Topic: Design, Construction and Experimental Testing of Multi-Air-Stage Wood Gasification

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ABSTRACT

This study focuses on gasification system design and construction of a wood biomass in a multi-air-stage downdraft gasifier. The gasification system consists of a multi-air-stage downdraft gasifier, equipped with a cyclone, a heat exchanger, a bag filter, a blower and a flare tower. The design calculation was developed based on the required gasification process power output and air equivalence ratio (ER). To find out the dimension for each part, the measurement refers to the essential parameter of each equipment, the theoretical and the experimental data obtainable from several literatures. The gasifier had 0.15 m in internal diameter, 0.1 m in refractory wall thickness and 2.1 m in height. Separated into hopper, gasifier and ash chamber, it has three stages of air injection. Cyclone diameter was 0.127 m with 0.064 m in inlet height and 0.031 m in inlet width. A shell and tube heat exchanger design as one-shell and two-tube pass, 0.46 m in diameter, 2 m in length, and use 24 tubes in total. There was four requires bag for bag filter. A one horse power induced draft blower was used to absorb the synthetic gas and at the end this system finalized with a 2 m long flare tower to burn the gas. The outcome design was used for the experimental testing of multistage wood gasification.

Experimental testing was conducted on the outcome design of multi-air-stage wood gasification. Measuring the temperature distribution along the gasifier wall; the CO, CO_2, CH_4, and H_2 gas concentration was analyzed; the heating value of producer gas, tar analysis, and gasification efficiency were calculated. It showed that the multi air-stage gasifier followed the right pattern of downdraft gasifier. The average hot gas and cold gas efficiencies of this design are 11.79% and 28.05% for wood chips and 17.09% and 34.06% for wood chip-wood pellet mixture respectively.

Key words: Design, Biomass, Gasification, Downdraft, Multistage.