Fibre separation from raw juice using a rotary juice screen

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Abstract Data collected over the last 15 years showed that more cane fibre and of a more fine nature were entering the process due to dust-like formation of fibre particles at the cane preparatory devices. Rotary juice screens (RJS), generally of 500 µm wedge bar opening, provided at the milling station were inadequate and excessive quantities of fine cane fibre were finding their way to the raw juice causing serious problems at all subsequent processing stages. Stage-wise juice screening by gravity flow operation using rotary juice screens with a first-stage screen having a 500 µm opening, the second stage having a 350 µm opening and the third and final stage a hot raw-juice screen with a 120 µm opening. The fibre content of juice was analyzed at each stage to determine a fibre balance that showed: unscreened raw juice at 10,000 ppm, first-stage screened raw juice at 2, 000 ppm, second-stage screened raw juice at 700 ppm, third-stage screened hot raw juice at 70 ppm, and net cane fibre removal of 99%. This removal from the raw juice has resulted in multiple advantages such as colour reduction of screened hot raw juice by 15-20%, reduction of fibre solids loading on the juice clarifier by 95%, no carryover of fine cane fibre through clear juice and, hence, no inclusion of fine fibre in sugar crystals and improved performance at each subsequent unit operation.

Key words Fibre, raw juice, rotary juice screen

INTRODUCTION

Mill engineers are focused in their efforts to maximize the preparation index (PI) of prepared cane with the intention of further improving mill extraction performance. However more and more, very fine fibre or bagacillo particles are found in many parts of the sugar factory (Table 1). Higher quantities of this fine fibre are passing through 450/500 µm wedge bar openings of the rotary juice screens (RJSs) due to dust like formation of fibre particles at the cane preparatory devices. This can create serious processing problems at the clarification house, as well as causing mechanical problems such as choking at pumps, juice heater headers and even in wide gap PHEs. This was further aggravated when these fine, light-weight fibre particles started appearing in clear juice so much that the final product, sugar, was being contaminated.

Table 1. Fibre content in screened mixed juice – 15 years of data collection.

5-year period	Fibre content in the screened mixed juice (%)
2000-2004	0.135 to 0.150
2005-2009	0.150 to 0.165
2010-2014	0.180 to 0.230

These findings, based on ICUMSA accepted methods, are independent of the fibre content in the unscreened mixed juice, which varied from 0.8% to 1.2%. This clearly indicates the increasing trend of improved preparation at cane preparatory devices and a consequent increase in fine bagacillo particles going to the process house.

MATERIALS AND METHODS

We use method GS7-13 (1994) 'The determination of cane fibre in juice, mud and filter cake by filtration method' to determine the fibre content in juice.

ROTARY JUICE SCREENING SYSTEM

Two-stage rotary juice screening system

For the two-stage juice screening using a rotary juice screen at the milling station the first-stage screened mixed juice is delivered to a second-stage rotary juice screen, preferably by gravity flow. The first stage already exists at a standard milling tandem, generally using a 500 µm opening screen. Bagasse separated at the first-stage rotary juice screen is discharged into the rake carrier and the screened mixed juice is delivered to the second-stage rotary juice screen by gravity flow.

The second-stage rotary juice screen is provided with a trommel screen with a wedge bar opening of 350 µm. Screened mixed juice from this stage is discharged into the existing screened mixed juice receiving tank and pumped to the juice clarification process. The additional bagasse separated at the second-stage screen is also discharged into the intermediate rake carrier. A standard two-stage installation of a RJS is shown in Figure 1.

Table 2. Rotary juice screens suitable for a 5000 tonnes of cane per day milling plant.

Screen duty	Wedge bar opening (µm)	Screen drum		Speed (rpm)	Juice temperature (℃)
		Diameter (mm)	Length (mm)		
First stage	500	1800	3600	10	Ambient
Second stage	350	2000	4000	8	Ambient

Fig 1. Two-stage RJS installation at a milling tandem of a 5000 tonnes of cane per day plant.

Hot raw juice screening system

The hot raw juice RJS has a screen drum with an opening of 120 µm (Joshi 2015b) - specification in Table 3. Hot raw juice at 70-80℃ from the existing heaters is delivered to this screen and the screened juice is fed to the juice reaction vessel by gravity flow. The additional bagasse separated at this screen is discharged into a slurry preparation tank and pumped to the mills.

Table 3. Totally closed and fully insulated RJS suitable for 5000 tonnes of cane per day plant.

