterability of a sugar is dependent to a large extent on the quantity and nature of impurities in the crystal, little definition is lost if refining quality is described in terms of filterability alone, or preferably filterability and grain size.

The Improvement in Filterability

Filterability determinations have been made on all raw sugar processed at the Refinery since February, 1963. Omitting the results for that month, the last month of raw sugar production during the 1962-63 season, the following trends emerge for each of the five major contributing mills and for all local raws received. The figures for the 1965-66 season represent sugars received up to the end of December 1965 only:

Table I

	Filterability % CSR 20°C		
	1963/64	1964/65	1965/66
Empangeni	26	30	32
Felixton	22	29	42
Amatikulu	42	37	46
Darnall	26	38	36
Tongaat	38	40	25
All raws received	30	36	35

If this year's production from Tongaat is excluded from the average of all raws received, the filterability figure for 1965/66 becomes 39 per cent.

The improvement may be viewed differently by grouping sugars according to their filterability ratings. The tons of sugar produced falling into each group was used to determine the percentage distribution, on a filterability group basis, of sugars processed in each season.

Table II

	Filterability Grouping			
	≥40%	40-30%	30-20%	≤20%
1963/64	20.0	32.6	28.4	19.0
1964/65	36.1	35.1	21.9	6.9
1965/66	35.6	32.6	19.5	12.3

If the disappointing sugars from Tongaat are omitted from the 1965/66 evaluation, the following distribution emerges:

	≥40%	40-30%	30-20%	≤20%
1965/66	45.6	37.0	13.5	3.9

There has been a steady increase in the percentage of sugars filtering greater than 40 per cent while, at the other end of the scale, the percentage of sugars filtering below 20 per cent has decreased from 19 per cent to 4 per cent.

Many factors have influenced the results shown in tables one and two, chief among which is the very irregular nature of the supply of sugars to the Refinery. Sugars have been received regularly from Empangeni, Felixton, Amatikulu and Tongaat, while Darnall has been a regular supplier apart from the first nine months of 1965. Melville and Illovo have supplied sugar on occasions while Glendale, Sezela,

Renishaw, Umfolosi, Doornkop and Gledhow have contributed sugar during the latter half of 1965.

The fluctuations in supply affect the overall picture in two ways. Firstly, the recent offerings of good filtering sugars from Melville, Sezela and Doornkop may have brought about a bias in favour of an apparent overall improvement for this season. This bias is more than balanced however by the other effect which has resulted from the all too familiar pattern of good quality sugars from the refinery's main suppliers being sidetracked for export.

Despite influencing factors the tables indicate that, apart from Tongaat, which has recently been supplying a high proportion of B sugar, all contributors have improved the filterability of their sugars since 1963/64.

The Improvement in Grain Size

The improvement in the specific grain size of raw sugars received over the past three seasons may not seem as dramatic as the increase in filterability. It is likely however that grain size results are more susceptible to variations in supply, for some of the "part time" suppliers have contributed sugars of very poor grain size. The specific grain size and percentage of grain passing a Tyler 28 sieve for each of the major contributing mills and for all Natal sugars received are given in Tables III and IV.

Table III
Specific Grain Size (mm)

	1963/64	1964/65	1965/66
Empangeni	.55	.54	.61
Felixton	.59	.59	.66
Amatikulu	.50	.52	.58
Darnall	.57	.62	.62
Tongaat	.68	.58	.54
All raws received	.59	.58	.59

Table IV
Percentage of Fine Grain

	1963/64	1964/65	1965/66
Empangeni	42.6	43.3	30.3
Felixton	36.2	35.4	27.0
Amatikulu	57.7	47.7	37.7
Darnall	39.4	30.5	29.3
Tongaat	24.9	36.6	43.7
All raws received	37.9	36.9	36.1

The depressing influence on this year's contributions from Tongaat can again be seen. With Tongaat analyses omitted the average grain size for 1965/66 is 0.61 mm.; with 33.5 per cent of fine grain.

Reduction in Crystal Impurity Content

The variations in crystal ash and crystal starch content of sugar received are shown in Tables V and VI. Another major impurity, gums, has been determined in the crystal since December, 1964, too late to allow a meaningful analysis of trends.

An evaluation of variations in the concentration of other impurities such as reducing sugars, silica, phosphate and wax, has not been attempted.

Table V
Sulphated Ash in Crystal (ppm.)

