OPERATION OF DECANTER DURING TWO SEASONS – A CASE STUDY

Ashok Wagh
General Manager (Sugar), M/s. Gangakhed Sugars and Energy Limited,
Vijaynagar, Makhani, Tal: Gangakhed, Dist: Parbhani (Maharashtra)
E-mail: gmprocess@gmail.com

ABSTRACT

At a new 6000 TCD, greenfield sugar complex with 30 MW cogeneration and 60 KLPD distillery of Gangakhed Sugar and Energy Ltd. we had decided to adopt most modern and latest technologies at all stations. At juice clarification station Solid Bowl Decanter system was preferred and installed instead of Rotary Vacuum Filter technology. This paper highlights the operational details of entire system together with the data collected during two full crushing season operation for 2009-10 & 2010-11. The repeat performance as observed during two consecutive seasons has undoubted proven and has technically justified this modern technology as a alternative to Rotary Vacuum filter.

Keywords: Solid bowl decanter machine, conditioning of feed slurry, polymer addition, suspended/insoluble solids, consistency of muddy juice, centrate.

Equipments at and around Solid Bowl Decanter System having direct/indirect influence on decanter operation.

ROTARY JUICE SCREEN

Suviron make Rotary Juice Screen, a first & foremost step of juice clarification was supplied & installed at milling station, which greatly contributed to separate almost 85–90% of total suspended solids present in the unscreened mixed juice prior to further juice clarification process of conventional heat-lime/sulphite-heat sequence. The residual bagacillo content in the screened juice was found to be in the range of 1.3–1.5 grams/ltr. on oven dry basis.

SOLID BOWL DECANTER STATION

This station comprises of following

1. Mud receiving tank

   The muddy juice *i.e.* underflow of clarifier is taken to a mud receiving tank located on ground floor.

2. 1st stage mud conditioner

   One no. mild steel fabricated 1st stage mud conditioner complete with planetary driven stirrer.

3. 1st stage conditioned muddy juice transfer pumps

   Two nos. (one in operation, one as standby) progressive cavity positive displacement pumps with motor mounted on common base frame to transfer 1st stage conditioned muddy juice to 1st stage decanters.

   Magflow meter in the delivery line to read and record the liquid flow is installed. Pressure relief valve is provided in the delivery line as a safety precaution.

4. Decanter machine–1st stage

   Alfa Laval make, two nos. Solid bowl centrifugal decanters complete with motor drive mounted on anti-vibration pad/block for 1st stage. All standard safety precautionary measures like emergency manual tripping mechanism are provided for both machines.

5. Flocculent solution preparation and storage

   Two Nos. independent flocculent preparation and storage tanks are provided for decanter station, fitted with motor driven agitator.

6. Dosing pump

   4 nos. (two in operation, two as standby) flocculent dosing pumps are provided with drive suitable for VFD application.

7. Controlled addition of water

   This is achieved by magflow meter with transmitter, control valve with AFR and I/P converter, in the inlet piping of hot water.

8. 2nd stage mud dilution tank

   Mild steel fabricated tank to receive solids discharged from 1st stage decanters for mixing with measured quantity of hot water with motor driven agitator is provided.

9. 2nd stage mud conditioner

   One no. mild steel fabricated 2nd stage mud conditioner complete with planetary driven stirrer.

10. 2^{nd} stage conditioned mud slurry transfer pumps

Two nos. (one in operation, one as standby) progressive cavity positive displacement pumps with motor mounted on common base frame to transfer 2^{nd} stage conditioned mud slurry to 2^{nd} stage decanters.

Magflow meter in the delivery line to read and record the liquid flow is installed. Pressure relief valve is provided in the delivery line as a safety precaution.

11. Decanter machine – 02^{nd} stage

Alfa Laval make two nos. Solid bowl centrifugal decanter complete with motor drive mounted on anti-vibration pad/block for 2^{nd} stage. All standard safety precautionary measures like emergency manual tripping mechanism are provided for both machines.

12. 1^{st} stage Centrate receiving tank (Centrate–I)

One no. mild steel fabricated 1^{st} stage Centrate receiving tank complete with inlet, outlet and drain connection.