Screen application	Opening (µm)	Screen drum		Speed (r/min)	Juice temperature (℃)
		Diameter (mm)	Length (mm)		
Hot raw juice	120	1800	4800	8	70-80

This rotary juice screen is of totally closed construction and with full insulation followed by aluminium cladding because the temperature of the juice is 70-80℃. At the mill ing plant, the feed juice temperature is about 35-40℃ and, hence, the rotary juice screen assembly is generally of an open structure.

An installation at the 5000 tonnes of cane per day Sonhira factory is shown in Figure 2 and a flow diagram of the process is given in Figure 3.

Fig 2. The hot raw juice RJS with gravity flow return at Sonhira factory.

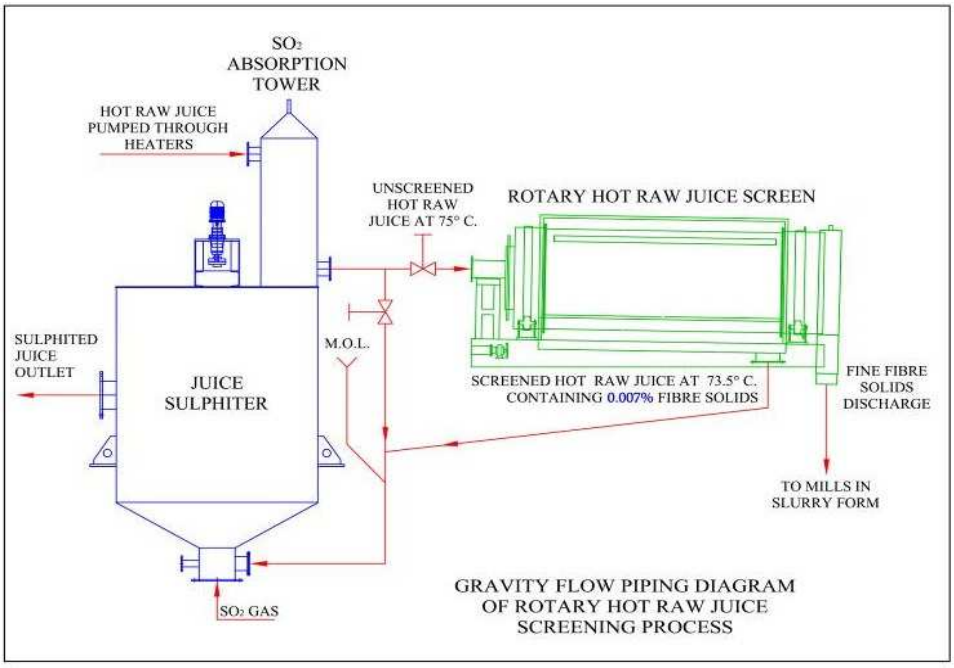

Fig 3. Flow diagram of the hot juice RJS installation.

RESULTS AND DISCUSSION

We collected and immediately analysed more than 50 samples from the two-stage RJS system as well from the hot raw juice screening system (Joshi 2015a). The average of the data collected for the 2-stage rotary juice screening system is given at Table 4 and the averages of the data collected for the hot juice screening system are given in Tables 5-6. The net removal of cane fibre was 99%, highest ever achieved.

Table 4. Fibre content in mixed juice at one of the two-stage RJS systems.

Fibre in unscreened mixed juice	Fibre in screened mixed juice after first stage RJS	Fibre in screened mixed juice after second stage RJS	Fibre separation efficiency across 2-stage RJS system
0.809% (8090 ppm)	0.177% (1770 ppm)	0.069% (690 ppm)	91%

Table 5. Fibre content in hot raw juice at one of the installations.

Fibre in feed to hot raw juice- RJS	Fibre in outlet juice of hot raw juice - RJS	Fibre separation efficiency across hot raw juice - RJS
0.170% (1700 ppm)	0.0063% (63 ppm)	96%

Table 6. Colour reduction after installation of the hot-juice screening system.

Colour of unscreend hot juice before RJS	Colour of screend hot juice after RJS	Juice-colour reduction
18417 IU	15538 IU	2879 IU 15.6 %

The benefits of removing maximum fibre using the rotary juice screens were found to be:

- Contamination of sugar crystals due to fine fibre is avoided.
- Reduction in hot raw juice colour by 2000 to 3000 IU is achieved.
- Reduction in fibre entering the process house.
- Reduction of floating particles in the clear juice.
- Elimination of chocking at pumps, juice heater headers, tubes and PHE, etc.

CONCLUSIONS

- Two-stage screening installed at milling station effectively reduces the fibre content of mill juice.
- Hot raw juice screening is the effective way to further reduce fine fibre and also colour of hot raw juice.

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