	1963/64	1964/65	1965/66
Empangeni	1500	1200	880
Felixton	1700	1100	780
Amatikulu	1200	1300	1160
Darnall	1500	1000	890
Tongaat	1400	1100	1360
All raws received	1500	1100	1090

Omitting Tongaat results the average crystal ash content for 1965/66 becomes 1000 ppm.

Table VI
Starch in Crystal (ppm.)

	1963/64	1964/65	1965/66
Empangeni	770	730	590
Felixton	630	540	500
Amatikulu	560	550	420
Darnall	800	530	470
Tongaat	770	390	520
All raws received	730	520	490

Table VII summarises the percentage reduction in the concentration of starch and ash in the crystal over three seasons.

Table VII
Reduction in impurity %

	Ash in Crystal	Starch in Crystal
Empangeni	41	23
Felixton	54	21
Amatikulu	3	25
Darnall	41	41
Tongaat	3	32
All sugars received	27	33

The reduction in the concentration of impurities within the crystal over three seasons has been most marked. It is outside the scope of this paper to comment on the various process changes within the industry which may have brought about this reduction. It should be mentioned, however, that the Refinery has received during 1965 considerable consignments of B sugars from factories who produce A sugar for export. The crystal impurity content of a B sugar is likely to be significantly higher than for an A sugar from the same factory, whatever clarification and boiling process is employed.

The Seasonal Effect

Sugars produced at different times of the year may vary considerably as far as refining quality is concerned. Using as an example filterability, graph 1 illustrates the number of tons of raw sugar received every month for the past three seasons which filtered above and below an arbitrary datum of 30 per cent filterability,

