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Non-Conventional Energy Resource

P.A.Gadge[1] Mithilesh Sarodkar[2],Vivek Ninave[3],Anshul Somkuwar[4], Chandan Patil[5]

Head of Department of Mechanical Engineering,V.M.I.T. Nagpur[1]

Undergraduate Student,Department of Mechanical Enginering,V.M.I.T,NAGPUR[2,, 3, 4, 5]

Abstract: Cogeneration is the use of single input of fuel to simultaneously produce useful electricity and heat from the same source. In the production of electricity, heat is normally wasted as exhaust. If the wasted heat from the electricity generation process can be reused, a large amount of fuel will be saved. Therefore, cogeneration conserves more energy both thermal and electrical. Considering the diminishing oil reserves, most countries are now switching into energy sector development based mainly on biomass, coal, and gas. With the new power sector structure and emerging market, industries can receive maximum benefit from the application of cogeneration. There is always a ready market for excess industrial power from cogeneration systems, which is a very competitive power source.

The use of Synchronous or Induction generators for steam turbine cogeneration has been briefly discussed in this paper.

KEYWORDS: Cogeneration, Energy Sector Development, Thermal Energy, Electrical Energy.

1. INTRODUCTION

Co-generation is the concept of producing two forms of energy from one fuel. One of the forms of energy must always be heat and the other may be electricity or mechanical energy. In a conventional power plant, fuel is burnt in a boiler to generate high-pressure steam. This steam is used to drive a turbine, which in turn drives an alternator through a steam turbine to produce electric power. The exhaust steam is generally condensed to water, which goes back to the boiler.

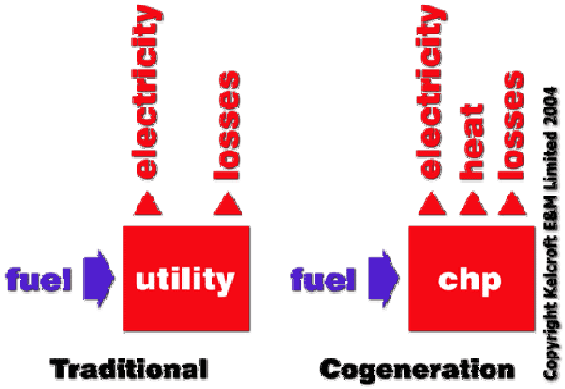

Fig 1. This shows Output obtained in Traditional way and Cogeneration..

As the low-pressure steam has a large quantum of heat, which is lost in the process of condensing, the efficiency of conventional power plants is only around 35%. In a cogeneration plant, very high efficiency levels, in the range of 75%–90%, can be reached. This is so, because the low-pressure exhaust steam coming out of the turbine is not condensed, but used for heating purposes in factories or houses. Since co-generation can meet both power and heat needs, it has other advantages as well in the form of significant cost savings for the plant and reduction in emissions of pollutants due to reduced fuel consumption. Even at conservative estimates, the potential of power generation from co-generation in India is more than 20,000 MW. Since India is the largest producer of sugar in the world, biogases-based cogeneration is being promoted. The potential for cogeneration thus lies in facilities with joint requirement of heat and electricity, primarily sugar and rice mills, distilleries, petrochemical sector and industries such as fertilizers, steel, chemical, cement, pulp and paper, and aluminum.

2. INVESTIGATION OF FUEL RESOURCES

The source of energy fuel is a critical element in the development of the cogeneration project.

Biomass: It is an environmentally friendly organic matter, which is available on a renewable basis through natural processes. Biomass fuel reduces carbon dioxide and stabilizes greenhouse gas concentration in the atmosphere. Biomass fuels are agricultural crops and wastes, wood and wood waste, and energy crops. Biogas is a colorless, odorless, inflammable gas, produced by organic waste and biomass decomposition (fermentation). Biogas can be produced from animal, human and plant (crop) wastes, weeds, grasses, vines, leaves, aquatic plants and crop residues, etc.

