Industrial COGENERATION India

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Sanjay Khatal
(Director General)
Cogen India

We, at Cogeneration Association of India (Cogen India), launched the National Cogeneration Awards in 2022, followed by another successful recognition of the sector's achievements in 2023. We have been profiling case studies of the winners in each newsletter issue, and this time some second and third rank winners from 2023 *(refer the Oct 2023 issue for further details*) are included – two from the private sector (*Rajshree Sugars and Chemicals Ltd. and Shreenath Mhaskoba Sakhar Karkhana Ltd.*) and two from the cooperative sector (*Loknete Sunderraoji Solanke SSK Ltd. and Shri Tatyasaheb Kore Warana SSK Ltd.*). The nominations for 2024 are in, and for those who wish to attend the Awards Event this year, please refer to the announcement details within.

Each case study has unique features – one has covered their operational challenges, with the technical modifications made and benefits achieved. Another has talked about their experience with using refuse-derived fuel (RDF) in their sugar cogeneration plant and distillery power plant, and of using biogas as an auxiliary fuel. One plant has described the challenges they faced with using biomass briquettes and pellets as additional renewable fuel, and their success with cane trash collection and use. Each award winner has also described their innovative energy and water conservation activities, and the benefits accrued.

Contents

Cogen India welcomes **Shri Pralhadji Joshi**, Honourable Minister for Consumer Affairs, Food & Public Distribution; and New & Renewable Energy, Government of India.

As we all know, the REC (Renewable Energy Certificate) Policy for tradable RECs was launched in 2010-11. Each REC is one MWh of electricity generated from a renewable energy source. The RECs generated are traded in the open market. Since the REC mechanism was a new concept for cogeneration plants, many sugar mills credit the REC revenue earned by cogeneration plants to Cogen India, which organized several meetings to make such plants aware of this revenue mechanism. The REC sale of one such plant has been tabulated within, along with the revenue earned.

Cogen India has been working towards harnessing sugar industry potential all over India, and organized two business meets in Madhya Pradesh and Karnataka recently in this endeavour. The response was tremendous and we hope to continue these partnerships and collaborations to capture this potential in these two states, over the next few years.

Flexibility to adopt the changes in demand and supply is the key to a sustainable modern sugar complex, which integrates innovative technologies and practices to optimize energy consumption while expanding the product portfolio. An expert viewpoint article talks about achieving maximum bagasse savings in sugar complexes though simple, yet innovative solutions. The plant described, is saving more than 13% bagasse, which is being utilized in a paper plant as feedstock after de-pithing.

contd on pg 21

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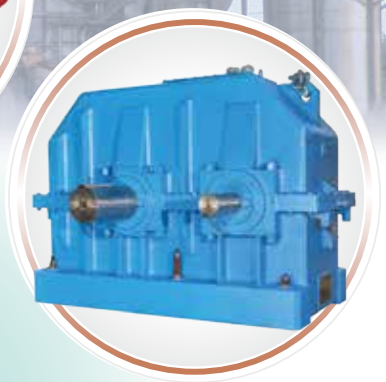

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Harnessing Sugar Industry Potential in Madhya Pradesh and Karnataka

Background

The sugar sector in India is undergoing a transformational change from being standalone sugar-producing units to becoming Bio-Energy Hubs. This revolutionary role of developing into 'Agro-Energy Processing Units' from the erstwhile 'Agro-Processing Units' is the result of the mission mode program of the BioFuel Policy – 2018 by the Government of India.

In the near future, the bio-energy concept of complete utilization of sugarcane biomass, molasses and press mud will become pivotal for a sustainable sugarcane industry. Production of bio-energy will be one of the most proficient ways to achieve sustainable development. Sugar mills would need to transform from 'Producers of Sugar' to 'Bio-Energy Hubs', marking a change in the philosophy. The challenges, opportunities and methods to pursue this transformation are enormous.

In view of the above, the Cogeneration Association of India (Cogen India) had successfully organized business meets on the theme 'Sugar Factories: The Future Innovative Energy Hubs' for Northern (Lucknow, Uttar Pradesh), Southern (Belagavi, Karnataka) and Western (Pune, Maharashtra) Regions during 2022-23.

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Mr Sanjay Khatal, Director General, Cogen India
Ms Anita Khuller, Senior Associate Consultant, Cogen India

Madhya Pradesh: Potential & Challenges

In a continuous effort to update the sector, Cogen India identified the State of Madhya Pradesh as an important State in the Sugar Value Chain of our country, with 19 operational sugar mills out of 534 mills operational in India, annually crushing 50.00 lakh tons of sugarcane producing 5.0 lakh tons of sugar with an average recovery of 9.50% to 10.5% involving a financial implication of INR 1,100 crore, benefitting farmers. With this, Madhya Pradesh stands to be one of the fastest developing States with a substantial need for energy. About 42% of the energy generated in the State is from renewable sources. Madhya Pradesh is also a part of one of India's Green Energy Corridors and has a total renewable energy potential of approximately 30 GW from different sources.

It was identified that the sugar mills in Madhya Pradesh are facing major issues for implementing cogeneration projects such as:

- Power plants set up by sugar factories in Madhya Pradesh are either treated as Independent Power Plants (IPP) or Captive Power Plants (CPPs), unlike in all other States of India where such power plants are treated as cogeneration power plants.
- Sugar mills are being charged Cross-Subsidy Surcharge (CSS) and Additional Surcharge (AS) on the power used for running sugar mills from the cogeneration power plants, which is a serious concern as no State levies such charges on captive consumption.

To explore the opportunities in the renewable energy sector, as well as to address the issues faced above, Cogen India organized a business meet on "Integrated Strategy for Harnessing Biomass Potential at Sugar Industry in Madhya Pradesh" on March 21, 2024 at Radisson Hotel, Bhopal, with the main objectives of:

1) Identifying key technical, financial and commercial issues, and barriers for setting up bagasse/biomass-based cogeneration power plants in the State of Madhya Pradesh,
2) Finding a way out to resolve these issues/barriers through discussion and experience sharing amongst

From left: Shri V. Maheshwari, Shri A.S.Bains, Shri S. Khatal, & Shri P. Mittal

the technology providers, stakeholders and project promoters, during the technical sessions, and

3) Creating awareness about the latest, innovative bio-energy technologies for upgradation of sugar factories.

Business Meet Proceedings

The Business Meet witnessed excellent response. Around 65 delegates, including sugar mill participants, guests, faculty, sponsors and organizers, attended this event.

The Inaugural Session was chaired by:

- Shri Amanbeer Singh Bains, MD, M.P. Urja Vikas Nigam Limited (MPUVNL), Government of Madhya Pradesh
- Shri Vivek Maheshwari, Director, Ramdev Sugars
- Shri Akhilesh Goyal, Director, Durga Sugars
- Shri Sanjay Khatal, MD (MSFCSFL) & DG (Cogen India)
- Shri Pradeep Mittal, Dy. Executive Director, Dalmia Bharat Sugars Ltd.

The following technology providers/speakers from industries shared their views during the Technical Sessions at this conference:

MITCON Pune: Introduction to Precision Agriculture in the Sugar Industry

Mr. Tushar Jadhav emphasized the need of using advanced technology and data analysis to optimize the efficiency of farming practices, mainly focusing on soil management through Artificial Intelligence.

Clarke Energy: Biogas-to-Power and Renewable Natural Gas

Mr. Abhijit Rajguru thoroughly explained the technology wherein the biogas generated in distilleries during the treatment of spent wash or by using press mud, can be efficiently used in an gas engine to generate power.

Covalent: Ethanol, Biofuel & Renewables

Dr. Sandeep Chichbankar signified the development of green, sustainable, futuristic technologies and establishing harmony with the existing ones while implementing biofuels and renewable energy projects.

Sitson India: Energy Efficiency in Sugar Industry

Mr. Nilesh Jadhav described Energy Conservation and Waste Heat Recovery measures in various industrial plants, including sugar industry.

Biofics: Cogeneration CBG and Bio-Fertilizer Plants

Mr. Ashish Tripathi described the Smart Biogas Generator based on an advanced technology that ensures complete waste utilization for high value generation. He also explained the Operational Features of a Smart Biogas Plant.

Protos Engineering: Particle Board

Mr. Deepak Bhatia and Mr. Pratik Vaydande explained the profitability of Particle Board production as against other conventional by-products from bagasse.

Cogeneration Association of India

Mr. Pradeep Mittal, Dy. Executive Director, Dalmia Bharat Sugar & Industries Ltd., on behalf of Cogen India, briefly summarized the comparative status/key parameters/ issues of cogeneration power plants in MP as against those in other major States of India having operational cogeneration power plants.

Conclusion & Action Plan

With only 19 sugar factories operational in Madhya Pradesh, the response/participation for the business meet was remarkable. The delegates present were knowledgeable and enthusiastic about the advanced/ innovative technologies presented and their implementation for higher yield of cane and subsequent renewable energy power generation in sugar factories.

Since the MP State DISCOM does not sign PPAs with the cogeneration power plants at sugar factories in the State due to claimed availability of surplus power along with ample cheap solar and wind power in the State, and due to strong representation for removal of CSS of INR 1.5 per unit on captive consumption being imposed by the MP State DISCOM, Cogen India will work with all stakeholders to extend the requisite regulatory support for removal of these key barriers and address these challenges.

Seminar on 'Sugar Industry - Biofuel, Ethanol & Allied By-Products'

With the similar objectives and vision to explore the

opportunities in the renewable energy sector, Cogen India and S. Nijalingappa Sugar Institute jointly organized a seminar on 'Sugar Industry - Biofuel, Ethanol & Allied By-Products' for sugar mills/distilleries in Karnataka on April 30, 2024 at Hotel Fairfield Marriott, Belagavi, Karnataka.

The following dignitaries graced the inaugural session (*refer photo below*):

- Dr. Sandeep Chichbankar, Founder & MD, Covalent Projects & Engineering Pvt. Ltd. Pune
- Dr. R.B. Khandagave, Director, S. Nijalingappa Sugar Institute, Belagavi, Karnataka
- Shri R.V. Vatnal, Former President SISSTA & Director Technical, Nirani Sugars Ltd.
- Shri Nalin Shah, President, Biofuels & Green Chemistry, MITCON, Pune
- Shri Sanjay Khatal, MD (MSFCSFL) & DG (Cogen India)

Shri Madhav Raut, Cogen India Board Member and Jt. MD, Shreenath Mhaskoba Sakhar Karkhana Ltd., Pune was also present.

The seminar witnessed excellent response with around 125 delegates. The topics were more or less similar to that of the MP Business Meet. In addition, Praj Industries Ltd. presented on 'Transition from Sugar Factory to Bio-Refinery' and emphasized on the need for sugar mills to transform into bio-refineries, for more sustainability.

Paques Environmental Technology Pvt. Ltd. explained their technology for "Treatment of BMSW (Bio Methanated Spent Wash) Evaporator Condensate with Ammonia Nitrogen to Integrate Process". VM Biotech highlighted the Optimization of Ethanol Production to Improve Sustainability of Sugar Industry, and Mr. Sura Bhojraj, senior personnel with vast experience in the sector, delivered a comprehensive presentation on Comparison of Evaporators.

As on March 31, 2024, the installed capacity of cogeneration power projects (bagasse & non-bagasse) in the State of Karnataka cumulated to 1,890 MW. Approx. 51% of the State's installed power capacity comes from renewable energy sources viz. solar, wind and bio-power. However, the major issue being faced by Karnataka cogenerators is the CSS being imposed on the cogeneration plants. Further, the Karnataka DISCOM too is not willing to sign PPAs with the upcoming cogeneration plants. With this, despite a conducive tariff of INR 6-6.50 per unit, the State still has an untapped potential of about 700-800 MW of cogeneration power projects.

Cogen India will work in close coordination with the State Sugar/Cogeneration Associations to solve these issues and promote this sector.

Cogen India invites all Renewable Energy Power Generators under its "Umbrella" and sends out an appeal to become Members of the Association.

