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Biomass Waste to Energy for a Particleboards Industry

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Extended Abstract

The conversion of waste to energy and usable resources using suitable and matured technologies has received considerable attention worldwide [1]. Given the existence of a homogeneous waste stream with appreciable calorific value at selected process industries, combustion of biomass-based waste is currently in many instances perceived as the power generation of choice. More specifically, for particleboards manufacturing industry, the implementation of combustion-based power generation for converting biomass-based waste to energy is a point of interest as it partly furnishes power leading to a reduction of electricity demand from the grid. In addition, it can also be a source of revenue to the company upon selling to the grid at time of excess electricity generation.

In this work a combustion-based biomass power plant is studied for Maichew particleboard factory located in the northern part of Ethiopia. The factory is a private company with annual production capacity of 40,000 m^3 boards from Eucalyptus trees. It requires about 600 kW installed capacity of electricity and the supply is mainly the national grid. The monthly electricity consumption of the factory is 390,000 kWh and based on the current Ethiopian Electric Utility (EEU) tariff of 0.02405 USD/kWh, the monthly utility bill is around 9379.5 USD. The factory generates huge amount of wood waste that has very limited usage. In order to study the viability of biomass-based waste to energy, information related to the amount and characteristics of the waste is essential. Determinant factors include the calorific value (energy content of the fuel), chemical composition, ash content, and moisture content.

The biomass waste generation rate was determined using the factory's waste biomass prospectus and other mathematical equations so as to predict the power production potential. The waste biomass was first collected from different waste generation sites of the factory. After size reduction and homogenization, the waste was characterized via proximate and ultimate analysis for its elemental composition and its calorific value was determined using bomb calorimeter at Messobo Cement factory's laboratory. The elemental composition was used for predicting the achievable flame temperature for power generation in association with the previous study by T. Gebreegziabher et al. [2]– [4]. The optimum operating parameters for the design, modelling and simulation of the combustion-based biomass power plant for this study are adopted from earlier studies carried out by T. Gebreegziabher et al. [5].

The factory's waste biomass generation rate was found to be 656.924 kg/hr. The waste used for characterization had a moisture content and calorific value of 1.75% and 23.6 MJ/kg respectively. From the kinetics study of the combustion process, the maximum adiabatic flame temperature attained in the combustion chamber at stoichiometric air fuel ratio is 1738.398 ℃. The simulation study of the power plant was carried out in Excel with water 97 Excel Add-In and equivalently verified in Engineering Equation Solver. Based on the study the power generation potential of the waste was estimated at 993.2 kW. The study signifies the factory is well placed to benefit from the proposed power plant.

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