Aspen simulation of Hybrid Concentrated Solar Power - Biomass Integrated Gasification Combined Cycle Process

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Biomass integrated gasification combined cycle has been used for power production from biomass. It is a process where biomass is partially combusted in a gasification unit to produce synthetic gas, which is combusted in a synthetic fired generation unit to produce electricity. The excess heat from gasification and synthetic fired generation is then passed to a steam cycle. This process results in improved thermal efficiency compared to direct biomass combustion, and less pollutants as the impurities in the synthetic gas can be removed before sent to the synthetic gas fired generation unit. The biomass gasification process is endothermic and normally operated at very high temperature. The heat and temperature needed for the biomass gasification is normally provided by combustion of biomass, inside the gasification unit or externally. This results a higher carbon dioxide emission. Concentrated solar power (CSP), which is a renewable energy resource collected from a solar collector and stored at high temperature, has potential to be used to provide energy for biomass gasification. The apply of CSP can reduce the carbon dioxide emission. In this study, an Aspen simulation was conducted to simulate the hybrid CSP-IGCC process. Biomass gasification process with internal combustion and external combustion were both simulated in Aspen using thermodynamic equilibrium model. The option of co-production of bio-char from a carbonizer was also studied. It is found that the heat storage temperature from CSP system needed for the hybrid CSP-IGCC process is feasible with current CSP technology. The energy efficiency of the hybrid CSP-IGCC process is higher than biomass IGCC process only as well as CSP.

Keywords: Biomass; Integrated Gasification Combined Cycle; Concentrated Solar Power; Hybrid CSP-IGCC; Bio-Char

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