For further details, please contact:
Cogen India
Phone: 020-25511404 and 9823004221
Email: cai@cogenindia.org

Cogeneration Association of India Announces

National Cogeneration Awards-2024

After the resounding success in the years 2022 and 2023 to highlight their achievements, we invited nominations this year for -

1. **Best Cogeneration Power Plant**
2. **Best Cogeneration Manager**
3. **Best Instrument Manager/In-charge**
4. **Best DM/WTP Manager/In-charge**
5. **Best Electrical Manager**

Each above category has Four Awards bifurcated for Co-operative and Private Sector Sugar Mills as well as for Boiler Pressure below & above 80 kg/cm².

Accordingly, there will be total 20 (Twenty) numbers of Awards.

Results to be announced

For details on the Awards Event,
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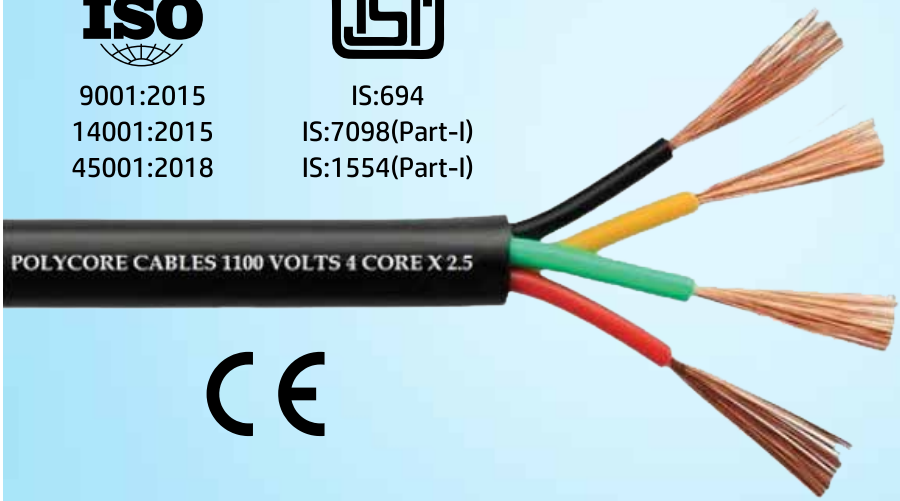

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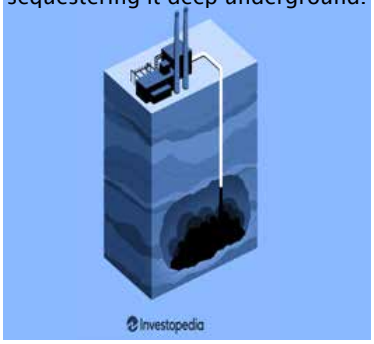
New Technologies in Power Plants & Cogeneration

As the global demand for cleaner, more efficient energy solutions intensifies, the power generation industry is undergoing significant technological advancements. These innovations are not only enhancing the efficiency and sustainability of power plants, but also revolutionizing cogeneration systems. Here, we explore some of the cutting-edge technologies shaping the future of power generation and cogeneration.

Carbon Capture and Storage: The Future of Power Generation

Carbon Capture and Storage (CCS) is a pivotal technology in the transition towards more sustainable fossil fuel power generation. It involves capturing carbon dioxide (CO_2) emissions from sources like power plants and industrial processes, transporting the CO_2 to a storage site, and securely depositing it underground in geological formations. This technology addresses the pressing need to reduce greenhouse gas (GHG) emissions while utilizing existing energy infrastructure.

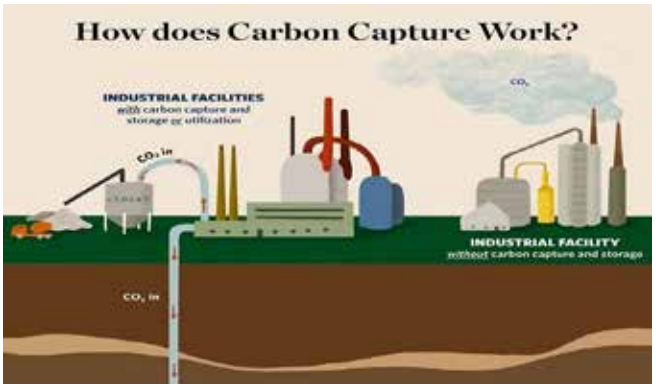
Carbon Capture
A process for trapping CO_2 and sequestering it deep underground.



The Importance of CCS

Fossil fuels, including coal, oil, and natural gas, remain a significant part of the global energy mix and cannot be phased out entirely in the short term, due to economic and logistical challenges, despite the growth of renewable energy. CCS offers a way to mitigate the environmental impact of continued fossil fuel use by preventing CO_2 from entering the atmosphere.

How CCS Works



1. **Capture:** The CO_2 is separated from other gases produced in electricity generation or industrial processes, using the following techniques. Pre-combustion involves gasifying the fuel and capturing CO_2 before combustion. Post-combustion captures CO_2 from the flue gases after combustion, and oxy-fuel combustion burns the fuel in oxygen, producing a flue gas that is mostly water vapour and CO_2, which is easier to separate.
2. **Transport:** Once captured, the CO_2 is compressed and transported to a storage site, via pipelines, which are the most common and cost-effective method, or by ships, which might be used for longer distances or where pipeline infrastructure is not available.
3. **Storage:** The CO_2 is injected into deep underground rock formations, such as depleted oil and gas fields, deep saline aquifers, or un-mineable coal seams. These geological formations must have a cap rock layer that acts as a seal to prevent CO_2 from escaping.

Benefits & Challenges

Benefits:

- **Emission Reduction:** CCS can capture up to 90% of CO_2 emissions from power plants and industrial sources.
- **Support for Renewable Integration:** By mitigating emissions from fossil fuel plants, CCS can act as a bridge technology while renewable energy capacity is ramped up.
- **Enhanced Oil Recovery (EOR):** Injected CO_2 can be used to enhance oil recovery from existing oil fields.

Challenges

- **Cost:** The technology is expensive. High capture costs, infrastructure for transport, and ensuring safe, long-term storage add up to significant investments. Currently, without carbon pricing mechanisms or government incentives, widespread adoption is economically challenging.
- **Energy Penalty:** CCS processes consume a substantial amount of energy, reducing the overall efficiency of power plants.
- **Storage Risks:** Ensuring that CO_2 remains securely stored underground is critical. There are concerns about potential leaks, which could negate the benefits of CCS and pose environmental and health risks.

contd on pg 35

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Rajshree Sugars and Chemicals Ltd., Unit-II, Mundiyampakkam: Case Study

3rd Rank in "Best Cogeneration Plant 2023 Award" for Above 87 kg/cm^2 Category (Private Sector)

Introduction

Founded in 1987 by Late Shri G. Varadaraj, Rajshree Sugars and Chemicals Limited's (RSCL) sugar plant was set up in one of the most backward areas of the Theni district of Tamil Nadu, which paved the way for economic and social development of the area by not only providing employment but also farming opportunities to the local people.

Currently, Mrs. Rajshree Pathy serves as the Chairperson and Managing Director of the Rajshree Group of Companies. She is also the founder of the India Design Forum. In recognition of her contributions, she was honored with the Padma Shri Award by the Government of India in 2013.

RSCL is a company with interests across integrated fields such as Sugar, Distillery, Power Generation and Biotechnology. Its range of products includes white, brown and demerara sugar, alcohol/ethanol, organic manure, bio-products, and green power.

Expansion & Innovation

RSCL acquired the Mundiyampakkam plant from M/s South India Sugars Limited in 2002 and subsequently expanded its capacity from 3500 TCD (tons of cane crushed per day) to 5000 TCD in 2006. The management team at RSCL made a strategic decision to establish a new cogeneration project, which included an 87 ata high-pressure boiler and a 22 MW turbine. This initiative aimed to reduce carbon emissions and energy costs. The installation of the new cogeneration system commissioned on June 1, 2005 replaced the existing low-pressure bagasse-based boilers. The plant generates a total of 22 MW, with 6.5 MW being utilized for captive consumption, while the remaining surplus power is exported to the state's Tamil Nadu Electricity Board (TNEB) grid.

Notably, the Mundiyampakkam cogeneration plant is the first unit in South India to be registered under the Clean Development Mechanism (CDM). The Certified Emission Reductions (CERs) earned from Oct-2009 to Oct-2015 was 816,547 credits. Each CER credit is equivalent to one ton of carbon dioxide.

RSCL was also the first sugar cogeneration plant in India to install an air-cooled condenser to condense excess steam from the turbine, which resulted in water conservation of 600 m^3 per day of raw water.

RSCL's Semmedu plant was established as an integrated greenfield complex, combining Sugar, Cogeneration, and Distillery units. In 2009, it installed a 3500 TCD sugar plant along with a 110 ata high-pressure boiler for 20.5 MW cogeneration. Subsequently, in April 2012, the plant underwent modernization, introducing an 80 KLPD zero liquid discharge (ZLD) system alongside a 30-ton incineration boiler and a 3 MW power plant.

The technical and commercial performance of the cogeneration plant has been consistently good. Due to this the Cogeneration Association of India awarded us the 3rd rank in "Best Cogeneration Plant in India 2023 Award" for above 87 kg/cm^2 category (Private), which was received from the hands of Chief Guest Hon. Sharad Chandraji Pawar (MP) Rajya Sabha at Pune on 16 September 2023 (*refer photo above*).

Boiler & Turbine Information

Mechanical

Boiler	:	Thyssenkrupp
TG & Auxiliaries	:	Skoda/Triveni/TDPS
ESP	:	BHEL
ACC	:	Paharpur
Pump	:	KSB
Compressors	:	Atlas Capco & Chicago Pneumatic
WTP	:	Ion Exchange

AWARD WINNER

Electrical

VFD	:	ABB
Transformers	:	BBL & Voltamp
HT Panels & MCC	:	Siemens
Synchronizing & Protection System	:	Alstom
ESP Transformers	:	ADOR Corona

Instrumentation

DCS	:	Yokogawa
Governor Control	:	Siemens
Field Transmitters & Analysers	:	ABB
Oxygen Analyser	:	Yokogawa
TG Vibration Monitor	:	Bentley Nevada
TG OSPS	:	Woodward

Thermal Cycle

The thermal cycle of the 22 MW cogeneration plant at Mundiyampakkam is 87 ata with a two-stage extraction-cum-condensing turbine with the following parameters:

S. No.	Description	Values
1	Boiler capacity (TPH)	120
2	Boiler outlet steam pressure (ata)	87
3	Boiler outlet steam temperature (Deg. C)	515
4	Feed water inlet temperature (Deg. C)	170
5	HP heater inlet temperature (Deg. C)	115
6	Steam to bagasse ratio	2.50
7	TG capacity (MW)	22
8	Turbine inlet steam pressure (ata)	84
9	Turbine inlet steam temperature (Deg. C)	510
10	Uncontrolled extraction pressure (ata)	10
11	Uncontrolled extraction temperature (Deg. C)	250
12	Controlled extraction pressure (ata)	3
13	Controlled extraction temperature (Deg. C)	154
14	No. of HP Heaters	1
15	Condensing system	ACC

Energy Conservation Initiatives in Sugar & Cogeneration Plant

Significant efforts were undertaken to reduce steam and power consumption in the sugar mill and auxiliary consumption in the cogeneration plant. Key initiatives included:

