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Performance Augmentation of a Combined Cycle Power Plant with Waste Heat Recovery and Solar Energy

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Abstract : In the present time, energy crises are considered a severe problem across the world. For the protection of global environment and maintain ecological balance, energy saving is considered one of the most vital issues from the view point of fuel consumption. As the industrial sectors everywhere continue efforts to improve their energy efficiency, recovering waste heat losses provides an attractive opportunity for an emission free and less costly energy resource. In the other hand the using of solar energy has become more insistent particularly after the high gross of prices and running off the conventional energy sources. Therefore, it is essential that we should endeavor for waste heat recovery as well as solar energy by making significant and concrete efforts. For these reasons this investigation is carried out to study and analyze the performance of a power plant working by a combined cycle in which Heat Recovery System Generator (HRSG) gets its energy from the waste heat of a gas turbine unit. Evaluation of the performance of the plant is based on different thermal efficiencies of the main components in addition to the second law analysis considering the exergy destructions for the whole components. The contribution factors including the solar as well as the wasted energy are considered in the calculations. The final results have shown that there is significant exergy destruction in solar concentrator and the combustion chamber of the gas turbine unit. Other components such as compressor, gas turbine, steam turbine and heat exchangers having insignificant exergy destruction. Also, solar energy can contribute by about 27% of the input energy to the plant while the energy lost with exhaust gases can contribute by about 64% at maximum cases.

Keywords : solar energy, environment, efficiency, waste heat, steam generator, performance, exergy destruction
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