Coal: It is a combustible, sedimentary, organic rock (composed primarily of carbon, hydrogen and oxygen) formed from vegetation, which has been consolidated between other rock strata to form coal seams, and altered by the combined effects of

microbial action, pressure and heat over a considerable time period. Coal is the world's most abundantly found fuel, which is typically inexpensive. Cleaner coal grades are used as a fuel to minimize emission of pollutants that can harm human health. Clean Coal Technologies (CCTs) has been developed to improve pollution control, higher thermal efficiency, lower fuel cost and greater fuel efficiency. Coal is cleaned before burning by removal of ash, mixing with limestone to remove sulphur dioxide, nitrogen oxide and other traces of minerals.

Natural gas: It is a fuel, which is obtained from oil wells. Natural gas is a hydrocarbon (a compound of hydrogen and carbon) formed by the decomposition of vast numbers of microscopic plants and animals millions of years ago. Broken down by heat and the pressure of overlying rock, these organisms were transformed into oil and gas and stored in cavities beneath the surface of the earth. Many gas-fired cogeneration plants have developed due to the greater availability of natural gas, which has led to significant reduction in installation cost and better environmental performance as compared to other technologies.

Need for cogeneration

The major source of loss in the conversion process is the heat rejected to the surrounding water or air due to inherent constraints of different thermodynamic cycles employed in the power generation. In a cogeneration plant, very high efficiency levels, in the range of 75%–90%, can be reached. A number of environmentally positive consequences flow from this fact: Power tends to be generated close to the power consumer, reducing transmission losses, stray current, and the need for distribution equipment significantly. Cogeneration plants tend to be built smaller, and owned and operated by smaller and more localized companies than simple cycle power plants. As a general rule, they are also built closer to populated areas, which causes them to be held to higher environmental standards.

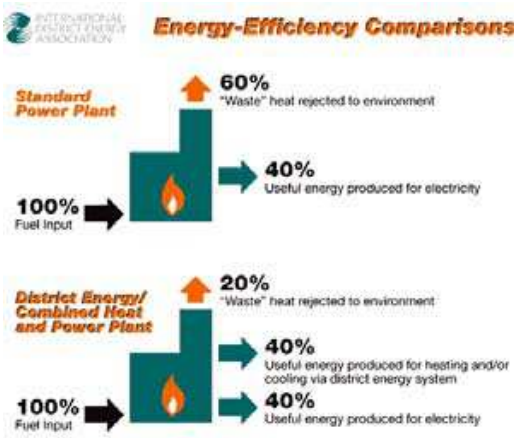

Fig 2. This shows Energy Efficiency Comparisons.

4. COGENERATION TECHNOLOGIES

A typical cogeneration system consists of an engine, steam turbine, or combustion turbine that drives an electrical generator. A waste heat exchanger recovers waste heat from the engine and/or exhaust gas to produce hot water or steam. Cogeneration produces a given amount of electric power and process heat with 10% to 30% less fuel than it takes to produce the electricity and process heat separately.Topping cycle plants produce electricity first, and then the exhaust is used for heating. Bottoming cycle plants, which are rare, produce heat for an industrial process first, and then electricity is produced using a waste heat recovery boiler. Bottoming cycle plants are only used when the industrial process requires very high temperatures, such as furnaces for glass and metal manufacturing.

2. TYPES OF COGENERATION CYCLES

Topping Cycle

In the topping cycle, natural gas is burned in a gas reciprocating engine or gas turbine that drives an electric generator to produce electric power.

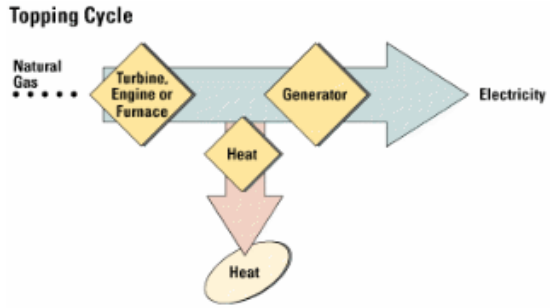

Fig 3. This shows the working process of Topping Cycle.