1. **Cane Preparation Optimization:** The cane preparation equipment was interlocked, and an automation system monitored it using a Distributed Control System (DCS). This approach improved mill performance, achieving maximum extraction with reduced bagasse pol and moisture content.
2. **Flash Heat Recovery System:** Condensate water from the 2nd and 3rd evaporator bodies was collected in a closed vessel. The flash vapor from this vessel was then utilized in subsequent bodies, resulting in a 1% reduction in steam usage per ton of cane.
3. **Continuous Pan Installation:** Continuous pans were installed for B and C massecuite boiling, utilizing low vapor pressure. Additionally, 9 ata steam was eliminated for molasses conditioning by using the first body vapor.
4. **Air-Cooled Condensate Preheating:** The air-cooled condensate was preheated using hot water from the sugar plant, leading to a 3 ata steam reduction in the deaerator.
5. **Vapor Line Juice Heating:** Raw juice heating from 30 to 52°C was achieved by utilizing vapor from the 5th body. Direct Contact Juice Heaters were used for sulphur juice and clear juice heating.
6. **DCS Automation:** The DCS ensured controlled steam supply to the sugar process, resulting in steam and power savings.
7. **Mill Excess Water Pump Optimization:** By minimizing the operating hours of the mill excess water recirculation pump (from 12 hours to 2 hours) through an auto-level controller, 14,520

Performance Highlights

Year	Cane Crushed, MT	Power Generation, Lakh Units	Power Export, Lakh Units	Power to Sugar, Lakh Units	Power to Cogen., Lakh Units	PLF %	Aux. Cons. %	Specific Steam Cons., MT/ MW	Steam Fuel Ratio
2013-14	1,199,336	1,331	934	273	124	92.32	9.31	5.26	2.37
2014-15	810,299	886	629	181	75	93.22	8.52	5.21	2.54
2015-16	935,968	1,088	782	217	89	96.76	8.22	5.15	2.55
2016-17	891,136	1,015	729	201	85	93.75	8.36	5.20	2.55
2017-18	558,176	682	493	131	58	84.44	8.55	5.26	2.53
2018-19	549,137	636	453	128	55	85.47	8.64	5.28	2.50
2019-20	493,968	607	439	117	50	86.39	8.32	5.27	2.50
2020-21	576,566	684	489	134	60	78.46	8.85	5.29	2.49
2021-22	655,969	765	547	150	67	87.24	8.76	5.29	2.51
2022-23	757,199	906	644	179	83	85.81	9.14	5.32	2.52

Rajshree Sugars & Chemicals Ltd – Unit-II Cogeneration Plant

units of power are being saved annually.

8. **Variable Frequency Drive (VFD) for Cane Unloader:** Installation of a VFD improved efficiency for the cane unloader.
9. **LED Lighting Upgrade:** Conventional sodium vapor lamps and tube light fittings were replaced with energy-efficient LED lamps.
10. **Enhanced Combustion Efficiency:** Baffle plates were added from the casing plate to the first row of Air Preheater (APH) tubes, improving APH outlet air temperature. Modifications to overfire air nozzles further increased steam fuel ratio by 0.05.
11. **SWAS Cooler Optimization:** Providing demineralized water for SWAS coolers eliminated sample cooler choking and reduced deaerator steam consumption.
12. **Regularly performing thermography studies** to assess the health of the electrical system.

Water Conservation

In the sugar plant, water recycling is maximized, and excess condensate is cooled to ambient temperature for use in spray pond makeup and other sugar process requirements. As a result, total raw water consumption in the process has been eliminated.

Operating Challenges

During operations, various challenges related to machinery and equipment arise. In response, specific measures have been implemented to enhance efficiency.

a) APH tube choking

Problems faced

- APH tubes frequent failure due to cold end corrosion
- Unable to maintain ESP inlet flue gas temperature
- Clinker formation in ESP Hopper
- Frequent Jamming of ash conveying lines

Modification

- APH - first pass tubes MOC changed to SS-304 from Carton steel

Benefits

- APH tubes failure completely eliminated and APH outlet air temperature increased & flue gas temperature maintained as per design

b) Ash accumulation in boiler bank outlet duct

Problems faced

- Heavy ash accumulation in boiler bank outlet duct
- Frequent buffing in boiler furnace

Modification

- Boiler bank outlet flue gas duct bottom plate radius reduced

Benefits

- Improvement in boiler operation

c) Drum feeder jamming

Problems faced

- Reduction in speed when silo level more than 60%
- Not able to operate with 100% level in bagasse silo
- Frequent damage of shaft

Modification

- Comb plate pitch increased
- Drum feeder split shaft changed into single shaft

Benefits

- Drum feeder stoppage avoided

d) Turbine nozzle chest chamber leak

Problems faced

- Nozzle chest chamber steam leak during startup
- Steam leak leads to LVDT malfunction and HP control valve hunting

Action taken

- Nozzle chest chamber studs MOC changed

Benefits

- Steam leakages avoided and improved efficiencies

e) Interlocking of 110 kV SF6 & tie breaker

Problem faced

- During commissioning, when the RSCL side 110 kV SF6 trips, grid tie breaker did not open resulting in frequent turbine trips

Root cause

- Found interlocking between tie breaker & SF6 was not done

Correction

- Interlocking done

Benefits

- Turbine tripping avoided

f) Alternator trips on OC setting

Problem faced

- Alternator tripped twice due to over-current during grid disturbances

Correction

- Over-current setting was raised from 1500 Amps to 1650 Amps

g) Turbine – Overspeed trip

Problems faced

- Turbine tripped on overspeed during home load
- Overspeed trip set: 6050 RPM
- Grid breaker over frequency trip: 5750 RPM with 2 second delay

Correction

- Grid breaker over frequency trip - 5750 RPM with 200 ms delay

h) Line out 110 kV SF6 breaker failure

Problem faced

- 110 kV SF6 line out breaker failed due to its FRP push rod damage

Correction

- We have redesigned the damaged push rod by inserting an aluminum extension piece without affecting the electrical parameters (insulation level)

CSR & Learning Initiatives

As part of its Corporate Social Responsibility (CSR) initiative, RSCL installed a Modular Oxygen System at the Government Villupuram Medical College Hospital in Mundiyampakkam during Covid. Healthcare continues to be promoted in the neighborhood with regular health camps in and around the factory. This facilitates better relations and smoother work atmosphere around the plant.

RSCL also supports the Rajshree Sugar Ramakrishna Vidyala Matriculation Higher Secondary School, Munidiyampakkam, Villupuram District, Tamil Nadu, which is managed through Rajshree Sugars Sri Ramakrishna Educational Society.

Additionally, the Company has established a Safety Committee to ensure compliance with Occupational Health & Safety guidelines and prevent accidents. The committee meets monthly to evaluate the effectiveness of safety programs and investigate the root causes of any accidents.

Furthermore, RSCL conducts on-the-spot training and plant training programs on topics such as Safety, DCS, troubleshooting, root cause analysis, and Mechanical Standard Operating Procedures for employees at various levels, facilitated by engineers and chemists.

Awards

Besides the Cogen India award in 2023, our sugar factory has received various state as well as national awards as below.

- SVP Memorial Award for Cane Development given by SISSTA in the year 2001-02.
- SVP Memorial Award for Best Sugar Factory Performance given by SISSTA in the years 2003-04 & 2004-05.
- Safety Awards given by the Hon'ble Minister for Labor Welfare, Tamil Nadu in the years 2009, 2010 & 2011.
- Best Cogeneration Award – 2nd Prize given by SISSTA in the years 2010 and 2011.
- Best Cogeneration Award – 1st Prize given by SISSTA in the year 2012.
- Best Sugarcane Development Award – 3rd Prize given by SISSTA in the year 2013.

Courtesy:
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Uncommon Cogeneration By Shreenath Mhaskoba Sakhar Karkhana Ltd.

3rd Rank in "Best Cogeneration Plant 2023 Award" for Below 87 kg/cm^2 Category (Private Sector)

The concept of cogeneration defines the simultaneous production of steam and power. In the sugar industry, there is tremendous potential to improve sugar factory performance by focusing on energy conservation and energy efficiency. By upgrading low-efficiency machinery to high-efficiency equipment, it is possible to reduce operating and maintenance cost, and improve the overall plant performance. This article provides the cogeneration power plant details and innovative approach for operation of the same at Shreenath Mhaskoba Sakhar Karkhana Ltd. (SMSKL).

Plant Details

SMSKL is one of the leading sugar factories in the Pune district of Maharashtra. Established in the year 2005, the sugar factory is of 4,500 TCD. Due to the government's motivation to increase renewable power, we took a step forward and installed a 10 MW cogeneration plant in January 2012. We are using the existing sugar plant boiler for this cogeneration plant by enhancing its capacity and installing a new 10 MW turbine. The complex also has a distillery of 200 KLPD and a 2G Ethanol Plant (R&D) of 3 KLPD. There is a Compressed Biogas (CBG) plant of 10 MT per day. An innovative addition was the Spent Wash Dryer (Powder) of 40 tons per day.

Power Plant Equipment

Boiler

- Capacity – 70 TPH; Before cogeneration it was operated at first a pressure of 32 kg/cm^2, then at 40 kg/cm^2 pressure (Steam temp. 425^{0}C ± 5^{0}C)
- One boiler of 32 TPH and 42 kg/cm^2 pressure was added in season 2014-15 and its capacity increased from 32 TPH to 50 TPH in season 2022-23
- Now total operating load of both the boilers is 102 MT/hour
- A fully automatic DCS system has been installed

SMSKL sugar complex

Power Generation

- 3 MW Triveni-make TG set (Backpressure type)
- 10 MW KEPL-make TG set (Backpressure type) commissioned in the year 2012
- Power generation increased from 2.5 MW to 12.5 MW
- Power evacuation – 5.5 to 7.0 MW
- One Triveni-make 4 MW condensing-cum-backpressure TG set installed to run in the off-season for distillery operation
- 25% RDF (Refused Derived Fuel) segregated from municipal corporation solid waste used successfully
- Power connected to 33 kVA grid. However, for 33 kV grid, there is high frequency of grid failure, which affects power generation
- 7.5 MVA, 33 kV/11 kV switchyard has been

Table 1: Sugar Cogeneration Plant: Power Generation Details

Season	Working Days	Total Units (in crores)	Karkhana Use (in crore units)	Export to MSEDCL (in crore units)	Rate Per Unit (Rs.)	Revenue Generated (in Rs. crore)
2011-12	65	0.66	0.37	0.29	4.79	1.40
2012-13	146	2.45	1.02	1.42	4.79	6.80
2013-14	137	2.42	1.01	1.41	5.69	8.31
2014-15	178	2.90	1.40	1.50	6.07	9.11
2015-16	141	2.77	1.29	1.48	6.33	9.38
2016-17	65	1.29	0.62	0.67	6.53	4.37
2017-18	150	2.85	1.46	1.38	6.24	8.61
2018-19	125	2.71	1.48	1.06	6.43	6.82
2019-20	90	2.11	1.11	1.00	6.64	6.64
2020-21	172	4.38	2.37	2.01	6.64	13.34
2021-22	182	4.51	2.44	2.07	6.64	13.74
2022-23	148	3.60	1.92	1.68	6.64	11.15
2023-24	144	3.49	1.99	1.50	6.83	10.24

AWARD WINNER

RDF feeding conveyor system

installed and is connected to the MSEDCL substation, which is 6 km from the SMSKL site

- Installation cost was Rs. 2.78 crore per MW against Rs 5-6 crore per MW in general

RDF as Auxiliary Fuel for Boiler

The main aim of this project was to find a greener way for the disposal of urban waste, but instead we achieved three-dimensional targets – (a) Municipal corporations get relief from the crucial disposal problem of solid waste, (b) Waste is converted into energy, and (c) Sugar and by-products industries get secondary fuel to use in the off-season.

The Indian sugar industry is seasonal (half year), with power plants matching the capacity approximately suitable for bagasse (fuel) produced out of the daily sugarcane crushing. However, the power plant capacity remains idle for about 50-60% of the time in the off-season. So we were in search of a suitable fuel. We came in contact with M/s. Bhumi Green Energy, Pune (India), which is engaged in processing of municipal corporate waste successfully. We contracted them to supply RDF to our factory for use as supporting fuel in the off-season, along with bagasse.

