Journal of The Gujarat Research Society

ISSN: 0374-8588
Volume 21 Issue 9, September 2019

An Overview of the Analysis of the Useful Output Energy of the Thermal Power Plant

Sunil Kumar
Faculty of Engineering, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India

ABSTRACT: In the economic development of the country, the power generation industry plays a key role. The increasing demand for electricity has made power plants of scientific interest, but most power plants are built according to energy efficiency requirements based solely 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 discriminate between The efficiency of energy and quantity. The present study deals with the comparison of the electricity and energy analysis of coal- and gas-fired thermal power plants. A comprehensive overview of various studies on thermal power plants over the years is given in this article. The study will also shed light on the scope for further research and suggestions for development in current thermal power plants.

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

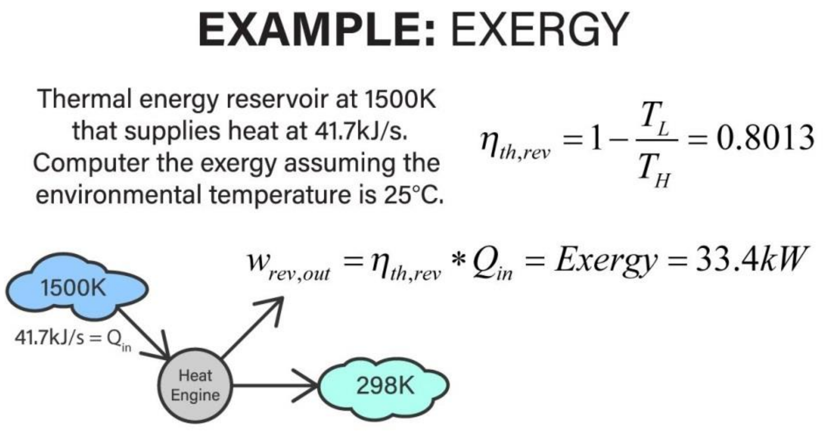
INTRODUCTION

The study of the exergy method is based on the Second Law of Thermodynamics and the notion of irreversible entropy development. The principles of the exergy method were laid down in 1824 by Carnot and in 1865 by Clausius. Energy-related engineering systems are constructed and their efficiency is primarily evaluated using the energy balance derived from the Thermodynamics First Act[1]. For more than a century, engineers and scientists have generally applied the First Rule of Thermodynamics to measure the enthalpy balances to quantify the loss of efficiency in a process due to energy loss. In recent years, however, the Second Law Study, hereinafter referred to as the energy analysis, of energy systems has attracted the attention of energy engineers and the scientific community more and more. In the thermodynamic study of thermal processes and plant systems, the exergy principle has gained significant interest after it was shown that the First Law analysis was inadequate from an energy efficiency perspective. The method of exergy analysis was developed and has been used since 1960 in Russia, Europe, Germany and Poland[2][3]. The exergy research represents the third stage in the analysis of plant systems, following the mass and enthalpy balances, based on the Second Law of Thermodynamics. The purpose of the exergy study is to recognize exergy loss magnitudes and locations with a view to improving existing systems, processes or components or creating new processes or systems. This study enables one to measure the loss of productivity due to the loss of energy quality in a process. It does not explicitly show how the method can be improved. It may, however, define where the method can be strengthened and thus indicate what areas should be considered. Often the simple energy balance will not be sufficient to detect device weaknesses. The exergy analysis is well thought-out in such circumstances to be critical for locating the imperfections of the systems. Many researchers around the world have recently carried out a large number of studies on the basis of exergy analysis in different device applications

Exergy:

Journal of The Gujarat Research Society
ISSN: 0374-8588
Volume 21 Issue 9, September 2019

Exergy is a measure of the full capacity of a system to perform useful work as it proceeds to a given final state in equilibrium with its environment. Energy, in general, is not retained as energy but is lost in the system. Energy loss is the indicator of irreversibility, which is the cause of loss of efficiency. The location, magnitude and magnitude are thus described by an exergy analysis measuring the exergy destruction magnitude. The core of thermodynamic inefficiencies in a thermal device.



.

