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Short Communication

Steam Power Plants and the Operation of Rankine Cycle

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ABOUT THE STUDY

Steam is an odorless, invisible gas made up of vaporized water. It is frequently interspersed with minute droplets of water, giving it a white, cloudy appearance. In nature, steam is produced by volcanic processes that heat subsurface water and is discharged from hot springs, geysers, fumaroles, and some types of volcanoes. Steam also can be generated on a big scale by technical systems, like, for example, those employing fossil-fuel-burning boilers and nuclear reactors [1].

Steam power is a significant source of energy for industrial society. In power plants, water is heated to steam, and the pressurized steam powers turbines that generate electrical current. Steam's thermal energy is therefore turned to mechanical energy, which is then transferred to electricity. The steam used to power turbogenerators generates the majority of the world's electricity. Steam is also commonly used in industrial operations such as steel, aluminum, copper, and nickel production, chemical synthesis, and petroleum refining. Steam has traditionally been utilized in the household for cooking and warmth [2].

Steam power plants are widely used for energy generation around the world, and coal is frequently used to fuel these plants. Although the world's existing coal reserves will last for nearly two centuries, the technology utilized to generate electricity from coal today has major negative environmental consequences. Exergy analysis is one of the most essential analysis techniques accessible since it is a valuable, quick, and straightforward way for assessing and optimizing thermal generating stations. Exergy analysis provides valuable insights on plant performance. The results of exergy analyses can help efforts to improve the efficiency, and possibly the economic and environmental performance, of thermal power plants [3,4].

Energy and exergy analyses are used to assess and better understand the performance of steam power plants, as well as to identify and evaluate potential process adjustments to increase plant efficiencies. Following that, some alternative process setups are proposed. Exergy is beneficial for providing a full breakdown of the losses for the overall plants and their components in terms of waste exergy emissions and irreversibilities. Some sample examples are provided to highlight the significance of exergy in improving the performance of steam power plants. Measures to improve efficiency should be balanced against other considerations and adopted only when necessary [5].

Dry steam power plants became the first kind of geothermal power plant, with the first being erected in 1904 at Lardarello, Italy. At temperatures above 150°C, dry steam power plants use 99.99% dry steam. Such generators are uncommon due to the scarcity of dry steam. Underground steam is routed through a pipe on a turbine/generator combination. Because steam is utilized directly to power a steam turbine, there is no need to burn coal or alternative fossil fuels to produce electricity [6].

Single, double, or even triple flash stages are used in flash steam power plants. Single and double flash stage plants are commercially available and account for up to two-thirds of all geothermal power plants installed. In the literature, quadruple and quintuple flash stage plants are potentially researched to boost total power plant energy and exergy performances. The conversion of high temperature and pressurized geothermal fluid to steam and salinity is the key concept regulating the flash steam power plant. To generate electricity, steam is fed into a steam turbine. The reinjection of brine into the geothermal well ensures the well's long-term viability [7,8].

The Rankine cycle is thought to be optimal for steam power plants. It is made up of the four thermodynamic cycles listed below. The Organic Rankine cycle (ORC) is a low-temperature renewable energy application. Its renewable energy component is currently 1% solar thermal, 20% recovery of waste heat, 31% geothermal, and 48% biomass. Because the ORC is intended for low-temperature availability, it comprises a working organic fluid with a low boiling point. R-601 (n-pentane), R-123, R-134a, benzene (C_6H_6), R-245fa, R-717 (ammonia), and R-601a are some of the working liquids. (isopentane) [9-11]. We employ a parabolic trough with a solar collector in the discussion, with the parabolic trough concentrating solar radiation onto the solar

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collector. A working fluid in the solar collector absorbs heat and transmits it to the water in the evaporator. The evaporator's water absorbs heat and produces steam for the steam power plant. We can substitute the solar parabolic trough and solar dish with biomass and geothermal to operate renewable energy power plants for steam power stations.

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