



Sugar Recovery Improvement with Addition of Decanter and Refinery in Saraswati Sugar Mills

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ABSTRACT

In India, sugar is refined using the Double Sulphitation method. This is the most widely used and cheapest process of sugarcane juice clarification as compared to other available process. However the major drawback of the Sulphitation process is that Sulphur enters sugar during its refining process. The end product that we consume contains sulphur dioxide approximately to the extent 20 to 70 ppm. This limit has been prescribed keeping in view the impact of sulphur on human health. Due to advantages for health, product value, market access, operational efficiency, environmental benefits, enhanced competitiveness, and brand recognition, among other reasons, the double sulphitation process has gradually been replaced with sulphur less refining by many sugar plants. Mud filtering is one of the areas of sugar loss that require attention during the process conversion. Adopting decanter technology to save bagasse and reduce pol is one step toward minimizing sugar loss. This paper elaborates the improved sugar recovery due to conversion of existing plantation white sugar plant to refined sugar plant and mud filtration with decanter centrifuge machines without compromising on steam & power, etc.

Keywords : Decanter, refining, bagasse, pol, erection and commissioning, ZLD, ATFD.

INTRODUCTION

Intake of sulphur dioxide beyond prescribed limit causes irritation of respiratory issues, like bronchitis and asthma, severe airway obstruction, causes irritation of the upper respiratory tract which sometimes may cause pneumonia,

Excess intake of sulphur dioxide may cause sneezing, sore throat, wheezing, shortness of breath, chest tightness and suffocation,

Sulphur dioxide on consumption, comes in contact with water forms sulphurous acid which inhibits mucociliary transport,

Bi-sulphite ion produced when sulphur dioxide reacts with water is likely to be the main initiator of sulphur dioxide induced broncho-constriction,

Increased product value

Higher quality sugar: Refined sugar is of higher quality and purity compared to plantation white sugar. This allows producers to command a premium price in the market.

Diversified Product Range: Refineries can produce a range of products including white refined sugar, liquid sugars, and specialty sugars, catering to different market needs and increasing revenue streams. Great flexibility

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in the end product production viz. Raw sugar / Refined sugar / White sugar depending upon the domestic as well as the international market requirement.

Improved sugar recovery: (Figure 1)

Processing is done at almost neutral pH, hence sugar loss due to inversion is avoided. (Table 2)

Table 1 : Plant overview

Plant Name	Saraswati Sugar Mills Ltd., Yamunanagar, Haryana
Crushing capacity	10000TCD
Final product	Refined sugar <30IU color
Refinery system installed	Phosphofloatation > multibed filters > Ion exchange resin decolorization with zero liquid discharge Brine recovery and rinse water recovery system
Ethanol plant	160 KLPD with incineration boiler and 5.63 MW power plant
Ethanol plant feedstock	Syrup, B molasses and C molasses

There is nominal rise in calcium content from mixed juice to clear juice, this gives lesser molasses production and scaling is greatly reduced leading to:

- *Reduced down time*
- *Less chemical consumption for descaling*
- *Steady crush rate*
- *Steady steam consumption*

Avoidance of corrosion of plant and machinery due to elimination of sulphur di-oxide gas, hence maintenance cost reduced.

No deterioration of sugar during long storage which is quite common in our country, no reprocessing required

Improved market access

Broader Market Reach: Refined sugar meets the quality standards required by many industrial users, food and beverage manufacturers, and consumers, thus expanding market opportunities.

Export Opportunities: High quality refined sugar is often required in international markets, opening up export opportunities and potential foreign exchange earnings.

Operational efficiency

Continuous Operation: Integrating refining with raw sugar production allows for a more streamlined and continuous production process, reducing downtime and improving overall efficiency.

End product quality is not dependent on cane quality

Cost savings

Economies of Scale: Larger, integrated operations can benefit from economies of scale, reducing per-unit production costs.

