Biokrishi Technologies Private Limited

Biokrishi Technologies Private Limited

Case Study

Jakraya Sugar pvt ltd a Cane Sugar Manufacturing factory in Solapur, Maharashtra, India.

It shows:

- How the Antimicrobial products and effective hygiene practice methodology would work in a sugar factory
- Estimate sucrose losses and acidity in juices after biocide treatment.
- Decisions on Technical and commercial criteria
- Challenges and Questions that remain
- Trial results

Prepared by
Biokrishi Technologies Private Limited
DSK Vishwa,Varun D, Flat N0 703, SN 126, Dhayari Pune 411041 ,Maharashtra ,India

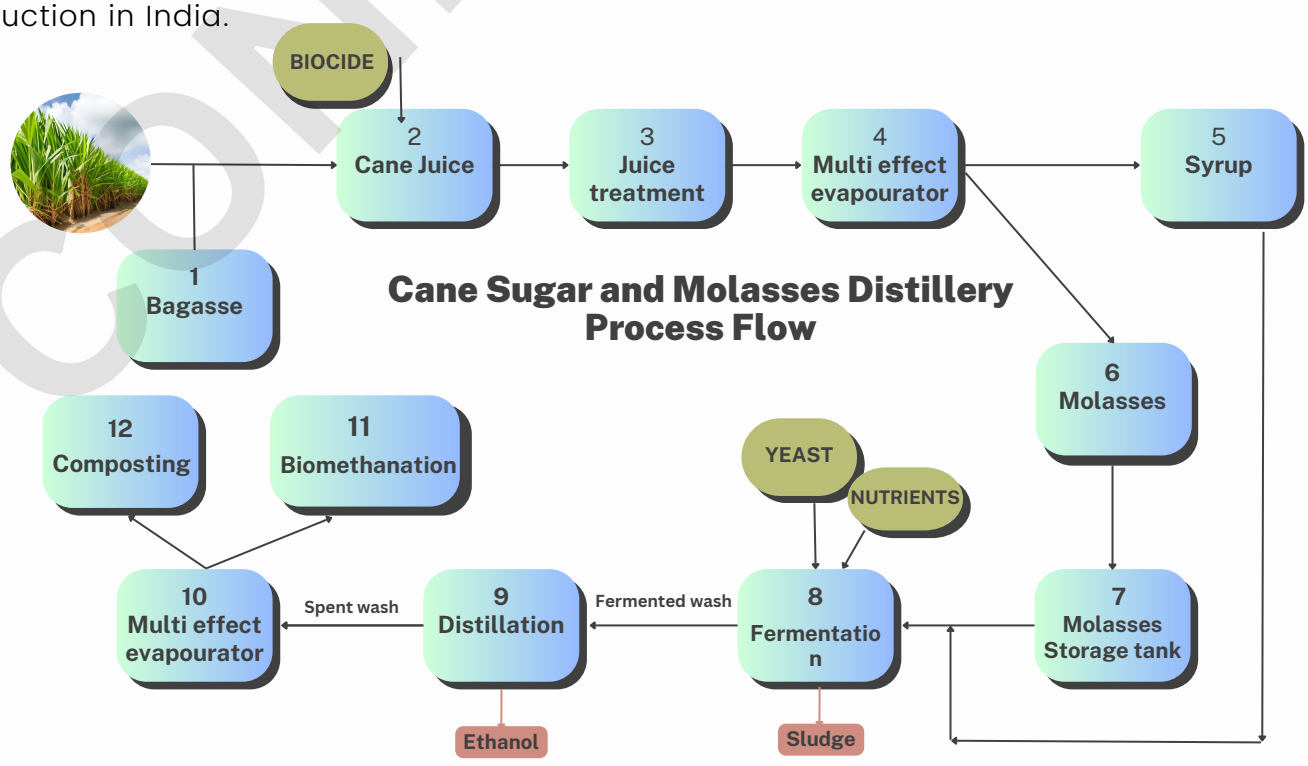
31ST JAN,2023

Introduction

To promote the country's fuel grade ethanol producing distilleries. The Indian government has approved the manufacturing and procurement of ethanol from sugarcane-based raw materials such as C & B heavy molasses, sugarcane juice/sugar syrup, surplus rice and maize with the Food Corporation of India (FCI). Although most distilleries are familiar with ethanol production from C molasses, changes in process substrate, such as B molasses and sugar syrup substrate, necessitate the optimization of fermentation media as well as microbial contamination control strategies.

