Triveni TURBINES

Power Solutions for the Sugar Industry

With over five decades of experience, Triveni Turbine Ltd (TTL) o customized steam turbine solutions to industrial customers and power producers for power and heat requirements, globally. Triveni Turbines is one of the largest manufacturers of industrial steam turbines generators (STG) in the sub-30 MW range. The company also designs and manufactures steam turbines up to 100 MW delivering robust, reliable and efficient end-to-end solutions.

Triveni Turbines manufactures steam turbines at its world-class facilities in Bengaluru, India. With installation base of more than 6,000 steam turbines across 20 plus industries, Triveni Turbines is present in over 75 countries across the globe.

Apart from manufacturing, the company also provides a wide range of aftermarket services through its refurbishment arm, Triveni REFURB to its own fleet of turbines as well as turbines of other makes of up to 500 MW supported by its team of highly experienced and qualified service engineers that operate through its global servicing offices.

Our steam turbine generators (STG) are used by independent power producers in Biomass, Waste-to-Energy, District Heating and Geothermal etc. as well as by industrial customers such as Sugar, Distillery, Cement, Steel, Textiles, Pulp & Paper, Chemicals, Petrochemicals, Fertilisers, Solvent Extraction, and Palm Oil to Food Processing and more.

Triveni Turbines has a long-standing association with the sugar industry and has supplied tailor-made steam turbine solutions since 1968. Over 2,500 steam turbines are currently in operation in sugar plants across 36 countries, totalling approximately 5,000 MWe of power generation capacity.

The company offers Condensing and Back-Pressure steam turbines for process steam and power generation applications, which are designed for higher efficiency and are capable of performing under varying process steam requirements and operating conditions. The governing and actuating system of these turbines provides speedy response and stable control to accommodate grid fluctuations and frequent load throw-off conditions.

Sustainable Power Generation Using Thermal Renewable Fuel in Sugar Industry

A conventional power plant burns fossil fuels in a boiler to produce high-pressure steam to drive a turbine, which in turn drives an alternator to generate electricity. However, a combined heat and power (CHP) or cogeneration plant can use thermal renewable fuels, such as bagasse (a sugarcane by-product) to generate steam for power generation. The CHP plant also utilizes the steam extracted from the turbine for various sugar manufacturing processes, making it more efficient.

By using bagasse as fuel, the CHP plant can generate enough power to run the sugar mill during the season and sell excess power to the grid during the off-season, pro-

Triveni's Product Offerings for Sugar Industry

TYPE	SUB-TYPES
Back-Pressure Turbine Generator	1. Straight Back-Pressure 2. Controlled Extraction Back-Pressure 3. Uncontrolled Extraction Back-Pressure
Condensing Turbine Generator (with water- or air- cooled condenser)	1. Controlled Extraction Condensing 2. Uncontrolled Extraction Condensing
POWER OUTPUT Up to 100 MW	**PARAMETERS:** Inlet Steam Pressure – Up to 140 Bar Inlet Steam Temperature – Up to 545 Deg C

viding additional revenue. Furthermore, the cost of power generated by the CHP plant is around 14-15% lower than that of Independent Power Producers (IPPs).

Case Studies

1. Bagasse-based cogeneration plant installed overseas driven by Triveni 30 MWe back-pressure steam turbine with an inlet steam of 65 Bar and inlet temperature of 500 Deg C with 2.5 Bar exhaust.

The plant's main goal is to generate electricity while also utilizing the extracted steam for various processes in sugar manufacturing. This cogeneration approach enables the plant to operate more efficiently, reducing the overall energy costs and carbon footprint. The use of bagasse as a fuel source also contributes to the plant's sustainability objectives.

The installation of this bagasse-based cogeneration plant demonstrates the viability and effectiveness of utilizing renewable energy sources in the power generation sector. The Triveni 30 MWe steam turbine's high-performance capabilities allow for efficient power generation, making it a reliable and cost-effective choice for cogeneration plants worldwide.

Challenge: A customer had a requirement for a steam turbine with higher efficiency, and their expected delivery within 7 months.

Solution: To meet the customer's needs, a steam turbine with reaction technology was installed. The turbine's steam path was designed to handle a significantly large volumetric steam flow, while the rotor with reaction blading ensures higher efficiency.

Benefits: The exterior casing of the turbine was single-cast, which includes guide blade carriers, allowing for faster start-ups. The turbine's reaction stages also provide better efficiency, leading to increased energy output.

Overall, the installation of this steam turbine offers improved performance and energy savings for the customer.

2. Bagasse-based cogeneration plant installed overseas driven by Triveni 2*16.5 MWe back-pressure steam turbine with an inlet steam of 42 Bar and inlet temperature of 400 Deg C.

The Triveni steam turbines are designed with back-pressure technology, allowing for efficient steam utilization and energy generation. The turbines also feature a robust construction with high-quality materials, ensuring long-term reliability and performance.

