TECHNO COMMERCIALLY PREFERRED TECHNOLOGY OF HOT RAW JUICE ROTARY SCREEN OVER SYRUP CLARIFICATION SYSTEM

Kadam S.F.[1] and Deshmukh P.S.[2]

ABSTRACT

Now a days much efforts are centralized towards improvement in sugar colour. To achieve better sugar colour, various technologies are used at various stages. In a standard double sulphitation plant juice and syrup sulphitation is the key process to achieve desired sugar colour. In addition to standard juice and syrup sulphitation process syrup clarification system is also used to reduce final sugar colour. Need of syrup clarification system depends on effectiveness of juice clarification process. Installation of syrup clarification system involves higher capital investment and recurring cost of chemicals such as flocculants, color precipitant, lime and phosphoric acid. Hence we decided to adopt a simple hot raw juice screening technology to reduce sugar colour; developed by M/s. Suviron Equipmets Pvt Ltd. This technology helped to reduce final sugar colour by 10-15 IU. This paper highlights the installation details, operational details and lab analysis results of outputs of Rotary Juice Screening System for Hot Raw Juice and brief techno-commercial comparison between Syrup Clarification System and Hot Juice Screening System.

Keywords: *Unscreened and Screened Mixed Juice, Hot Raw Juice, Rotary Juice Screen, Fibre, ppm, Bagacillo, Syrup Clarification System.*

Equipment details:

At milling tandem the rotary screen is open type of construction as the juice temperature is ambient. As hot raw juice screen is installed after first heating it is necessary to avoid temperature drop across the screen. Hence this screen is of totally closed type of construction. Feed end, discharge end, juice collection trough and top of the screen are closed to avoid temperature drop.

The screen is made from working screen in stainless steel construction having much finer opening supported with backing screen also of stainless steel construction. Feed and discharge end drum and other juice contact parts like feed pipe, distributor, juice collection trough etc are also of stainless steel construction. Other non wetted parts are of mild steel construction. The screen drums along with drive and discharge end

1.Managing Director, 2. Chief Chemist, Sonhira Ssk Ltd., Wangi, Mohanraokadamnagar, Wangi, Tal: Kadegaon Dist.: Sangli - 415305 E-mail: Sonhirasakhar@yahoo.co.in

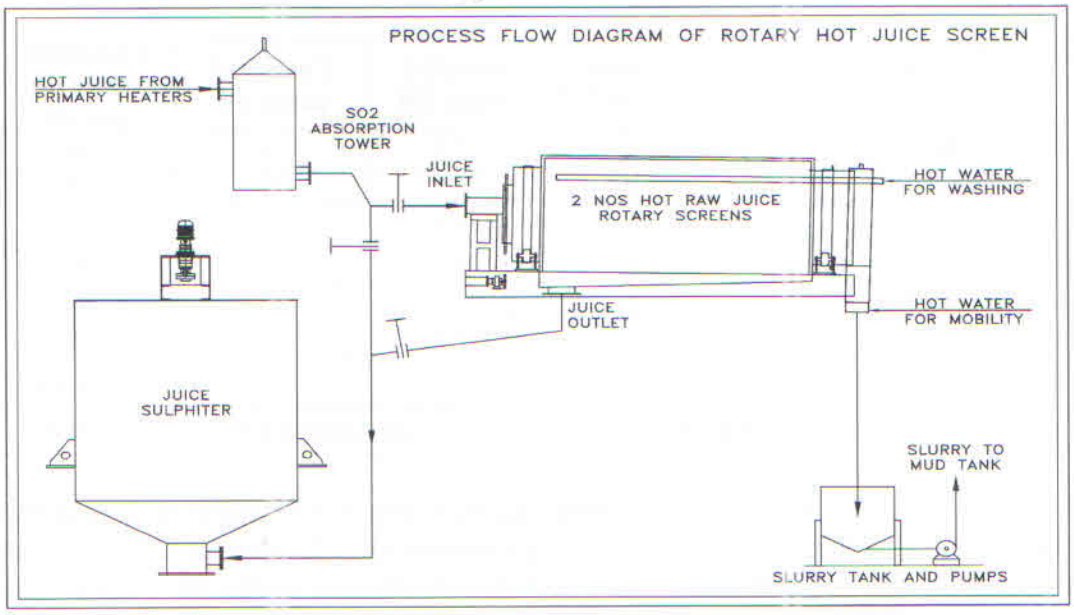
drums are supported on 4 nos. rollers which are mounted on heavy duty base frame. Power is transmitted through chain – sprocket arrangement. Spray nozzles are fitted on piped header located inside the screen drum to cover the entire length of screen. Screen washing is carried out automatically by a timer operated pump.

