Cogeneration-Way Of Coexisting

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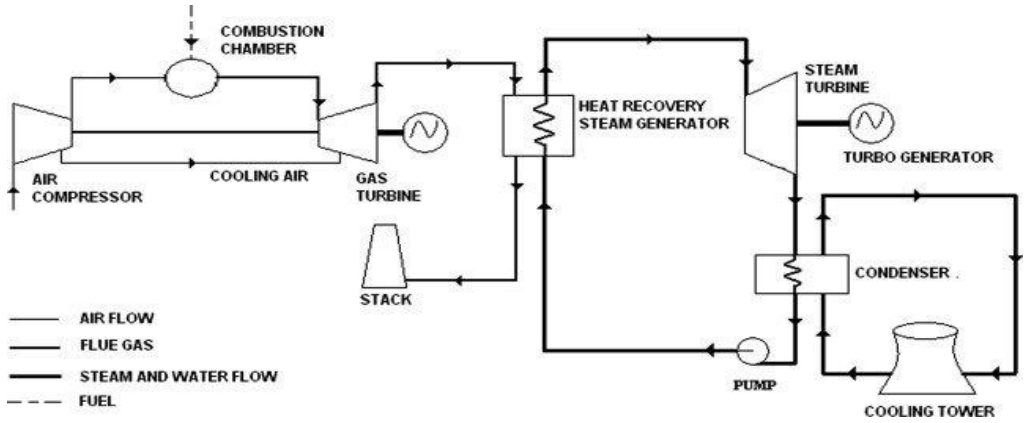
Abstract- Contributing factors like climate change, diminishing availability of fuel and constant hike in its cost and the advancement of digital technology era paved the way for the emergence of smart grid from a conventional grid. Pre-existing innovation, micro grid can also be integrated with smart grid characteristics by considering various topologies, including cogeneration system where from a single source of fuel when fired, both electricity and thermal energy can be produced. Cogeneration system promises better efficiency, lower costs and able to reduce greenhouse gas emissions compared to singular conventional methods. This paper provides an overview of cogeneration systems, including their basic operation and the various types of prime movers that can be used in power plants, buildings, and industrial plants. Using the data of existing plants, this study is to explore different parameters like fuel sources that can be used and the places where the system of cogeneration can be applied. To substantiate the success of the cogeneration system, a number of cogeneration applications are discussed. Overall, this paper is to understand about cogeneration system as well as a detailed explanation about the challenges, advancements and opportunities of cogeneration systems.

Index Terms- Cogeneration, CHP, Higher efficiency power plants, Stubble burning remedies, Bio waste-Bio gas production

I. INTRODUCTION

A steam based system in general, uses a fuel source to get fired up so that the resulting steam can be used to generate power. This system includes a steam turbine which gets its required rpm through the steam produced, but once the process is done the steam is released in to the environment which can be considered as pollution and also wastage of an energy form. So a system where this steam energy that is being left out as a wastage will be utilized for different purposes can be termed as a cogeneration system.

A Cogeneration system or a CHP (Combined Heat and Power) is a system in which a single fuel source gives two different outputs like generating power and air conditioning an airport.



Cogeneration system is mainly classified in to two categories based on when the power is generated once the fuel is fired.

1. Cogeneration with topping cycle

2. Cogeneration with bottoming cycle

1. **Topping cycle power plant:** If the given fuel is used to generate electricity initially and the generation of thermal energy follows during the process then this sort of power plant is considered as a topping cycle power plant. This energy is mostly employed to provide process heat in the absence of other thermal sources. This type of cogeneration is the most common.

2. **Bottoming cycle power plant:** In a bottoming cycle CHP plant, the principal fuel is used to generate high-temperature thermal energy. The heat that is discarded in this technique is subsequently used to generate electricity with the help of a recovery boiler and a turbine generator. This type of plant is now widely utilized in manufacturing processes that require high-temperature heat in boilers while also refusing heat at very high temperatures. They are utilized in sectors such as cement, steel, ceramics, petrochemicals, and gas, among others. Plants in the bottoming cycle are uncommon and are not suitable for topping cycle plan ts.

There are four different types of topping cycle power plants.

1. **Combined Cycle CHP Plant:** A combined cycle CHP plant primarily consists of a diesel engine or a gas turbine that provides electrical or mechanical power and is tracked through a heat improvement system that generates steam and drives a steam turbine as a result.

2. **Steam Turbine CHP Plant:** Turbine powered by steam CHP plants generate electrical power and process vapor by burning coal to generate high-pressure vapor, which is then utilized by a steam turbine to provide the required power, and the exhaust vapor is then used as low-pressure procedure steam to heat water for various uses.

3. **Internal Combustion Engine:** An internal Combustion Engine is a device that burns fuel inside the body. A cooling system is included in the CHP plant, and water is sent through a heat recovery system to produce vapor, rather than hot water for gap heating.

4. **Gas Turbine:** A standard gas turbine is used to drive a generator for power generation in this gas turbine CHP facility. A heat recovery boiler is used to generate process heat and steam from the turbine exhaust.

