BIOMASS GASIFICATION WITH PREHEATED AIR: ENERGY AND EXERGY ANALYSIS

by

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Due to the irreversibilities that occur during biomass gasification, gasifiers are usually the least efficient units in the systems for production of heat, electricity, or other biofuels. Internal thermal energy exchange is responsible for a part of these irreversibilities and can be reduced by the use of preheated air as a gasifying medium. The focus of the paper is biomass gasification in the whole range of gasification temperatures by the use of air preheated with product gas sensible heat. The energetic and exergetic analyses are carried with a typical ash-free biomass feed represented by $CH_{1.4}O_{0.59}N_{0.0017}$ *at 1 and 10 bar pressure. The tool for the analyses is already validated model extended with a heat exchanger model. For every 200 K of air preheating, the average decrease of the amount of air required for complete biomass gasification is 1.3% of the amount required for its stoichiometric combustion. The air preheated to the gasification temperature on the average increases the lower heating value of the product gas by 13.6%, as well as energetic and exergetic efficiencies of the process. The optimal air preheating temperature is the one that causes gasification to take place at the point where all carbon is consumed. It exists only if the amount of preheated air is less than the amount of air at ambient temperature required for complete gasification at a given pressure. Exergy losses in the heat exchanger, where the product gas preheats air could be reduced by two-stage preheating.*

Key words: *biomass, gasification, air preheating, exergy efficiency*

Introduction

Designing a combine heat and power (CHP) plant[1], which should consist of a downdraft biomass gasifier, a gas-cleaning system, and a gas engine due to the limited potential for heat energy consumption plenty of excess heat emerged. The use of this heat to improve gasification efficiencies by preheating the gasifying air was the motive for this paper. The bases are works of Prins *et al.* [1] and Mathieu *et al.* [2].

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