A New Era in fibre removal – Hot raw juice screen

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Abstract:
Rotary screen having 0.5 mm opening is used to screen unscreened juice resulted from mills. This single stage rotary screen is not found adequate as quantity of fine fibres are increasing due to very fine cane preparation.

In view of present scenario of fine fibre in mixed juice due to highly efficient cane preparatory devices, it is now a necessity to have further screening arrangement to reduce these fibres to avoid problems like chocking of juice pumps, juice heaters, fine particles in clear juice.

For sugar industry stage wise operation is not a new concept. For example, to achieve maximum sugar extraction milling tandem consist of 4 to 6 mills and another example is of pan boiling where A, B and C massecuite pan boiling takes place.

Similarly, to minimize the quantity of fine fibre particles in screened juice now it is important that the juice screening should be carried out in stages at mill house. i.e. initially by using rotary screen of 0.5 mm opening (coarse separation) followed by rotary screen having 0.35 mm opening (fine separation).

After successful implementation of this two-stage screening system at mill house, we have developed a new technology of screening hot juice by using rotary screen having 0.18 mm opening which is now well tested and established in sugar factories in Maharashtra, Karnataka and Uttar Pradesh. This proven technology of rotary juice screening is used after first heating of mixed juice upto 70 to 75 deg. C.

This Patented (379825) technology is helpful to reduce maximum possible fibre, reduces juice and sugar colour. This technology also helps to produce sugar that meets the standards required by beverage manufacturers.

This paper gives introduction of this unique juice screening system, installation details, operational details, data collected at various installations and advantages of the system.

Keywords:
Unscreened mixed juice, screened mixed juice, rotary juice screen, fibre, ppm

Methods:
Following internationally accepted ICUMSA methods are used for analysis of all intermediate products and final product, sugar.

a)	Fibre content of juice	- ICUMSA GS7-13 (1994)
b)	Colour of juice	- ICUMSA GS1/3-7
c)	Turbidity of juice	- ICUMSA GS7-21 (1994)
d)	Colour of white sugar	- ICUMSA GS 2/3 – 9 and 10
e)	Beverage floc test of sugar	- ICUMSA GS 2/3 – 40
f)	Conductivity ash of sugar	- ICUMSA GS 2/3/9 – 17
g)	Sediment content of sugar	- ICUMSA GS 2/3/9 – 19
h)	Sulphur Dioxide content of sugar	- ICUMSA GS 2/1/7/9 – 33

Introduction:
To achieve maximum extraction, we have to increase the PI of prepared cane. Higher PI results into very fine fibre particles in unscreened juice. These fine particles escape through the opening of rotary juice screen installed at mills.

From the inception of Rotary Juice Screen in India during the year 1998, we have collected thousands of readings in respect of fibre content in screened juice from 0.5 mm wedge bar opening screen and the average data is tabulated below :

Period	Average Fibre content in screened mixed juice	
	gram / kg	%
2000 - 2015	1.8	0.18
2015 - 2020	2.0	0.20
2020 - 2023	2.2	0.22
	1 g / kg = 0.1 % ≈ 1 g/ltr	

Above results indicates increasing trend of fine fibre in screened juice. This trend was rarely observed in earlier times but now fine fibres are observed in almost every factory. Therefore, it is very important to reduce fibre particles in screened mix juice without disturbing the higher mill extraction.

Further screening of mixed juice is carried out initially at mill house using 0.35 mm opening rotary screen as a second stage screen (Patent No. 428495). At this second stage screen around 50% of residual fine fibres are removed say from 0.22% to 0.1%. The two stage Rotary Juice Screening System also reduces the fibre load on hot raw juice screening system. Much fine fibres having size less than 0.35 mm cannot be separated at mill house because opening less than 0.35 mm clogs the screen.

Hence to reduce these very fine fibres a well proven – gravity flow – rotary juice screen is installed to screen the mixed juice after primary heating say around 70 to 75 deg.C. Screening at this temperature helped to enhance screening efficiency and to reduce chocking problem. 0.18 mm opening screen is used to achieve maximum possible fibre reduction from juice prior to defecation/sulphitation.

Equipment details:
At milling tandem as the juice temperature is ambient and hence these rotary screens are of open type of construction. Hot juice screen is installed after primary heating and hence to avoid temperature drop across the screen it is of totally closed type construction. Feed end, discharge end, juice collection trough and top of the screen are closed to avoid temperature drop. Insulation and cladding to stationary parts of rotary screen and juice piping helps to minimise the temperature drop.

The filtering media screen is in stainless steel 316 construction having 0.18 mm opening supported with backing screen of stainless steel 304 construction. All juice wetted parts like feed and discharge end drums, distributor, juice collection trough etc are also of stainless steel 304 construction. Other non wetted parts are of mild steel construction. Periodic screen washing by clear juice and hot water is carried out automatically by a timer operated pump.

Location details:
The Rotary Screen for hot juice screening is located near juice sulphiter/defecator. The hot juice from So_2 absorption tower is connected to juice inlet pipe of rotary screen by gravity and screened hot raw juice outlet of the screen is connected to juice sulphiter by gravity. If sufficient space is not available near juice sulphiter / defecator then hot juice from juice heaters is fed to rotary and screened juice outlet is connected to So_2 absorption tower or defecator. Thus re-pumping of juice is not required. The fine fibres discharged from the screen is delivered to slurry tank by gravity and is pumped to mills/mud tank of vacuum filter in a slurry form.

