INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Power generation and consumption is a major yardstick to determine the development of a nation. Spurred by the energy crisis and environmental pollution, researchers have paid attention to the use of alternative sources of energy for sustainable power production worldwide. In the present context, coal shares the maximum percentage as a primary source of energy for power generation in the world. Major share in power generation in India and China are reported to be obtained from coal. According to IEA 2019 report, China derives 72% of electricity from the combustion of coal, whereas the same is reported to be 58% in India. Similarly, Japan and USA have derived electricity by utilizing 32% and 40% of coal, respectively. To enhance the economic growth, there is a need to increase the energy utilization, where a substantial amount of energy is obtained from the secondary energy resources such as energy derived from biomass and other renewable energy sources. Biomass with 14% of the global share is stored in the unhygienic condition in a tropical country like India. In this context, the gasification process is one of the promising alternatives, that can be efficiently used for the production of cleaner energy. Fluidized bed gasification is one such technology for power generation that can be made assessable to a large section of the population even in rural and remote areas of our country. Pressurized circulation fluidized bed (PCFB) gasification is an advanced form of atmospheric circulating fluidized bed (ACFB) technology that has certain advantages like compactness and higher bed to wall heat transfer rate. However, this technology requires further study to thoroughly understand the complexities of flow behaviour and heat transfer during gasification process specially when used with various biomass blends and composite fuels. In the present work, the effect of various operating parameters such as bed inventory, particle size, superficial

velocity, blends of coal with sawdust (percentage by weight) and operating pressure on bed hydrodynamics, i.e., bed voidage, suspension density, and solid circulation rate are studied experimentally in a PCFB gasifier. Further, an attempt is made to investigate the gasification process in a PCFB gasifier considering coal and locally available biomasses such as sawdust and rice husk and sugarcane bagasse as a feed material. A PCFB unit with a riser of 3 m height and 0.1 m inner diameter is fabricated for the investigation where the operating pressure is in the range of 1-4 bar.

Maximum decrement of 8.2% in bed voidage is observed as operating pressure varies from atmospheric to 4 bar. Further, the suspension density is found to increase with an increase in inventory weight. Peak increment of 28.3% in suspension density is perceived with an increase in inventory weights at a pressure of 4 bar. It is observed that the concentration of CH_4 increases with pressure for all the three feed materials. The concentration of CH_4 is found to be increasing from (3.65 to 4.86 vol%) and (2.98 to 3.46 vol%) for sawdust and rice husk, respectively. Similarly, the LHV is found to be increasing with pressure for coal and sawdust. There is a significant increase of 12% in LHV with an increase in pressure from 1 to 4 bar for both coal and sawdust. The CGE is found to increase by 34, 51, and 61% for rice husk, coal and sawdust, respectively with the increase in pressure from 1 to 4 bar.