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Inplant Cogeneration System: The Utilisation Of Waste Heat From Power Plant

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Abstract
India is one of the largest sugarcane growing nations. So, lot of waste material is getting produced during the production of sugar. The cogeneration technique helps to reuse these waste products for generation purpose. Cogeneration based on biomass is environmentally friendly, and all kinds of biomass resources can be used. As a result of this, the sugar units today are integrated plants which apart from manufacturing sugar, generate power and supply to the grid and also have distillery to produce ethyl alcohol. It is a system of commercially available technologies that lower general gas consumption and related GHG emissions via generating each strength and beneficial heat from the same gas input. For industries in want of energy in distinctive forms consisting of electricity & steam, (maximum extensively used form of warmth strength), the cogeneration is right answer due to its viability from technical, within your means in addition to environmental perspective.

Keywords-*Electrical energy, cogeneration cycles, Different equipments used,etc.*

INTRODUCTION

Meeting electricity call for in sustainable way is one of the essential demanding situations that India is facing. This massive potential addition is massive task for the United States. At present strength generation in India is ruled by using the coal which is a first-rate supply of carbon emission. Cogeneration is on-web page era & utilization of power in unique forms concurrently by making use of gas energy at top-rated efficiency in a cost-powerful & environmentally accountable way. India is one among the most important customers and manufacturers of sugar within the international Sugar production is an power in depth industry and calls for both steam in addition to electricity.

Bagasse is the leftover of the sugarcane after crushing and is burnt as a gas inside the boiler of sugar mill. Bagasse cogeneration has been practiced in sugar turbines for the reason that lengthy to satisfy sugar generators personal power wishes. However, imparting excess power to the grid has gained momentum global in remaining one decade. It offers numerous advantages including close to – zero gas value, improved viability of sugar turbines, electricity protection, fuel range, reduced transmission and distribution losses and carbon emission reduction. In view of this, GOI has launched a program to enhance surplus electricity generation from bagasse cogeneration. Bagasse cogeneration is renewable energy and comes under Ministry for New and Renewable Sources of Energy of Govt. of India.

Cogeneration systems are of several types & almost all types primarily generate electricity along with making best practical use of heat, which is an inevitable by-product. Cogeneration means the combined production of electricity and heat in an energy conversion facility. Technically, it means that part of the heat (steam, hot air) for the production of electricity in steam or gas turbines, or residual heat from combustion engines or fuel cells is used for room heating or as process heat in industry or commerce. Basically, the cogeneration principle could

be used in any generation facility. It makes only sense, though, when there is a demand for the heat. The heat demand should be large and continuous over a large part of the year.

Cogeneration is above all meaningful for applications where there is a large and continuous (not just seasonal) demand for heat close to the cogeneration facility. If there is no demand for heat from a cogeneration facility, its efficiency for the production of electricity will be lower than for optimized thermal power stations. Larger cogeneration facilities have in general lower production costs than smaller units. But on the other hand, transport of heat to users takes longer and is more expensive.

PRINCIPLE OF COGENERATION

Cogeneration or combined warmth and power (CHP) are described as the sequential era of two one of a kind kinds of beneficial strength from a single number one energy source, typically mechanical energy and thermal energy. Mechanical energy can be used to force an alternator for generating strength, or rotating system along with motor, compressor, pump or fan for delivering diverse services. Thermal energy may be used both for direct process packages and for circuitously generating steam, warm water, and hot air for dryer or chilled water for technique cooling. Cogeneration provides a wide range of technologies for application in various domains of economic activities. The overall efficiency of energy use in cogeneration mode can be up to 85 per cent and above in some cases.

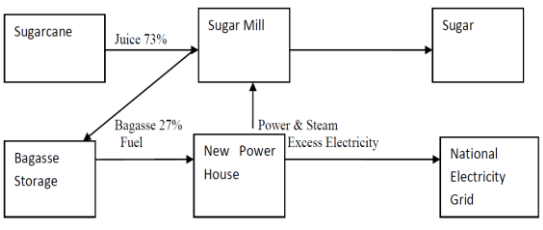

Fig1. *Principle of cogeneration*

TYPES OF COGENERATION

A cogeneration system can be classified as both a topping and a bottoming cycle on the idea of the series of energy use.