Figure 1: Explanation of Exergy with example and diagram

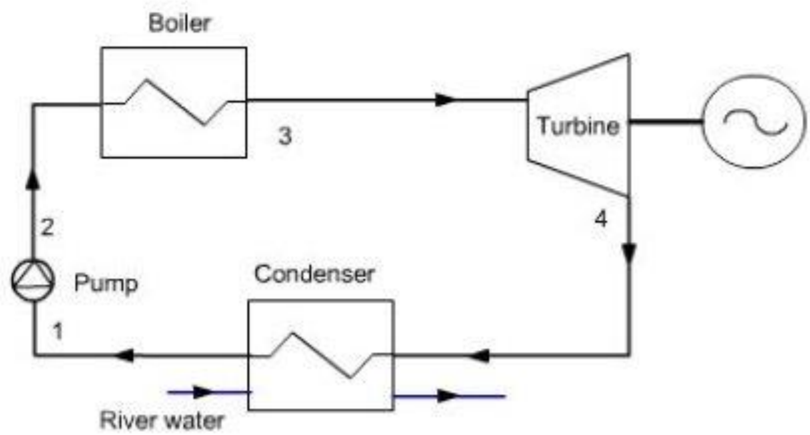


Figure 2: Power Cycle in thermal power plant

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

The full thermodynamic modeling of one of Iran's gas turbine power plants based on thermodynamic relations has been proposed by **Mohammad Ameri and Nooshin Enadi (2012)**[4]. The findings of the exergy study showed that the combustion chamber (CC) is the most destructive part of exergy relative to other components of the cycle. Also, due to the high temperature difference between working fluid and burner temperature, its exergy performance is lower than other components. As part of this research report, both thermodynamic modeling and energy analysis of a gas turbine cycle were conducted. The results of the exergy study show that, due to the chemical reaction and the large temperature difference between the burners and the working fluid, the combustion chamber is the most important exergy destroyer in a power plant.

Marc A. Rosen, Ibrahim Dincer and Mehmet Kanoglu (2008) have been studied to explain the use of exergy as a measure for defining and identifying the advantages of sustainable energy and technologies, so that they can be easily understood and appreciated by experts and non-experts alike, and increase the use of sustainable energy and technologies. Exergy can be used to analyze and enhance energy systems, and by offering more valuable and practical knowledge than energy provides, it can help better understand the advantages of using green energy. Performance gains and thermodynamic loss reductions due to more sustainable technology are clearly defined by Exergy. Performance gains and thermodynamic loss reduction due to green technology are clearly defined by Exergy. Exergy can also classify better than the environmental and economic advantages of energy technology. For this cause, energy has an important role to play in growing the use of renewable energy and technologies[5].

T. N. Alagumurthi, Ganapathy, R. P. Gakkhar, and K. Murugesan (2009)-It is studied that energy evaluation must be carried out by energy the number, as well as the quality. In general, however, the normal energy analysis measures energy only by its quantity. The energy analysis, however, assesses the quantity as well as the nature of the energy. In order to enhance current systems, processes or materials, the purpose of the energy analysis is to recognize the magnitudes and locations of actual energy losses. The present paper deals with an energy analysis performed at Thermal Power Station-I, Neyveli Lignite Corporation Limited, Neyveli, Tamil Nadu, India, on an operational 50 MWe unit of lignite fired steam power plant. Exergy losses occurred in the different subsystems of the plant and the mass, energy and exergy balance equations were used to determine their components[6]. The relation between the energy losses and the energy losses of the individual plant components reveals that the condenser produces a maximum energy loss of 39 percent, while the combustion engine produces a maximum energy loss of 42.73 percent.

CONCLUSION

The following conclusions can be taken from this analysis:

1. The first study of the law reveals that significant energy losses in condensers have been observed. The second analysis of the law (exergy) reveals that combustion chambers in both steam and gas turbine thermal power plants are the primary source of irreversibility. An energy optimization strategy provides a rational approach for optimizing the probability of thermal power production

2. The first study of the law reveals that significant energy losses in condensers have been observed. The second analysis of the law (exergy) reveals that combustion chambers in both steam and gas turbine thermal power plants are the primary source of irreversibility.

3. The key energy destruction occurs due to inefficient heat transfer between hot stream (flue gas) and cold stream in the process of heat recovery (water & air). This demonstrates that careful inspection of the heat exchanger system is necessary.

Journal of The Gujarat Research Society
ISSN: 0374-8588
Volume 21 Issue 9, September 2019

4. Preheating the reactants is the most common method of minimizing the irreversibility of a combustion process. Preheating is usually carried out after the main heating duty has been performed and before the combustion product is discharged into the atmosphere.

5. The energy analysis shows that improving the power plant's efficiency contributes to a substantial overall output increase.

6. In any section of the factory, such as a boiler and combustion chamber, there is some inherent irreversibility that cannot be eliminated due to the current state of technological development.

7. In the boiler, the largest energy loss is found to occur. As a result, attempts to increase the output of the power plant should be aimed at improving the boiler's performance, as this will lead to the greatest improvement in the plant's efficiency.

REFERENCES

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

[2] S. A. Kalogirou, S. Karellas, V. Badescu, and K. Braimakis, "Exergy analysis on solar thermal systems: A better understanding of their sustainability," *Renewable Energy*. 2016, doi: 10.1016/j.renene.2015.05.037.

[3] W. Fratzscher, "The exergy method of thermal plant analysis," *Int. J. Refrig.*, 1997, doi: 10.1016/s0140-7007(97)85546-6.

[4] Mohammad Ameri and Nooshin Enadi, "Thermodynamic modeling and second law based performance analysis of a gas turbine power plant (exergy and exergoeconomic analysis)," *J. Power Technol.*, no. 92 (3) (2012) 183–191, 2012.

[5] M. A. Rosen, I. Dincer, and M. Kanoglu, "Role of exergy in increasing efficiency and sustainability and reducing environmental impact," *Energy Policy,* 2008, doi: 10.1016/j.enpol.2007.09.006.

[6] T. Ganapathy, N. Alagumurthi, R. P. Gakkhar, and K. Murugesan, "Exergy analysis of operating lignite fired thermal power plant," *J. Eng. Sci. Technol. Rev.*, 2009, doi: 10.25103/jestr.021.23.