A SIMPLE AND INEXPENSIVE EVAPORATOR ENTRAINMENT SEPARATOR

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Abstract

Use of angle iron separators in two evaporator vessels at Darnall resulted in a marked reduction in entrainment rates. Efficiencies in excess of 90% were observed with negligible pressure differential across the separator. Separator efficiency can be evaluated rapidly by using a centrally based Auto-Analyser.

Introduction

To avoid sugar losses by entrainment, all evaporator vessels are fitted with some means of separating droplets of juice from the vapour stream. Numerous designs of "save-alls" or "entrainment separators" are currently in use, the principle of operation being that from a change in direction and velocity of the vapour, small droplets of juice are collected and returned to the juice surface.

Evaporator Station

The layout of the evaporator station at Darnall is described in Figure 1 showing the steam flow only. It should be noted that while Fletcher 2 supplies vapour to Fletcher 3 and 4 in parallel, the juice remains series connected.

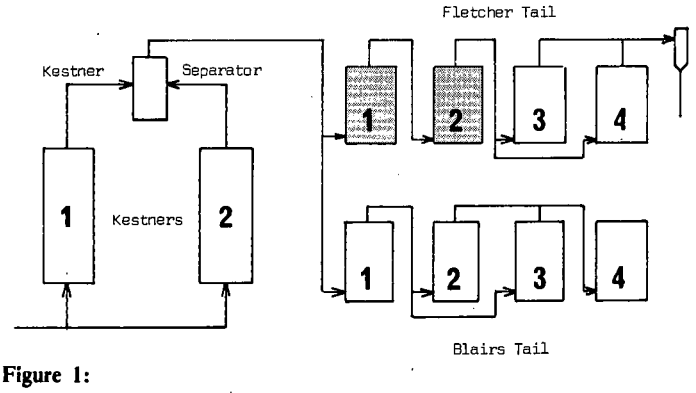

Figure 1:

In August 1977, severe carry over problems led to a detailed investigation of the entrainment rates in all evaporators. Prior to this investigation, it was known that the entrainment rates of these vessels was unacceptable, and results showed Fletcher 1 and 2 vessels to be the worst (shaded in figure 1).

Following the expansion of the mill in 1976 and 77, and converting the Fletcher tail from a quin to a quadruple arrangement, vapour velocities in these two vessels had risen to $\pm$ 1,5 m sec^{-1}.

Modifications to the original "save-all" (see Figure 2) included the fitting of more and bigger J tubes, and welding deflector strips on the outside wall, where the vapour undergoes centrifugal action.

Umfolozi and Tongaat sugar factories have used angle iron separators with success. In the case of Tongaat,[1] this consisted of a single tier arrangement situated under the demister screen, to reduce the load on the screen and hence the cleaning frequency.

Plant

A home made angled separator was subsequently fitted to No. 2 Fletcher. This consisted of 150 mm diameter galvanised guttering in two layers with a double inverted configuration. The entire structure, which spanned the full diameter of the cast iron evaporator, was supported by four legs standing on the tube plate. While in operation a marked improvement in entrainment

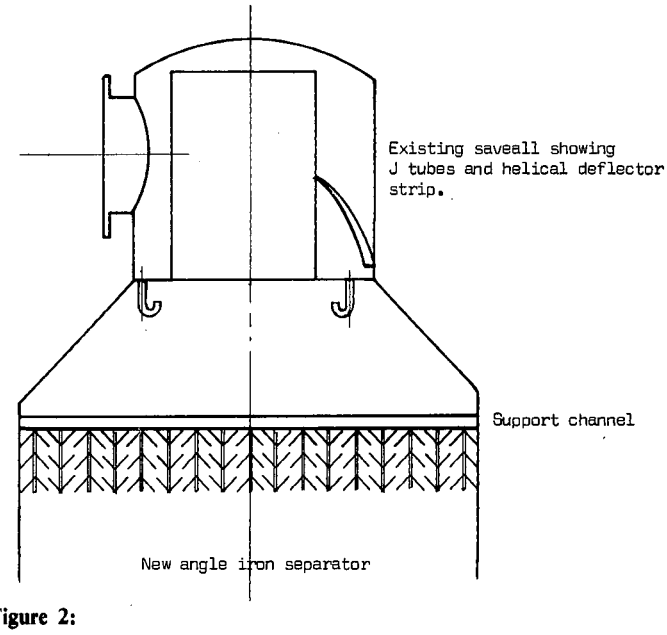

Figure 2:

rates was found, but after a short while the flimsy structure collapsed. As the design was successful, it was decided to install a rigid angle iron separator. (Figure 3).