Reduced Transportation Costs: Refining sugar on-site eliminates the need to transport raw sugar to an off-site refinery, lowering transportation and handling costs.

Environmental benefits

Energy Efficiency: Modern refineries can incorporate energy-efficient technologies and practices, reducing overall energy consumption and emissions.

Waste Reduction: On-site processing of raw sugar and its by-products can lead to better waste management practices and reduced environmental impact.

Enhanced competitiveness

Brand Recognition: Offering high-quality refined sugar can enhance brand reputation and competitiveness in the market.

Customer Loyalty: Providing consistent, high-quality products can help build and maintain customer loyalty.

Risk mitigation

Market Price Fluctuations: The ability to produce and sell refined sugar helps mitigate risks associated with raw sugar market price fluctuations by offering a higher-margin product.

Supply Chain Control: Vertical integration gives better control over the supply chain, reducing dependency

on external refineries and improving supply chain reliability.

Advantage in ethanol plant

Volatile acidity: Due to less Sulphur content in final molasses going to distillery it has lower volatile acidity which improves fermentation efficiency and hence improves yield from per ton of molasses.

Sox emission: Due to Sulphur presence in slop generated by Sulphur presence in spentwash when it is burned in incineration boiler Sox emission level increases

which can be avoided with the refined process and saves environment.

Major installation

1. Complete melt phospho floatation clarification system followed by deep bed filters
2. 2 stage IER decolorization system
3. Zero liquid discharge brine recovery system with ATFD
4. Decanter mud removal system

Comparison of double sulphitation (crushing season 2022-23) and refinery (crushing season 2023-24):