Waste heat, obtained from the engine's jacket water and/or the exhaust gases, is transferred via heat exchangers or waste-heat boilers to replace heat

normally supplied from conventionally fired gas equipment.

Bottoming Cycle

With the bottoming cycle, high-temperature exhaust heat from a high-temperature process furnace is converted to steam in waste-heat boilers to run a steam turbine driving an electric generator. Electric power production is dependent upon the amount of waste heat available.

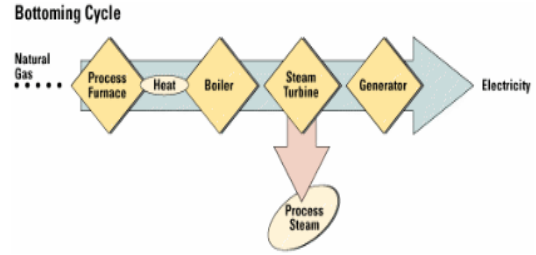

Fig 4. This shows the working process of Bottoming Cycle.

Combined Cycle

Practical for 5,000 kW or greater installations, this process uses a gas turbine topping cycle process and uses steam produced in a waste-heat recovery boiler to power an auxiliary steam turbine-driven electric generator similar to the bottoming cycle.

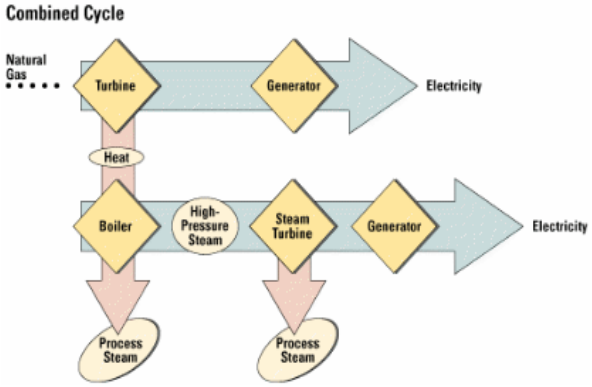

Fig 3. This shows the working process of Combined Cycle.