Several scientific studies in the microbiological field have been critical for the evolution of the ethanol industry in India, including the improvement and development of new biocides for mill sanitation in the sugar industry that controls bacteria and their byproducts formation, application of biocides at the right area in milling operation and other process modification in the sugar and cane syrup manufacturing for better control of bacterial contaminants, and the improvement of syrup quality in the process at sugar industry.

Bacterial infections and acidic byproducts are some of the most significant contributors to the poor recovery of cane sugar and ethanol from the byproducts of sugar factories. Low-quality byproducts like syrup and molasses prevent yeast from fermenting sugar into ethanol. Annually, the sugar industry with its own distillery ethanol plants spends a lot of money on products that are used to prevent the spread of infection. The industry is being confronted with new scientific and technological boundaries and products in order to improve the sanitation in the sugar factory and the fermentation process for ethanol production in India.



Problem statement

Jakraya Sugar Factory Case:

In all, 150 KLPD The ethanol plant at Jakraya distillery in Solapur, Maharashtra, was facing contamination difficulties during ethanol production when they use sane syrup for the fermentation. Despite the use of enzyme-based antibacterial solutions, it was established that they had a serious problem with a bacterial infection and slow rate of fermentation that was impacting the plant's functioning and daily ethanol production. Jakraya distilleries differ in terms of raw material i.e cane syrup must make up. Jakraya Distillery use cane syrup from their own sugar factory connected to the distillery and usually ferments Cane syrup musts of sugar cane diluted with water.

When cane syrup arrived at their company's operations it was used continuously without any storage for several weeks, and ethanol fermentations could take place 4 to 5 months of the year or till the end of the cane crushing season. Unlike C molasses & B molasses, syrup must be stored in a storage tank, and a strategy must be developed to reduce the toxic acid byproducts formation in syrup and to avoid loss due to microbial contamination. Furthermore, due to **improper sanitation and cleaning practices, the industry faces bacterial contamination difficulties** not only in the milling area of the sugar factory but throughout the month of cane crushing season.

Along with bacterial contamination issues in milling and distillery, it also has difficulties with alcohol recovery, process, due to cane syrup (raw material) fluctuations especially the organic acids, and stuck fermentation due to low pH in the fermentation process.

Biokrishi team solves the Microbial contamination in the milling and high organic acid syrup problem for sugar industry plant

The high organic acid formation in syrup problems began in December 2022, when the sugar factory began operations and used cane syrup for the fermentation process (diverted 30% Syrup to Ethanol production). Based on the sugar industry management's request, the Biokrishi team visited their plant to monitor the overall manufacturing process and identify the root causes. The objectives for resolving the problem have been set based on plant monitoring.

Process Overview

Process monitoring , challenges and Objectives

Mill Cleaning

At the start of factory ,In cane crushing area, each mill is managed, and cleaned separately from the other with the help of raw water, clean water followed by hot water for an half hour.It is also cleaned weakly with the help of hot water .It was discovered that the method of cleaning the mills was inefficient and ineffective, and that it did not adhere to our earlier suggestion to the sugar plant.In fact, minor amounts of stagnated and spilled juice have been observed in several areas.

Mud Filter Process

Similar to mill areas, cleaning takes place in the press mud area at the beginning of the plant, with raw water followed by hot water.Then it is cleaned once a week with hot water.