Distillery Power Plant Specifications

a) Turbo Generator (TG) Set
Type: Condensing cum backpressure type
Power generation: 4,000 kW
Inlet steam pressure: 43 kg/cm^2
Inlet steam temperature: 420 ^{0}C

b) Boiler
Type: Water tube, Bi-drum
Steam pressure: 45 kg/cm^2
Capacity: 50 t/h
Steam temperature: 440 ± 10 ^{0}C

c) Steam used for:
Molasses distillation plant: 5.1 t/h, pressure 3.5 kg/cm^2, Temperature below 150 ^{0}C
Alcohol dehydration plant: 1.4 t/h, pressure 3.5 kg/cm^2, Temp below 150 ^{0}C
Spent wash evaporation plant: 3.5 t/h, pressure 0.5 kg/cm^2, Temp below 100 ^{0}C

d) Power (total 2,990 kW) used for:
Distillation and dehydration plant: 825 kW
Biogas generation and handling: 50 kW
Factory maintenance: 95 kW
Employees' quarters and street lights: 20 kW
Excess power fed to the grid: Approx. 2,000 kW

Operating Observations

The distillery power plant is operated at about 75% capacity for safety of boiler pressure parts from the external side as RDF is a heterogeneous fuel. Moisture and ash/grit percentage varies widely as there is no control on the quality of composite waste received from citizens. However, M/s. Bhumi had tried their level best to process it to supply RDF of better quality. The fuel arrives in trucks duly packed with a tarpaulin from the company's processing plant situated in Pune city 60 km from our sugar factory. The present cost remained Rs. 2,000 PMT for bagasse and Rs. 1,400 PMT for RDF ex-our factory in the year 2024. Thus we got cheaper and sufficient fuel with higher caloric value for our power plant in the off-season to run our distillery and for distillery-based by-products. The rate for the power produced from the distillery power plant and fed to grid is Rs. 7.83 per kWh (2023-24).

During the operation of the distillery plant, we have analyzed the fuels and flue gases for various parameters, and the results are given below.

Table 2: Analytical Data for Fuels (Distillery Power Plant)

Parameters	Unit	RDF	Bagasse
Gross Calorific Value	kCal/kg	2,700-3,000	2,250
Equivalent Ton		0.8	1.0
Cost	Rs./t (USD/t)	1,400 (17.5)	2,000 (25)
Sulphur Content	weight %	0.2-0.5	0.02
Moisture Content	weight %	25-35	50
Ash Content	weight %	<15	<4
NOx Content	weight %	1-1.5	0.33
Carbon Content	weight %	35-40	22.9
Oxygen	weight %	25-30	21.3
Hydrogen	weight %	5.8	2.8

Flue gases from the stack were analyzed for various combinations of fuel as above. The year-wise operating parameters regarding fuel consumption and power generation of the distillery are recorded and tabularized as follows.

Table 3: Stack Analysis Report (Distillery Power Plant)

Parameters	Unit	Method	Limit	Bagasse + RDF (60:40 %)	Bagasse + RDF (80:20 %)	Bagasse (100 %)
Total particulate matter	mg/Nm³	IS 11255 (Part-1) 2019	150	98.9	101.5	99.1
Sulphur dioxide (SO_2)	mg/m³	IS 11255 (Part -2) 2019	100	87.9	88.6	85.6
Hydrocarbon	PPM	IS 5182 (Part -22) 2019		BDL (Below Desired Level)	BDL	BDL
Carbon dioxide (CO_2)	%	MASA 3rd Edition		0.02	0.03	0.01
Oxygen (O_2)	%	IS 5182 (Part – 9) 1974		19.6	19.5	19.4
Carbon monoxide (CO)	%	5182 (Part – 10) 1999	0.01	0.005	0.0009	0.0005

Table 4: Distillery Power Generation & Utilization Data (Off-Season)

Year	No. of days	Unit	Power Generation	Power Consumption			
				Captive	Power plant & auxiliary	Fed to grid	Total
2020	30	kWh	1,046,357	31,000	229,471	785,886	1,046,357
2021	57	kWh	2,658,917	688,445	728,047	1,342,425	2,658,917
2022	61	kWh	3,627,681	1,170,238	888,968	1,568,475	3,627,681
2023	69	kWh	2,766,501	1,546,908	697,518	522,075	2,766,501

Table 5: Fuel Type & Ratio (Off-season) at Distillery Power Plant

Year	Bagasse	RDF	Total	Ratio (Bagasse:RDF)	Steam Generation	Steam to Fuel Ratio
	t	t	t	%	t	
2020	3,350	1,008	4,358	76:24	12,202	2.8
2021	6,132	1,613	7,745	79:21	21,702	2.8
2022	9,789	2,795	12,584	77:23	36,921	2.9
2023	10,346	5,502	15,848	66:34	31,697	2.0

Table 6: Utilization of RDF during Season (Sugar Cogeneration Plant)

Season	RDF	Equivalent bagasse saved	Bagasse burnt	Bagasse saved with bagasse burnt
	t	t	t	%
2019-20	3,350	4,187	41,835	10
2020-21	2,886	3,607	86,838	4.15
2021-22	4,774	5,967	95,080	6.27
2022-23	4,108	5,135	70,136	7.32
2023-24	5,474	6,842	75,128	9.10

RDF Use in Both Power Plants: Conclusions

1. Municipal corporation waste can be systematically processed and converted into energy at a typical sugar mill.
2. Sugar factory power plant can be operated for 300 days in a year by utilizing alternate fuels.
3. Sugar factory by-product units can be operated economically with steam and power supplied from this project.
4. There is saving of about 30% in fuel cost due to this non-conventional fuel.

Biogas: Auxiliary Fuel

Biogas generated in our biogas digester at the distillery plant is transferred through a pipeline to the boiler. The boiler has been modified to fit a biogas burner and is burning biogas as an auxiliary fuel. Data of biogas usage and income generated by selling of bagasse, which is saved due to consuming biogas for the boiler since commissioning of our distillery plant, is tabulated on the next page.

Energy Conservation Measures

1. Variable frequency drives are being used at various locations, which allows us to operate the unit on auto mode and helps in high power saving.

Table 7: Biogas Generation & Bagasse Savings

Year	Biogas Generation, m^3	Saved Bagasse, MT	Bagasse Sale Price Rs./MT	Income in Rs.
2016-17	2,378,087	5,489	1,804	10,283,368
2017-18	1,147,396	2,689	1,664	4,475,624
2018-19	2,992,012	6,904	1,506	10,398,084
2019-20	2,473,577	5,755	2,881	16,580,677
2020-21	3,940,576	9,134	1,348	12,313,377
2021-22	3,230,712	7,500	1,921	14,407,502
2022-23	0	0	0	0
2023-24	1,773,363	2,708	2,692	7,290,369.4
	17,935,723	**40,179**		**75,749,001.4**

Table 8: REC Revenue (Since Commissioning of Sugar Cogeneration Plant in 2012)

Year	Income in Rs.
2012-13	205,375.64
2013-14	60,573.92
2014-15	2,010,914.62
2015-16	6,435,906.87
2016-17	1,1169,912.1
2017-18	1,7592,369.8
2018-19	10,272,503.6
2019-20	12,733,958.4
2020-21	0
2021-22	0
2022-23	0
2023-24	12,226,097
Total Income	**72,707,611.95**

2. Advanced planetary gearboxes have been installed by replacing old worm-type gearboxes and open gearing. Due to this power consumption has reduced.
3. All factory lighting lamps have been replaced by LED lamps.
4. For minimizing steam consumption in the boiling house and proper vapor bleeding, a vapor line juice heater, DCH, flash heat recovery system, etc. are used.
5. Condensate water from the evaporator is directly fed to the deaerator instead of the feed tank, which saves additional pumping power and reduces heat loss.

Courtesy:
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Acknowledgement
We are thankful to Hon. Dr. P.A. Raut, Chairman & MD of our factory for giving permission to submit this article. Also, thanks to the SMSKL team.

contd from pg 1... Editorial

As new technologies evolve for power plants and the cogeneration industry, we are starting a new section on this topic. This time we have profiled Carbon Capture and Storage (CCS) for our readers. In addition, the Ministry of Power (MoP) notified the Carbon Credit Trading Scheme (CCTS), 2023 to develop the domestic carbon market, as the country aims at decarbonizing the economy and has committed to cut emissions by 45% from the 2005 levels by 2030. This will be covered in more detail in the next newsletter issue.

Cogen India is poised at the right junction to assist industry to achieve their maximum potential. We are proud to announce our consultancy offering in the area of solar energy solutions for sugar/cogeneration plants. We have also submitted a proposal to the Government of Maharashtra for cogeneration plant subsidies to offset the impact of lower tariffs.

We look forward to your feedback to make this newsletter more useful to our readers, and hope all stakeholders will join us as members to take this "Green Revolution" forward.

AISTA Sugar & Bioenergy Conclave 2024
26-28 July 2024
Mumbai, India
Web: https://aistasugarconclave.com/

Cogeneration Case Study: Loknete Sunderraoji Solanke SSK Ltd., Maharashtra

Introduction

Loknete Sunderraoji Solanke Sahakari Sakhar Karkhana Ltd. is located at Sundernagar, Post - Telgaon (Bu), Tq. Dharur, Dist. Beed. Previously known as Majalgaon SSK Ltd., it was established by Late Shri Sunderraoji Solanke, Former Dy. Chief Minister of Maharashtra State for economic growth in the region and upliftment of the farmers.

The southern part of Majalgaon was completely dry and had a cropping pattern of only Millets during the Kharif season. Rabi crops were rarely grown. On 21 December 1992, through Shri Solanke's visionary efforts, the sugar factory was inaugurated. The initial cane crushing capacity was 2500 TCD with 1.5 MW cogeneration, having electrical DC Drives for mills. The cogeneration plant was commissioned at the hands of Hon. Gopinathraoji Munde, Dy. Chief Minister of Maharashtra State on 3 November 1995.

The management took a major decision to increase inter-canal irrigation facilities from Majalgaon Dam. Further, the Upali Dam was constructed, which helped to increase the cane crop cultivation. The increased high yield and recovery led the management to increase the capacity of the sugar plant from 2500 TCD to 3500 TCD, which was commissioned in the year 2001.

In the year 2008, the Maharashtra State Government launched its Renewable Energy Policy and gave permission to install a bagasse-based cogeneration plant in the sugar factory. The management took a step ahead to install a 22 MW cogeneration plant and also increased the sugar plant capacity from 3500 TCD to 5000 TCD – both commissioned on 23 November 2013.

In January 2010, a distillery with capacity 45 KLPD was erected and commissioned successfully.

Present Scenario

At present, we are successfully running the 6000 TCD sugar mill and 22 MW cogeneration plant. As per the Central Government Policy regarding ethanol and zero liquid discharge, the distillery capacity was increased from 45 KLPD to 90 KLPD and again further to 150 KLPD, by direct diversion of Syrup, B-Heavy Molasses, and Mixed Juice. A separate 25 TPH capacity incineration boiler has been installed along with a 2.5 MW TG Set, which supplies steam and power to the distillery.

Innovations

1) Modifications in Mill House:

a) To increase the cane feeding, the cane density in the main cane carrier was increased up to 400 kg/m^3, by installing a separate auxiliary cane carrier for harvested cane.
b) A hydraulic tippler of 50 MT capacity was installed. The chopped cane pieces from the cane harvester increased the cane density.
c) A pre-chopper with 300 HP drive and gear box was installed.
d) Hydraulic de-hooking system has been installed for all cane un-loaders. This increased the feeding of cane to the cane carrier.
e) The Tooth Roller Juice Extraction (TRJE) system has been installed in all mills, which has improved the juice extraction and avoided chute jamming problems.
f) All the tail bar couplings are replaced by rope-less couplings.
g) All the mills are fully automated and the cane feeding system is controlled by the Distributed Control System (DCS). A precise juice flow and imbibition of water flow has been achieved along with a constant cane crushing rate.

2) Modifications for Power Saving:

a) All the Conventional Gear Boxes (about 35 in no.) of Cane Carriers, Inter Rake Carriers and Bagasse Elevator/Carrier, and of all Mixers, Pug Mills, Crystallizers, etc., were replaced by Planetary Gear Boxes.