Sugar recovery

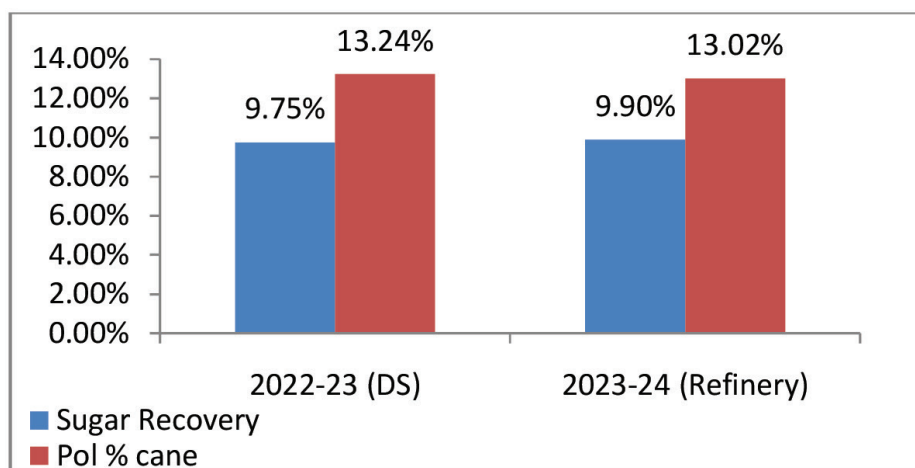


Figure 1 : Sugar recovery

B heavy Molasses production

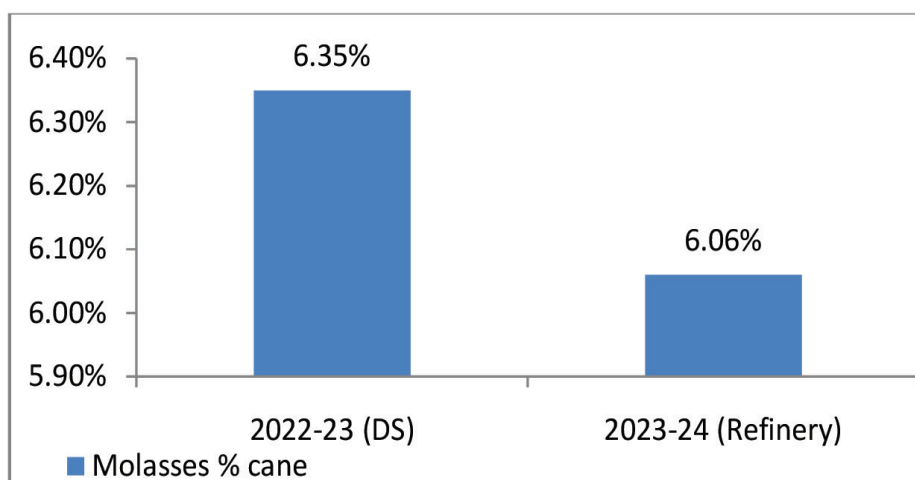
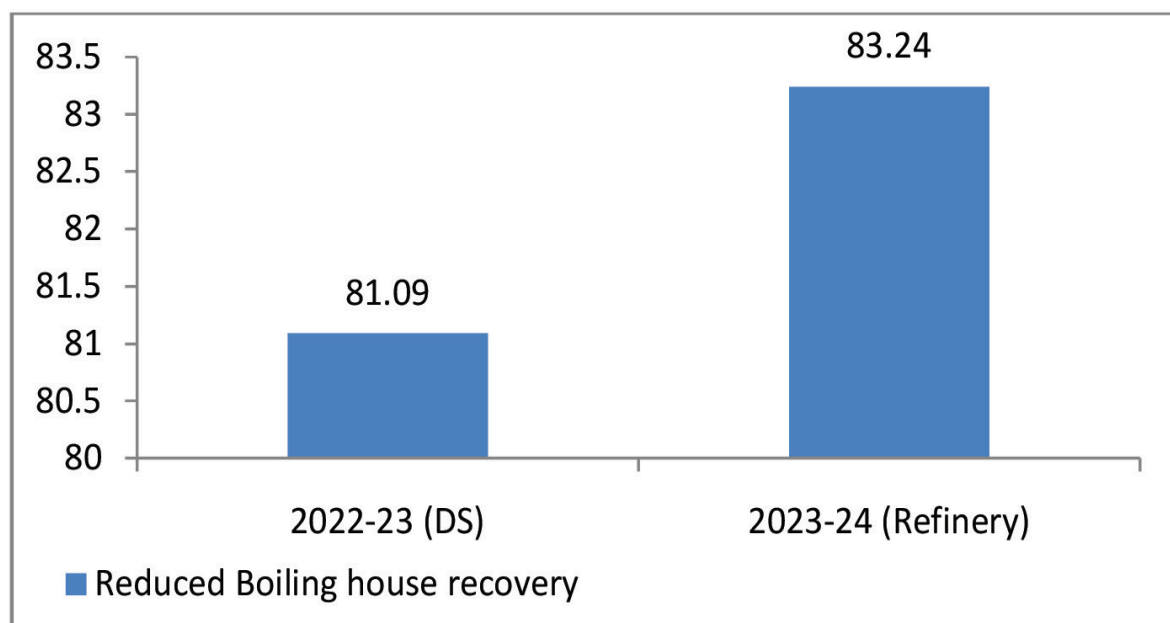


Figure 2 : Molasses % cane

Reduced Boiling house recovery**Figure 3 : Reduced boiling house recovery***Reason***Table 2 : pH and RS Parameters**

	With refinery (season 2023-24)	Without refinery (2022-23)
RS in Mixed juice per 100 bx	3.57	3.39
RS in Clear juice per 100 bx	3.91	3.79
Increase in RS	0.34	0.4
Unknown losses	0.07	0.1
pH of syrup going to pan station	5.88	5.48
Inversion loss @ 70degC	0.0056%	0.014%

*Others***Table 3 : Other savings in refinery**

Saving in Lime	0.077% on cane
Saving in Sulphur	0.05% on cane
Cost saving in chemical	0.85 Rs. /Ton of cane
Premium price of sugar	50 Rs. Per quintal of sugar
Gain in ethanol recovery	4.5 L/T of molasses
Extra power	1.2 kW /ton of cane
Extra manpower cost	4Rs./Bag



Figure 4 : Melt clarification system



Figure 5 : Multi bed filtration system



Figure 6 : Ion exchange column (IER)

Role of decanters in sugar recovery and other savings

Decanter technology allows saving of bagasse @ 0.50% cane and 0.03% sugar loss in filter cake which itself is a major motivation to opt for the decanter application so as to increase the sustainability and profitability of plant.