Parameters	QUANTITY
Number of Mills	4 NOS
Cane crashing (MT per day)	2500-3000
Duration of the season	100-120 Days
Juice flow (ton per hrs)	170

Despite cleaning efforts in the milling and press mud areas, the factory continues to experience bacterial contamination issues, leading to an increase in organic acid levels within the syrup. The primary concern of the factory pertains to the use of this syrup from the sugar factory for ethanol production in the distillery. Upon closer examination of the syrup's quality, we found that the reduced and poor recovery for ethanol production in the distillery is also related to the syrup and mill sanitation within the sugar industry.

Microscopic and Chemical Observations of Cane juice and syrup

Contamination of Bacteria in Cane juice from Jakraya factory

The primary bacterial communities were represented by **Gram-positive rods and a little amount of Gram-positive cocci**, according to the microscopic examination of cane juice samples. Despite the fact that Gram-positive bacteria are the most common cause of bacterial contamination, a case of severe loss in sugar .While no contamination has been detected in sugar factory syrup, this might be due to the killing of bacterial contamination throughout the process.

Chemical composition of cane juice and syrup from the Jakraya factory

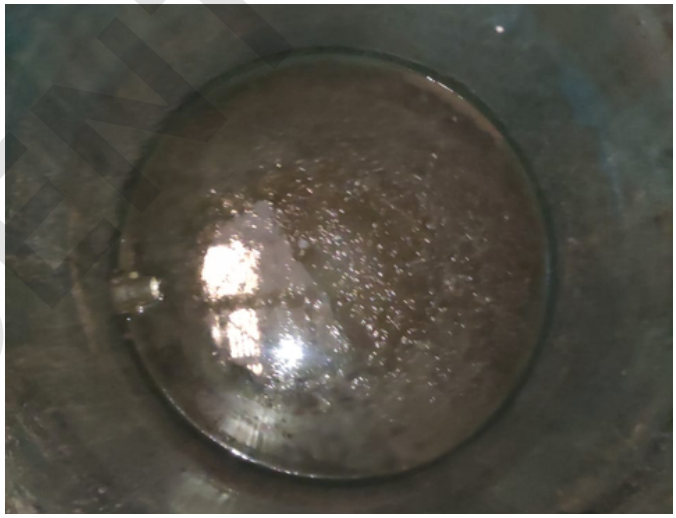
Regarding the other criteria for syrup, such as TRS, FS, and UFS, they were found to be acceptable. However, even after the use of biocides, the TVA concentration in the syrup was discovered to be high, ranging from 1900-2000 ppm. Variations in characteristics, such as RS% and TA%, have been observed in cane juice. The **highest titratable acidity** has been found to be around 21.88% at 100 brix in mixed juice. Additionally, a 1% increase in RS% has been noticed when transitioning from primary juice to mixed juice, which reduces sugar.

Problem Findings and Challenges

Jakraya Milling and other process observations

1. Based on microscopic examination Bacterial contamination, primarily of the gram positive rod, has been reported in mills where juice has been spilled or is stagnant.
2. An ineffective cleaning schedule has been found, resulting in an increase in microbiological contamination. This also increases the chances of microorganisms growing in the juice.
3. A 1% rise in RS% has also been found after switching from main juice to mixed juice lowering sugar (invert sugar).
4. Visual checks revealed no microbiological contamination in the mud filtration section.
5. A lot of bagasse particle has been seen, particularly in the region where dosing has been performed, resulting in an increase in bagasse particle in the doses tank, resulting in inappropriate dosing of biocides products.
6. Below the milling area, several of the spots where juice remains stationary throughout the milling process have been observed.
7. A red spot has been discovered in Some of the sugar cane that was brought to the milling area


Contamination in the milling area

Stagnant juice below the milling

Sludge formation in the dosing tank


Biocide dosing before and after cleaning of tank

Propose solutions

Biokrishi Cost-effective, efficient chemical based Biocide Solutions

The Biokrishi team has proposed the following product to control bacterial contamination based on visual process monitoring, microscopic and chemical examinations of milling area samples.

