

Loss in Polarization of Natal Raw Sugars on Storage.

By L. BLACKLOCK.

Having regard to the state of the Sugar market to-day, and the extraordinarily low prices which our product realises, no apology is needed for the introduction of a subject for your consideration and discussion, which is intimately connected with, and has a distinct bearing upon the value of sugar to the buyer or refiner.

The amount realised for the outturn of a mill is dependent upon certain polarization figures obtained from the product at the time of delivery to the buyer. It has long been known that deterioration of sugar is inevitable with the lapse of time. And in general a more or less rapid loss of polarization occurs, beginning in exceptional cases right from the time of manufacture.

Generally speaking, the longer the period between manufacture and delivery, the greater the loss, and the lower the equivalent received for the sugar in pounds, shillings and pence. This loss is to some extent controllable—being governed by several well-known factors, and it is only by concentrating on these factors that serious losses to the mills and the industry can be reduced, and to a great extent obviated.

The export quota has now reached considerable dimensions, and the price realised for export sugar has a large influence in modifying the value of each mill's output for the season. This export sugar is paid for on a 96° Pol. basis, and a sliding scale, with the usual bonuses for higher qualities. The analysis upon which the payment is made, is that of a sample taken at the time of arrival at its destination. This time may be anything from four weeks to four months from the time of manufacture, so that, in addition to sugars being of high grade, good refining quality, strong grain, low sulphur dioxide, it is most important that they also be of good keeping quality.

The necessity for this was exemplified only recently, in the case of a large cargo of Natal sugar shipped overseas. The greater part of the cargo had lain in storage in Durban some four months. A sample drawn from this sugar at the time of loading into the ship's hold showed a rather startling analysis.

An average over the cargo showed against the original mill record of polarization a loss of nearly 5 degrees. Practically the whole cargo was in a state of active inversion. An investigation was carried out, full analyses of the mill record bottles, and of the ships' samples were made, and the considered opinion of the investigators was, that the sugars had not been sufficiently dry when bagged to ensure compliance with the factor of safety rule, as affecting their keeping quality.

This factor of safety is based on a definite relationship between the moisture and non sucrose contents of a sugar. The establishing of this relation was the result of researches made in Australia, some 15 years ago, and it was subsequently adopted by the Colonial Sugar Refining Co., there, as a guide in their dealings with raw sugars.

It was found that the moisture in a sugar must not be more than half the other non sugars if the product was to keep. In other words, if the percentage of water is divided by the residue left after subtracting from 100 the sum of the sucrose plus water—the result must not exceed .50 or simplifying this $\frac{\text{water}}{100 - \text{sucrose}}$ should not exceed .30.

The more recent investigation of Browne, shows that this rule is one that can be relied upon in the great majority of cases. A most important corollary to this rule is, that slight fluctuations in moisture content have a much greater influence on high grade, than on low grade sugars.

Thus, 10% of increase in moisture, will raise the factor of a 99 degree sugar, having say .28% water from .28 to .35, transforming it from one of fairly good keeping power, to one decidedly unsafe. The same increase in respect of a 90 test sugar having 2.8% of water, will only raise the factor from .28 to .29.

The export sugars in question, and indeed the bulk of the Natal export quota were high grade raws, to which this corollary is particularly applicable. The control and limitation of moisture content in these sugars is, therefore, most important—a fact which the refining interests have always appreciated, and which justifies the attitude taken up by the refinery upon the moisture question.

During the past season, the great majority of the sugars supplied to the refinery have been fairly dry, and it was only during the last three weeks of the campaign, when some 10,000 tons of sugar which had been in storage four or five months came to be melted that any serious deterioration was noticed.

The average loss of polarization over this quantity amounted to 1.35%, the invert sugar content having increased to 1.17%. Had it been possible to keep this sugar up to its original sucrose content, the outturn for the season would possibly have been increased by some 180 tons refined sugar. This loss affected the refinery directly, but the whole industry indirectly.

Deteriorated sugars which are exported have a restricted sale to begin with, for only a refiner who can be sure of melting them immediately will buy them, and the price obtained is that of low grade, instead of high grade raws:

The safety factor rule referred to is, of course, only defining one set of conditions under which inversion may proceed. In the great majority of cases, the primary agents effecting the destruction of sugar in storage are micro-organisms, such as fungi, yeasts and bacteria. These organisms are present in all sugars, but the degree of infection, and the number of such bodies present per unit of weight, can be controlled by strict cleanliness in the mills; sterilised water or molasses wash in the centrifugals, and abolition of all breeding spots, fermenting pools, etc., especially along the course of the sugar from the centrifugal machines to the store room.

Given favourable conditions, such as a highly infected sugar mill, the sugar, of course, deteriorates with greater rapidity, but this deterioration can only occur under certain conditions, which favour the activity and multiplication of the organisms.

A diluted molasses film, or a dilute sugar solution, preferably of slightly acid reaction, is a suitable medium for their growth. Such a film exists on raw sugars, which have been washed up by water in the centrifugals, and not sufficiently dried by exposure to normally dry air, or by heat in some drying apparatus.