In topping cycle, the fuel energy is used to generate steam at excessive temperature & at excessive strain & electrical power is generated in usual manner. right here, the gasoline furnished is used to first produce electricity & then thermal energy, that is the derivative of the cycle & is used to fulfill system warmness or different thermal necessities. it is extensively used & is the maximum popular technique of cogeneration.

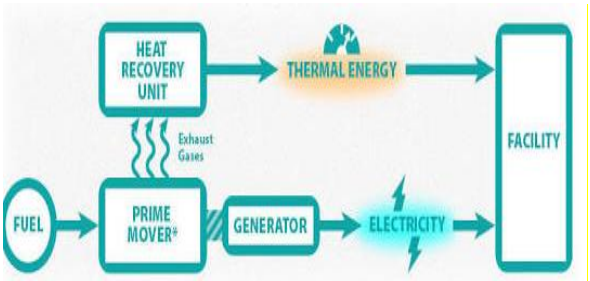

Fig 2. Topping Cycle

In bottoming cycle, the steam produced in boiler at high temperature & pressure is directly used for the manufacturing process & the reject heat from the process is used for generation of electrical energy, obviously at low efficiency. It is of little thermodynamic or economic interest because its combined efficiency is less than that for separate generation of process steam & electricity.

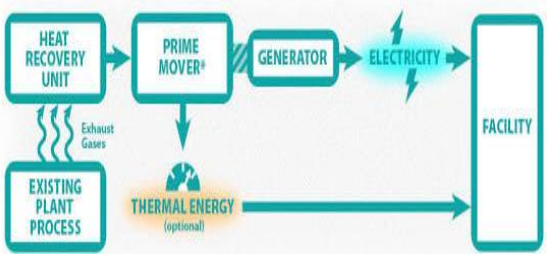

Fig 3. Bottoming Cycle

COGENERATION TECHNOLOGIES

A broad range of mature technologies is available for cogeneration. They can use all energy carriers, from biomass or

hydrogen in small facilities, such as mini-CHP units and fuel cells, to coal and nuclear energy in facilities of any desired size.

The commonly used cogeneration technologies are:

1. Steam Turbine Systems
2. Gas Turbine Systems
3. Combined Cycle Systems
4. Diesel Engine Systems

BLOCK DIAGRAM OF CO-GENERATION PROJECT

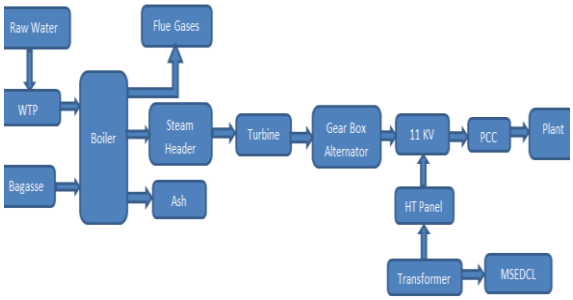

Fig 4. *Block Diagram of Co-generation Project*

Water Treatment Plant (W.T.P.)

The raw water contains of some impurities and dirty material collected (coagulant) which destroys the equipment's. So WTP helps to remove such impurities which results in improvement of efficiency.

Safety valve

The function of the safety valve is to prevent the increase of steam pressure in the holler above its design pressure. When the pressure increases above design pressure, the valve opens and discharges the steam to the atmosphere. When this pressure falls just below design pressure, the valve closes automatically. Usually the valve is spring controlled. In brief, the function of safety valve is to blow off the steam when the pressure of steam inside the boiler exceeds the sate limit set pressure.

