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Name of Ph.D Scholar: Syed Mohammad Mahmood
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Name of Supervisor: Prof. M. Emran Khan
Department : Mechanical Engineering

Findings

Over the past few years several studies have been conducted on solar operated power plant. In solar thermal power plant, the solar collector is the major component which absorbs the incoming solar radiation, converts it to heat, and transfers the heat to a working fluid that are usually air, water, or oil, flowing through. Solar heating is not a new technology, but advanced techniques to increase the solar absorptivity and output temperature range are increasingly manifesting. required for a given application is what determines the type of collectors.

Solar thermal power plants got popularity and boost when concentrated solar power (parabolic trough, power tower, and dish/engine) plants were built successfully in California in 1990. These plants use trough type solar concentrators with some type of heat transfer to generate steam turbines, using the Rankine cycle at a low temperature of less than 150^{o}C. However, in recent years, worldwide researchers are more interested in solar heliostat based central receiver system that shows the best performance characteristics due to its flexible nature of operating temperature range of 150-200^{o}C. A heliostat field collector generates electric power from sunlight by focusing concentrated solar radiation on a tower-mounted heat exchanger (receiver). The system uses hundreds of sun-tracking mirrors to reflect the incident sunlight onto the receiver where molten salt flows and absorbs the heat reflected. These plants are best suited for utility-scale applications in the 30 MW to 400 MW range.

In this study, a solar-powered cogeneration cycle is proposed, which is an integration of the Rankine cycle and organic Rankine cycle whose primary objective is to generate power and convert the available solar energy to its truest potential. The analysis is performed to recover the waste heat from the steam turbine so as to operate the Rankine cycle by using the different refrigerants (R-113, R-11, and **R-1233zd)**. The analysis also predetermines the effects of direct normal irradiation (DNI), a mass flow rate of molten salt and steam, turbine inlet pressure, and temperature on first and second law efficiency for all components in the cycle. The novel concept of uncertainty analysis is introduced first time in this research and model in order to provide accurate results with precision removing all human and machine errors in the study which came out to be 3.81 % that is the desired range. As the DNI increases from 600 W/m^2 to 1000 W/m^2, (32.31% to 37.99%) first law efficiency and (24.14 % to 25.51 %) second law efficiency is increasing on employing the organic Rankine cycle (ORC). Analysis of the result indicates that maximum exergy destruction that occurs in the central receiver is around 42%, heliostat 31%, HRSG 10%, heat exchanger 3.6%.

Further, elaborates the study and an effort has been done to develop the thermal modeling of solar milk pasteurization system operated through N number of fully covered semi transparent photovoltaic thermal integrated parabolic concentrator (N-PVT-IPC). The thermal mathematical model of the present proposed system has been exhaustively demonstrated to the assessment of performance parameters namely, solar cells electrical efficiency, electrical power output, useful thermal energy gain and the temperature of milk (which is to be pasteurized) in terms of both design and climatic conditions. Moreover, effect of operating parameters such as mass flow rate of withdrawn milk, number of collector, packing factor, and mass flow rate of collector fluid on milk pasteurization temperature have been comprehensively discussed. The present numerical simulations have been carried out for New Delhi, India climatic condition by using MATLAB R2015a software. Based on mathematical computation, it has been found that the milk temperature for pasteurization increases significantly with increase in the number of PVT-IPC collectors at lower packing factor. Further, it is also concluded that the proposed pasteurization system under optimal design and operating parameters can produce 216 kg of pasteurized milk, by using six hours of sunshine operation during a summer day. Correspondingly from the simulation of present study it is inferred that the proposed system is self-sustained up to six hours for a sunshine day.