EVALUATION OF THE SACCHAROFLEX 2000 REFLECTANCE MEASURING INSTRUMENT FOR REFINED SUGAR COLOUR ESTIMATION AT HULETTS REFINERY

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Abstract

Due to the successful use of the Saccharoflex 2000 reflectance measurement instrument on the estimation of refined sugar colour elsewhere in the world, it was decided by Tongaat-Hulett Sugar to evaluate the instrument at the refinery in Durban. Tests were carried out on first, second, third and fourth refined sugars, the results of which showed a good correlation between the ICUMSA colour measurement and the reflectance reading obtained from the Saccharoflex 2000. The instrument offers a number of advantages, the main one being that a refined sugar colour value can be obtained in less than a minute. The refinery has therefore purchased one for process control.

Keywords: colour measurement, ICUMSA, refined sugar, reflectance

Introduction

Colour is an important quality control parameter in sugar refining. The current ICUMSA method involves dissolution, filtration and pH adjustment of the sample prior to measuring the absorbance with a spectrophotometer. This process takes time and is not ideal for process control, where a quick indication of the colour value of streams in the refinery would have a number of advantages. Colour instruments which can rapidly estimate the colour of raw and refined sugar are available. Nielson (2000) described the Neltec instrument installed in refineries in America and Europe, that can give a value for the colour of refined sugar on-line by correlation with reflectance measurements. Also, work carried out by Moodley *et al.* (1999) showed that the Hunterlab colour measuring system could be used successfully to estimate the colour of raw sugar in the laboratory.

A Saccharoflex 2000 reflectance instrument, supplied by Schmidt and Haensch, was used on the pan floor in the refinery of the Mhlume mill to obtain a quick value of the refined sugar colour. The colour results were used to optimise the wash water settings in the refined sugar centrifugals. Due to the many potential benefits associated with this instrument, it was evaluated at the Huletts refinery over a two-month period. A photograph of the instrument is given in Figure 1.

The instrument is easy to use and is calibrated once daily using Brunswick standards 0 and 6. A photograph showing the refinery analyst measuring the colour of a sample of refined sugar is shown in Figure 2.

Results and discussion

Samples of refined sugars were analysed for colour by the ICUMSA method, and the reflectance was measured using the Saccharoflex 2000 to generate the calibration data. The results are plotted in Figure 3.

Figure 1. The Saccharoflex 2000 colour measuring system.

Figure 2. Huletts refinery analyst using the Saccharoflex 2000 instrument to read the reflectance of a refined sugar sample.

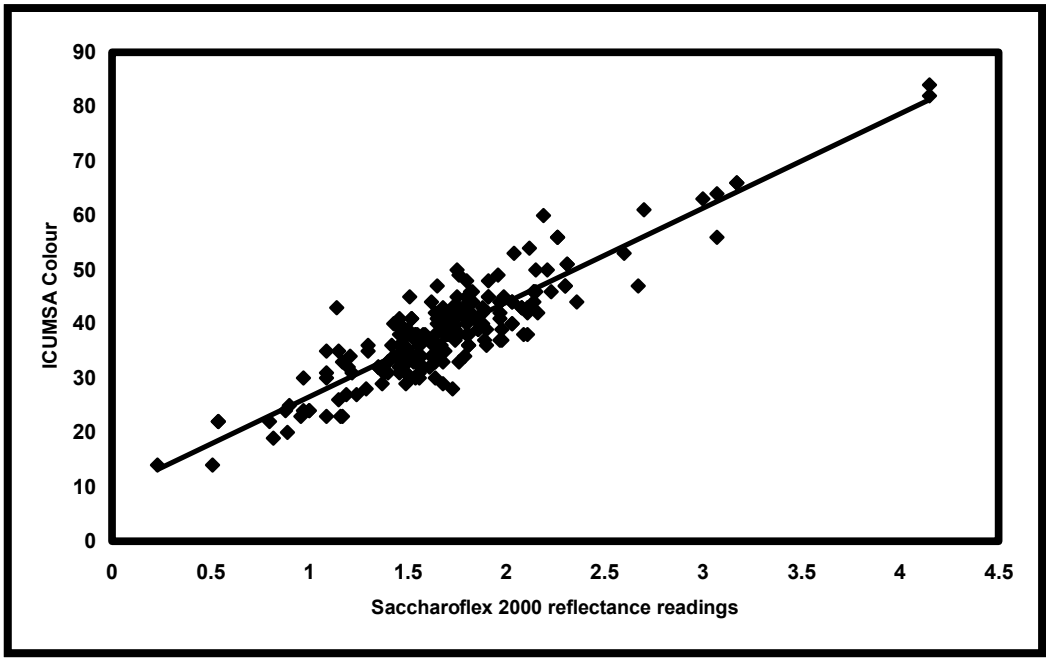

Figure 3. Saccharoflex 2000 reflectance measurements versus ICUMSA colour values.