13. 1^{st} stage Centrate transfer pump

Two nos. (one in operation, one as standby) Centrifugal type pump complete with electric motor mounted on common base frame, to transfer the 1^{st} stage Centrate (*i.e.* Centrate–I) to juice reaction vessel. (Juice sulphiter)

14. 2^{nd} stage Centrate receiving tank (Centrate–II)

One no. mild steel fabricated 2^{nd} stage Centrate receiving tank complete with inlet, outlet and drain connection.

15. 2^{nd} stage Centrate transfer pump

Two nos. (one in operation, one as standby) Centrifugal type pump complete with electric motor mounted on common base frame, to transfer the 2^{nd} stage Centrate (*i.e.* Centrate – II) to mills for imbibition.

16. Rubber belt conveyor

An endless rubber belt conveyor with drive, to transfer rejected cake upto delivery point for discharging into a bin.

17. Mud bin

One no. mild steel fabricated conical mud bin with outlet connection and mounting chairs is provided.

PROCESS DESCRIPTION

Solid Bowl Decanter System for Muddy juice treatment is essentially a two stage operation.

A) 1st stage operation

Clarifier underflow *i.e.* muddy juice from Short Retention Time Clarifier is taken to 1st stage muddy juice receiving tank by gravity having pH 6.5-6.8 and consistency of 1065 to 1080 gram/lit. For better separation at decanter centrifuge muddy juice pH 7.0 to 7.2 is maintained by addition of milk of lime. The outlet of muddy juice tank is connected to 1st stage mud conditioner for proper mixing and preparation of muddy juice prior to feeding to decanter machines. Then this conditioned muddy juice is transferred to 1st stage Decanter machines through 1st stage progressive cavity pumps. For safety purpose pressure relief valves are fitted at delivery line of each muddy juice transfer pump.

Muddy juice which is going to 1st stage is measured and indicated magnetic flow meter and transmitter. This feed is equally dividing into each decanter machine for smooth operation and better results. At muddy juice entry of decanter machine polymer solution addition connection is provided. The polymer is important for smooth operation and solid liquid separation in decanter centrifuge. “Anionic” grade polymer with 0.05 % concentration solution is used.

The decanter machine rotated at 3250 RPM. Machine having one inlet for muddy juice and two outlets *i.e.* one for centrate means liquid and another for mud *i.e.* solids.

The centrate-I which is generated at 1st stage decanter operation is having brix 11-13 Deg and purity 80-82. Separate tank is provided to collect the centrate-I with two nos. centrifugal type pumps to transfer centrate-I to juice sulphiter.

B) Second stage operation

1st stage decanter cake is mixed with hot water in 2nd stage mud slurry preparation tank. For control and proportionate addition of hot water, control valve and magnetic flow mater is provided in hot water pipeline. 2nd stage mud conditioner is provided at outlet of 2nd stage mud slurry tank. By using progressive cavity pump this homogeneous mixture of 2nd stage mud slurry is transferred to 2nd stage decanter machines. Magnetic flow meter is installed in the delivery line.

There are two decanter machines for second stage with separate polymer connection for each machine.

The rejected cake from 2nd stage decanter is having pol % in the range of 1.0 to 1.5 % and moisture percentage in the range of 65 to 70 %. As per actual weighment records quantity of rejected cake during the season 2010-11 is 1.65% on cane. For conveying of rejected cake belt conveyor is provided.

Centrate generated in 2nd stage operation is collected in centrate-II receiving tank and two nos. centrifugal pumps are provided to transfer centrate-II to mill imbibition.

Two nos. polymer preparation and storage tanks are provided for polymer preparation with stirrer for each tank. Anionic grade polymer solution of 0.05% concentration is prepared in batches.

DATA COLLECTION

Exhaustive data collection was conducted throughout first two crushing seasons adopting random and composite sampling method.

