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Study on Thermal Power Plant

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ABSTRACT: Study of energy conservation helps engineers to find the way to produce electricity by using heat at various thermal power plants. They use coal as primary source to produce heat and extract the heat produced during the combustion process and convert it into electricity. A thermal power station is a place where heat energy is converted into electric power. This paper discusses the heat generation by using steam, advantages of the thermal power plant, disadvantages of thermal power plants, and efficiency of the thermal power plant. Steam driven thermal power plant converts heat energy into mechanical power. The mechanical power further used to run turbines and movement of turbines will supply power to the generator attached with the power plant. Generator is an electrical device used to convert mechanical energy into electrical energy. Heat produced by thermal power plants is in huge amounts and can be able to supply electricity at various cities, in this paper calculation of heat produced by thermal power plants and waste heat flow out from thermal power plants has been discussed. Thermal energy is a good source of energy which is used to produce electricity for many applications; it has great future scope for various applications.

KEYWORDS*:* Efficiency, Heat, Boiler, Coal, Electrical Energy, Heat Energy, Mechanical Power

I. INTRODUCTION

A thermal power or heat generation point is a place in whichheat energy is converted into electric energy or power. In most stations where steam or heat is the source which converts heat energy into mechanical energy and mechanical energy used for generation of electricity. Firstly there is a huge place called coal bunker where coal stored after that coal is pulverized into small pieces which get stored in a coal bunker for 14 days [1]. Water is stored in a lake reservoir. Water used for this process should be pure so that it works more efficiently. There is another plant called a hydro power plant used for water treatment. Water is heated above a threshold temperature after heating of water it turns into steam or vapor and runs a steam turbine which operates an electrical generator by applying force on it, generator is an electrical device used to convert mechanical energy into electrical energy [2].

After steam is passed through the turbine the steam is cooled down in a condenser and recycled to the container where it was heated. This is known as a Rankine cycle which is common for every power generating station. There is various types of power generating station such as hydro power plant, wind power plant, thermal power plant etc. they all are vary or differ each other because of the variation in the design, like various thermal power generating station differ from each other because of the efficiency, size of boiler, nuclear energy, solar energy, size of coal bunker, availability of water, heat source [3].

Generation of electricity from heat or steam or coal is held at a place called thermal Power Plant station, this is basically a place where conversion of energy from one form to another form, it works as a converter which converts fossil fuels into electrical energy or power. Fig. 1 shows the conversion cycle of the thermal power plant energy [4]. Boiler which boils the coal steam into high temperature steam is connected to the pass out turbine which will pass its heat to the generator and generator takes steam as input mechanical energy and gives electrical energy. Process heater is connected with a turbine which will heat steam more and send it to the pass out turbine. Condenser is connected with the pass out turbine so that it will condense the heat or collect condensed heat. The condenser in a thermal power plant is a heat transfer equipment used to condense or cool down heat or gaseous substance from its gaseous to liquid state only by cooling it [5].

There is very little need of coolant either water or some other thing but the most basic coolant is water or surrounding air. The main use of a condenser in thermal power plants is to receive exhausted or dissipated steam from a steam engine or turbine to condense or cool down the steam or cool steam. Many problems which were raised in the thermal

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power plant was global warming due to exhausted heat from the boiler which is in huge amounts and very warm so in this study utilization of waste heat has been shown [6].

Fig. 2 shows Heat exchange process used in many applications like in fridge, AC. Heat exchanger is a chamber which will work as an intermediary which takes heat as input and gives flue gas as output, Flue gas is waste gas or gas which can be reusable. Heat exchangers throw out the waste steam and heat loss, it takes water to boil. In thermal power plant production of electricity in which during the production, steam is used to rotate the turbine which further drives the electrical generator to produce electricity. The first thermal power plant was built by Sigmund Schocket in Ettal 1878. The power plant which was first invented is able to drive 24 dynamo generators. A steam condenser or condenser basically cools down the steam or warm vapor below the atmospheric pressure [7].