Advantages of decanter system:

Mechanical advantages

- No high/low vacuum installation
- No separation of bagaccillo and mud ixing
- Small space requirements for installation
- Fully automatic
- Low maintenance cost compared to rotary vacuum filter installation
- Energy consumption less than half of a rotary vacuum filter

- Totally closed system, leak and splash-free
- Built-in CIP system for cleaning of pipe lines and decanter with hot water.

Process advantages

- Reduction in sugar loss than rotary vacuum filters.
- Reduction in mud quantity due to no bagaccillo addition.
- Wash water consumption nil
- Steam saving up to 0.5 %, on cane
- No loss of purity by microbial action in the Centrate due to :
 - I. Short retention time
 - II. Sanitary conditions in the closed decanter system
 - III. No contamination from bagaccillo.
 - IV. High temperature of the centrate

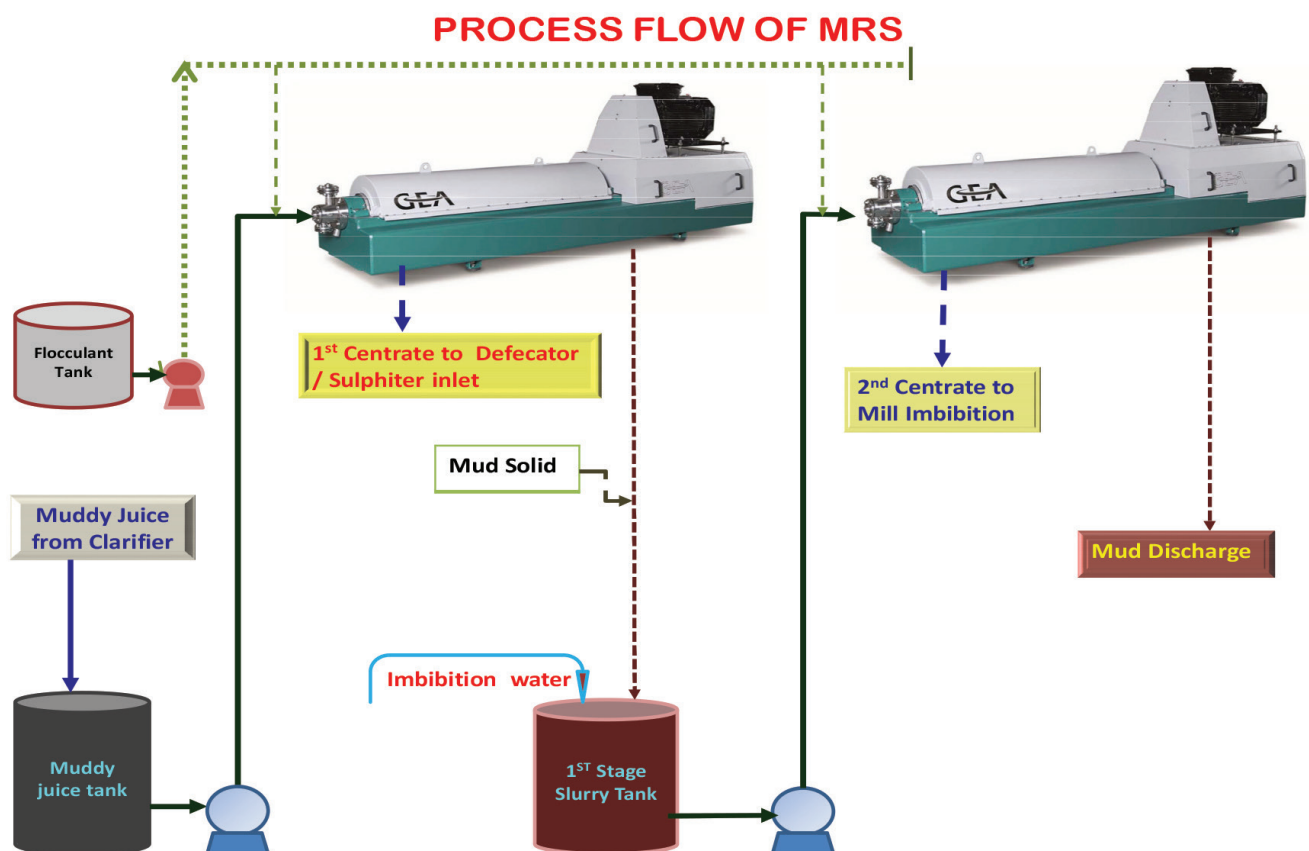


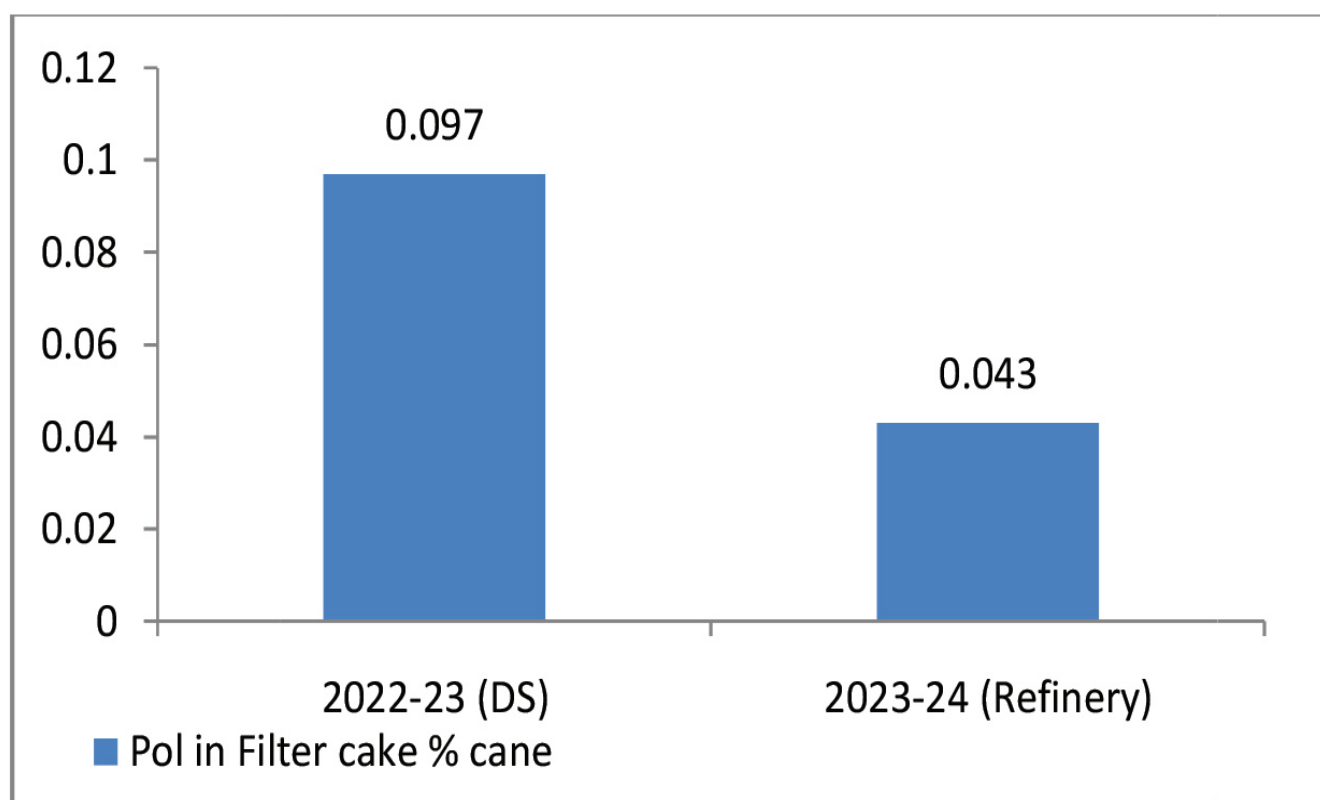
Figure 7 : Decanter station process flow diagram



