AN EVALUATION OF VISC-AID TREATMENT AT DARNALL MILL

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Abstract

The claimed benefits of the use of Visc-Aid were investigated at Darnall Mill during the 1976 season. Method of application and results are discussed.

Introduction

Visc-Aid, a chemical pan additive, is manufactured by Fabcon International and marketed in South Africa through Farmers' Organisation. The claimed benefits of this product are that it improves pan circulation by increasing massecuite fluidity, thus allowing faster and more uniform growth of crystals with subsequent easier separation from molasses. When added to pans and crystallisers, the nett effect would be an increase in overall recovery of sucrose. A comprehensive test to validate these claims was carried out at Darnall Mill.

Method of comparison

The procedure took the form of a three week control period followed by three weeks with Visc-Aid addition, repeated to cover a total of 15 weeks. The test periods for the comparison were:

Period 1 (W/E 20/6 27/6 4/7) Control
Period 2 (W/E 11/7 18/7 25/7) Visc-Aid added
Period 3 (W/E 1/8 8/8 15/8) Control
Period 4 (W/E 22/8 29/8 5/9) Visc-Aid added
Period 5 (W/E 12/9 19/9 26/9) Control

The method of comparison was to group all the "Control" period data together and to determine the mean value and standard deviation for the particular parameter under consideration. Similarly, data for all the test periods were grouped and analysed.

A normal t-test was done on those two mean values in order to determine the statistical significance of any difference which may have occurred.

A level of significance of 5% means that it can be said, with confidence of 95% that the difference between the means did not occur by chance but through the interaction of some outside factors.

This method of comparison was applied to Boiling House Recovery, Target Purity Difference, etc., but as these are based on weekly figures, there was an insufficient number of data points. The comparison was, therefore, expanded to cover the parameters listed below on a daily average basis.

Actual parameters compared were:
(1) Exhaustion of A, B, and C massecuite
(2) Massecuite Brix
(3) Massecuite Viscosities
(4) Pan Boiling Times

The application of the chemical

Visc-Aid was added at the suppliers' recommended rate of 10 ppm on cane, proportioned to syrup, A, B and C massecuites, and continuously metered by chemical dosing pumps.

From a stock solution of 1% Visc-Aid, 5 ppm (or half the total amount) was added to the syrup at the pan feed tank and 1,7 ppm sprayed into the last of each of the A and B crystallisers. A 0,5% solution, equivalent to 1,7 ppm on cane, was drip fed into the last C crystalliser. All the above dosing rates were checked twice per shift.

Sampling

Samples were taken of every A, B and C massecuite for analyses. Nutsches of massecuites after cooling and, where applicable, after reheating were taken every 4 hours.

Molasses samples were taken every 2 hours and analysed.

Results

(*a*) *A Massecuite Exhaustion*

In assessing the values given in Table 1, for a change in any result to be statistically significant and not due to chance the associated t-value must be greater than 2. The most significant change was therefore the improved exhaustion of A massecuites when comparing the grouped control and test periods. Of the three components of overall purity drop, that for pan boiling indicated the best improvement, the difference in purity of molasses across the centrifugal was not as marked, while the purity drop for the crystallisers was virtually unchanged. In addition while the change in each of these components is not in itself significant, when grouped together as overall purity drop the combined result becomes significant. Some care must be observed when interpreting the statistical significance of these results, and the difference, where significant, must also be viewed in real terms. Thus the improvement in A massecuite exhaustion for example, was significant with the t-value of 2,36 and in real terms rose from 64,90 to 65,56, a difference of 0,66%.

TABLE 1

A-Massecuite	Control: Mean	Control: Std. Dev.	Visc-Aid: Mean	Visc-Aid: Std. Dev.	t-value	Degrees of Freedom	Level of Significance
Molasses purity	69,81	1,06	69,30	1,53	1,81	60	Not significant
Exhaustion	64,90	1,27	65,56	1,40	2,36	74	5%
Overall purity drop	17,02	0,80	17,46	1,02	2,30	66	5%
Pan drop	16,27	0,63	16,53	0,65	1,98	79	Not significant
Crystalliser drop	2,89	1,21	2,87	0,88	0,13	98	Not significant
Centrifugal drop	−2,15	1,08	−1,94	0,41	1,39	88	Not significant

(b) B Massecuite Exhaustion

Referring to Table 2, it appears that with the addition of Visc-Aid, there are marked improvements in B molasses purity (1,3 units), B massecuite exhaustion (1,18 %) and overall purity drop (0,83 units). All these results are highly significant at 98 or 99% confidence levels. As with A massecuite most improvement has occurred in the pans which would seem to indicate that Visc-Aid was carried through via Syrup and A massecuite.

There is also, unlike the A massecuite, a more significant drop in the crystallisers.

(c) C Massecuite Exhaustion

In view of the fairly lengthy residence times in process from syrup through to final molasses, the comparisons involving final molasses were staggered by 72 hours in an attempt to cater for this.