Crystal formation enters into consideration here. Poor crystal formation is usually accountable for high moisture content of raw sugars, as small crystals and irregular grain carry increased molasses film. Such sugars call for excessive washing, for they purge badly. Thus the protective molasses film is destroyed, part of the crystal goes into solu-

tion, and fermentation and loss of polarization follows. In this latter case it is seen that as the molasses film is destroyed the ratio of water to non sucrose elements rises rapidly, and the dangerous conditions obtain, which have been defined by the factor of safety rule.

This favourable medium for the existence of destructive organisms, can also be produced in a dry or safe keeping sugar, by absorption of moisture from humid atmosphere—or undue exposure to damp conditions of storage. Having the medium provided, development is encouraged and stimulated by any or all of the following conditions:—

Acidity:

Sugar having acid reaction, is more liable to deteriorate than one having neutral or alkaline test.

Bad Storage Conditions:

Access to humid atmosphere, permitting further absorption of moisture. Also possibility of further infection by contact with sweating sugars.

Elevation of Temperature:

Having produced a clean high-grade raw sugar, it will be realised then, that we have a product which is difficult to keep in its original high polarization condition over any protracted period, and therefore sugar destined for export as well as that going to the local refinery should be carefully controlled, in the first place, in respect of its moisture content. The grain should be of uniform size—about 1mm.; the sugar should not be acid. It should be purged, conveyed and bagged under clean conditions.

The practice of mixing low purity sugars with high purity sugars after drying in the effort to make a medium quality raw, cannot be too strongly deprecated in this connection. The mixture is never perfect, and apart from the impossibility of obtaining a representative sample for analysis and payment, such a mixture is invariably of bad keeping power, although each of the component sugars would probably keep well by itself. Equilibrium in the bag seems to be disturbed by the migration of moisture from the low to the high grade sugar, and fermentation and inversion soon occur.

Storage and transport conditions should be as perfect as possible—it should be remembered that the lowest temperatures possible in the store is the safest. That even a slight degradation of sugar in stock can cause serious losses, as is shown by the following refinery figures taken over the later years.

Season 1926/27. Over a total of 65,000 tons—the available sugar lost before melting = 349 tons.

Season 1927/28.	Over a total of 99,214 tons—the available sugar lost before melting = 595 tons.
„ 1928/29.	„ „ „ „ 111,939 tons—the available sugar lost before melting = 754 tons.
„ 1929/30.	„ „ „ „ 85,895 tons—the available sugar lost before melting = 319 tons.

While the sugars from the mills this Season were on the whole of good keeping quality, there is still some little room for improvement in this respect.

There is nothing new in the above remarks. They were inspired by the investigation into the cause of extraordinarily low polarization figures returned on sales notes of sugars sent overseas, and are intended to sound a note of warning, and possibly to provide a subject for ventilation and discussion.

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CHAIRMAN (Mr. Dodds): I think you will agree with me that this subject is of such importance as to be a sufficient excuse for allowing Mr. Blacklock to chip in with his paper in an already over-crowded programme, and I am sure the Association and the Industry ought to be very grateful to Mr. Blacklock for having brought this important matter to their attention. With regard to this factor of safety, he mentioned, I would like to ask Mr. Blacklock whether it is determined as a regular routine in his tests?

Mr. BLACKLOCK: No, it is not. It has only cropped up recently.

CHAIRMAN: It supplies a powerful argument in favour of drying raw sugars, especially where the practice is carried out in the case of some factories of washing with water in the centrifugals.

Mr. MOBERLY: Is anything done for keeping the humidity in the air down in the storerooms?

Mr. BLACKLOCK: Nothing is done in our case. We have perfect storage in other respects, but we

cannot govern it, but we can estimate it and regulate it by opening or closing the doors. But we try to keep the temperature as equal as possible having regard to the saturation of the atmosphere at the same time.

Mr. MOBERLY: Would it be practicable to fit up the storerooms in such a way that any air entering or coming in could be treated by some means?

Mr. BLACKLOCK: I think it is too big a thing to tackle. Our storeroom serves a double purpose; the raw sugar store is both a place to dry sugar over a long period and also to receive and pass on sugar arriving daily from the mills. One side of the storeroom is generally more or less open for the purpose of off-loading sugar from the trucks, therefore, one cannot, of course, deal with the air coming in through these big apertures. The ideal would be, as you suggest, to dry the air by passing it over lime, or cool it before it enters the store, which would be better still, as the effect would be both cooling and drying, and perhaps partly sterilising.

Mr. PALAIRET: Do we understand the store is cooled, or is the air cooled as it comes in, because cooling in this climate leads to condensation?

Mr. BLACKLOCK: I was referring to the air coming in and to the hot atmosphere which is accumulated in the store to make it more equable with the outside air.

CHAIRMAN: It is really a case of extracting the moisture from the air coming in by cooling.

Mr. BLACKLOCK: It is also a case of opening or shutting the doors to regulate the atmosphere. On a dry day it is good thing to open the doors to let the air through, but on a wet day it is equally desirable to keep them all shut tight, if possible.

CHAIRMAN: If there are no further comments, I will ask you to pass a very hearty vote of thanks to Mr. Blacklock for his paper.

Carried with acclamation.

CHAIRMAN: The next item is one left over from yesterday—the Report of the Committee on Training Sugar House Assistants.

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