Figure 8 : Installation of decanters at SSM

RVF vs Decanter**Table 4 : RVF vs decanter**

Parameters	Decanter	RVF
Cake Moisture w/w	70%	72.50%
Cake pol %	1.50	2.20
Bagacillo	0	5 kg per ton of cane crushed
Water consumption	net 1.8-2.0 % on cane	5.0-6.50% on cane
Filtration area	100m ² per ton of solids loading	0.6m ² per ton of cane crushed
Power requirement	185 units/h for 5 nos. decanter machines	225 unit/h for 2 nos. 14' X 28' RVF
maintenance cost	Low	Higher than decanter
Vacuum requirement	No	essential
Leakage	Totally Closed System, Leak And Splash-free	Heavy chance of leakage
Cleaning	Inbuilt CIP	
Space requirement	Less spacious	More than decanter (Approx double)

**Figure 9 : Pol in filter cake % cane*****ZLD (Zero liquid discharge)***

For making environment green, SSM included zero liquid discharge system with ATFD. Reject from brine recovery system concentrated in (3+2) effect evaporator

set from 4% concentration to 40% concentration. This 40% concentrated reject sent to agitated thin film dryer from it gets out in form of powder.

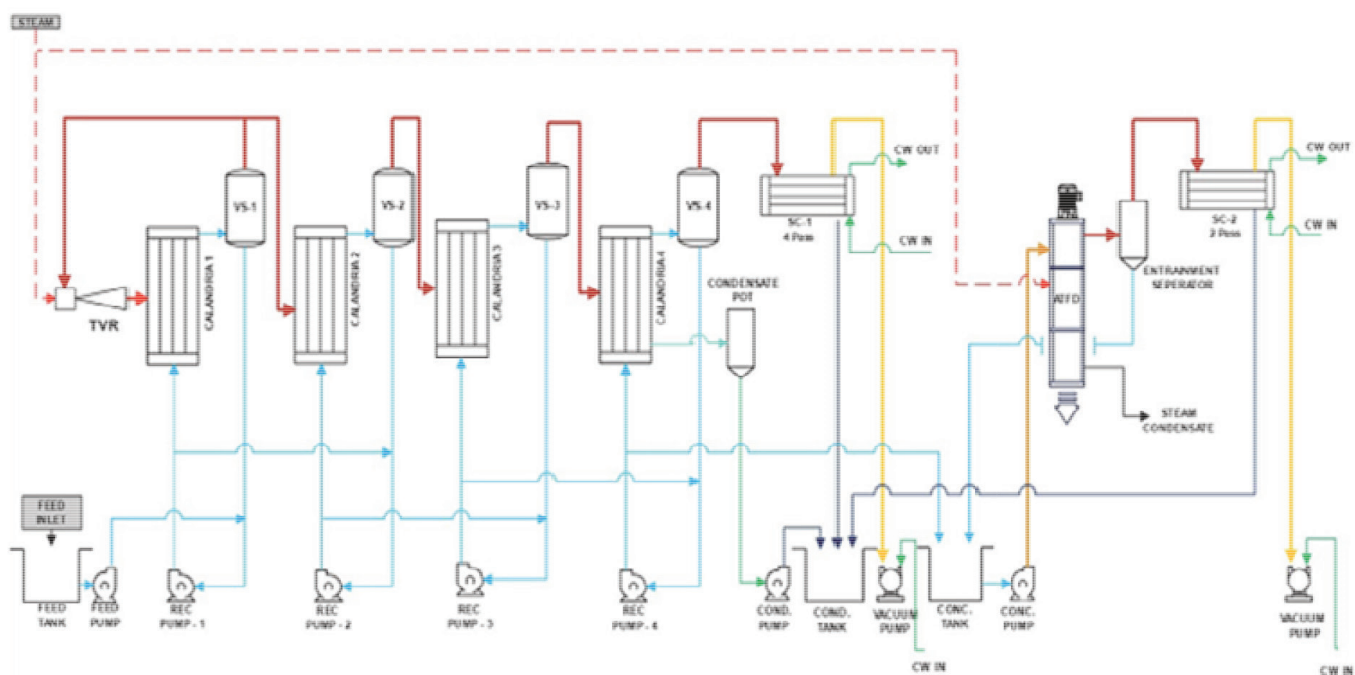


Figure 10 : Pol in filter cake % cane

About agitated thin film dryer (ATFD) -



Figure 11 : ATFD Installation at SSM

Table 5 : Total sugar losses

	With refinery (season 2023-24)	Without refinery (2022-23)
Sugar in cane	13.023	13.24
Sugar in bagasse	0.443	0.423
Sugar in filtercake	0.043	0.097
Sugar in molasses	2.575	2.883
Undetermined losses	0.072	0.103
Total losses	3.133	3.506

Table 6 : Overall saving

Total cane crushed (As per RT8C)	14.6637	Lakh ton
Gain In Recovery due to refinery	0.12%	
Gain In Recovery due to decanter	0.03%	
Total Gain in sugar	2200	Tons
Sugar rate	38740	Rs./Ton
profit due to sugar	852.11	Lakhs
Premium on Refined sugar@ 50 Rs./qtls	717.6	Lakhs
Total profit due to sugar	1569.71	Lakhs
Reduction in chemical cost	0.85	Rs./ton of cane
Cost saving	12.46	Lakhs
Gain in ethanol recovery	4.5	L/Mt of molasses