For reasons unknown, the significant improvement in the C massecuite and molasses purity profile, as shown in Table 3, took place in the crystallisers and not the pans, as was the case in A and B massecuites.

The results shown in Table 5, show that there was very little difference in both the C massecuite purities and brixes during the entire test. The change in purities across the crystallisers of 0,79 units represents the most significant result achieved viz. the t-value of 3,84 or 99,9% confidence levels. In real terms the use of Visc-Aid appears to have improved the overall purity drop, resulting in a final molasses purity 0,73 units lower than in the control periods.

(d) Reducing Sugar/Ash Ratio

Based therefore upon the comparison of daily data it would appear that the following differences are significant and in the right direction:

A — exhaustion
A — purity drop
B — exhaustion
B — purity drop
C — purity drop
B — molasses purity
C — molasses purity

It must however be ascertained whether the differences are due to Visc-Aid or to some other parameter (e.g. cane quality) which has changed.

As the Reducing Sugar/Ash ratio can be used as a guide to molasses exhaustibility, the daily final molasses purities for both control and test periods have been corrected to a common R S/ash ratio (formula in appendix) to make allowance for changes in massecuite quality and thereby enable direct comparisons to be made.

As can be seen in Table 4, in terms of both statistical and real values, there appears to be no conclusive evidence in favour of Visc-Aid. The purity difference drops from 0,73 units for the uncorrected values to 0,09 units once R S/ash ratio is taken in to account.

TABLE 2

B-Massecuite	Control: Mean	Control: Std. Dev.	Visc-Aid: Mean	Visc-Aid: Std. Dev.	t-value	Degrees of Freedom	Level of Significance
Molasses purity	46,02	1,95	44,72	2,47	2,76	66	1%
Exhaustion	62,55	2,83	63,73	2,07	2,07	64	2%
Overall purity drop	23,50	1,78	24,33	1,51	2,49	90	2%
Pan drop	20,95	1,15	21,37	1,03	1,89	87	Not significant
Crystalliser drop	5,36	1,48	5,66	1,33	1,04	87	Not significant
Centrifugal drop	−2,81	0,91	−2,70	1,01	0,58	73	Not significant

TABLE 3

C-Massecuite	Control: Mean	Control: Std. Dev.	Visc-Aid: Mean	Visc-Aid: Std. Dev.	t-value	Degrees of Freedom	Level of Significance
Molasses purity	30,61	2,09	29,88	1,60	1,97	96	Not significant
Exhaustion	58,93	3,44	59,16	2,01	0,43	101	Not significant
Overall purity drop	20,41	2,25	21,18	1,13	2,29	98	5%
Pan drop	14,73	1,45	14,62	0,81	0,48	100	Not significant
Crystalliser drop	6,94	1,39	7,73	0,81	3,84	101	Beyond 0,1%
Centrifugal drop	−1,26	0,30	−1,23	0,27	0,49	87	Not significant

TABLE 4

	Control: Mean	Control: Std. Dev.	Visc-Aid: Mean	Visc-Aid: Std. Dev.	t-value	Degrees of Freedom	Level of Significance
Final molasses purity	30,61	2,09	29,88	1,60	1,97	96	Not significant
Corrected final molasses purity	30,25	1,00	30,14	0,87	0,57	89	Not significant

It is also clearly evident from Figure No. 1 the effect R S/ash ratio has in the purity profile. Although the R S/ash ratio plotted is applicable to final molasses, the plots for A and B molasses follow almost exactly.