Installation and process Details:

Our present crushing capacity is 7500 TCD. Two nos. Hot Raw Juice Screens each having 1800 mm diameter x 4800 mm long are installed to operate both in parallel operation. These Rotary Screens for hot raw juice screening are located near juice sulphiter. The hot raw juice from SO_2 absorption tower is delivered to juice inlet pipe of both rotary screen and screened hot raw juice outlet of both the screen is delivered to juice sulphiter before shock liming addition point **by gravity**. The bagasse discharged from the screen is delivered to a slurry preparation tank by gravity and then pumped to mud tank of vacuum filter in a slurry form.

Auto washing system comprises of hot water tank, high head wash water pump, strainer and nozzle header is provided for both the screens.

Process flow diagram:



Comparison between Hot raw juice rotary screen and Syrup Clarification System:
All the calculations are made for 7500 TCD plant.
For calculation purpose quantity of syrup is considered as 30% cane at 60° brix.
Syrup quantity at 30 % cane will be 2250 ton per day.

1. Chemical requirement

For Hot Raw Juice Screen no any chemical required.

For Syrup Clarification System following chemicals are required

Chemical	Dose (ppm)	RequirementKg per day	Rate	Chemical cost per day (Rs)
Color precipitant	150	200	150	30000
Flotation polymer	10	13	250	3250
Phosphoric acid at 80-85 purity	250	400	80	32000
			Total Rs.	65250

For syrup clarification system chemical cost shall be approximately Rs. 65000 per day

2. Electrical load

At our plant for 2 nos. Hot Raw Juice Screens the power consumption is as below:

Duty	Operation hours	Installed power kW	Consumed power kW	Consumed power per day kW
Screen drive - A	24	7.5	6	144
Screen drive - B	24	7.5	6	144
Wash Water pump - A	2.5	9.3	8	20
Wash Water pump - B	2.5	9.3	8	20
Slurry tank drive	24	1.5	1	24
Slurry Pump	24	3.7	3	72
Total consumed power per day				424 kWh
Assuming power tariff of Rs. 6 per kWh the cost of power consumption will be				Rs. 2544

For syrup clarification system consumed electrical power is considered around 0.15 kWh per TCH which will result power consumption of 1125 kW per day. Assuming power tariff of Rs. 6 per kWh the cost of power consumption will be Rs. 6750 per day.

3. Dilution due to water addition

For 2 nos.Hot Raw Juice Screen considering 01 min. ON time and 10 min OFF time total water requirement is observed around 90 ton per day as per following calculations.

Cycles per day = 131 nos.
Water added per cycle = 0.35 ton (350 litre)
Water added per day per screen = 45 tons/day
Water added for 2 nos. screen = 90 tons/day

Hence total juice will be diluted by 90 tons per day. (Option of using clear juice for screen washing exists)

At syrup clarification system all chemicals are prepared using hot / cold condensate. For 7500 TCD plant the water requirement for chemical preparation shall be around 30 ton per day as per following calculations

Chemical	Requirement Kg per day	Dilution ratio	Water requirement litre per day
Color precipitant	200	1 kg in 20 litre	4000
Flotation polymer	13	1 kg in 1500 litre	19500
Phosphoric acid	400	1 kg in 20 litre	8000
Total water requirement			31500 litres Say around 30 ton per day

At Syrup Clarification System to enhance reaction kinetics it is essential to heat raw syrup upto 85 degree C. Direct contact heater is used to raise temperature from 60°C to 85°C.

By considering heating media vapours at 90°C we can calculate vapour requirement using below formula

$$\text{Vapours required} = \frac{\text{syrup quantity x specific heat x temperature rise}}{\text{Total heat of vapours}}$$

$$= \frac{2250 \times 0.64 \times 25}{635.1}$$

= 56.68 ton per day
= say 57 ton per day

Thus there will be further dilution of syrup (by means of condensed vapours) by57 ton per day.Hence total dilution will be 30 + 57 = 87 tons.

Total dilution in both the systems is almost the same.

4. Bagasse Saving

At Hot Raw Juice Screen fibre content in feed juice is around 0.155 % and fibre content in screened juice is around 0.018 %. Thus there is fibre separation of around 0.137% cane. (as measured by ICUMSA method no GS 7-13). This additional fibre is delivered to mud tank of vacuum filter and fresh bagacillo from mills to mud mixer of rotary vacuum filter is reduced accordingly to this extent.

Fibre saved by Hot Raw Juice Screen	= 0.137 % cane
Let us consider fibre % mill bagasse	= 50
Hence additional mill bagasse	= 0.274 % cane
	= 0.274 x 7500 / 100
	= 20.55 Tons
Bagasse sale rate	= Rs 2000 per ton
Additional revenue	= 20.55 x 2000
	= Rs. 41100 per day

At Syrup Clarification System there is no any bagasse saving.