Stop valve

It regulates the flow of steam supply outside. The steam from the boiler first enters into an ant-priming pipe where most of the water particles associated with steam is removed.

Feed check valve

It's far non-return sort of valve fitted to the screwed spindle to adjust the lift. Its characteristic is to adjust the supply of water that's pumped into the boiler, by way of the feed pump. These valves should have its spindle lifted earlier than the shell barely underneath the everyday water stage of boiler.

Solid Waste (Bagasse)

Bagasse is the fibrous matter that remains after sugarcanes are crushed to extract their juice. It is dry pulpy residue left after the extraction of juice from sugarcane. T can also be very useful to generate electricity. Dry bagasse is burnt to produce steam. The steam is used to rotate turbines to produce the power.

Boiler (Steam Generators)

Steam mills or boilers use warmness to convert water into steam for a diffusion of applications. Steam is a key aid because of its extensive availability, tremendous houses and dependable nature. Steam Boiler or in reality Boiler is essentially a closed vessel into which water is heated until the water is converted into steam at required stress.

Feed pump

In the boiler water is continuously converted into steam, which is used by steam engine. Thus we need feed pump to deliver water to the boiler continuously. The pressure of steam inside the boiler is high so the pressure of feed water has to be increased proportionately before it is made to enter the boiler. Generally the pressure of feed water is 20% more that of pressure of steam of boiler.

Super heater
A super heater is an important device of steam generating unit. Its purpose is to increase temperature of saturated steam without raising its pressure. It is generally an internal part of the boiler and is placed in the path of hot flue gases from the furnace.

Steam turbine
The dry and superheated steam from the super heater is fed to the steam turbine through main valve. The heat energy of steam when passing over the blades of turbine is converted into mechanical energy. After giving heat energy to the turbine, the steam is exhausted to the *condenser* which condenses the exhausted steam by means of cold water circulation.

Economizer
An economizer is device used to heat feed water by utilizing the heat in the exhaust flue gases before leaving through chimney. As the name indicates the economizer improve the economy of boiler. It may be noted that the temperature of feed should not be less than about 35˚c. Otherwise there is danger of corrosion due to moisture in the flue gases being deposited in cold tubes.

Air heater
Air pre-heater is used to recover heat from the exhaust flue gases. It is installed between the economizer and chimney. The air required for the purpose of combustion is drawn through the air pre-heater, where its temperature is raised. Hot flue gas is passed through the tubes of the air heater internally while atmosphere air is passed over the outside of tubes.

Alternator
The steam turbine is coupled to an alternator. The alternator converts mechanical energy of turbine into electrical energy. The electrical output from the alternator is delivered to the bus bars through transformer, circuit breakers and isolators.

MSDCL (Switch Yard)
The switch yard is located near the TG building. The area required for accommodating the power transformer, insulators and the structures, circuit breakers, isolators etc. is given in the switch yard layout. The switch yard layout has been prepared based on MSEDCL requirement. The cogeneration project maximum power transmitted, which will be exported to MSEDCL's substation located near the plant.

COGENERATION IN SUGAR INDUSTRY

Bagasse is the fibrous residue of cane stalk acquired after crushing and the extraction of juice. Each ton of sugarcane can yield 250kg of bagasse. The composition of bagasse varies with range and maturity of sugarcane as well as with harvesting methods used and efficiency of the sugar mill in processing the sugarcane. The cost of bagasse as a gas relies upon largely on its calorific fee, which in flip is laid low with its composition, specially with recognize to water content and to the calorific price of the sugarcane crop, which depends particularly on its sucrose content material.

Every ton of sugar has an energy potential equivalent to that of 1.2 barrels of petroleum. Historically, sugar mills have been designed to meet their energy requirements by burning bagasse: this was seen as an economic means of producing electricity whilst cheaply disposing of bagasse. The process of bagasse cogeneration is sketched out in Figure below.

