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Research Paper

Advanced power generation using biomass wastes from palm oil mills ☆

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ABSTRACT

This study focuses on the energy-efficient utilization of both solid and liquid wastes from palm oil mills, particularly their use for power generation. It includes the integration of a power generation system using empty fruit bunch (EFB) and palm oil mill effluent (POME). The proposed system mainly consists of three modules: EFB gasification, POME digestion, and additional organic Rankine cycle (ORC). EFBs are dried and converted into a syngas fuel with high calorific value through integrated drying and gasification processes. In addition, POME is converted into a biogas fuel for power generation. Biogas engine-based cogenerators are used for generating both electricity and heat. The remaining unused heat is recovered by ORC module to generate electricity. The influences of three EFB gasification temperatures (800, 900 and 1000 °C) in EFB gasification module; and working fluids and pressure in ORC module are evaluated. Higher EFB gasification leads to higher generated electricity and remaining heat for ORC module. Power generation efficiency increases from 11.2 to 24.6% in case of gasification temperature is increased from 800 to 1000 °C. In addition, cyclohexane shows highest energy efficiency compared to toluene and *n*-heptane in ORC module. Higher pressure in ORC module also leads to higher energy efficiency. Finally, the highest total generated power and power generation efficiency obtained by the system are 8.3 MW and 30.4%, respectively.