Fig. 3 shows a combustor, a combustor is one of the chambers present in thermal power plants and plays a very important role in efficiency of thermal power plants. It is a space acquired by a gas turbine in a thermal power plant named ramjet or scramjet engine. At both the combustion places, the other name of the combustor is the burner combustion chamber. In gas turbine system combustor where combustion takes place is supplied high pressure air by the compression system and fuel with high air pressure start combustion and waste gases will fly away through the combustion chamber.

1.Design of Rankine cycle with a two-stage steam turbine:

This research about the efficiency of thermal power plants, amount of heat or coal required for the production of huge power, every power generating station is of different power rating depending upon their availability of coal water and area. Thermal power plants are a place where a huge amount of power is produced by using tons of coal and many liters of water, so the study comprises the amount of coal and water required for how much production of heat and how much heat is then responsible for production of electric power, and amount of heat exhausted in surrounding [8].

II. LITERATURE REVIEW

There has been many research paper published in the field of thermal energy and transformation of energy from one form to other among all the research paper a research paper titled Energy Analysis of Thermal Power Plant by Vikas et al. discloses the different parts of thermal power plant, types of thermal power plant, efficiency of thermal power plants and how electricity from heat can be feasible with respect to nature. Various papers have been published which discuss the efficiency of thermal power plants and how they produce electricity transfer to the various locations. This paper gives the effect of thermal heat on the environment and energy analysis equation of thermal power plants. This paper discusses energy analysis of combustion chambers, thermal power plants work on the principle of conversion of heat energy into electrical energy. Combustion is the process of burning coal in the presence of oxygen. In the combustion chamber the amount of heat evolves from the chamber used to run the turbine so there is a different mathematical formula used to find out the value of heat evolving from the combustion chamber. For any power plant its energy analysis means the amount of input fuel needed to give for the production of the required amount of power or electricity. Discussed different types of condenser and its application at various places, also give a brief introduction about the energy analysis of feed pumps [9].

In research paper titled An analysis of a thermal power plant working on a Rankine Cycle: A theoretical investigation by RK Vaporia et al. disclose the information about the Rankine cycle, construction of different chamber like combustor, turbine, boiler and coal bunker, information about the Carnot cycle and Rankine cycle and heat exchange process. Steam power plants play a very important role in the field of electricity production, so today's electricity production source worldwide is steam power plants such as hydropower, gas power, biogas power, solar cells etc. One newly developed method of electricity generation is the Magneto hydro dynamic power plant [10]. This paper discussed the steam cycles used in power systems. Also explain the thermodynamics analysis of the Rankine cycle, this cycle helps to determine how efficiency and reliability of steam power plants can be increased. Changes in thermodynamic results in non-ideal or irreversible functioning of various steam power plant components have been identified. A comparative study between the Carnot cycle and Rankine cycle efficiency has been analyzed resulting in the introduction of regeneration in the Rankine cycle. Factors affecting efficiency of the Rankine cycle have been identified and analyzed for improved working of thermal power plants.

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III. CONCLUSION

Analysis of thermal power stations and generation of power by using heat which is produced during combustion of coal. Heat energy calculation and efficiency of thermal power plant calculation is also discussed in this paper, hence the need of heat energy so that it will be converted into electricity. It provides the basic understanding about the parts of a thermal power plant and particular use and construction in the power plant, information about the Rankine cycle, Carnot cycle and heat exchange process. This paper consists of technological knowledge, searching and analysis of many important factors affecting the thermal power plant's overall efficiency and other related factors responsible for deviation from ideal working of the Rankine cycle have been discussed. Efficiency of a simple Rankine cycle is improved by using an intermediate reheat cycle, enabling improved thermal conditions of the working fluid. However, it cannot reach the thermal conditions as in the case of the Carnot cycle where heat addition and heat rejection occurs at a specified temperature range. The regeneration is vital to improve the efficiency as it uses the sensible heat of exhaust steam for the preheating of feed water.

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