Components of Cogeneration System:

1. The Prime Mover is the engine that drives the generator.

2. System of Fuel organization.

3. The Generator is used to create energy from the building's power distribution system, while the Heat Recovery System is utilized to collect utilizable heat from the locomotive (engine).

4. Cooling system that cannot be enhanced for dissipating heat that is emitted from the locomotive

5. Ventilation & Combustion Air Systems provide clean air and transport waste gases from the engine, while the Control System ensures safe and efficient operation.

6. The Enclosure is utilized to protect the engine as well as the machinists, as well as to reduce noise.

Influence of Cogeneration:

1. Manufacturing costs are reduced and production is increased using cogeneration.

2. It is possible to improve plant efficiency.

3. It aids in water conservation and cost reduction.
4. This is used to reduce certain material emissions into the air, such as mercury, Sulphur dioxide, and carbon dioxide, which would otherwise cause the greenhouse effect.

5. In comparison to a traditional power plant, these systems are less expensive.

Problem Definition:

Energy conservation and its full-fledged utilization has always been the primary motive of any system which is applied for the purpose of energy generation of any kind (thermal, electrical etc.). Efficiency makes a whole lot of differ ence when the case of energy utilization is considered as it includes preserving the energy, transmitting it and distributing it. Systems that perf orm the designated tasks should also have the ability to give the results in its maximum possible efficiency.

Co-generation in the same way provides a case where the efficiency is considered as maximum as it utilizes the fuel source for one purpose and in turn it also utilizes the source that was meant to be left out as an exhaust wastage. There are many applications where co-generation is being used, in different ways and for different outcomes while the generation of electric power is common among them. There are still many applications that are to be explored where cogenerating systems can be utilized while considering different forms of fuel source. While preparing a detailed report over the basic structure and operation of cogeneration system, there is a necessity to understand the present day utilization of this system and also to study different ways of its utilization that are yet to be explored in the future.

Literature Survey:

The concept of co-generation system was first deployed in to action in the late 1980s. It was actually considered as a step to reduce the pollution that was being caused by releasing the aftermath steam from power plants (i.e. nuclear, thermal). Since then there was a lot of research carried out on this topic in order to explore different ways in which it can be utilized. The system has been updated many times from just being utilized in high capacity power plants to mills utilizing this system to generate the ir own power from the wastage they produce. Then the era of utilizing it for commercial purposes also came into action like in airports etc. The papers that were submitted before covering this topic by different researchers from different fields are di scussed and are considered for literature survey. These papers describe the formulation of laws by the government that forced the emergence of the system of co-generation. Challenges faced by the companies that came forward to set up this system connecting their mills or plants or refineries in terms of capital, construction, maintenance and safety measures that are to be considered in order to utilize it at its maximum efficiency.

Follo wing independence, the Government of India (GOI) decided to centralize power sector planning and de legate power system control to state governments. The Central Electricity Authority (CEA) and State Electricity Boards (SEB) were established at the federal and state government levels, respectively, to carry out these tasks. The CEA is under the jurisdict ion of the Ministry of Power and Energy Department. The SEBs are responsible for around 7500 MW of total generating, as well as the majority of transmission and distribution to end users. India has five private utilities that provide 500 percent of the cou ntry's electricity. BSES (Bombay Suburban Electric Supply), TEC (Tata Electric Companies), AEC (Ahmadabad Electricity Company), and SEC (Surat Electric Company) are the companies that make up CESC (Calcutta Electric Supply Corporation). State governments h ave permitted these utilities to function freely, resulting in a higher level of technical and financial health than the SEBs. De spite the increased installed capacity, India's power systems are still failing to overcome chronic power outages and poor powe r quality, resulting in a 2% GDP loss. The utilities' solution to India's persistent power disruptions has been voltage decreases and involuntary load shedding. As a result of these issues, the Government of India has implemented the following new private power policies. 1) Coal/lignite or gas-based thermal, hydroelectric, wind, and solar energy projects of any magnitude can be built by the private sector. 2) The private sector can establish units as "licensees" that distribute power in licensed areas from their own generation or acquired power, or as "generating businesses" who generate power for grid supply. 3) Licensees will operate in an economically and legally liberalized environment. 4) Private-sector captive power plants will be allowed to sell or distribute surplus electricity to state electricity boards. In India, the cogeneration situation has changed as a result of this approach. As a result, private industries such as chemical manufacturers, oil refiners, and fertilizer manufacturers, in addition to sugar, pulp and paper, and textiles, have begun to choose cogeneration.

