THE WASHING OF DEMISTER SCREENS AT ILLOVO

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Abstract

This paper re-introduces the concept of *in situ* washing of wire mesh demister screens that are used in the separation of entrained juices from vapour streams. The use and the positioning of proprietary spray nozzles are explained and the visual observations are noted.

Introduction

In the past number of years the sugar industry has improved its overall performance by "fine tuning" both the extraction and boiling house recovery. In the latter case, losses caused by entrainment during the evaporative processes have received constant attention, with numerous devices being developed to reduce this.[1] These devices have varied from the numerous baffle type eliminators and the turbine-type, to that which is currently favoured by the industry, the wire mesh demister.

The wire mesh demister is a relatively simple separating device that has a high collection and removal efficiency. The separating action is essentially that of impingement and the redirection of the vapour flow. The vapour can easily change direction through the mesh but the heavier liquid droplets cannot and they therefore adhere to the mesh. Collected droplets then coalesce into larger droplets and run through the mesh, back into the vessel. As a consequence the screen will be saturated with a sugar solution which, over an extended operating period (with the associated boiling conditions and high temperatures), will become part caramelised and then finally carbonised within the wire mesh. The screen gradually loses its performance and has to be removed for cleaning.

Operating conditions at Illovo

At Illovo each evaporating vessel has its own built-in wire mesh demister screen, with the exception of the two Kestners which share a common separator and screen. There are a total of six sets of screens in the evaporator system. These are changed on a pre-programmed basis every time the mill shuts down for in-crop maintenance and tube cleaning, which is usually every third week. A typical schedule is shown in Figure 1, which in the given scheme results in a total of four sets of screens having to be changed each shut down.

The changing of screens has a number of problems associated with the operation:

- It requires a relatively long period both to set up the screens being changed and to remove and clean them afterwards. At Illovo this procedure can take up to one week with two units of labour and supervision being required.
- The screens are boiled in sodium hydroxide, a hazardous material that must be handled with extreme care and under competent supervision.
- Screens are normally sited in areas that are cramped and difficult to work in. This is further exacerbated by the hot and humid conditions that are found within each vessel after shut down. Under these adverse working conditions screens tend to be roughly handled and suffer, in some cases, quite severe mechanical damage. With today's prices of screens being about R1 000 mm^{-2} surface area they are expensive to replace.
- Four units of labour and a supervisor are occupied in the removal and installation of screens on each stop day.

Installation of a screen washing system

In view of the problems and associated costs incurred during screen changes on a stop day, it was decided to investigate the use of *in situ* washing. As this was not a new concept, advice was sought throughout the C.G. Smith Group, but without any real success. The idea had not been fully exploited so it was decided to investigate further.

CRUSH WEEK	VESSEL SEPAR.	1C	2	3A	3B	4
3	■	■		■		■
6	■		■		■	■
9	■	■		■		■
12	■		■		■	■
15	■	■		■		■
18	■		■		■	■
21	■	■		■		■
24	■		■		■	■
27	■	■		■		■
30	■		■		■	■
33	■	■		■		■

■ : TO BE CHANGED

FIGURE 1 Screen change programme - 1986/87 season

Nozzle Selection

Rather than try to design a nozzle, a proprietary type was selected that would meet the following criteria:

- The spray pattern should cover a wide surface area.
- The volume of water should be sufficient to clean the surface of the screen efficiently.
- The nozzle selected must be easy to obtain; an "off the shelf" item.
- The nozzle should be effective in terms of wear life and cost.

Considering the above requirements the nozzle selected was the Spray Systems[2] type ½ HH35W which gave a full cone spray pattern with an angle of 120°, for water pressures in the range of 65 to 300 kPaG. Brass, rather than stainless steel, was selected for the material of construction because of the price differential

Material : Brass R17,95/unit *
: Stainless Steel (316) R80,44 *
(* as at February 1987)

It is envisaged that a three year life can be expected from brass nozzles of this type.

Nozzle Siting

When inspecting fouled screens that had been taken out from the evaporators, it was observed that all the contamination was on the underside (facing the vapur flow), penetrating upward to a depth of 1/2 to 2/3 within the pack. In all cases the screens were relatively clean on the top surface.

The construction of the screens themselves was taken into account, being fabricated in two distinct layers as shown in Figure 2.

Rather than try to wash down through the clean, high density part of the screen it was decided to concentrate the cleaning upwards onto the bottom contaminated section and let the separating action of the screen itself prevent the washings from being re-entrained into the vapour phase. A pipe system was designed to be sited below the demister screen in such a position that the nozzles would provide a maximum cleaning effect.