	Name of the Product	Product benefits	Dose in ppm (on juice flow)	Application area
1	BT 0108	Antimicrobial agent	6	Mill sanitation
2	BT 0109	Carbamate base	7	Mill sanitation
3	BT 0110	Quaternary base	10	Mill sanitation

Along with the products mentioned above, we have suggested a few process improvements such as

1. Cleaning and sanitation with hot water at mill side in every shift on daily basis
2. Spraying biocides in each mill area, drain area, and other surrounding region close milling with a spray pump, or alternatively every weak e.g. Spraying of BT0110 was done during the dose of BT 0109 in the juice, and vice versa. (10 ppm solution of biocide in soft water)
3. Removal of accumulated dust and sugarcane parts
4. Regular and proper dosing of biocide and cleaning of biocide tanks at area with extension line

To obtain precise findings, 16 days trials were carried out for control and test products and the test findings were compared to control independent trials.

Trial plan

Sr no	Trial no	Product dosages (ppm) use In Mill sanitation			
		Competitor	BT 0109	BT 0110	Number of days
1	Control	6 (daily)	7 (For first 7 days)	10 (after 7 days)	16 days
	Mill number	1 , 3 & 4	2	2	

Sr no	Trial no	Product use In Mill sanitation			
		BT 0108	BT 0109	BT 0110	Number of days
1	Test	6 (daily)	7 (For first 7 days)	10 (after 7 days)	16 days
	Mill number	1 , 3 & 4	2	2	

TRIAL OBSERVATIONS

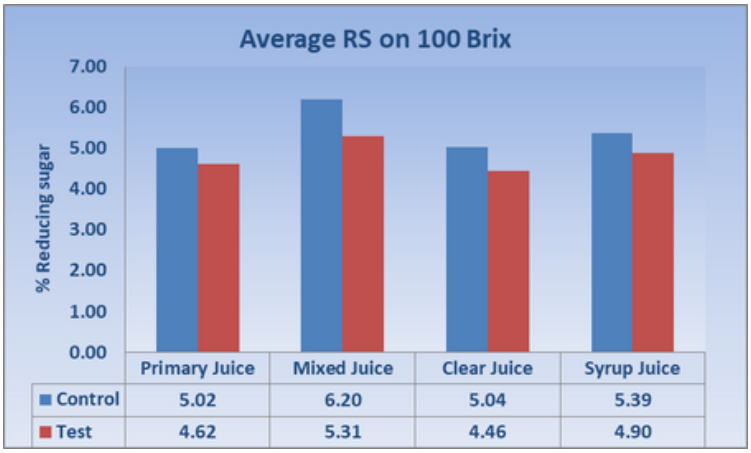
Control Data (28th Dec 2022 to 12th Jan 2023)

	Primary Juice		Mixed Juice		Clear Juice		Syrup Juice	
Day	RS 100% Brix	TA 100% Brix	RS 100% Brix	TA 100% Brix	RS 100% Brix	TA 100% Brix	RS 100% Brix	TA 100% Brix
1	3.97	16.78	6.35	19.64	4.45	14.64	4.95	15.54
2	5.44	17.98	6.11	20.55	5.1	13.97	5.34	14.24
3	4.66	17.01	5.75	21.33	4.5	14.88	4.75	15.53
4	5.39	17.67	6.18	21.04	5.54	15.62	5.83	16.13
5	4.97	16.85	5.96	20.1	4.76	13.63	5.09	14.03
6	5.23	17.64	5.99	21.34	5.43	15.34	5.8	15.98
7	4.03	16.56	6.01	19.88	4.34	14.23	4.76	15.14
8	5.23	17.36	6.04	20.96	4.95	14.01	5.35	14.79
9	4.53	17.53	6.91	20.39	5.01	15.39	5.51	16.29
10	5.53	18.11	6.2	20.68	5.19	14.1	5.43	14.37
11	5.15	17.2	6.24	21.52	4.99	15.07	5.24	15.72
12	5.52	17.79	6.31	21.16	5.67	15.74	5.96	16.25
13	5.25	16.94	6.24	20.19	5.04	13.72	5.37	14.12
14	5.42	17.85	6.18	21.55	5.62	15.55	5.99	16.19
15	4.52	17.11	6.5	20.43	4.83	14.78	5.25	15.69
16	5.43	17.77	6.24	21.37	5.15	14.42	5.55	15.2
Avg.	**5.02**	**17.38**	**6.20**	**20.76**	**5.04**	**14.69**	**5.39**	**15.33**