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b) All the Juice Pumps Drives were replaced by Variable Frequency Drives (VFDs).
c) The old Sodium Vapor Lamps (SVLs) and Mercury Vapor Lamps (MVLs) of 500 W and 250 W were replaced by the LED lights (almost 647 in no.). The power saving achieved is 1,432 kWh per day, which is about 70% saving (Rs. 2,153,698 per year). Also, an agreement was signed with E-Smart Energy for 10 years, which includes free repairing of LED lights.
d) All the above modifications reduced the captive power consumption to 18.5 kWh/T of cane crushed from 24 kWh/T of cane crushed.
e) HT Power Capacitors have been installed for 2 nos. of Fibrizer Motors having capacity of 1000 kW of power.

3) Implementing the Condensate Collection System and Reducing Water Consumption:

a) The condensate generated in the boiling house is collected in an overhead hot water tank, from where the overflow is fed to the raw water reservoir through two-stage spraying water systems. The first stage and second stage reduce the condensate water temperature from 85°C to 50°C and from 50°C to 35°C respectively. This reduces the cooling water requirement considerably.
b) The second body condensate is fed to a cooling tower of capacity 50 m^3/hr. The cooled water up to 35°C is used as make-up water for the cogeneration cooling tower.
c) As usual, the cooling water of the Mill, Sulphur Burner, Compressors, etc., is fed back to the reservoir.
d) The RO reject of 15 m^3 quantity is given to the distillery.
e) Dry cleaning of mills is carried out, with hot water cleaning once a week.
f) An underground sweet water tank is built in the centrifugal section. Any spillage or gland leakages in pumps are collected in this underground tank and fed back to the raw juice tank.

4) Steam Saving Measures:

a) With respect to the Central Government Policy, for sugar diversion, the second body juice is diverted to the distillery where a Plate-type Heat Exchanger cools the juice from 95°C to 35°C. The cooling water is taken from the existing cogeneration cooling water. The diversion of this second body juice of 30 TPH has achieved a steam saving of 6%.
b) The conventional sulphur burners were replaced by electrical sulphur burners (3 nos. with 200 kg/hr capacity).
c) The steam-operated superheated wash system has been replaced by an electrical one.

The overall steam consumption has reduced from 42% on cane to 36% on cane.

Cogeneration Plant Performance

At present, the 22 MW cogeneration plant is working satisfactorily. It includes a boiler of 120 TPH capacity with working pressure at 87 kg/cm^2 and temperature 515°C. The Power House has two TG sets of 6 MW (backpressure) and 16 MW (double extraction-cum-condensing).

Sr. no.	Year	Power Generated (kWh)	Distillery + Auxiliary + Captive Power (kWh)	Power Export (kWh)
1	2014-15	59,377,250	21,049,250	38,328,000
2	2015-16	35,443,760	13,406,960	22,036,800
3	2016-17	6,910,000	3,868,000	3,042,000
4	2017-18	65,795,400	24,415,800	41,379,600
5	2018-19	79,527,515	27,919,571	51,607,944
6	2019-20	39,589,400	14,963,294	24,626,106
7	2020-21	79,834,400	29,263,349	50,571,051
8	2021-22	100,495,800	35,807,371	64,688,429
9	2022-23	67,857,600	25,269,849	42,587,751
10	2023-24	63,184,000	23,038,000	40,146,000

Revenue from REC Mechanism

The REC (Renewable Energy Certificate) Policy for tradable RECs was launched in 2010-11. Each REC is one MWh of electricity generated from a renewable energy source. The RECs generated are traded in the open market. Since the REC mechanism was a new concept for cogeneration plants, the credit for REC revenue earned by cogeneration plants goes to Cogeneration Association of India, which organized several meetings to make cogeneration plants aware of this revenue mechanism.

Biomass (Cane Trash) Collection

The factory has developed an efficient cane trash collection system with maximum collection in a day being about 150 MT. The farmers in the area have purchased a cane trash baler. The bales are loaded in the farm and supplied to the factory. There they are cut

Revenue from REC Mechanism

Year	REC Sale	Revenue Earned (Rs.)
2015-16	2,780	4,091,632.60
2016-17	4,328	6,392,492.60
2017-18	15,783	16,051,604.20
2018-19	41,519	53,566,866.80
2019-20	16,891	26,409,240.00
2020-21	3,014	3,014,000.00
2021-22	24,337	24,337,000.00
2022-23	505	6,111,000.00
2023-24		5,476,750.00

Quantity of Cane Trash Collected

Year	Qty. of Cane Trash (in MT)
2016-17	313.080
2017-18	1,978.930
2018-19	10,846.638
2019-20	4,701.330
2020-21	14,075.470
2021-22	10,552.130
2022-23	3,693.360
2023-24	5,489.430

by the cutter to a size of 6 to 10 cm. This cane trash is fed to the cogeneration boiler.

Other Renewable Fuel: Biomass Briquettes & Pellets

It was decided to run the 25 TPH Incineration Boiler on other renewable fuels, such as biomass briquettes and pellets. Thermax B & W supplied the boiler, which could be operated with 2.4 TPH coal and 10 TPH spent wash with 55% brix with an AFBC grate. The manufacturer did not recommend the use of renewable fuel, but we were insistent on the provision for bagasse feeding. We then installed a 10 TPH bagasse handling system. During Season 2022-23 a bagasse quantity of 3 TPH was fed to the boiler. This worked positively and the coal consumption was reduced from 2.4 TPH to 1.1 TPH. This also helped to increase the Boiler Steam Pressure.

At the end of Season 2022-23, we decided to use biomass briquettes and pellets instead of coal. In the last 8 days of the 2022-23 season, the boiler was operated 100% on briquettes. During Season 2023-24, the boiler operated 100% on biomass.

Challenges

The very first challenge was the irregular supply of briquettes from the supplier. So the Karkhana decided to install briquette machines (3 x 20 MT each) at the site, since the total briquette quantity required is 60 MT per day. The machines were installed by Sai Nirman Bio Coal, Aurangabad and a Memorandum of Understanding was signed with the company. The Karkhana will provide bagasse and power, and the company will supply the briquettes. This has saved major transportation cost.

For the very first trial, we fed briquettes to the incineration boiler through the existing coal handling system. The crushed biomass briquettes were taken in the bunker. But we faced two problems:

a) The first screen of the screener got jammed due to fine fiber particles of biomass. So we bypassed the first screen. This worked properly and we could take the biomass to the bunker.
b) The crushed biomass then caused jamming in the bunker and screw feeder. So we decided to bypass the bunker.

Next, we fabricated a silo of capacity 5 MT to store the crushed briquettes. Separate drum feeders were installed to feed the briquettes at the end point of the screw feeder. This made it possible to feed the briquettes to the furnace. But the uncontrolled feeding of biomass caused the uncontrolled pressure of steam. To control the feeding, we installed a VFD to the drum feeder, and this worked very efficiently.

The steam pressure and temperature achieved was steady. But, the fine un-burnt particles caused jamming in the superheater. The boiler manufacturer had recommended Indian coal as a fuel with 30% ash content, but the biomass has around 5% ash content. The incineration boiler needs about 30% ash in fuel to remove the deposition on the pressure parts. Due to deposition of fine particles, we were forced to shut down the system every month. To increase the ash percentage in the fuel, we added 30% of press mud in the briquettes. So now the briquettes combination is 70% bagasse and 30% press mud. This increased the ash content in fuel from 5% to 15%, which worked very well. No deposition of particles was found and the boiler operated continuously.

Another critical problem was the big pieces of briquettes were not fluidized and rested on the boiler bed. The burning of biomass pieces on the bed raised the bed temperature and further, there was formation of clinker, which avoided fluidization leading to shut-downs to clean the furnace. So we decided to increase the number of bed drains. The recommended bed material quantity is 1 MT per day. We gave frequent bed drains to avoid clinker formation. The bed material consumption was

increased from 1 MT to 3 MT per day. This avoided the clinker formation. Further, the boiler operation was smooth and steady; there was no jamming nor any rise in bed temperature.

During the Season 2023-24, we operated the incineration boiler on complete biomass without any interruption with the cooperation of our technical team. We succeeded in avoiding the use of 100% fossil fuel and have thus positively impacted the environment.

The biomass pellet plant was supplied to us by Sai Non-Conventional Energy, Nashik. It is fully automated, considering the flow of bagasse quantity, level, moisture percentage, and furnace temperature, and comprises of the following:

(1) Bagasse silos, (2) Hot air furnace, (3) Rotary drum drier, (4) Hammer mill, (5) Pellet machine.

The plant was started on 8 February 2023 with substantial effort to streamline the project. The most challenging factors were as under:

1) The moisture content in bagasse was 50% and had to be reduced to 10% to 15%.
2) Bagasse is composed of approximately 50% Cellulose, 25% Hemicellulose and 25% Lignin. The Lignin in particular is an issue while making pellets.
3) Controlling the flow of bagasse into the drum drier.
4) Maintaining the desired temperature in the rotary drum drier.
5) Bagasse jamming in the pellet machine.

All these factors were overcome by using the automation system in the plant, particularly binding of pellets. If the material fed to the pellet machine is of lesser quantity than recommended, it results in powder production instead of pellets.

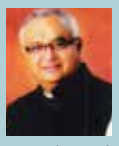
To solve this problem, we decided to inject the spent wash of 55% brix to the pellet machine in the mixer, by the dosing pump. This spent wash bound the loose material perfectly and delivered shiny pellets. It also worked as a lubricant between the dye and the pellets, which increased the capacity of the pellet machine. The spent wash has a calorific value of about 1400 kCal/kg so increased the calorific value of the pellets. Around 10 MT of spent wash was consumed in the pellet plant. The pellets comprising of bagasse and spent wash were fired as fuel in the incineration boiler. By replacing coal, the use of fossil fuel has been eliminated.

Awards & Recognition

Name of the Award	Year of Award
1st Prize for Technical Efficiency from V.S.I. Pune.	1998-99 & 1999-2000
1st Prize for Technical Efficiency from Sakhar Sangh, Mumbai	1998-99
1st Prize for Best Co-operative Sugar Factory & 2nd Prize for Cane Development from National Federation, New Delhi	1999-2000
1st Prize for Technical Efficiency from Sakhar Sangh, Mumbai	1999-2000
1st Prize for Maximum Sugar Export All India	2005-06
2nd Prize for Best Co-operative Sugar Factory from The Maharashtra State Co-operative Bank Ltd., Mumbai	2012-13
Best G.S.T. Work Prize from the Govt. of India, New Delhi	2020-21

Acknowledgements:

Hon. Late Shri Sunderraoji Abasaheb Solanke
Founder Chairman



Hon. M.L.A. Shri Prakashrao Sunderraoji Solanke
Sr. Director & Vice President, Sakhar Sangh, Mumbai

Hon. Shri Dhairyasheelrao Sunderraoji Solanke
Mentor

Hon. Shri Virendra Prakashrao Solanke
Chairman

Hon. Shri Jaisingh Dhairyasheelrao Solanke
Vice Chairman

The author expresses his deep gratitude towards Hon. Founder, Ex. Dy. Chief Minister, Maharashtra State, Late Shri Sunderraoji Solanke, Hon. Shri Prakashdada Solanke, MLA, Hon. Shri Dhairyasheelrao Solanke, Ex. Chairman, Hon. Shri Virendra Solanke, Chairman, Hon. Shri Jaisingh Solanke, Vice Chairman, Hon. Board of Directors, Loknete Sunderraoji Solanke SSK Ltd., and Hon. Shri Ravindra Chindha Badgujar, Managing Director.

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Achieving Maximum Bagasse Savings in Sugar Complexes: The Ultimate Guide

Abstract

Flexibility to adopt the changes in demand and supply is the key to a sustainable modern sugar complex, which integrates innovative technologies and practices to optimize energy consumption while expanding the product portfolio. Many factories have achieved steam consumption down to 30% on cane for maximum cogeneration. But nowadays, many countries, especially India, have adequate electricity, which has reduced the sale rate of cogeneration electricity. Bagasse, being the cheapest fuel for distilleries, has a high demand in the market due to increased production of ethanol, resulting in a hike in the bagasse purchase rate. The fiber in bagasse is also a good raw material for the paper and pulp industry.

