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Reduction in environmental CO_2 by utilization of optimized energy scheme for power and fresh water generations based on different uses of biomass energy

Tao Hai [a b c], Masood Ashraf Ali [d], As'ad Alizadeh [e], Sattam Fahad Almojil [f], Abdulaziz Ibrahim Almohana [f], Abdulrhman Fahmi Alali [f]

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Abstract

Renewable energy sources are undoubtedly necessary, considering global electricity demand is expected to rise dramatically in the coming years. This research looks at a unique multi-generation plant from the perspectives of exergy, energy, and economics; also, an environmental evaluation is performed to estimate the systems' CO_2 emissions. The unit is made up of a biomass digester and gasifier, a Multi effect Desalination unit, and a supercritical CO_2 (SCO_2) cycle. In this study, two methods for using biomass are considered: the first is using synthesis gas generated by the gasifier, and the second is utilizing a digester to generate biogas. A comprehensive parametric study is performed on the designed energy unit to assess the influence of compressor pressure ratio, Gas turbine inlet temperature, supercritical CO_2 cycle pressure ratio, and the number of effects of multi-effect distillation on the system performance. Furthermore, the exergy study revealed that the exergy destruction in the digestion unit was 11,337 kW, which was greater than the exergy destruction in the gasification unit, which was 9629. Finally, when compared to the gasifier, the amount of exergy efficiency, net output power, and freshwater production in the digester was greater.