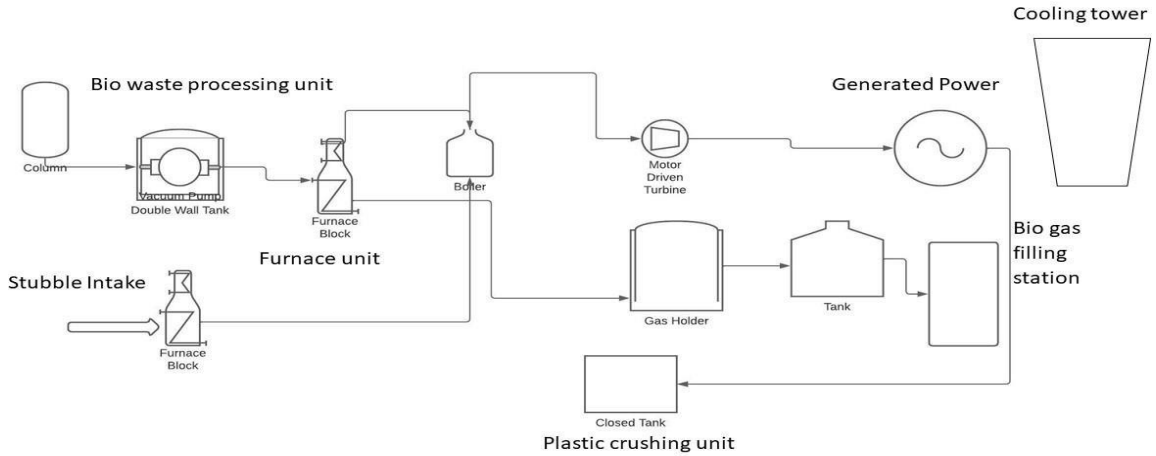
The benefits of cogeneration and why it is still a viable enterprise are explored. Cogeneration can use both bottoming and to pping cycles; however, due to its usefulness in big cogeneration power plants, the topping cycle is the main emphasis of contemporary cogeneration projects. The impact and reasons for the removal of many of the disincentives to cogeneration under the Public Utility Regulatory Policies Act are examined.

In a typical example of a major cogeneration power plant now under construction, the relative efficiency of conventional and combined-cycle cogeneration power plants are compared. When designing a cogeneration power plant, the electrical engineer has a lot to think about. Many applications will be found in industrial plants and will employ industrial thinking within the facility; but, due to the interface with the electric utility in the switch yard, many decisions will be impacted by conventional elect ric utility thinking. For preliminary design guidance, a basic discussion of the electrical engineer's considerations is given, inclu ding electrical system arrangement, integration of the new generation into the plant electrical system, short circuit matters, one –line diagrams, generator characteristics, excitation systems, step-up transformer ratings and characteristics, auxiliary transformers (station service), distribution systems, and system grounding. Industrial, or in plant, electrical generation, on the othe r hand, is not always cogeneration. Cogeneration, as the prefix suggests, entails the creation of more than one type of energy and is de fined as "the sequential production of essential heat and power (electrical and/or mechanical) or the recovery of low -level energy for power generation." Cogeneration has been performed in various forms for years due to the need for both process heat and electrical energy in many businesses, as well as the availability of low-cost or waste fuels.

Waste heat from an exothermic operation, such as a furnace or kiln that would otherwise be wasted is sent through an expander turbine to generate electrical power, which is an example of low-level energy recovery, or "bottoming." Typically, they are small units, less than 10 MW, and induction rather than synchronous generators are used. The first phase of cogeneration, which is defined as "the successive creation of essential heat and power...," is known as "topping" and is the primary focus of curren t cogeneration initiatives. The non-condensing steam turbine cycle, in which high-pressure steam is supplied into a turbine and withdrawn for process usage at one or more lower pressures, is an example of topping. Through a generator placed on the turbi ne shaft, the energy released to the turbine during the pressure reduction is recovered as electrical energy.

Proposed System:

Considering the basic model of a CHP it can be updated to a plant that could be a compilation of many Eco friendly functional plants. Input sources for the plant can be the pollution provocative situation like "stubble burning" in India and waste management system. Utilizing the generated output in its maximum efficiency is also a contributing factor in making a plant effective. The proposed system consists of Bio waste processing unit and its input valve can directly be connected to the drainage system. Waste management system or Bio waste processing unit produces steam along with bio gas which can be transferred and utilized at bio gas filling stations, while the steam can be given as the input to the steam turbine. A stubble intake unit conveys stubble to the furnace unit. Steam produced by burning stubble will also be transferred to the steam turbine. Power generated after the process is immediately utilized by the plastic crusher unit that takes input from the conveyor connected to the unit from the plant intake unit. Bio mass can also be collected by encouraging the establishment of public toilets which in turn hel ps in maintaining cleanliness.



Plant efficiency is always a contributing and considerable factor in case of a power plant. The maximum proved efficiency of a co-generation system is 90% while the maximum proved efficiency of a bio mass based combined heat and power generating system is 96%. Co-generation proves to be more efficient because of its combined outputs. Compiling multiple applications, utilizing different types of abundant inputs and maximum usage of the obtained outputs makes the plant more efficient.

II. CONCLUSION

Building a power plant takes a lot of things like capital, area, manpower, time etc. Utilizing the plant to its full extent can only be considered as compensation. Co-generation is the only favorable way in which it is possible to achieve. Future plants are being designed considering at least one way of co generating and former plants are upgrading to co-generation. This justifies the statement "Co-generation is the way of Co-existing".

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