In this context, ISGEC Heavy Engineering Limited has installed a sugar complex of 7500 t cane/day crushing capacity expandable to 10,000 t cane/day, and a 120 kl/day B-heavy molasses-based ethanol production facility, with 15 MW incidental cogeneration that has 26% steam consumption to maximize bagasse saving. This plant is located in Bijnor, Uttar Pradesh state, India, three hours away from Delhi. This plant is saving more than 13% bagasse, which is being utilized in a paper plant as feedstock after de-pithing.

Sugar Plant at a Glance

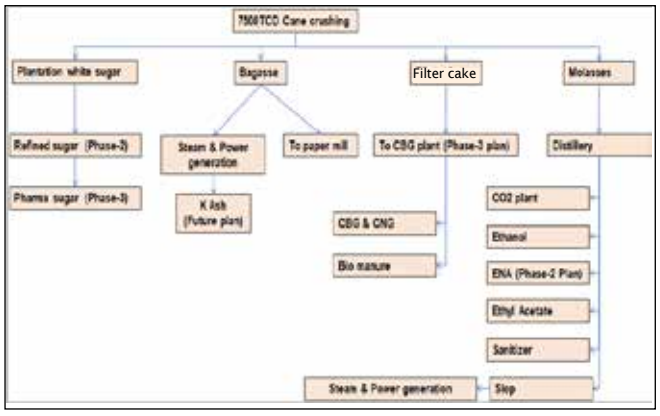

Figure 1: Sugar complex overview

Need of Bagasse Saving

Bagasse is one of the most promising biomass sources for renewable energy. Its use in paper industry, furniture industry and electricity generation keeps bagasse always in demand, which is increased drastically due to its consumption round the year. On the contrary, bagasse production is limited to 180 days per annum. This encourages saving of steam in sugar plants also.

To balance this production and consumption, we need to adopt/implement better schemes and technologies for steam saving, and thereby bagasse saving.

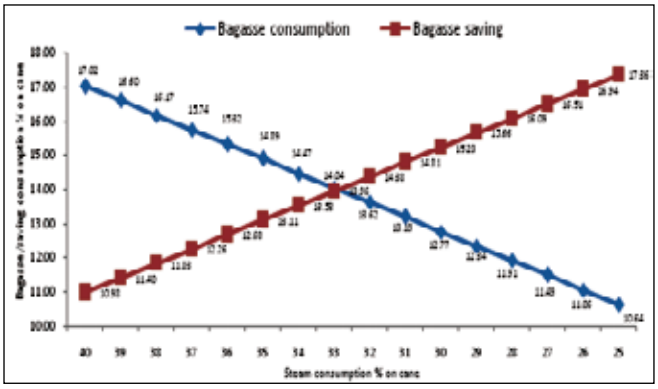

Figure 2: Bagasse consumption/saving vs steam saving

The following new technologies are being adopted in the process house to achieve minimum steam consumption and thus maximum bagasse saving:

1) **Septuple effect evaporator set (seven evaporators in series):**

The evaporator station is the heart of the process house, where substantial amounts of exhaust steam can be saved. From the Rillieux principle, it is well known that higher the number of effects, the higher the steam economy. But this number of effects has been limited to five effects till now due to the overall temperature difference – the extreme range of temperatures within which evaporation is carried out is restricted to 60 deg C. Conventional rising film evaporators work on higher dT, so to achieve this overall dT of 60 deg C, we are restricted to maximum five effects.

The other benefit of keeping more bodies in series is that we can take bleeding from later effects to minimize steam consumption. To keep the maximum bleeding at later effects, it is very necessary to maintain an optimum temperature of low-pressure vapors, which can be achieved by minimizing the temperature difference between effects.

By the heat balance rule ($Q = UA\Delta T$), the temperature difference is inversely proportional to the overall heat transfer coefficient. So it is always recommended to

Table 1: Sugar complex overview

Crushing capacity	7500 TCD in Phase-1 10000 TCD with refinery in Phase-2
Sugar production	Double sulphitation white sugar
Process highlights for steam saving upto 26% on cane	Septuple effect evaporator (all falling film evaporators) set with condensate flash recovery system MVR to use second last effect vapor for pan boiling Two massecuite boiling: Complete B-heavy diversion to distillery, use of B-massecuite vertical continuous pan (VCP)
Phase-2 expansion	MVR to use on A VCP and evaporator with refinery addition
Steam generation plant	100 TPH @ 68 ata, 485±5°C, travelling grate boiler
Boiler fuel	- 100% bagasse - 40% bagasse + 60% bagasse pith (weight basis) - 30% rice husk + 70% bagasse pith (weight basis) - 25% woodchips + 75% bagasse pith (weight basis)
Power plant	15 MW captive backpressure turbine
Distillery capacity	120,000 liters per day ethanol on B-heavy feedstock
Incineration for ZLD	25 TPH, 45 ata slop-fired incineration boiler with 2.5 MW power generation

choose an evaporator body with higher heat transfer coefficient to minimize ΔT so that maximum vapor bleeding can be taken from later effects.

So, to achieve overall dT across the evaporator with maximum number of bodies, the falling film evaporator is the best option among all type of evaporators due to less dT and higher heat transfer coefficient (HTC).

In this plant, unlike a conventional quintuple effect evaporator set, a falling films-type septuple effect evaporator set has been installed.

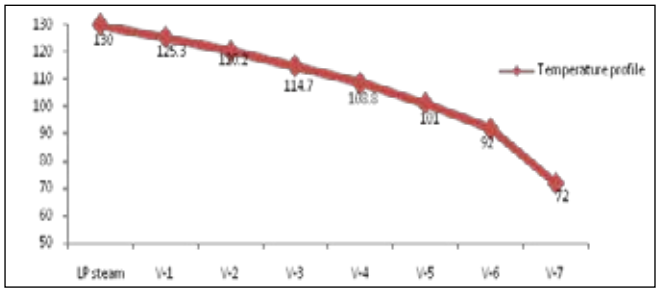

Figure 3: Vapor temperature profile in septuple effect evaporator set

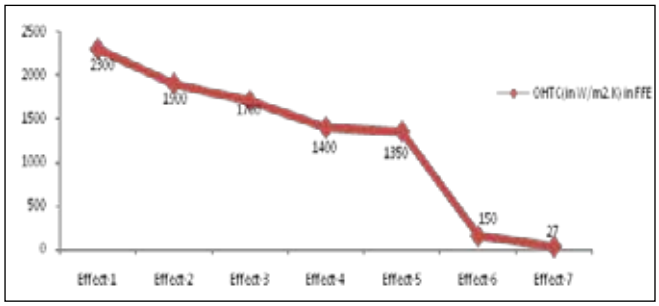

Figure 4: Expected HTC profile in septuple effect evaporator set

The total heating surface to be used for all effects thus increases proportionally with the number of effects, so that investment costs increase whereas energy consumption decreases.

2) Vapor bleeding scheme:

Vapor bleeding is very important for reducing steam consumption. Here most boiling/heating is done by using low grade vapors like V6/V5/V4 of the septuple effect evaporator set and most of the waste heat is utilized to reduce load on the condensing system. The vapor bleeding scheme is given in Table 2 and refer Figures 5 and 6 for heat and mass balance diagrams (HMBD).

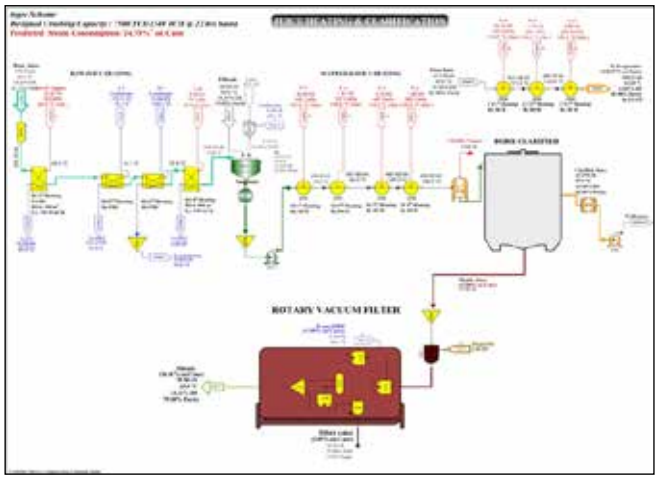

Figure 5: Juice heating scheme

3) Mechanical vapor recompression:

Mechanical vapor recompression (MVR) is an old technology for increasing steam economy. An MVR is a blower fan that takes secondary steam/vapor and delivers the compressed vapor at higher enthalpy. The speed of the fan ranges from 2500-3300 r/min depending upon the inlet vapor flow rate and temperature. Blades and

Table 2: Vapor bleeding scheme

Heating	Vapor used	Type of heat exchanger
Raw juice 1st heating	VCP vapors (waste vapors)	Vapor line type vertical tubular heater
Raw juice 2nd heating	Low temp condensate (waste heat)	Liquid to liquid plate type heater
Raw juice 3rd heating	High temp condensate (waste heat)	Liquid to liquid plate type heater
Raw juice 4th heating	V-6	Dead end type vertical tubular heater
Sulphited juice 1st heating	V-5	Direct contact heater
Sulphited juice 2nd heating	V-4	Direct contact heater
Sulphited juice 3rd heating	V-3	Direct contact heater
Sulphited juice 4th heating	V-2	Direct contact heater
Clear juice 1st heating	V-3	Direct contact heater
Clear juice 2nd heating	V-2	Direct contact heater
Clear juice 3rd heating	V-1	Direct contact heater
Pan washing	V-1	For vertical & batch type vacuum pans
Sugar dryer air heater	V-1	Vapor to liquid plate type heater
B sugar melter	V-2	Direct contact heater
Molasses conditioning	V-3	Direct contact heater
B graining	V-5	Batch type pan with top mounted mechanical circulator
A massecuite boiling	V-5	Batch type pan with top mounted mechanical circulator
A1 massecuite boiling	V-5	Batch type pan with top mounted mechanical circulator
B massecuite boiling	V-6	Vertical continuous pan

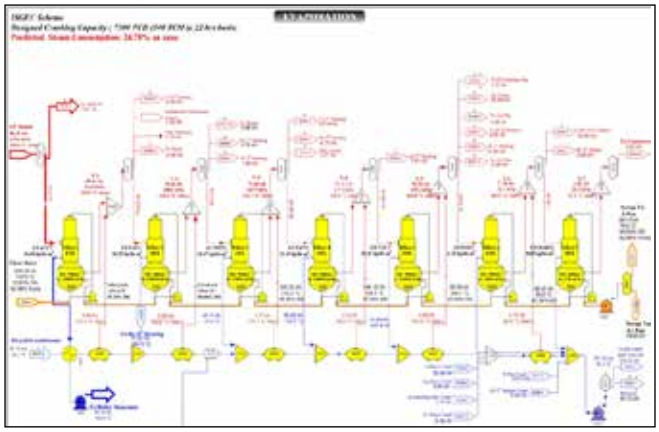

Figure 6: Septuple effect evaporator configuration

casing metallurgy are major elements for care as they handle entrained vapors. The main components of the MVR are shown in Figure 7.

Generally, a mechanically operated compressor or fan recompresses the vapor of an evaporation effect from a lower evaporation pressure and temperature level to the heating pressure of the same evaporation effect. In this way, its heat energy is re-used for heating and does not have to be condensed without being used.

MVR Uses at Sugar Plant

a) With MVR, vapor temperature can be increased by 10 deg C, which can be utilized for pan boiling.
b) With MVR, outlet vapors can be utilized by recycling to the calandria of continuous pan or syrup/melt concentrator.