PRESENTATION OF DATA

Sr. No.	Description	Brix %	Pol %	Purity
1.	Centrate I	10 to 11	08 to 09	80 to 82
2.	Centrate II	03 to 04	1.5 to 2.1	50 to 52.5

Sr. No.	Description	Season Average value	Unit
1.	First stage muddy juice consistency	1065 to 1080	gm/lit
2.	Second stage muddy juice consistency	1035 to 1050	gm/lit
3.	Pol % rejected cake	1.0 to 1.5	%
4.	Moisture % rejected cake	65 to 70	%
5.	Rejected cake % cane	1.65	% cane
6.	Pol lost in rejected cake % cane	0.017 to 0.025	% cane

Cost economics of the system

Rotary Vacuum Filter	Solid Bowl Decanter System	For total crushing of 5,54,182 tons during the second season 2010-11	
1. Sugar recovery		**Loss**	**Gain**
The sugar loss % cane through filter cake is generally observed as 0.06 % and more	The sugar loss % cane through rejected cake as actually observed is 0.025%.	The reduction in sugar loss through final cake shall be 0.035% cane. Considering	

		sugar price Rs. 25,000 per ton the gain works out as 0.035 x 5,54,182 / 100 = 194 tons. x Rs. 25,000	
			Rs. 48,50,000
2. Direct bagasse saving			
Approximately 1% cane of bagacillo is required to work as filtering media to achieve best results.	Bagacillo not at all required.	This will result in net bagasse saving @1% cane *i.e.* 5540 tons which, based on bagasse unit price of Rs. 1500 per MT works out as	
			Rs. 83,10,000
3. Cake transportation			
Assuming filter cake % cane as 3	Rejected cake % cane is actually observed as 1.63	The saving on account of cake transportation due to reduction in total cake by 1.37 % on cane *i.e.* 7592 tons works out as Rs. 3,56,824 considering transportation cost as Rs. 47 per ton.	
			Rs. 3,56,824
4. Chemical consumption			
Not required	Chemical requirement during the season 2010-11 was Rs. 2.71 per ton of cane crushed.	Additional recurring cost on account of chemical requirement works out as,	
		Rs. 15,01,800	
5. Reduction in power consumption			
The operating power shall be 175 kW	The operating power shall be 165 kW	The reduction in power consumption corresponding to reduction in operating power of 10 kW. At the unit rate of Rs. 4.80 per kwh the gain works out as 10 x 24 x 172 days x Rs. 4.80 =	
			Rs. 1,98,140
		Loss	**Gain**
		Rs. 15,01,800	**Rs. 1,37,14,968**
Net gain during the season		**Rs. 1,22,13,168**	

Influence of polymer on Solid Bowl Decanter operation:

Initially during first trial season cationic polymers were tried, but it was found to be interfering with other anionic polymer normally used at SRTC as settling aid.

RESULT AND DISCUSSION

Although, the Solid Bowl Decanter Centrifuge was operated mostly in double stage format a fair trial was given to operate in single stage as well for some time and quite interesting results were observed. Various permutation and combinations with respect to differential speed, dam plate, dilution ratio, polymer dosage, slurry feed rate etc. were given a good trial.

During the second season 2010-11 the total crushing of our factory is 5,54,182 tons. The average crushing was 3214 tons per day (including stoppages) and 4705 tons per day (excluding stoppages). During the entire crushing season, we have not faced any operational and mechanical problems of decanter system. The data and results shall be collected during next crushing season for continuous operation @ 6000 TCD.

CONCLUSION

Soon after getting the Solid Bowl Decanter station stabilized and operating charge hands having received on site proper training, the Solid Bowl Decanter Centrifuge station was found to be streamlined in all respect such a way that the resulting centrate was taken to process instead towards mill. The pol percentage cake ranged between 1.0–1.5 with moisture content of 65–70%.

It would be therefore concluded that this technology has definite edge over the old Rotary Vacuum Filter technology and shall certainly find its place in sugar industry in future.

ACKNOWLEDGEMENTS

The author express his grateful thanks to Honorable Shri Ratnakarji Gutte, Chairman; Shri Sunil Gutte, Joint Managing Director and management of M/s. Gangakhed Sugar & Energy Ltd., for permitting me to present this paper during 10th Joint Annual Convention of STAI and DSTA.

The author is also thankful to technical staff of sugar factory and Suviron, for assisting in operation.