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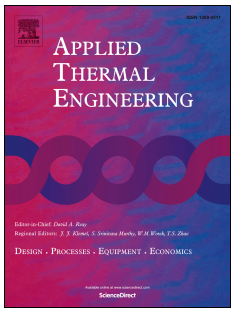

Biomass Gasification for Combined Heat and Power Generation in the Cuban Context: Energetic and Economic Analysis

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Abstract: In the present work is performed a technical and economic analysis of a combined heat and power generation system (CHP), designed to operate coupled to an internal combustion engine (ICE) fuelled with biomass producer gas, in order to generate electricity and hot water for isolated communities of power distribution network. In the proposed system configuration, the energy of the engine's hot exhaust gases is recovered (cogeneration), making this system more attractive in relation to conventional configurations, which are normally used to produce solely mechanical and electrical energy. The proposed system is composed of a modified downdraft gasifier, Imbert technology; coupled to an internal combustion engine, model ZIL−130. The system is designed and built in the laboratory of fluid mechanics at the University of Camagüey. The feedstock studied for the gasifier was Dichrostachys Cinerea, collected in neighboring areas to the proposed place of installation. The main energy flows and the costs associated with the production of producer gas were determinate. From the mass and energy balances, the thermal and electric efficiencies of the cogeneration systems resulted in η_{hw}=32.4% and η_{ge}=23.4% respectively, whereas the overall efficiency led to η_{global}=33.3%. In the economic analysis were studied the Internal Rate of Return (IRR), the Net Present Value (NPV) and time of return on investment (TRI) or payback, considering a project lifespan of 15 years. For the annual interest rate of 12%, the electricity should be sold at 0.3USD/kWh in order to the project be feasible. The IRR resulted in 12%, the NPV was 20,571 USD and payback period resulted in 5.3 years. In the proposed configuration, the system consumes 1.46 kg of biomass per kWe produced, with a maximum cost of generated electricity of 0.022 USD/kWh.

Keywords: biomass, cogeneration, gasification, internal combustion engine, downdraft gasifier.