The installation of this bagasse-based cogeneration plant is a testament to the effectiveness of Triveni steam turbines in the power generation industry. The turbines' high-performance capabilities and efficient design enable the plant to meet its energy demands while reducing its carbon footprint. Overall, the project demonstrates the viability of utilizing renewable energy sources for sustainable power generation.

Challenge: A customer had a requirement for a steam turbine that could operate at maximum efficiency with two different inlet steam parameters: 42 Bar (a) for a new boiler and 21 Bar (a) for an existing one.

Solution: To meet the customer's needs, the steam path of the turbine was meticulously designed to handle extremely high volumetric steam flow, ensuring maximum efficiency at both inlet steam parameters.

Benefits: The blade and nozzle of the turbine were constructed using high-quality materials, specifically American Society for Testing and Materials (ASTM) grades. This ensures longer blade life and reduced operational expenditures. The plant utilized the generated power to produce sugar, with the remaining power sold to the local electricity grid, contributing to sustainable energy generation.

Overall, the installation of this steam turbine demonstrates the effectiveness of precise steam path design and high-quality material construction in maximizing energy efficiency and sustainability. The project serves as an example of the importance of meeting customer requirements and utilizing renewable energy sources in power generation.

As sustainability becomes increasingly important for industries, the sugar industry is also exploring ways to reduce its reliance on fossil fuels. One of the key challenges faced by the industry is how to improve energy efficiency and lower capital expenditure (CAPEX) over a wider range of operational flow conditions than traditional steam turbines can offer.

To address this challenge, an innovative hybrid axial exhaust steam turbine solution has been developed (Figure 1).

Figure 1: Axial exhaust turbine with controlled extraction for sugar factory cogeneration

In the sugar industry, steam turbines must be able to operate under different flow conditions during both on-season and off-season periods. During on-season, the high-pressure (HP) section of the turbine is fully loaded, while the low-pressure (LP) section operates with partial loading. In contrast, during off-season, both HP and LP sections are fully loaded.

Triveni Turbines has developed a unique blade path that keeps the conversion efficiency relatively flat across widely varying flow conditions. The axial exhaust turbine solution helps to reduce both operational expenditures (OPEX) and CAPEX, making it an attractive option for the sugar industry looking to improve its sustainability practices.

Triveni Turbines provides **aftermarket** solutions for rotating machinery worldwide, including steam turbines, compressors, and gas turbines. To operate turbines efficiently and save costs, they may need to be redesigned to meet new parameters. Triveni REFURB enhances the efficiency of turbines of any make and age by replacing critical components such as rotors, guide blade carriers, and bearings. They also offer services such as health surveys, condition assessments, and long-term service agreements.

Over a period of time, the existing turbines degrade thereby reducing the efficiency of the turbines by consuming more steam. Our Triveni REFURB team provides solutions to enhance the efficiency of turbines of "Any make, Any age" by only replacing the critical components of the turbine i.e., rotor, guide blade carriers and bearings, which ensures the efficiency is restored and thereby reducing the carbon footprint.

The re-engineering will be done to ensure the old rotor and stator can be reused within the existing casing once the price of power improves, thereby giving the customer flexibility of choosing any option based on the fluctuation of power pricing and enhancing the efficiency in either case

Case studies show how Triveni REFURB converted double extraction-condensing and single extraction condensing turbines to back-pressure turbines to improve efficiency and meet changing process needs. The re-engineering process retains the existing system and only modifies the turbine internals to suit the new parameters, reducing costs and carbon footprint.

Triveni REFURB is today a multi-brand repair arm of Triveni Turbines offering various benefits of efficiency enhancement services on Steam Turbines, Renovation & Modernization, Re-engineering/Reverse Engineering, Health Survey and Condition Assessment, Residual Life Assessment (RLA), Overhauling, Operation & Maintenance (O&M) and Long-Term Service Agreements (LTSA), and Remote Monitoring (Triveni Touch).

The demand for thermal renewable energy sources is increasing globally, and the turbine industry is shifting towards energy conservation through the usage of renewable sources. Governments are promoting bagasse-based cogeneration, biomass power, waste heat recovery, and municipal solid waste-based power generating solutions to achieve sustainability goals. Replacing coal-fired power plants with clean fuel-based power generation will further drive the demand for renewable/thermal renewable power generation in the future.

ADVERTISERS

UPCOMING MEETINGS & CONFERENCES

2023

MAY 7-10 | **Sugar Industry Technologists (SIT),** New Orleans, LA USA; SugarIndustryTechnologists.com

JUNE 13-15 | **Joint Florida and Louisiana ASSCT,** Savannah, GA. USA

AUGUST 4-8 | **American Sugar Alliance (ASA),** Napa CA

AUGUST TBD | **Florida Division of ASSCT,** Belle Glade, FL USA; ASSCT.org

SEPTEMBER 18 - 22 | **Association of Sugar Technolgists of Latin America (ATALAC),** Costa Rica

SEPTEMBER 20 - 22 |**Association of Sugar Technologists or Mexico (ATAM),** Veracruz, Mexico; atamexico.com.mx