Figure no. 1: - **Process flow diagram**

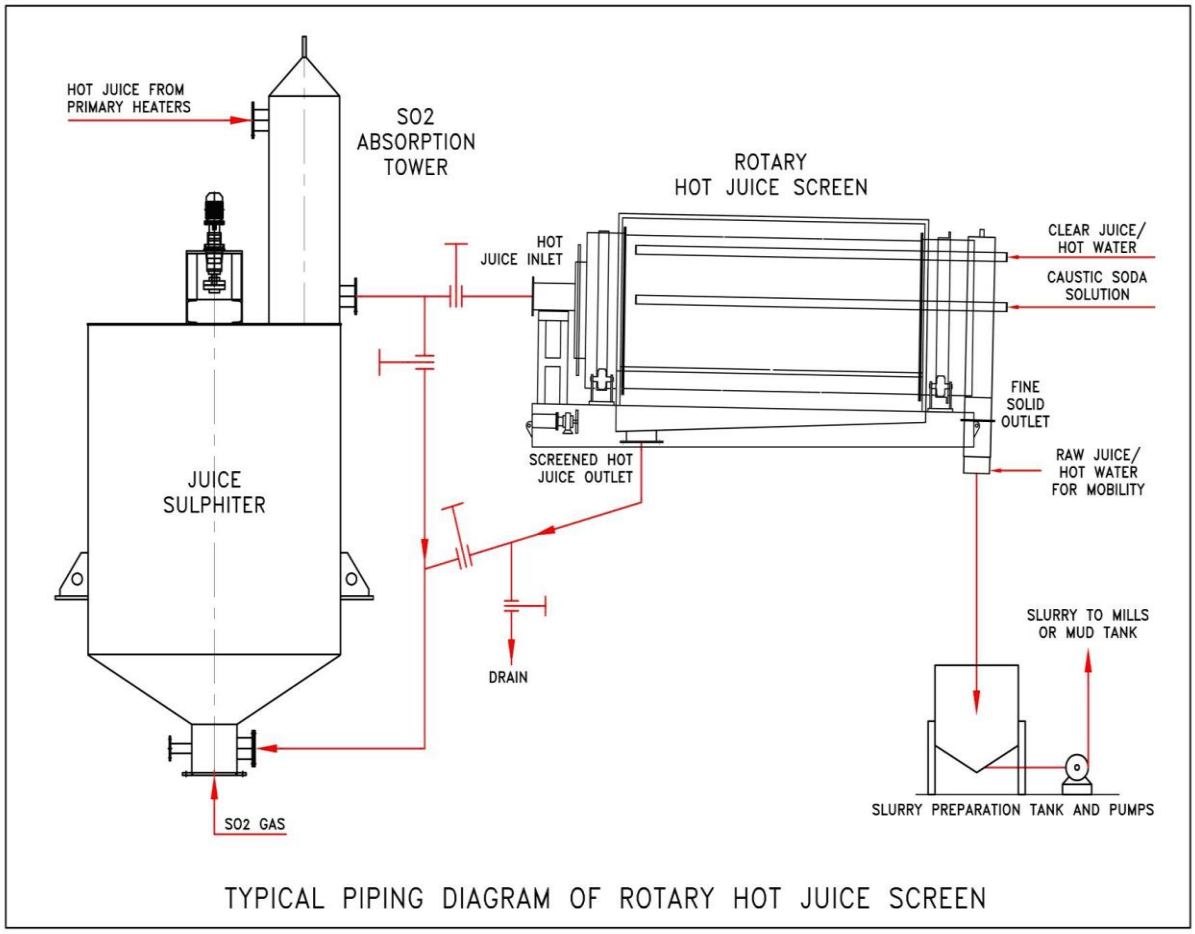

Figure no. 2: - **Installation of Rotary Screen for hot juice screening**

Data collection at various installations of Hot Raw Juice Screening System :

Sr	Name of Sugar Factory	Fibre separation g/kg - Dry basis		
		Before screening	After screening	Separation
		a	B	a-b
1	Balrampur Chini Mills Ltd. Balrampur	2.42	0.30	2.12
2	Rajarambapu Patil SSK Ltd	1.45	0.37	1.08
3	Kinyara Sugars Ltd - Uganda	2.02	0.68	1.34
4	Natural Sugar & Allied Industries Ltd	1.8	0.41	1.39
5	Atharv Intertrade Pvt Ltd. (Daulat SSK)	1.4	0.5	0.90
6	Daund Sugars Ltd.	1.8	0.35	1.45
7	Jarandeshwar Sugar Mills Pvt. Ltd	1.75	0.30	1.45
8	Khatav Man Takuka Agro Processing	1.99	0.49	1.50
9	Karmaveer Shankarrao Kale SSK Ltd	2.12	0.48	1.64
	Average of 9 sugar factories	**1.86**	**0.43**	**1.43**

Advantages of "Hot Raw Juice" – Rotary Juice Screen:

1. Reduction of Clear Juice colour.
2. Reduction of Clear Juice turbidity and improved transmittance.
3. Additional bagasse for extra power generation, when slurry is recycled to mills.
4. Lowest fibre in screened hot raw juice - less than 500 PPM (0.5 g/l).
5. The Beverage floc test – Always 'Negative' using ICUMSA GS2/3-40 method.
6. Sediments – Using ICUMSA GS2/3/9-19, always much below the desired norm of 100 mg/kg as per specifications given by beverage manufacturer.
7. Reduced solid and colour loading on subsequent clarification process of mixed juice, filtrate, syrup and melt.
8. Improvement in sugar colour.
9. Other advantages like no chocking at pumps, headers and PHE.

Conclusion:

Total fibre separation from unscreened mixed juice to screened hot raw juice is achieved more than 95 %. This fibre reduction helps to reduce suspended solid loading of clarification house, improves overall performance and also will help to improve the keeping quality of sugar.

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