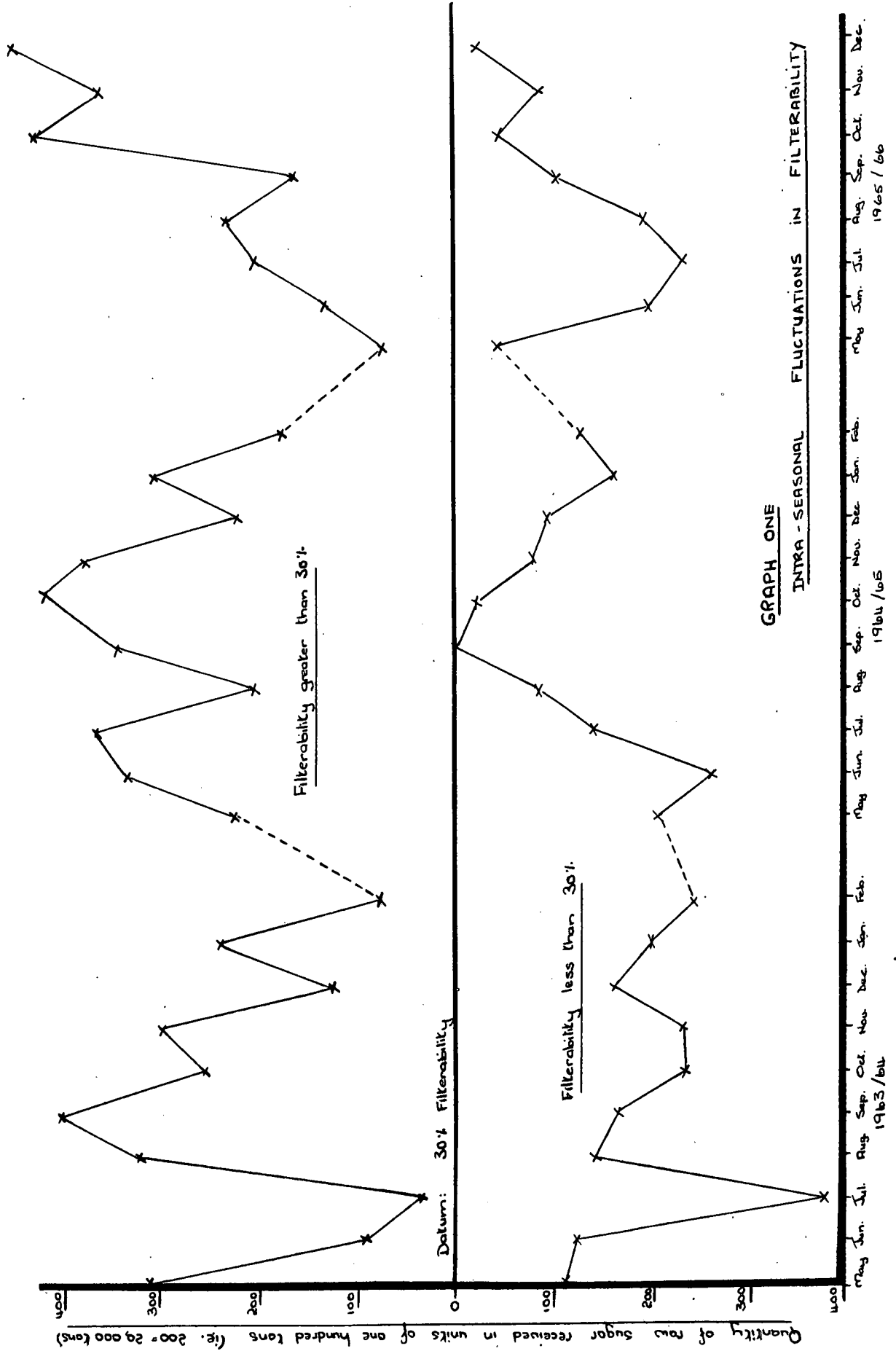


Table VIII summarises the percentage of sugars received each month which fell into each filterability grouping.

Table VIII
Filterability Grouping

Season	>40%	40-30%	30-20%	<20%
<i>Season 1963/64:</i>				
May	29	45	21	5
June	0	42	35	23
July	0	8	10	82
August	44	30	15	11
September	44	27	29	0
October	23	28	35	14
November	9	47	44	0
December	19	24	57	0
January	5	50	32	13
February	0	23	13	64
<i>Season 1964/65:</i>				
May	0	52	32	16
June	11	45	34	10
July	65	17	18	0
August	45	25	30	0
September	74	26	0	0
October	69	25	6	0
November	48	34	18	0
December	15	54	19	12
January	3	62	12	23
February	43	14	39	4
<i>Season 1965/66</i>				
May	45	16	35	4
June	6	34	45	15
July	32	14	25	29
August	44	10	12	34
September	29	31	38	2
October	51	40	6	3
November	27	53	17	3
December	46	49	5	0

The following points regarding Graph 1 and Table 8 should be noted:

- (a) The floods of June and July 1963 following on drought and cane fires, seriously affected the quality of cane delivered to some mills with the result that the quality of sugars produced by these mills slumped dramatically.
- (b) Once again the fluctuations in supply must be taken into account. A good example occurred in September 1965 when Felixton, who had been supplying sugar with a filterability well in excess of 40 per cent, had their production diverted from the Refinery to export. The removal of this considerable tonnage of good filtering sugar has resulted in a misleading deterioration in the filterability pattern for that month.

- (c) During the three months June, July, August 1965, Tongaat supplied 34 per cent (40,200 tons) of all Natal raws processed at the Refinery. Of this total 28,000 tons filtered below 20 per cent filterability. Within the same period Felixton (1,600 tons) and Empangeni (3,000 tons) were the only other suppliers of sub-20 per cent filterability sugar. It can be seen that the influence of Tongaat sugars or the filterability patterns for these three months was very considerable.

Conclusions

The quality of raw sugars processed at Hulett's Refinery has shown considerable improvement over the past three seasons. Filterability has increased, impurities within the crystal have decreased and grain size has improved though the sugars contain, on an average, about 10 per cent too much fine grain.

The improved quality of sugars sent to the Refinery is probably indicative of overall improvement in Natal sugars though the overall change in quality is likely to be less obvious.

It would appear, from a study of variations within each season, that the Refinery receives a greater percentage of good filterability sugars during the period July to December, with the peak months August to October.

However, because of the many factors which combine to influence the supply of raw sugar to the Refinery, it is not possible to assess whether the intra-seasonal fluctuation in quality noted for refinery sugar extends to Natal raw sugar as a whole.

Analytical Methods Used

Filterability was determined by the method devised by the Colonial Sugar Refining Company (2).

The Spectrophotometric method, based on the formation of the iodide complex (1) was used to determine starch.

Sulphated ash was determined (3) on sugar affined in the laboratory.

Grain size was calculated after sieving sugar washed according to the ICUMSA method (3).

Summary

The improvement in refining quality of raw sugars sent to Hulett's Refinery over the past three seasons is assessed in terms of filterability, grain size and impurities within the crystal.

Acknowledgments

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References

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