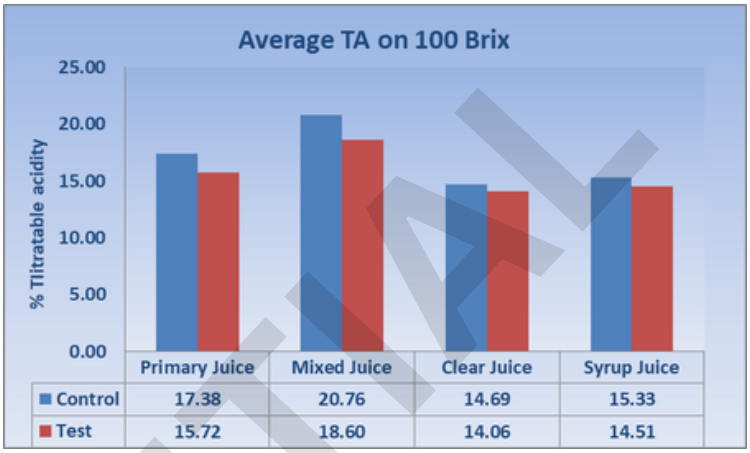
Test Data (13th Jan To 28th Jan 2023)

	Primary Juice		Mixed Juice		Clear Juice		Syrup Juice	
Day	RS 100% Brix	TA 100% Brix	RS 100% Brix	TA 100% Brix	RS 100% Brix	TA 100% Brix	RS 100% Brix	TA 100% Brix
1	4.55	15.78	5.43	17.98	4.12	14.11	4.56	14.85
2	4.65	15.54	5.13	17.56	4.34	14.01	4.97	14.24
3	3.78	16.1	4.88	18.96	4.23	13.34	4.54	14
4	4.78	15.34	5.54	19.52	4.66	14.56	4.89	14.88
5	5.15	15.23	5.74	18.55	4.91	13.88	5.14	14.34
6	4.56	16.05	4.75	19.88	3.98	14.29	4.76	14.46
7	4.03	15.21	4.82	17.45	4.18	13.43	4.67	14.01
8	4.23	15.38	4.98	17.34	4.01	13.75	4.34	14.18
9	4.47	15.58	5.16	18.41	4.3	13.92	4.73	14.37
10	5.11	16.53	5.99	18.73	4.68	14.86	5.12	15.6
11	4.74	15.67	5.22	17.69	4.43	14.14	5.06	14.37
12	4.27	16.29	5.37	19.15	4.72	13.53	5.03	14.19
13	4.91	15.46	5.67	19.64	4.79	14.68	5.02	15
14	5.43	15.32	6.02	18.64	5.19	13.97	5.42	14.43
15	4.75	16.26	4.94	20.09	4.17	14.5	4.95	14.67
16	4.52	15.76	5.31	18	4.67	13.98	5.16	14.56
Avg.	**4.62**	**15.72**	**5.31**	**18.60**	**4.46**	**14.06**	**4.90**	**14.51**