The results show a good correlation between the reflectance readings and the ICUMSA values. The linear regression equation is as follows:

$$ICUMSA\ colour = 17.39 \times reflectance\ reading + 9.14 \quad (1)$$
$$r^2 = 0.81,\ n = 218$$

The average difference between the ICUMSA colour and the colour value calculated from the reflectance measurements was less than 1%. This was not considered significant for process control.

The equation that was derived by Mhlume ([1]personal communication) is as follows:

$$ICUMSA\ colour = 14{,}75 \times reflectance\ reading + 10{,}38 \quad (2)$$

For the tests done at the refinery laboratory the equation derived by Mhlume was also used to calculate the ICUMSA colour. The average difference of the estimated refined sugar colour between the two equations was 3 units of colour.

The Sugar Milling Research Institute (SMRI) prepared 12 samples, which included a pair of duplicates of refined sugar for colour measurements. The ICUMSA colour was done by both the SMRI and TMD laboratories on the samples. The reflectance of the refined sugar samples was also measured, and equation 1 was used to estimate the ICUMSA colour value. The results are given in Table 1.

The following comments can be made regarding the results in Table 1:

- There was no significant difference (t-test) between the colour values measured by the SMRI and TMD laboratories. The duplicates (6 and A, 9 and B) agreed reasonably well.

[1] L Govender, Mhlume Sugar Mill

- Most of the colour values estimated by the Saccharoflex 2000 agreed reasonably well with the values measured by the SMRI and TMD except samples 9 (duplicate B) and 10. The colour results as estimated by the Saccharoflex 2000 for samples 9, B (duplicates) and 10 were higher than the ICUMSA colour values. No reason could be found for this. The duplicates (6 and A, 9 and B) agreed reasonably well.

Table 1. Comparison of colour results.

Sample	SMRI	TMD	Saccharoflex 2000
1	38	40	40
2	40	40	42
3	44	43	40
4	45	41	42
5	38	37	36
6*	24	26	24
7	32	35	29
8	34	44	37
9#	73	68	42
10	43	46	28
A*	24	27	23
B#	73	61	41

*Duplicates #Duplicates

The results of the investigation showed that the Saccharoflex 2000 can be used successfully to estimate the colour of refined sugar for process control purposes, and the instrument has therefore been in use in the laboratory since October 2003.

The refinery generally boils four white massecuites. Prior to 1991, these boilings were combined to produce the final refined sugar. In 1991 the twin streaming system, where most of the first and second refined sugars were sent to the silo and the rest of the refined sugars were combined to produce the H1 stream, was implemented. As a result of this, the number of colour analyses carried out per shift increased from 8 to 26.

A typical hour in the laboratory sees the following procedures being followed:
- The four white boilings are received from the pan house.
- The samples are analysed for colour.
- The results of the individual sugars are entered into the colour balance programme in the computer which determines the way the sugar from the centrifugals should be blended to produce the required refined sugar quality.

The total process takes about 45 minutes, and it is possible that some refined sugar which is out of specification could be sent to the packaging department. This ‘off-spec’ sugar would have to be rejected, incurring re-processing costs.

When compared with the ICUMSA method, the time taken to obtain a colour value with the Saccharoflex 2000 is reduced from 10 minutes to one minute.

Benefits of the Saccharoflex 2000
- Reduction in time to do the measurement of colour from 10 to 1 minute.
- Possibility of some labour saving.
- Reduction in chemical cost amounting to between R40 000 and R80 000 per annum.

- Possibility of reduction in amount of reject sugar due to quick colour measurement.
- Can be used by process to optimise centrifugal wash water settings.

Conclusion

The results showed that colour estimated by the Saccharoflex 2000 was comparable with the colour obtained by the ICUMSA method, and the instrument can therefore be used for process control.

Due to the benefits of the instrument, and based on a pay-back period of one year, the refinery has purchased an instrument for process control.

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