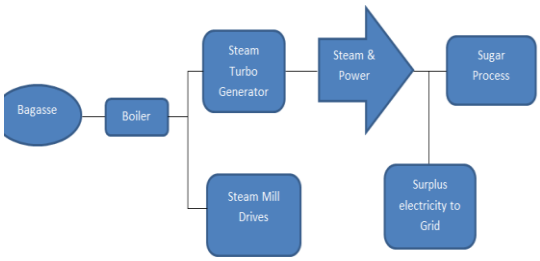

Fig 5. *Block Diagram of Co-generation Project implemented in sugar industry*

SUGARCANE PROCESSING FLOWCHART

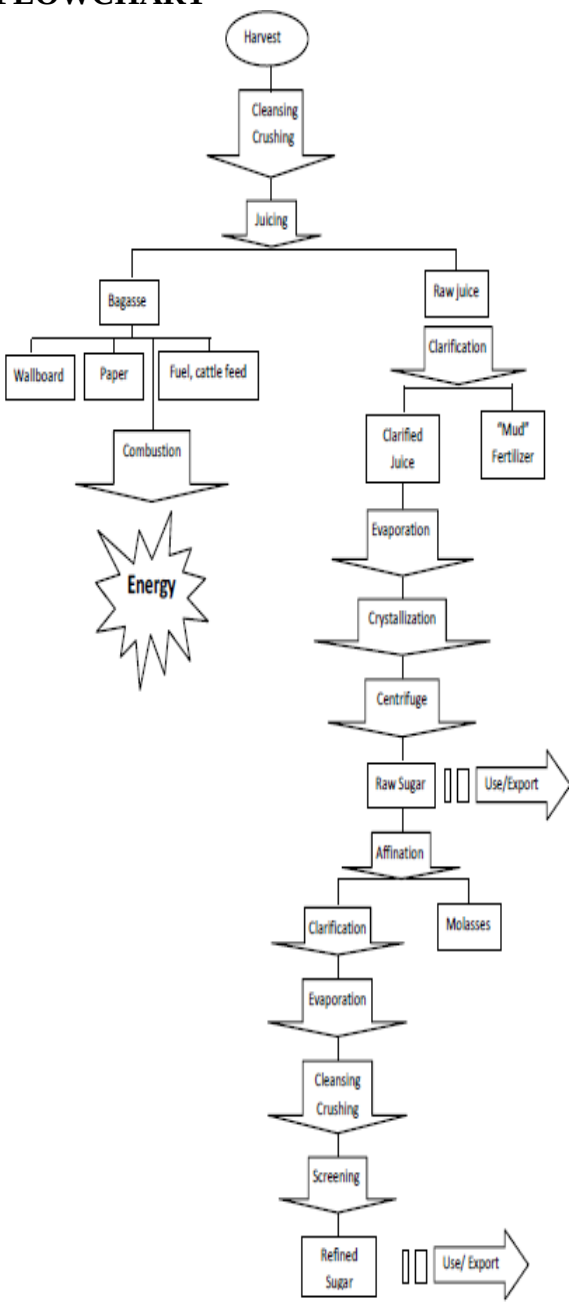

Fig 6. *Flow chart of Co-generation Project implemented in sugar industry*

ADVANTAGES OF COGENERATION

1. Increasing the thermal efficiency from 45% to 85% thereby eliminating waste of our resources.
2. Reducing dependency on non-renewable fossil fuels by optimizing a sustainable source of green energy.
3. Reducing greenhouse gases emissions by up to 50% by requiring less fuel input.
4. Reducing transmission and distribution losses due to the co-location of the energy system and the industrial operations.
5. Such kind of setup helps by allowing companies to replace aging infrastructure.
6. It provides higher savings in energy with maintaining the economic stabilization factor.
7. These plants are eligible for enhanced capital allowances.
8. They are really useful sources which provide additional security of supply.

CONCLUSION

It can be concluded from the CO-GENERATION plant that, for an increasing demand of electrical energy, the generation of electrical power from waste sources is being the best solution along with the conservation of electrical energy.

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