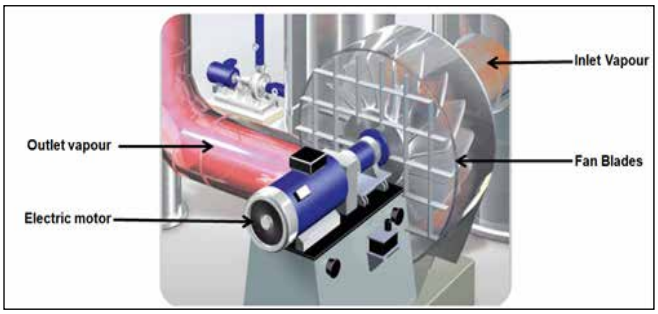

Figure 7: Mechanical vapor recompression set-up

4) Vertical continuous pan:

Crystallization is a key section of the sugar factory for controlling the sugar quality as well as energy consumption. A vertical continuous pan (VCP) gives the flexibility to use different pressure vapors in different modules and an inbuilt graining module obviates the demand for a separate batch pan. Here, the VCP is installed for B-massecuite boiling and using the 6th vapor of 92 Deg C. The VCP is designed to boil at 100% throughput on 85 Deg C vapor temperature (Awasthi et al. 2019).

In addition, MVR is proposed for the Raw VCP during the 2nd phase of the project where the process will be converted to a refinery and steam consumption will be the same. The vapor generated by the VCP is sent to the MVR, to be compressed and heated up with the 5th vapor as makeup. It will then be re-sent to the VCP to be used as heating steam. In this process, the VCP is also used as the condenser for the vapors. Additionally,

Table 3: Vapor bleeding scheme

	Unit	Without MVR	With MVR
A. Saving due to MVR at A VCP station			
Massecuite quantity	% on cane	30	30
Vapor load	% on massecuite	28	9
Vapor load % on massecuite	% on cane	10.5	2.86 (Only for makeup & graining)
Exhaust consumption against vapor demand	% on cane	3	0.8
Difference in exhaust steam consumption	% on cane		2.18
B. Saving due to MVR at evaporator station		V5	V6
Vapor demand	TPH	32.43	30.6
Exhaust consumption against vapor demand (TPH)	TPH	9.26	4.37
Difference in exhaust steam consumption (TPH)	TPH		4.88
Overall impact @ 340 TPH (% on cane)	% on cane		1.4
Total saving due to MVR (A+B)	**% on cane**		**3.58**

the VCP has advantages from the point of view of steam saving, exhaustion, and maintenance.

Artificial Intelligence (AI) in VCP: Advantages

- There is a steady rise in crystal content and in apparent crystal volume. The crystals' size varies within a narrow range and thus quality of sugar is maintained.
- False grain formation can be reduced/avoided by placing a pan microscope on the 1st chamber in case of high-grade massecuite, and 1st and last chamber in case of low-grade massecuite.
- Use of water can be minimized, which will further reduce the vapor load on massecuite.
- Exhaustion will be improved due to consistency in massecuite brix and crystal content.
- Using AI, systems can test hundreds of mathematical models of production and outcome possibilities, and be more precise in their analysis and results.
- With the help of predictive maintenance, equipment life will improve. Proactive/preventive/corrective maintenance involves regularly scheduled equipment upkeep to avoid sudden and unexpected equipment failure and resulting downtime.
- Minimize manual intervention – AI is automating your routine tasks, allowing you to complete them much faster and save substantial time. The output of industries also increases to several hundred times by using AI.

Conclusion

Here we share the idea of a sugar complex that can use the main sugarcane by-product (bagasse) in a more effective way, resulting in higher revenue. Bagasse no longer will be seen in the light of 'cost economics of power' but instead as a raw material for paper, ethanol and allied industries. It also encompasses the vision of

Table 4: Revenue from bagasse saving

Parameters	Values	Unit
Crushing capacity	341.0	Tons cane/ hour
Crop days	180	Days
Distillery capacity	120	KLPD
Off crop distillery days	61	Days
Net bagasse available	28.4	% on cane
Net bagasse available	418,366	Tons
Steam generation from HP boiler	97	TPH
Steam generation from incineration boiler	23.7	TPH
Bagasse consumption during season	195,066	Tons
Bagasse consumption during offseason	5,635	Tons
Bagasse saved for next season	1,000	Tons
Bagasse saving per year	216,664	Tons
Bagasse saving per year	16	% on cane
Bagasse price	39	USD/Ton
Revenue from bagasse	8.45	Mn USD

turning sugar factories into sugar complexes having many products under the one umbrella, with energy efficiency being central to this vision.

There are still several challenges to overcome, but current resolution (septuple effect, MVR) can be implemented in different setups of sugar mills.

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Drives for Sugar & Alcohol Industry

Introduction

The sugar and alcohol industries are increasingly focusing on sustainable practices to reduce water usage, energy consumption, and greenhouse gas emissions. Producers are adopting renewable energy sources like biomass, solar, and wind power to minimize their environmental impact.

In response to changing consumer preferences, many producers are diversifying their product lines, offering organic, non-GMO (genetically modified mechanism), and specialty sugars, along with artisanal and craft spirits. There's also a rising trend in producing alternative sweeteners and low-calorie substitutes to cater to health-conscious consumers.

Technology integration is revolutionizing these industries, with automation, data analytics, and artificial intelligence enhancing efficiency, productivity, and quality control. Advanced monitoring and control systems help optimize processes, reduce waste, and improve operational performance.

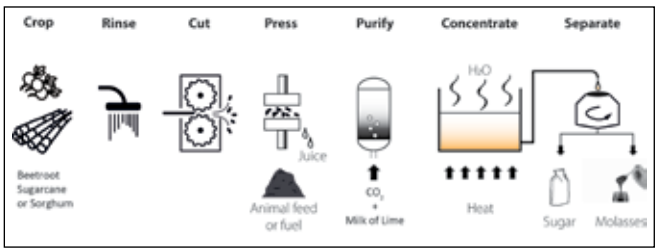
Circular economy initiatives are gaining traction as companies strive to minimize waste and maximize resource efficiency. Byproducts like bagasse (sugarcane residue) and vinasse (distillery waste) are being repurposed for energy generation, animal feed, compost, and other uses.

The health and wellness trend is driving demand for healthier, more natural products, prompting producers to focus on transparency, clean labeling, and the nutritional benefits of their offerings. Additionally, globalization is pushing sugar and alcohol producers to expand into emerging markets, adapt to different regulatory environments, and meet diverse consumer preferences.

Danfoss Drives in Sugar & Alcohol Industry

Danfoss drives play a critical role in the sugar industry, enhancing efficiency and reliability across various processes. In cane crushing, drives power the cane crushers that extract juice from sugarcane, ensuring smooth and efficient operation. They also power conveyors that transport sugarcane, crushed cane, and processed sugar within the mill, streamlining the material handling process.

In centrifuges, Danfoss drives ensure precise and reliable operation, separating sugar crystals from molasses efficiently. These drives also play a vital role in boiler systems, powering fans, pumps, and other equipment necessary for steam generation, which is crucial for numerous sugar production processes. Additionally, these drives enable energy-efficient variable speed control in fans and pumps, providing precise operation and reducing mechanical stress. This not only ensures smoother performance but also helps in compliance with regulatory standards. The drives contribute to significant energy savings and enhanced process control, minimizing downtime and maintenance costs.



Overall, the integration of Danfoss drives in sugar mills optimizes operational efficiency, reduces energy consumption, and improves the reliability of critical equipment, supporting the industry's goals for sustainability and cost-effectiveness. The application of variable frequency drives (VFDs) in sugar and alcohol production aims to: enhance energy efficiency, reduce operational costs, and provide better control over production processes.

Open a New Dimension: iC2 & iC7

The iC2-Micro is a compact and flexible drive, ideal for various applications with unmatched reliability. Succeeding the VLT® Micro Drive FC 51, it offers enhanced performance, user-friendliness, and easy installation. This next-generation drive reduces system complexity and cost while maintaining full performance. It features excellent motor control, torque open loop control, locked motor detection, and permanent magnet motor control.

Compatible with both induction and PM (permanent magnet) motors, the iC2-Micro integrates a control panel, potentiometer, RFI (radio frequency interference) filter, brake chopper, and intelligent cooling. Designed for easy retrofitting, it seamlessly replaces the VLT® Micro Drive FC 51 in existing plants, and the iC7 series of intelligent

AC drives combines compact design with integrated intelligence to enhance machine performance. Acting as powerful sensors, these drives efficiently regulate processes, reducing the need for external devices and cutting costs. They feature built-in EMC (electromagnetic compatibility) and harmonic filters for superior performance, even with long motor cables, and support secure data management in the cloud or internal networks, ensuring full data traceability.

Key Customer Value

- We built on a great foundation and improved power density, efficiency, and motor control, etc., even further.
- Motor-independent and with a built-in dual Ethernet port supporting all major Ethernet-based fieldbuses (e.g. PROFINET RT, EtherNet/IP, Modbus TCP & Ether CAT).
- Commissioning and upgrades are easy and often possible without extra hardware.
- Back-channel cooling concept reduces energy costs, and size of the cooling system, and extends drive lifetime.
- Automatic Motor Adaptation (AMA) for fast startup.
- Automatic Energy Optimization (AEO) for high system efficiency.
- Safe Torque Off (SIL3) as part of the standard offering ensures the safe operation of the drive.
- Dedicated motion application for automation made easy.
- Pluggable power cables up to 22 kW for faster commissioning.
- Configured to your needs and delivered in “one-box” from the factory.
- Customize your drive application beyond parameters with logic blocks. No programming.
- Secure by design with integrated crypto chip.

Conclusion

iC2-Micro and iC7 are the convenient drives that give you a new way to optimize efficiency and cost. With their compact design, they save panel space to reduce system cost. Since they are compatible with diverse motor technologies such as induction, IPM (interior permanent magnet) and SPM (surface permanent magnet), you can freely select the best-fit motor for your application. They are easy to commission, since they are equipped with startup wizards and application-oriented parameter groups. These compact drives are reliable and flexible, ready to power your pumps, fans, conveyors and mixers, textile machinery, palletizers, and packaging machines.

Features	Benefits
Spring type I/O terminals	Save installation time, avoid errors
Integrated control panel with LED display & indicators Remote control panel with extra functions (option)	Easy programming
RJ45 port	– Easy connection for external control panel option and PC tool – RS485 based
Application set-up wizards	Easy commissioning
Potentiometer for setting setpoints locally	Cost-effective with no external wiring
Compact design	Save cabinet space
Coated printed circuit boards (PCBs)	Improved reliability in harsh environments
Compatible with IPM and SPM motors	Freedom to choose your preferred motor
Integrated brake chopper and PID controller	Reduced cost
Flexible side-by-side mounting	Save cabinet space and cost
Operates at up to 50 ^{0}C without derating	– Reduced cost for external cooling – Improved uptime
2 variants, with and without EMC filter	Choose the best fit for the application
No forced air over PCB for whole power range	Improved reliablity
Removable fan	Easy maintenance
Fan on/off control	Reduce noise and energy saving
Natural cooling up to single-phase 200 V 0.75 kW drives without cooling fan	Reduce noise and eliminate channel blockage risk

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Success Story: Shri Tatyasaheb Kore Warana SSK Ltd. Warananagar

2nd Rank in "Best Cogeneration Plant 2023 Award" for Above 87 kg/cm^2 Category (Co-operative Sector)

Introduction

Founded in 1955 by Late Shri Vishwanath alias Tatyasaheb Anna Kore, the Shri Warana Sahakari Sakhar Karkhana (SSK) Ltd. Warananagar sugar plant was set up in one of the most rural areas of the Kolhapur district of Maharashtra, which paved the way for economic and social development of the area by not only providing employment but also farming opportunities to the local people.

Under the leadership of the Hon. President Dr. Vinay Kore (MLA) and Managing Director Shri S.R. Bhagat of Shri Warana SSK, the company's 44 MW bagasse-based cogeneration power plant received a National Level Rank II Award in the Co-operative Sector (in the category of above 87 kg/cm^2 boiler) from Cogeneration Association of India on 16 September 2023, due to its consistent technical and commercial performance. The award was received from the hands of Chief Guest Hon. Sharad Chandraji Pawar (MP) Rajya Sabha at Pune (*refer photo below*).

