CONTRIBUTION TO STUDY IN ADVANCED POWER GENERATION BASED ON PROCESS CONSUMING BIOMASS-GLYCEROL SLURRY

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Abstract
This work is part of a series of studies in advanced processes of thermal power generation consuming biomasses, urban wastes and high ash content coals. In the present instance, sugar-cane bagasse is mixed with glycerol to form a slurry. Glycerol is an abundant by-product of the increasing biodiesel production. That slurry is fed into a pressurized gasifier and the produced gas injected into a turbine. Heat exchanged during the produced gas cleaning process triggers a first Rankine cycle. Another Rankine cycle is driven by steam generated by heat exchange with the exhaust gas of the gas turbine. Thus, this is a combined process, designated FGSIG/GT (Glycerol Slurry Fuel-Integrated Gasifier / Gas Turbine). This study aims to improve the efficiency for such a process.

Key words:
Biomass, Gasification, Power Generation.

Introduction
The use of biomass as a renewable source of electricity generation, leading to near zero greenhouse gas emission, has increased. At the moment, almost all biomass-based thermal generation is based on traditional Rankine cycles. Former studies have shown that a new technology, called FSIG/GT (Integrated Gasifier Slurry Fuel/Gas Turbine) would lead to higher efficiencies\(^1\). The FGSIG/GT process is a variation of FSIG/GT, which applies glycerol instead water to form the bagasse slurry. The gasification pressure was set at 4 MPa, and aims to improve the efficiency found in a preliminary study of this process for the Configuration B operating at 2 MPa.

Results and Discussion

The simulators Comprehensive Simulator of Fluidized Bed Moving and equipment (CeSFaMB) and Industrial Process and Equipment Simulator (IPES) were used. The CeSFaMB was used to optimize the geometry and operation of the gasifier. The IPES software was applied for optimizing the whole power generation process. Apart from the operational pressure, the assumptions adopted here are similar to those set in a previous work\(^2\).

Conclusions
It has been shown that gasifications at 4 MPa, could lead to exergetic and cold efficiencies of 63.09 and 66.36\%, respectively, which surpassed those achieved in previous investigations. Furthermore, the produced gas was tars-free. This feature is important to avoid problems during the gas cleaning process, thus resulting in lower operation costs. The optimization of process parameters led to 1\(^{st}\) Law efficiency of around 46.5\%. This value is well above the presently 20\% achieved in sugar-alcohol production mills as well the 39\% obtained from previous studies with gasification at 2 MPa.

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