5. Color Reduction

In case of Hot Raw Juice Rotary Screen colour reduction across the system is around 20-25% whereas in case of Syrup Clarification System it is 15-20%. It is presumed that the impact on colour of final product sugar is almost same for both the systems.

Table shows below the color reduction at each stage from mixed juice to sugar with and without Hot Raw Juice Rotary Screen and Syrup Clarification System.

Intermediates	Average Color (IU)		
	Data collected before installation of Hot Raw Juice Rotary Screen (Without Syrup Clarification System)	Data collected after installation of Hot Raw Juice Rotary Screen	Without Hot Raw Juice Rotary Screen and With Syrup Clarification System (Assumed)*
Mixed Juice	16000	16000	16000
Sulphited Juice	14000	10500	14000
Clear Juice	10500	8500	10500
Raw Syrup	11500	9500	11500
Clear Syrup	----	----	9500
Sulphited Syrup	11000	9000	9000
A Massecuite	8000	7000	7000
Sugar	80	70	70

At Sonhira, no syrup clarification exists; nor there are any plans to add syrup clarification in future.

Above calculations are summarized below for cost comparison

Sr. No.	Parameter	Hot Raw Juice Rotary Screen	Syrup Clarification System
1	Operating cost on account of Chemicals per day	NIL	Rs. 65000
2	Operating cost on account of electricity per day	Rs. 2544	Rs. 6750
	Total operating cost per day	Rs. 2544	Rs. 71750

Hence we can conclude that operating cost of Hot Raw Juice Rotary Screen is much lesser than Syrup Clarification System.

As a bonus point in addition to above financial gains additional revenue of Rs. 41100 per day is generated by installing Hot Raw Juice Rotary Screen as worked at point no. 4 above.

Multiple advantages of Hot Raw Juice Rotary Screen:

1. Reduction of Clear Juice colour by 1500 – 2000 IU.
2. Reduction of Clear Juice turbidity and improvement in transmittance.
3. Additional separation of 0.15 to 0.165% cane dry fibre.
4. Lowest ever fibre in screened hot raw juice 200 – 300 ppm (Aprox. 0.2 to 0.3 g/l)
5. The white sugar produced has always tested negative to the beverage floc test.
6. The Sedimentation test for white sugar has shown average value of 30 mg/kg; much below prescribed values by bulk consumers like soft drink manufacturers.
7. Reduced solid and colour loading on subsequent process of juice, syrup and melt clarification.
8. No fibre contamination of sugar crystal.
9. Other mechanical advantages like no chocking at PHE.
10. Increase in capacity of existing clarifier and vacuum filter / Decanter capacity due to reduced solid loading.
11. And most importantly, improvement in sugar colour by 10 - 15 IU.

CONCLUSION

Total fibre separation is achieved around 95%. This fibre reduction helped to reduce suspended solid loading of clarification house and to improve the overall performance of process house, sugar colour reduction by 10 – 15 IU and also helped to improve the keeping quality of sugar.

Techno-commercial evaluation as discussed in this paper clearly goes in favour of Hot Raw Juice Screening System against Syrup Clarification System.

ACKNOWLEDGEMENT

Authors are thankful to the management of the sugar factory for permitting us to present this paper. We are thankful to the technical staff of the factory for their cooperation to operate this system and also for collection of data. We congratulate M/s. Suviron Equipments Pvt. Ltd., for this unique invention and wish them all the success in future.

REFERENCES

- *R.B. Mane, S.V. Joshi, (1999), Rotary Juice Screen for mill juice screening – proceeding of one day seminar held at Manjara S.S.K. Ltd., Latur.*
- *D.R. Jadhav, 1999, Performance of Rotary Juice Strainer – proceeding of one day seminar held at Manjara S.S.K. Ltd., Latur.*
- *V.R. Kaledhonkar, M.B. Jadhav, (1999), Separation of Bagacillo from Raw Juice – proceeding of one day seminar held at Manjara S.S.K. Ltd., Latur.*
- Subodh Joshi. (2015), 2-Stage screening of mixed juice to improve juice clarification- *Proceedings of 11th Joint Convention of STAI & DSTA, held at Pune.*
- Chaitanya S. Joshi. (2017). Removal of fine fibres from hot raw juice using proven Rotary juice screen technology – *Proceedings of 75th Annual Convention of STAI held at Kochi.*
- *Personal technical communication and discussion with Shri Subodh V Joshi, Sugar Technologist, the Patent applicant of the unique "Hot Raw Juice Screening System"*