The company has interests across integrated fields such as Sugar, Distillery, Power Generation, and Biotechnology. Its range of products includes white, brown and demerara sugar, alcohol/ethanol, organic manure, bio-products, and green power.

Expansion & Innovation

Shri Warana SSK subsequently expanded its capacity from 1,000 TCD (tons of cane crushed per day) to 10,000 TCD in 2011-12. The management team made a strategic decision to establish a new cogeneration project, which included a 110 ata high-pressure boiler and a 44 MW turbine. This initiative aimed to reduce carbon emissions and energy costs, and provide socio-economic and environmental benefits. The installation of the new cogeneration system commissioned on April 3, 2013 and replaced the existing low-pressure, bagasse-based boilers. The plant generates a total of 44 MW, with 12 MW being utilized for captive consumption.

The project was established on BOOT (Build, Own, Operate, Transfer) basis with the help of the Government of Maharashtra's Urjankur Nidhi Trust and Maharashtra Energy Development Agency (MEDA). It was successfully commissioned by Urjankur Shri Tatyasaheb Kore Warana Power Company Ltd. (USTKWPCL), Warananagar on 3 April 2013. The plant has been working continuously from the date of commissioning till date and provides power for all cogeneration sugar process power requirements, and distillery plant requirements while exporting surplus power to the state's Maharashtra Electricity Board (MSETCL) grid, as per a 13-year Power Purchase Agreement (PPA) signed in 2013 with USTKWPCL, currently at the rate of Rs. 7.18 per unit.

An average of 135 units of power are generated, out of which an average of 98 units of power are exported per ton of cane crushed. During season days 41 MW power is generated, of which 27.9 MW power is exported to MSEDCL, and during off-season days 44 MW power is generated out of which 39.5 MW power is exported.

Notably, the Warana cogeneration plant is the first single unit of capacity 1 x 44 MW in Maharashtra state, Kolhapur district to be registered under the Clean Development Mechanism (CDM). It is also the first cogeneration plant in Maharashtra state to install 1 x 44 MW TG set to export the power generated.

The Shri Warana plant was established as an integrated Greenfield complex, combining Sugar, Cogeneration, and Distillery units. It installed a 10,000 TCD sugar plant along with a 110 ata high-pressure boiler for 44 MW cogeneration. Subsequently, in April 2013, the plant underwent modernization, introducing a 60 KLPD (RS) and 75 KLPD ethanol plant zero liquid discharge (ZLD) system with 2x8,000 m^3 biogas plant.

Boiler & Turbine Information

Mechanical

Boiler	:	Walchand India Ltd.

AWARD WINNER

TG & Auxiliaries	:	Shin Nippon/Seisa/TDPS
ESP	:	Thermax
Cooling Tower	:	Paltech
Pump	:	KSB
Compressors	:	Ingersoll Rand & Atlas Copco
WTP	:	Doshion

Electrical

VFD	:	ABB & Yaskawa
Transformers	:	BBL & Voltamp
HT Panels & MCC	:	Siemens
Synchronizing & Protection System	:	Alstom
ESP Transformers	:	ADOR Corona

Instrumentation

DCS	:	Honeywell
Governor Control	:	Woodward
Field Transmitters & Analyzer	:	Honeywell
Oxygen Analyzer	:	Yokogawa
TG Vibration Monitor	:	Shinkawa

Thermal Cycle

The thermal cycle of the 44 MW cogeneration plant at Warananagar is 110 ata with a three-stage extraction-cum-condensing turbine with the following parameters:

S. No.	Description	Values
1	Boiler capacity (2 x 115 TPH)	230
2	Boiler outlet steam pressure (ata)	110
3	Boiler outlet steam temperature (Deg. C)	535
4	Feedwater inlet temperature (Deg. C)	210
5	HP heater inlet temperature (Deg. C)	125
6	Steam to bagasse ratio	2.50
7	TG capacity (MW)	44
8	Turbine inlet steam pressure (ata)	103
9	Turbine inlet steam temperature (Deg. C)	535
10	Uncontrolled first extraction pressure (ata)	21.8
11	Uncontrolled first extraction temperature (Deg. C)	342
12	Uncontrolled second extraction pressure (ata)	13.5
13	Uncontrolled second extraction temperature (Deg. C)	289
14	Controlled extraction pressure (ata)	3.0
15	Controlled extraction temperature (Deg. C)	144.7
16	No. of HP heaters	2
17	Condensing system (surface condenser)	SC

Power Conservation

1. Variable Frequency Drives (VFDs) were installed in the complete cogeneration plant, and its preventive maintenance and cooling system improved.
2. Conventional sodium vapor lamps and tube light fittings were replaced with energy-efficient LED lamps.
3. Governor extraction pressure minimum set point reduced from 1.7 to 1.0 kg/cm^2 – this achieved more power generation and constant process steam flow.
4. MCW pumps were linked with TG vacuum, and the CT fan was linked with inlet cooling water temperature in the DCS – this saved power up to 20 to 30%.
5. Both boiler master header pressure logics were put in the DCS – this achieved constant steam pressure with steam flow stabilization.
6. Drain condensate was recovered from all drains and taken in the Deaerator up to 2 TPH.

Water Conservation

In the sugar plant, water recycling is maximized, and excess condensate is cooled to ambient temperature for use in spray pond makeup and other sugar process requirements. As a result, total raw water consumption in the process has been eliminated.

Social Work & Training

Through USTKWPCL corporate social responsibility (CSR) more than 3,000 trees have been planted at the site. Primary operation and maintenance (O&M) technical training is provided for 200 engineering students from different colleges every year.

A safety committee has been formed in the cogeneration plant to ensure compliance with occupational health and safety (OHS) guidelines, to prevent accidents, respond to emergencies, and evaluate the effectiveness of the company's safety program. This committee also identifies safety hazards, investigates them thoroughly

Performance Highlights (Financial Year-wise Data)

Year	Cane Crushed, MT	Power Generation, Units in kWh	Power Export, Units in kWh	Specific Steam Cons. MT/MW	Steam Fuel Ratio
2013-14	1,306,289	158,654,652	133,584,788	5.78	2.32
2014-15	1,418,640	160,452,000	115,449,115	5.73	2.40
2015-16	1,379,835	183,048,000	134,818,519	5.68	2.51
2016-17	1,104,330	177,690,000	134,171,307	5.71	2.44
2017-18	1,081,081	132,073,000	92,062,875	5.76	2.34
2018-19	926,000	117,210,000	84,370,194	5.59	2.31
2019-20	626,890	66,849,000	42,980,406	5.90	2.29
2020-21	953,430	113,488,170	79,604,330	5.74	2.31
2021-22	1,312,860	137,949,847	95,210,243.5	5.84	2.15
2022-23	1,348,590	143,680,311	98,355,581.5	5.66	2.34
2023-24	1,204,825	136,354,065	90,631,037.5	5.71	2.41

and undertakes control measures. Safety audits are conducted every two years.

In the plant, training programs are regularly arranged for all skilled and unskilled manpower by engineers on various topics like DCS/automation, operations, equipment interlocks, HT/LT breakers, MCC/ PCC, mechanical standard operating procedures, troubleshooting, root cause analysis, and safety.

Awards

Besides the Cogen India award in 2023, our sugar factory has received other national and state awards as below:

- 1st Prize for Best Technical Efficiency (National Level) for Season 1988-89 and Best Cane Development Award (National Level) in 2010-11 from National Federation of Cooperative Sugar Factories, New Delhi.
- "Vanashri Puraskar" from Government of Maharashtra in 1999.
- Yashwantrao Chavan State Foundation Award 1989 for Achievements in Agriculture, Industry & Social Work.
- 1st Prize in Cane Development Work in South Maharashtra in 1992-93 and 1995-96 from Maharashtra Rajya Sahakari Sakhar Karkhana Sangh Ltd, Mumbai.
- "Sakhar Bhushan" Puraskar to our founder Late Shri Tatyasaheb Kore from Wai Urban Co-operative Bank in 1993.
- 1st Prize for Best Technical Efficiency (National Level) for Season 1997-98; Best Distillery Award (2003-04); and Most Innovative Sugar Factory Award (2004-05) from Vasantdada Sugar Institute Pune.

Courtesy:
1. Shri S.R. Bhagat, (Managing Director)
2. Shri B.B. Doshinge (CEO)
3. Shri J.G. Nibandhe, (Sr. Manager)
4. Shri S.S. Birajdar (Manager - E & I)
Shree Tatyasaheb Kore Warana Sahakari Sakhar Karkhana Ltd., Warananagar 416113
Tal – Panhala, Dist – Kolhapur, Maharashtra
Email: admin@waranasugar.com
Phone: 02328-22408/82

contd from pg 12... New Technologies

Future Prospects

Governments can accelerate CCS deployment through subsidies, tax incentives, and by implementing carbon pricing mechanisms that make emitting CO_2 more expensive than capturing and storing it. Technological innovation is also essential to reduce costs and improve efficiency. Research into alternative storage methods, such as mineral carbonation (where CO_2 reacts with minerals to form stable carbonates), could provide additional safe storage options.

Furthermore, integrating CCS with emerging technologies like hydrogen production from natural gas (with CCS to capture the resulting CO_2) can help in creating a hydrogen economy, further reducing emissions from various sectors.

In conclusion, while CCS faces significant challenges, its ability to reduce emissions from existing and future fossil fuel power generation makes it an essential technology for achieving global climate goals.

Author:

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(Some information has been sourced from: Investopedia; PGNiG; and IEA by the author)

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4. Please suggest other topics for inclusion in the next issue(s).

.....

5. Would you like to contribute articles? Please mention the topics below.

.....

6. Please indicate your interest in the following:

☐ Energy audit of your plant
☐ Implementation of a cogen/captive power plant
☐ Training of manpower at your plant
☐ Emission reduction trade services for your energy efficiency/renewable energy/cogeneration projects

Other areas where you may require Cogen India's services:.....

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7. Do you have a cogeneration/captive power plant? If yes, please send us the following details pertaining to your cogeneration plant:

Installed capacity (MW): ..... Surplus Power (MW): ..... Boiler Temperature/Pressure: .....

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The Cogeneration Association of India (Cogen India) strives to promote cogeneration and captive power projects in all applicable industrial and commercial sectors, and lobbies for conducive and sustainable policy and regulatory framework. Along with cogeneration, sugar mills in India have also ventured into the production of Ethanol and Rooftop Solar Power Generation, and hold the potential to venture into many new arenas of renewable energy, gradually transferring into Bio-Energy Complexes instead of remaining only a 'Sugar Industry'.

Cogen India thus has plans to extend its wings and provide advisory services on all aspects related to Bio-Power Projects.

Key Action Areas

- Strategies and measures to promote cogeneration projects in all applicable industrial and bio-power commercial sectors in India
- Capacity building and fuel linkage
- Interacting with Central & State Governments, state electricity boards, regulators, national and international bodies for ensuring sustainable policy framework and tariff rates
- Assisting other sugar-producing countries to set up their cogeneration sectors/projects

Activities

- **Inaugural launch of National Cogeneration Awards-2022, followed by National Cogeneration Awards-2023 and 2024 (www.cogenawards.com)**
- Successful organization of webinars, training programs/ business meets/field visits in sugar, rice, distillery, paper, food processing, bio-power, waste to energy sectors, etc.
- Quarterly (English) newsletter "Industrial Cogeneration India" - A unique forum for distribution of technical and sectoral information in India/abroad
- Marathi Bi-monthly newsletter "Nisarg Urja"- Appropriate to the aims and objectives of the association
- Sugar Cogeneration Handbook - 2021: Unique literature useful for stakeholders in the New and Renewable Energy sectors
- Member of the COGEN World Coalition (CWC), established in 2022 as an international non-profit association
- New Hydrogen India newsletter launched in Sept 2023

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