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A Review on the Energy Extraction of the Thermal Power Plant

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ABSTRACT: ***The power generation industry plays a key part in the country's economic development. The increasing demand for electricity has made power plants of scientific interest, but most power plants are built according to energy efficiency requirements based only on the first law of thermodynamics. The demand for energy supply is narrowing down day by day around the world. The actual useful loss of energy cannot be explained by the first law of thermodynamics, since it does not distinguish between energy quality and quantity. The current thesis deals with the energy analysis of coal-fired thermal power plants and offers a comprehensive overview of various researches on coal-fired thermal power plants over the years, thermal power stations. The key causes of loss and energy destruction in the power plant will be listed in this study. It will have ways and means to enhance the efficiency of the system and decrease the effects on the environment.***

KEYWORDS: ***Efficiency, Exergy destruction, Exergy analysis, Rankine cycle, Thermal power plant.***

Energy consumption is one of the most relevant measures showing the stages of growth of countries and the quality of living of populations. Population growth, urbanization, industrialization, and technological advancement contribute directly to increased consumption of oil. This increasingly rising trend brings in key environmental concerns such as greenhouse effects and pollution. Currently, about 80% of the world's electricity is produced from fossil fuels (coal, petroleum, fuel-oil, natural gas) fired from thermal power plants[1]. Exergy research based on the Second Thermodynamics Law has been found to be a useful tool in the design, evaluation, optimization and development of thermal power plants in recent decades[2]. The exergy analysis of thermal power plant is based upon both the first and the second laws of thermodynamic together, whereas the energy analysis is based upon the first law only. For these purposes, exergy analysis, which offers a more objective view of the process and a valuable method for engineering assessment, uses the modern approach to process analysis[3].

In a thermal power plant, the prime mover is powered by steam. Water is heated, converted into steam, and a steam engine that drives an electric generator spins. The steam is condensed in a condenser after it passes through the turbine and recycled to where it has been heated; this is known as a Rankine cycle[4].

Exergy

Exergy is a measure of a system's full capacity to perform useful work as it continues in equilibrium with its environment to a defined final state. In general, energy is not stored as energy, but in the system is lost. The loss of energy is the measure of irreversibility, which is the performance loss source. Therefore, the location, magnitude and magnitude are defined by an exergy study measuring the magnitude of exergy destruction. The root of inefficiencies in thermodynamics in a thermal system.

$$\dot{\eta} = {\text{Exergy output}}/{\text{Exergy input}}$$

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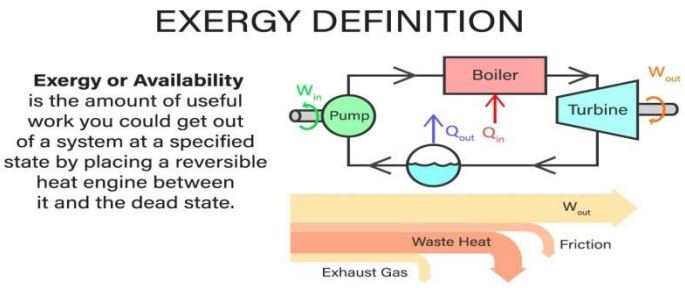

Figure 1: Definition with the application diagram

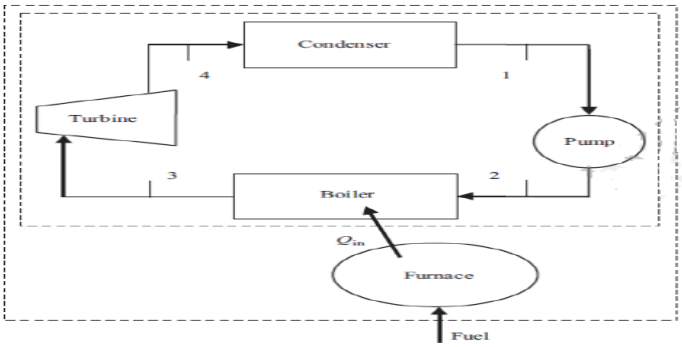

Figure 2: Power Cycle in thermal power plant

The following literature review summarizes significant research findings with respect to the study of the thermal power plant:

Mali Sanjay D and Dr. Mehta N S (2012) have noted that the process of energy and exergy analysis or thermal power plant and analysis carried out on energy and exergy analysis 125 MW of thermal power plants based on coal are on view[5]. Most power plants are constructed on the basis of energy efficiency requirements based only on the first thermodynamic rule. The actual useful loss of energy cannot be explained by the first law of thermodynamics, since it does not distinguish between energy quality and quantity[6]. The energy analysis presents only the results of quantities, while the energy analysis presents qualitative results on the actual use of energy. Exergy performance is lower at each and every point of device equipment in this study. There are also large energy losses available in the combustor, super heater, economizer, and air-pre heater parts. The comparison charts for energy efficiency, energy destruction and energy losses are also described in this article. Only a qualitative or exercise study of the conversion, transport and distribution of thermal energy will obtain the definite value of thermal energy.