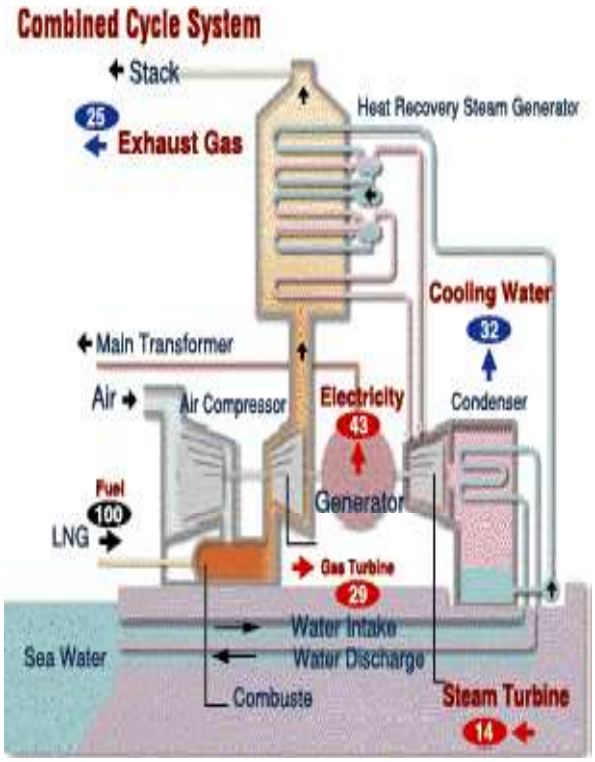

Fig 4.This shows Actual working of Combined Cycle

5. SCHEMATIC OF COGENERATION PLANT

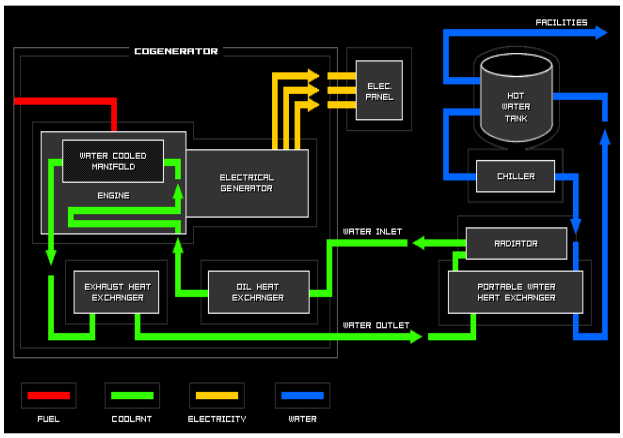

Fig 5. This shows the layout of a cogeneration plant. Generation of electricity and heat in the form of hot water is shown in the figure.

OPERATION AND MAINTENANCE: Routine maintenance is a key element in optimizing the production and life of cogeneration generating facilities. When integrated with ongoing unit operations and a program of inspection and upgrades, routine maintenance maximizes safely, reliability, availability, efficiency and environmental protection. While once a relatively straightforward job of restoring damaged or broken components, maintenance has evolved into a

sophisticated systematic programme of condition assessment, predictive techniques, corrective steps, preventive activities, and ongoing observation and evaluation of plant operations.

An effective operation and maintenance (O&M) organization and management can significantly influence the profitability of the cogeneration plant. The O&M team at the plant site must aggressively drive the plant to its economic and technical limits of high availability, reliability, output and efficiency while maintaining cost control.

In certain situation, the owners themselves form a team to operate the cogeneration plant.

ADVANTAGES OF COGENERATION:

- Cogeneration technology provides greater conversion efficiencies than traditional generation methods as it harnesses heat that would otherwise be wasted.
- It can result in up to more than a doubling of thermal efficiency or higher heat values (HHV).
- Carbon dioxide emissions can be substantially reduced.
- The heat by-product is available for use without the need for the further burning of a primary fuel.
- Cogeneration systems predominantly use natural gas, a fuel source that emits less than half the greenhouse gas, per unit of energy produced than the cleanest available thermal power station.
- By improving efficiency, cogeneration systems can reduce fuel costs associated with providing heat and electricity to a facility.
- Cogeneration systems are located at the point of energy use. They provide high-quality and reliable power and heat locally to the energy user, and they also help reduce congestion on the electric grid by removing or reducing load. In this way, cogeneration systems effectively assist or support the electric grid, providing enhanced reliability in electricity transmission and distribution.
- Because of its improved efficiency in fuel conversion, cogeneration reduces the amount of fuel burned for a given energy output and reduces the corresponding emissions of pollutants and greenhouse gases.
- Because cogeneration requires less fuel for a given energy output, the use of cogeneration reduces the demand on our limited natural resources—including coal, natural gas, and oil—and improves our nation's energy security.
- In separate production of electricity some energy must be rejected as waste heat, but in cogeneration this thermal energy is put to good use.
- Since co-generation can meet both power and heat needs, it has other advantages as well in the form of significant cost savings for the plant and reduction in emissions of pollutants due to reduced fuel consumption.
- Even at conservative estimates, the potential of power generation from co-generation in India is more than 20,000 MW

6. CONCLUSION

In the present scenario in the power industry, the nature and degree of application varies in the case of generation, transmission and distribution. New technologies in generation are driven by the need to optimize power generation and manage the high value assets in the plant, in the most efficient manner.

In time an increasing proportion of new power will come from a range of small-embedded generators, including cogeneration.

The traditional electricity system as we know it may well evolve beyond recognition as global and national pressures gain momentum to reduce emissions and a more holistic approach is taken to evaluating power generation, supply, and the provision of energy services to end users.

Cogeneration solutions simply reduce waste, with only 10%-15% losses, compared with the 55% or more losses using traditional generation methods and it is clear that cogeneration uses fuel more efficiently.

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