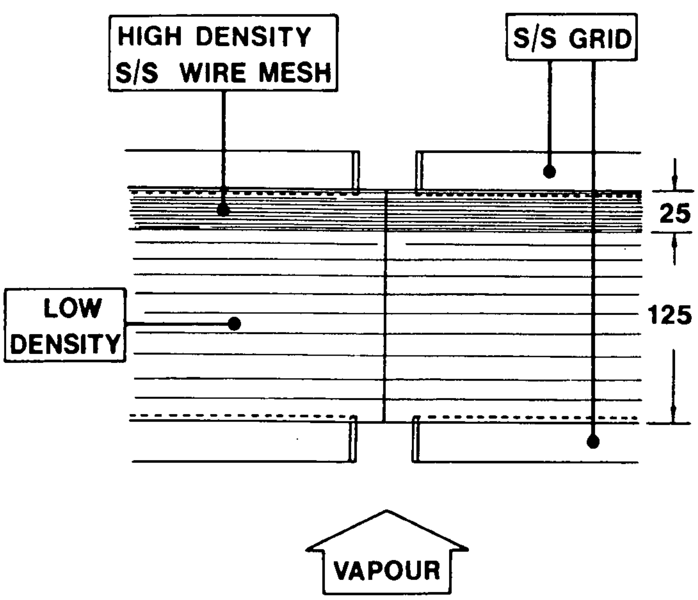

FIGURE 2 Demister screen section

Spray Pattern

Choosing a nozzle with the particular characteristics mentioned enabled large areas of the screen to be covered at a relatively low cost. The diameters that can be covered are shown in Table 1.

Table 1

The theoretical spray coverage for a ½ HH35W nozzle

Distance from screen (mm)	Diameter of spray pattern (mm)	Volume (ℓ m⁻² m⁻¹ at 300 kPaG)
100	346	265,9
200	693	66,3
300	1 039	29,5
400	1 386	16,6
500	1 732	10,6
600	2 078	7,4
700	2 425	5,4
800	2 771	4,1
900	3 118	3,3
1 000	3 464	2,7

Each screen was washed every second hour for five minutes with contaminated condensate (approximately 80°C) at a pressure of 300 kPaG.

Installed spray systems at Illovo

Final effect vessel

It was decided to try here first because this screen was the largest in the system (21,2 m^2 surface area) and difficult to change on stop days. In addition, it was also considered a critical area and was changed each stop day. This enabled us to inspect the screen on a regular basis and monitor the efficiency of the washing system.

The positioning of the spray pipes was somewhat restricted as a baffle type mist eliminator was sited approximately 700 mm below the support grid of the demister screen.

Initially a four spray configuration was tried, but this proved to be unsatisfactory mainly due to the flash effect caused by the hot condensate (80°C) entering a cooler environment (55°C). This reduced the spray angle by some 10 degrees, thereby reducing the coverage diameter and the effective cleaning. To overcome this an additional five sprays were used and the piping modified to the configuration shown in Figure 3.

This increased the water rate from 22,8 to 51,3 litres m^{-2} for the five minute washing period.

The final design proved to be quite effective, as inspection of the screen after three months of continuous operation showed it to be almost as clean as when it had been initially installed.

Third effect vessels

In the 3B vessel two spray nozzles were used due to internal obstructions, while in vessel 3A a single nozzle was tried. In both cases the nozzles were positioned 1000 mm below each demister screen.

The bottom of each screen could be observed from the inside of their respective vessels and the efficiency of the cleaning assessed without removal. The *in situ* washing appeared to be effective and no further modifications were made to the systems. The two screens were left in position for the remaining three months of the crushing season.