- Exergy efficiency has been found to be lower than energy efficiency; APH, super heater and economizer (heat exchanger) have been found to be key components that have led to exergy loss.
- 47.43 percent exergy loss has been found to occur in the combustor (furnace) which indicates that the combustor is not completely adiabatic and that combustion may not be complete. The irreversibility of the combustion process is attributed to it. This study

pin points out that the combustor needs required modification to minimize exergy damage, such as refractory (insulation) modification, so that plant performance can be improved.

- In the heat recovery method, significant energy destruction occurs, leading to inefficient heat transfer between hot stream (flue gas) and cold stream (water & air). This implies that it is important to carefully examine the heat exchanger system.

The performance assessment and benchmarking of thermal power plants in India will be provided by **Naveen Shrivastava, Seema Sharma and Kavita Chauhan (2012).** Very small amounts of performance improvement can lead to a significant financial contribution that can be used to add capacity to reduce the supply gap in demand. The relative technical efficiency of 60 coal-fired thermal power plants (the key source of electricity in India) has been assessed in this regard. In India, overall energy shortages and peak shortages were reported in 2008-09 as 11.2 percent and 11.85 percent respectively (Central Electricity Authority, 2009a,b,c,d), indicating the lack of adequate electricity supply availabl[7]. The Central Electricity Authority (Central Electricity Authority, 2009c) and some power plants have completed or are about to complete their economic lives, according to the National Perspective Plan for R&M. In order to increase overall efficiency, the replacement of older power plants with the new technological power plants is also recommended.

A thermodynamic analysis of a subcritical boiler-turbine generator for a 32 MW coal-fired power plant was performed by **P. Regulagadda, I. Dincer and G.F. Naterer (2010)**[8]. For the method, both energy and exercise formulations are made. In order to determine parameters that optimize plant efficiency, a parametric analysis for the plant is carried out under different operating conditions, including different operating pressures, temperatures and flow rates. The greatest loss of energy is found to occur in the boiler. As a result, efforts to improve the power plant's output should be aimed at improving the boiler performance, as this will lead to the greatest improvement in the efficiency of the power plant.

CONCLUSION

From this analysis, the following conclusions can be drawn;
1. The first study of the law indicates that large energy losses have been observed in condensers. The second study of the law (exergy) shows that combustion chambers are the primary source of irreversibility in both steam and gas turbine thermal power plants. An exergy optimization approach offers a rational solution to maximize thermal power output opportunities
2. The first study of the law indicates that large energy losses have been observed in condensers. The second study of the law (exergy) shows that combustion chambers are the primary source of irreversibility in both steam and gas turbine thermal power plants.
3. In the heat recovery method, the main energy destruction occurs due to inefficient heat transfer between hot stream (flue gas) and cold stream (water & air). This shows that it is important to carefully examine the heat exchanger device.
4. The most popular method of minimizing the irreversibility of a combustion process is preheating the reactants. Preheating is typically carried out after the main heating duty has been done and before it is discharged into the atmosphere using the combustion product.
5. The energy analysis shows that improving the efficiency of the power plant leads to a major increase in overall performance.

6. There is some inherent irreversibility in any plant part, such as a boiler, combustion chamber, that cannot be removed due to the current state of technological growth.
7. The greatest loss of energy is found to occur in the boiler. As a result, attempts to increase the power plant's output should be aimed at improving the performance of the boiler, as this will lead to the greatest improvement in the efficiency of the plant.

REFERENCES

[1] M. K. Hubbert, "Energy from fossil fuels," *Science*. 1949, doi: 10.1126/science.109.2823.103.

[2] B. Crawford and I. Oppenheim, "The Second Law of Thermodynamics," *J. Chem. Phys.*, 1961, doi: 10.1063/1.1701056.

[3] I. H. Aljundi, "Energy and exergy analysis of a steam power plant in Jordan," *Appl. Therm. Eng.*, 2009, doi: 10.1016/j.applthermaleng.2008.02.029.

[4] D. T. Morgan *et al.*, "RANKINE CYCLE," doi: 10.1615/atoz.r.rankine_cycle.

[5] Mali Sanjay D and Dr. Mehta N S., "Easy Method of Exergy Analysis for Thermal Power Plant.," *Adv. Eng. Res. Stud.*, no. E-ISSN2249–8974, 2012.

[6] R. E. Sonntag, "The first law of thermodynamics," in *The Engineering Handbook, Second Edition*, 2004.

[7] N. Shrivastava, S. Sharma, and K. Chauhan, "Efficiency assessment and benchmarking of thermal power plants in India," *Energy Policy*, 2012, doi: 10.1016/j.enpol.2011.09.020.

[8] P. Regulagadda, I. Dincer, and G. F. Naterer, "Exergy analysis of a thermal power plant with measured boiler and turbine losses," *Appl. Therm. Eng.*, 2010, doi: 10.1016/j.applthermaleng.2010.01.008.