World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Thermodynamic Analysis of a Multi-Generation Plant Driven by Pine Sawdust as Primary Fuel

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Abstract : The current study is based on a combined heat and power system with multi-objectives, driven by biomass. The system consists of a combustion chamber (CC), a single effect absorption cooling system (SEACS), an air conditioning unit (AC), a reheat steam Rankine cycle (RRC), an organic Rankine cycle (ORC) and an electrolyzer. The purpose of this system is to produce hydrogen, electricity, heat, cooling, and air conditioning. All the simulations had been performed by Engineering Equation Solver (EES) software. Pine sawdust is the selected biofuel for the combustion process. The overall utilization factor (ε_{en}) and exergetic efficiency (ψ_{ex}) were calculated to be 2.096 and 24.03% respectively. The performed renewable and environmental impact analysis indicated a sustainability index of 1.316 (SI) and a specific CO2 emission of 353.8 kg/MWh. The parametric study is conducted based on the variation of ambient (sink) temperature, biofuel mass flow rate, and boilers outlet temperatures. The parametric simulation showed that the increase in biofuel mass flow rate has a positive effect on the sustainability of the system.

Keywords : biomass, exergy assessment, multi-objective plant, CO_2 emission, irreversibility
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020