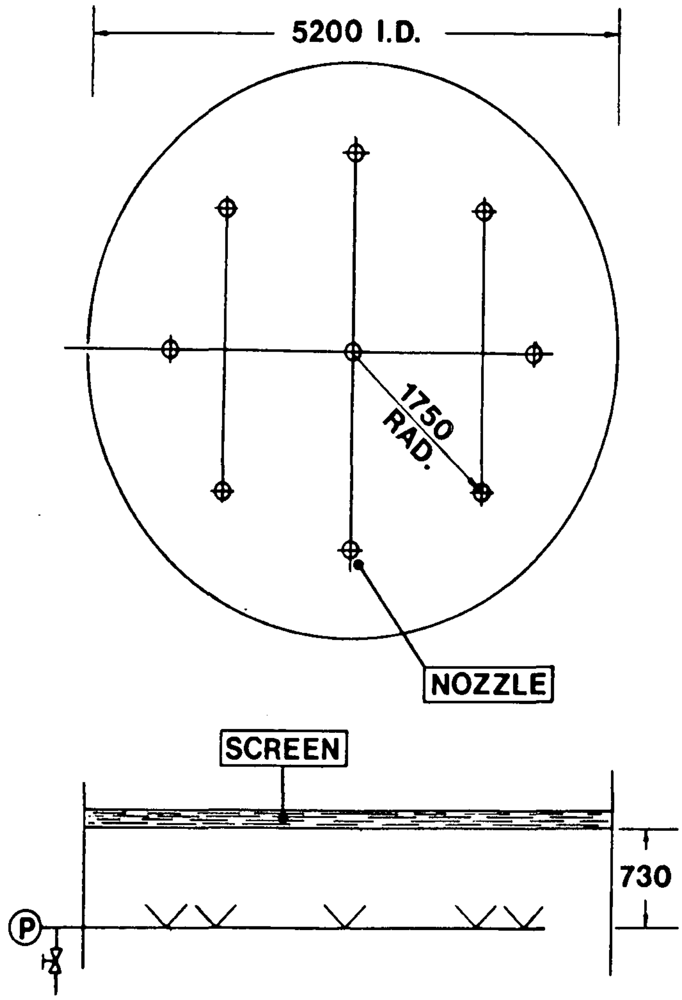

FIGURE 3 Final effect spray system.

Inspection after their removal at the end of the season showed that the cleaning was not as effective as that in the fourth effect vessel, though it was far better than when no washing was applied. The 3B vessel, with the two spray nozzles, was less effective than the 3A with a single unit and this was due to the presence of the internal obstructions. Another contributing factor was thought to be the large distance from the nozzle to screen face, which may have reduced the effectiveness of the water spray upon the screen's surface.

Future Developments: It is intended that the spray systems in the third effect vessels will be raised to a position 700 mm below the demister screens and that a four nozzle arrangement will be used in each. The wash water to each screen will increase, in the case of the 3A vessel from 13,5 to 54,0 litre m^{-2} and for the 3B from 36,9 to 73,9 litre m^{-2} for the five minute wash period. The obstructions within the 3B vessel are to be removed, during the 1986/1987 off crop.

In the remaining vessels a spray system is to be installed below each demister and inspections will be made during the crop to establish the effectiveness of each configuration. If they prove to be effecient all the screens will be left within each vessel until the end of the crushing season.

It is also intended to carry out extensive tests during the 1987/88 season to quantify the effectiveness of *in situ* screen washing.

It is also felt that the cleaning procedure can be further enhanced by the installation of a system of relatively inexpensive solenoid valves and timers, which will ensure that all the screens are washed at the correct time and for the required duration.

Potential Benefits: The costs for the installation of an *in situ* demister cleaning system are relatively low (Appendix 1) and in the case of Illovo a payback period of seven months could be realised.

Demister screens have a life expectancy of 3 to 4 years due to the rough handling they experience during the changing procedure. This life could be extended by perhaps a further two years if the screens are carefully inserted at the beginning of the crop and only taken out at the end of the season.

In addition, the fact that the screen is almost clean (no gradual fouling up) should allow improvements in the separating efficiency and result in lower entrainment losses.

Conclusion

The initial trials have shown that the *in situ* cleaning of wire mesh demisters is a viable concept that may improve performance and increase the overall life expectancy of the screens. The labour that is used in the cleaning and placement of these screens can be effectively used elsewhere on a stop day, when cleaning labour is at a premium.

Work is being done during the 1987-88 to optimise the installations and collect performance and cost data for further analysis.

REFERENCES

1. Perry, J (1963). *Chemical Engineers Handbook*, McGraw-Hill, p 18:82.
2. Spraying Systems Company - Monitor Engineering, "Catalogue of Spray Nozzles and Accessories".

APPENDIX 1

ESTIMATED COSTS & SAVINGS PER YEAR

1: SCREEN CHANGING COSTS	
a. LABOUR	3 600
b. CHEMICALS	580
TOTAL	4 180
2: SPRAY SYSTEM COSTS	
a. FOURTH EFFECT - ACTUAL	550
b. REMAINING VESSELS - PRED.	2 000
TOTAL	2 550
3: DEMISTER REPLACEMENT COSTS	
a. FOUR YEAR LIFE - NORMAL	15 000
b. SIX YEAR LIFE - EXPECTED	10 000
EXPECTED ANNUAL SAVING	5 000