Profit due to ethanol	115.56	lakhs
Bagasse saving Due to decanter	0.47	% on cane
Profit due to bagasse	199.87	lakhs
Total Saving	1897.598	lakhs

ATFD stands for evaporation of water or solvents to make concentrated liquid to dry powder or flakes. Most commonly, these systems are used in pharma industries, textile industries, agro chemicals industries, in sugar industries at effluent treatment plant for drying of products, drying of concentrated liquid for salt recovery, drying of chemical and petro chemical products to recover the powder to make system ZLD.

Concentrated outlet will be collected in collection tank from where it will be fed to Agitated thin film dryer (ATFD). ATFD is designed suitably to produce dry powder of the waste inlet. Evaporated water vapours are condensed in surface condenser.

CONCLUSION

Adding a refinery to a plantation white sugar plant offers substantial benefits including increased product value, improved market access, operational efficiency, cost savings, environmental advantages, enhanced competitiveness, risk mitigation, and overall value addition. This integration can transform a basic sugar production facility into a more versatile and profitable enterprise.

The plant has subsequently grown from 400TCH to 10000 TCD; so congestion in plant is obvious thing. Conversion of non-gravity plant to gravity, lack of approach for erection & commissioning, lack of space for assembling, high amount of work within such small period in such congestion was done with very precise micro level execution strategy to achieve this milestone.

ACKNOWLEDGEMENT

The saying "Plans are nothing; planning is everything" is a great fit for the CST, ISGEC and SSM design, project, and execution teams. It was the team work that allowed us to complete such a difficult assignment in such a short amount of time.

REFERENCES

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- 2) Feedback from Operation and Execution Team