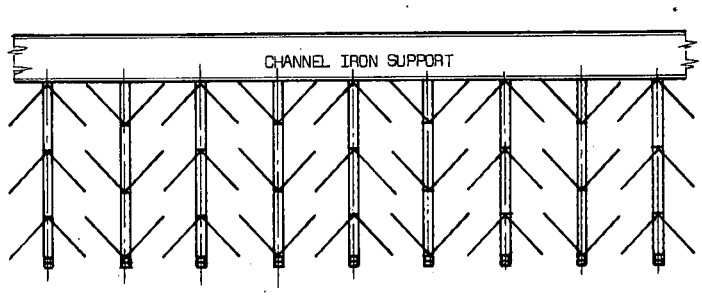

Figure 3:

Material used was 16 gauge, 260 mm wide mild steel plate, bent at 90° along the length. The entire structure is suspended from 2 channel irons, which in turn are supported by 4 legs resting on the tube plate (In the case of mild steel vessels, the channel irons would be welded directly to the wall).

The vertical distance between the angle irons is fixed by spacers on the support bolts. Removal of the angle irons is done simply by undoing the bottom retaining nuts. To allow the droplets of juice to run off, the whole structure is tilted 2° in one direction. Total cost, including installation and labour for the three tier system was R600.

Sampling and Analyses

Catch samples of the various condensates were taken every hour, and 10 drops of basic lead acetate added to approximately 15 ml of sample in a test tube. These samples were then sent to Huletts' Research and Development for analyses by auto-analyser.

The method of sampling and analysis developed by K. Schäffler[3] proved most successful, as a large number of samples could be accommodated, and results received within a short period.

Result and Discussion

TABLE 1

	ppm sugar		% reduction
	Before	After	
No. 2 Fletcher condensate	156	19	92,6
No. 3 Fletcher condensate	493	20	96,0
No. 4 Fletcher condensate	455	14	97,0

The results shown in Table 1 are the average of numerous individual tests. There can be no doubt that this type of entrainment separator is highly efficient, having reduced entrainment rates by over 90% to an acceptable level of 20 ppm sugar.

Using a water manometer, the pressure drop across the arrestor was measured and found to be ± 12 mm or 1,2 Pa (0,02 psl) which is negligible.

Future Proposal

A modified three tier unit is to be installed directly under the demister screen in the Kestner separator. It has been learned[2] that several mills have tried this, but found that, instead of an improvement, the angle irons caused an increase in vapour velocity and localised impringing on the demister directly above the slots.

To avoid this situation, every second angle iron in the top section has been removed (see Figure 4). In addition, the distance between the separator and demister is 0,450 m. These steps will hopefully allow the vapour to expand and "straighten up" before meeting the demister screen.

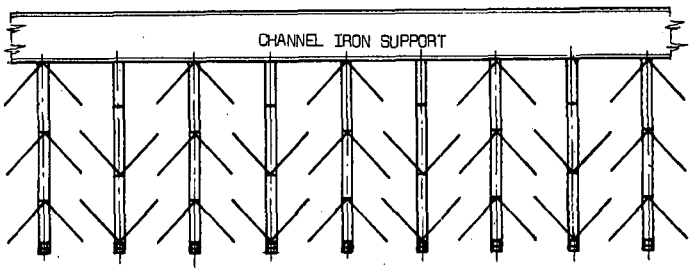

Figure 4:

Conclusions

This simple and inexpensive separator has reduced entrainment rates by over 90%.

Pressure drops measured proved to be negligible and will not affect evaporator capacity.

Consideration should be given to installing a modified three tier system below existing demister screens, to reduce load and cleaning frequency.

Resulting from the success achieved, this type of separator will be installed in another three evaporator vessels, but using 22 gauge 304 stainless steel.

Acknowledgement

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REFERENCES:

1. Tongaat Sugar Company – private communications.
2. S.M.R.I. – private communications with Mr. J. P. Lamusse.
3. Schäffler, K. J. (1978) – Sugar Entrainment Monitoring-SASTA Proc 52 (in press).