A comprehensive review on the exergy analysis of combined cycle power plants

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\textbf{ABSTRACT}

The arriving optimum improvement of a thermodynamic system of energy conversion such as a combined cycle power plant (CCPP) is complicated due to the existence of different factors. Energy and exergy analysis is utilized as effective methods to determine both the quantity and quality of the energy sources. This paper reviews the latest thermodynamics analysis on each system components of a CCPP independently and determine the exergy destruction of the plant. A few layouts of the CCPP plant from different locations considered as case studies. In fact, the most energy losses occurred in the condenser compared with the plant components. It found that in the combustion chamber (CC) the highest exergy destruction occurred. The ambient temperature causes an evident decrement in the power production by the gas turbine (GT). The result has proved that besides energy, exergy analysis is an efficient way to the assessment of the performance of the CCPP by recommending a more advantageous configuration of the CCPP plant, which would lead to reductions in fuel required and emissions of air pollutants.

\section{1. Introduction}

World’s population growth and substantial global economic development are causing the increase in demand for energy dramatically. The energy supply has undergone a shock due to the economic crisis that has inflicted the global market. The gap between energy supply and demand has risen continuously. Studies have determined that there was an approximate 6% average annual growth in the electricity demand for the world\textsuperscript{[1]}. Further, increase in demand for the energy expected for the next few years.

In general, there are many resources from which energy can be generated, including the conventional resources of fossil fuels, nuclear and renewable energy resources. The most common fuels used to generate energy are natural gas, coal and petroleum. Among the fossil fuels, coal has been one of the most abundant resources used for generating the electricity worldwide. In fact, the world energy demand greatly sustained by the combustion of fossil fuel\textsuperscript{[2]}. According to International Energy Agency (2010), by the year 2030 the coal consumption rate will be more than 6000 million tonnes of carbon equivalents, and across the globe, 42% of electricity supply mainly comes from the coal power plants.

Technically, the operation of a thermal plant that generates electricity using combustion of fossil fuel is much more complicated as compared to a hydroelectric plant. It required flowing fluids to work under extremely high temperature and pressure\textsuperscript{[3]}. Moreover, continuous supervision and maintenance on the complex automatic control units and operating conditions of the thermal power plants are necessary to ensure the power plant operating efficiently and produce maximum power\textsuperscript{[3–5]}.

To protection the mother nature and reduce the energy wasted, growing awareness was focused recently to the on more-efficient power generation system and generates power depend on the renewable