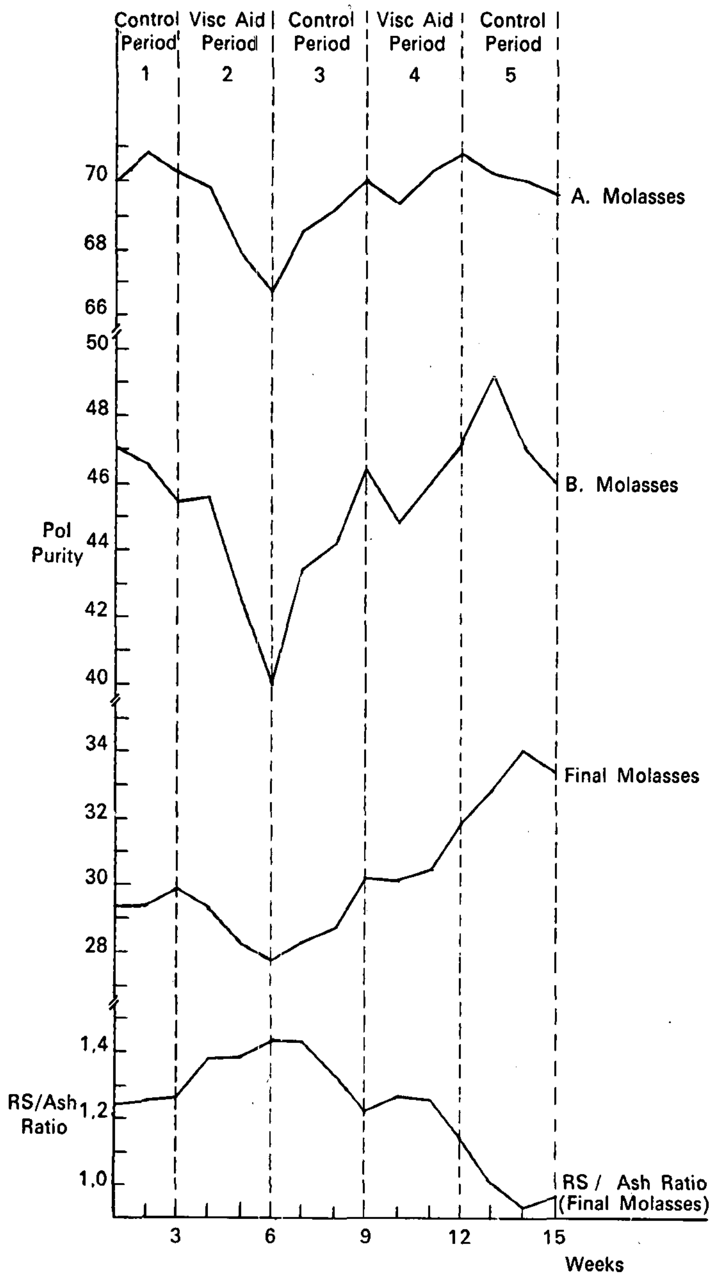

FIGURE I

(*e*) *Massecuite Brix*

Due to improved massecuite fluidity an increase in massecuite brixes should have been possible. Attempts were made to increase the brixes of A and B massecuites, while maintaining that of C, but problems of striking the massecuites were encountered.

(*f*) *Massecuite Viscosities*

Several attempts were made to monitor massecuite viscosity by using a Brookfield Viscometer with a No. 7 spindle. As the results proved inconsistent no data are given.

(*g*) *Pan Boiling Times*

The general impression was that pan boiling times were reduced slightly. Although cuitometers are fitted to B and C pans, they, unlike fully automatic systems, do not boil to a prescribed height above the tube plate.

Pan times were therefore extracted from the log book and based on these a 5% reduction was evident.

Cost comparison

Based on 100 000 tons of cane and 10 ppm of Visc-Aid on cane, the cost of using this product would be R4 060 (i.e. 4,06c/ton cane). In order to cover costs, this would require the production of an extra 34,7 tons of sugar at the current marginal value of R117 for Huletts.

In other words for cane at 13% pol; and an extraction of 96, an increase of 0,28% in Boiling House Recovery would be necessary. The increase, during the Visc-Aid periods, was not evident, but it should again be emphasised, that as this is based on a weekly figure statistical differences for so few data points is meaningless.

Other aspects which were not studied:

(1) less power consumption
(2) less steam consumption
(3) any other benefits.

Conclusion

As is usual in evaluations of this kind, it is difficult to remove or correct for the interference of changing conditions.

One must question whether the significant drops in A, B and final molasses purities were due to the change in R S/ash ratio alone, or whether a contribution was made by Visc-Aid. In this context, it should be emphasised that in almost every case the change, whether statistically significant or not was in the favourable direction. This in itself must then be highly significant.

TABLE 5

	Control:		Visc-Aid:				
A-Massecuite	Mean	Std. Dev.	Mean	Std. Dev.	t-value	Degrees of Freedom	Level of Significance
Purity	86,82	0,48	86,76	0,72	0,45	58	Not significant
Brix	92,73	0,28	92,76	0,22	0,68	94	Not significant
B-Massecuite:							
Purity	69,52	1,16	69,05	1,33	1,80	72	Not significant
Brix	94,28	0,50	94,47	0,46	1,87	85	Not significant
C-Massecuite:							
Purity	51,02	1,12	51,06	1,80	0,14	56	Not significant
Brix	97,34	0,35	97,29	0,46	0,51	64	Not significant

Though difficult to quantify, it is the author's opinion and that of the pan boilers that Visc-Aid was beneficial to process operations. With the installation of fully automatic pan boiling systems in the near future, together with a pilot C crystalliser in which conditions can be reproduced, it is planned to continue with this investigation next year.

In addition, Visc-Aid will be added to the centrifugal lubricating water in an attempt to obtain better mixing and minimise the amount of water required.

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Appendix

(i) $$\text{Exhaustion} = \frac{10\,000\ (\text{Purity massecuite} - \text{Purity molasses})}{\text{Purity massecuite}\ (100 - \text{Purity molasses})}$$

(ii) Daily molasses purities corrected for reducing sugar/ash as follows:

$$(\text{Corrected molasses purity})_{j,i} = (\text{molasses purity})_{j,i} - 19{,}6\ \log_{10}\left[\frac{\frac{RS}{Ash}\ \text{for week i}}{\frac{RS}{Ash}\ \text{for week i}}\right]$$

where the subscript (j,i) refers to day j from week i.