PRELIMINARY RESULTS OF HYDROGEN PEROXIDE TRIALS AT GLEDHOW REFINERY

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Abstract

Trials were undertaken at the Gledhow refinery (GH) to determine the effectiveness of hydrogen peroxide dosing under South African factory conditions for colour reduction. Peroxide was dosed into the raw melt at a rate of 200 ppm on brix. The peroxide apparently eliminated a colour rise from melt to limed liquor, but the first and second sugar colours were little changed. However, the colours of the third and fourth sugars dropped significantly, resulting in a lower colour for the packed refined sugar. The use of peroxide addition to raw melt thus was considered to be of benefit.

Introduction

Hydrogen peroxide (H_2O_2) has often been considered as a possible colour removal agent in sugar refining. Some laboratory tests have been performed at the Sugar Milling Research Institute (SMRI) in recent years, and these tests showed that peroxide worked well in combination with conventional decolourisation processes such as carbonatation. However, subsequent short tests run in a refinery were inconclusive (Moodley, 1994).

Recent marketing drives by a local supplier of hydrogen peroxide and competitive pricing has led to peroxide being reconsidered for colour control in refineries. Trials at GH refinery were undertaken to evaluate the effectiveness of peroxide, particularly with a view to controlling refined sugar colours to low specifications for particular customers.

Methods

Natural variations in incoming sugar quality and colour and processing conditions make it difficult to obtain clear results from factory trials when small improvements in colours (10-20%) are expected. It is thus necessary to run such trials by taking samples before, during and after chemical addition to smooth out these variations and to allow for the effects of the chemical being tested to work through the entire refinery, including all recycle streams. The peroxide trials at GH were run in five parts during the 1999 season from 5 July to 9 August, with peroxide being dosed during the second and fourth periods.

The hydrogen peroxide, supplied as a 50% solution, was dosed into the suction side of a melt pump at the melter outlet by means of a diaphragm pump. This was considered to be the best application point, following work reported by Moodley (1992) and by Davis *et al.* (1998) on ozonation. The dosage started at 120 ppm on brix, increasing to 200 ppm on brix on 15 July. For the second trial, a dosage rate of 200 ppm on brix was maintained throughout.

The results of this trial come from the routine sampling and analysis performed by the mill laboratory. The liquor samples were: raw melt (sampled just before the liquor wheel), filtered carbonated liquor and filtered sulphited liquor, sampled once per shift. First and second sugars were analysed for only one shift per day, while third and fourth sugars were generally analysed for two shifts per day. Dryer and packing station sugars were sampled at least once per shift, generally more, but averaged to a shift basis. All samples were analysed for ICUMSA colour at pH 7. Finally, two 30 kg samples of filtered sulphited liquor were taken, one during the first trial and one between trials (i.e. with no peroxide addition), and boiled in the SMRI pilot pan.

Results

The full set of results is available in a SMRI Technical Report (Davis, 1999), with the mean values of colours and colour removal percentages with and without peroxide dosing being shown in Table 1. The most important results are those of refined sugar colours, represented in Figure 1 by the daily average sugar colours measured at the dryer and at the packing station. The residence time of sugar in the conditioning tower means that there is a delay in sampling the packing station sugar. Hence, these colours have been shifted forward by 60 hours so that the packing station colours correspond with the dryer colours and the periods of peroxide dosing.

As a result of the variability of the colours, it was necessary to use statistical analysis to determine how significant an effect peroxide addition had on the refinery colours. For each product, a t-test was performed on shift samples to check for significant differences between those taken during peroxide addition and those taken with no addition. The p-values of these t-tests are shown in Table 1, with the lower values indicating more significant differences.

Discussion

There were a number of confounding factors in these trials, as follows.

- the variability in melt colours,
- a suspected, but not proven, large increase in colour (10 - 20%) between the melter and the sampling point just before the liquor wheel with no peroxide dosing,

- variations in the degree of sulphitation used in the first trial,
- rejection of some of the fourth sugars before and during the first trial, and
- the occasional practising of forward boiling of 3rd and 4th sugars. The pan boilers sometimes fed forward some fine liquor if they saw high liquor colours. This prevented fourth sugar rejects, but no records of forward boiling were available for these trials.

Hence, there is some uncertainty whether the lower sugar colours measured during peroxide addition were indeed the result of the addition, or whether it was coincidental that the melt colours happened to be lower during these periods.

However, the sugar colour differences reveal an interesting trend, in that there were no significant differences between the first sugar colours and between the second sugar colours, but the third sugar colours did show a significant difference, and the fourth sugar colours showed a highly significant difference. This was expected, as one of the benefits of peroxide dosing has been stated to be smaller colour increases during boiling as a result of the removal of colour precursors. These differences also carried through to the refined sugar colours.

The liquor samples boiled in the pilot pan were similar, with the peroxide dosed sample showing lower colours. The most interesting result is the colour increases from feed to massecuite during boiling, 19% for the non-peroxide dosed sample and 5% for the peroxide dosed sample. This seems to confirm the idea that peroxide dosing leads to lower colour increases, and so would explain the similar first sugar colours but increasingly lower colours the more boilings are done, as previously mentioned.

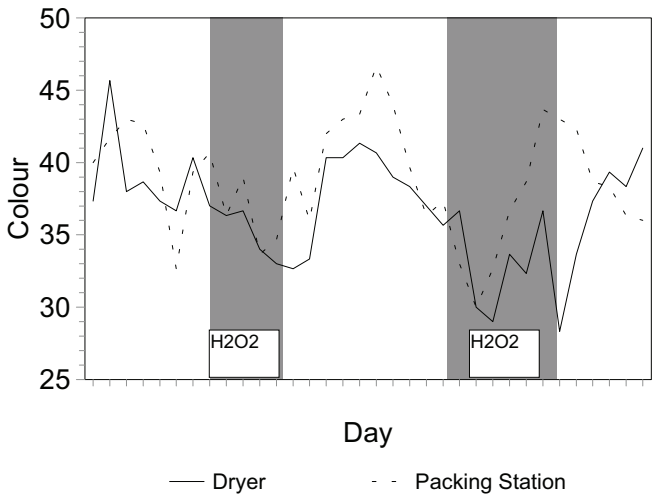

Figure 1. Refined sugar colours.

Table 1. Results of statistical analysis.

Variable	Mean value (no H_2O_2)	Mean value (with H_2O_2)	p-value	Significant at 1% level ?
Sampled melt colour	905	774	0.000001	yes
Carbonated liquor colour	572	502	0.000438	yes
Sulphited liquor colour	433	400	0.022911	no
% Colour removal over carbonatation	37	35	0.352763	no
% Colour removal over sulphitation	24	20	0.001999	yes
% Overall colour removal	52	48	0.010723	no
First sugar colour	26	22	0.025403	no
Second sugar colour	34	32	0.210625	no
Third sugar colour	54	48	0.001825	yes
Fourth sugar colour	80	63	0.000055	yes
Dryer sugar colour	38	34	0.000002	yes
Packing station sugar colour	40	37	0.000396	yes

Conclusions

- Despite some difficulties with sampling and consistent operation during the trials, they indicate that peroxide dosing into melt at 200 ppm on brix has a significant positive effect on refined sugar colours.
- The two main effects appear to be to prevent colour increases from raw melt to the liquor wheel, and to reduce colour increases during pan boilings.
- Further trials have been run, with more consistent process control and better sampling, but the results were not available at the time of going to press.
- The initial results are encouraging, and it is expected that the results of the further trials will demonstrate significant positive benefits of peroxide dosing to melt. Once these results are available, an assessment of the economics of the process will be made.

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