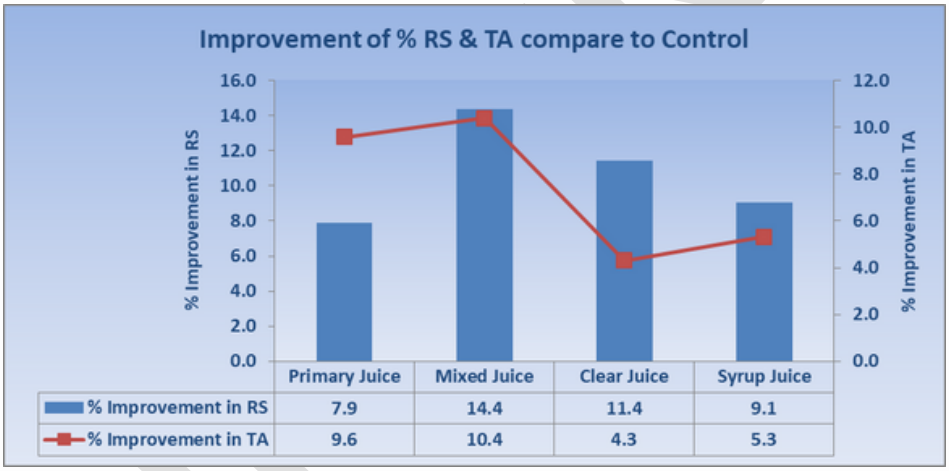
TRIAL RESULTS



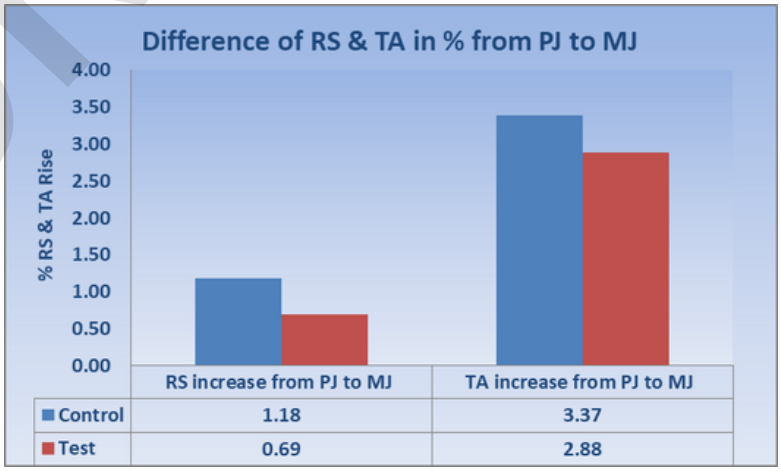
Graph 1: Average RS % on 100 Brix for Control and Test products



Graph 2: Average TA % on 100 Brix for Control and Test products



Graph 3: Improvement of RS & TA % after use of test products when compared to control products



Graph 4: Difference or increase in RS & TA % from primary to mixed juice after use of test products compared to control products

Results:

- Graphs 1 and 2 indicate that the RS and TA percentages in the test are always lower than the control.The RS% in primary and blended juice is 4.62 and 5.31, respectively. This not only reflects the least amount of sucrose inversion into reducing sugar or invert sugar but also the excellent control of microbial contamination in the milling area.
- Graph 3 indicates the percentage improvement in RS and TA in milling after using the test product. The greatest improvement in RS and TA% has been recorded in the milling area, which is the most essential section in the sugar factory, at 14.4 and 10.4%, respectively.
- The results of Graph 4 reveal that when compared to the control, both RS and TA% decrease in the test results. When compared to the control data, the RS% drops by about 0.69%. While the TA% drops by about 2.88% when compared to the control values of 3.37%.
- During the test product trial, all cleaning and sanitation were maintained in accordance with the recommendations. There has been no spillage or accumulation of cane juice.

After carefully examining the data and analysis, it is apparent that the use of BT 0108 at the recommended dosages excels beyond the competitor's product. The evidence suggests that the Biokrishi team's advice on improving hygiene and sanitation practices has produced positive outcomes for the Sugar factory. These results indicate that implementing these measures could enhance the overall effectiveness of the factory's operations.

It also implies that the **BT 0108 product is compatible with the BT 0109 and BT 0110 products.** In fact, its combination with other products aids in the effective management of microbial contamination and byproducts. **The initial low amount of titratable acidity in primary and mixed juice also aids in lowering the organic acid content in syrup**.

Based on the results mentioned above, Jakraya Sugar Management has been advised to use the product continuously during the whole sugarcane crushing season.