Abstract

This research conducted based on energy and exergy analysis to evaluate the performance of a 500 MW coal-based thermal power plant located at Mejia in India under the Damodar Valley Corporation. The primary objective of this research is to find out energy and exergy efficiencies of the turbine cycle, and irreversibility of different individual components of the plant at different unit load conditions (50%, 60%, 80% and 100%). Then the work extended to measure turbine heat rate at different unit loads to find out a condition at which reduction occurs in coal consumption rate as well as in harmful emissions like CO_2, NO_x, SO_2 and in ash generation.

Due to presence of a large number of concluding factors, a thermal power plant makes it challenging to accomplish the most efficient possible conversion of energy. The analysing of energy and exergy is a strong method to determine the quantity as well as quality of any energy system. It is found that the heat rate is lower at full load (100%) condition. On the basis of heat rate improvement, it is calculated that coal consumption as well as ash generation, sulphur dioxide and carbon dioxide emission are minimum at the full load condition.

In this work, an effort is made to improve performance and efficiency of the plant, and to reduce the harmful emissions such as CO_2, NO_x, SO_2, and to reduce ash generation. A suitable option to achieve this is integration solar energy with existing coal based conventional thermal power plant using parabolic trough collectors in place of low pressure heaters (LPHs) for heating the feed water. This eliminates bleeding of steam from the turbines. As a result, the steam flow rate increases through turbines, accordingly turbine power output increases and improves the turbine heat rate. This integration of solar energy leads to a significant reduction in coal consumption as well as reduction in the harmful emissions.

In brief, implementation of present model is essential in order to perform effectively by an existing coal based thermal power plant, which reduces coal consumption, reduces emissions, and moreover reduces the global warming.