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Effect of Different Factors on Temperature Profile and Performance of an Air Bubbling Fluidized Bed Gasifier for Rice Husk Gasification

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Abstract : In this work, study of temperature profile in a pilot scale air bubbling fluidized bed (ABFB) gasifier for rice husk gasification was carried out. Effects of different factors such as multiple cyclones, gas cooling system, ventilate gas pipe length, and catalyst on temperature profile was examined. ABFB gasifier used in this study had two sections, one is bed section and the other is freeboard section. River sand was used as bed material with air as gasification agent, and conventional charcoal as start-up heating medium in this gasifier. Temperature of different point in both sections of ABFB gasifier was recorded at different ER value and ER value was changed by changing the feed rate of biomass (rice husk) and by keeping the air flow rate constant for long durational of gasifier operation. ABFB with double cyclone with gas coolant system and with short length ventilate gas pipe was found out to be optimal gasifier design to give temperature profile required for high gasification performance in long duration operation. This optimal design was tested with different ER values and it was found that ER of 0.33 was most favourable for long duration operation (8 hr continuous operation), giving highest carbon conversion efficiency. At optimal ER of 0.33, bed temperature was found to be stable at 700 °C, above bed temperature was found to be at 628.63 °C, bottom of freeboard temperature was found to be at 600 °C, top of freeboard temperature was found to be at 517.5 °C, gas temperature was found to be at 195 °C, and flame temperature was found to be 676 °C. Temperature at all the points showed fluctuations of 10 – 20 °C. Effect of catalyst i.e. dolomite (20% with sand bed) was also examined on temperature profile, and it was found that at optimal ER of 0.33, the bed temperature got increased to 795 °C, above bed temperature got decreased to 523 °C, bottom of freeboard temperature got decreased to 548 °C, top of freeboard got decreased to 475 °C, gas temperature got decreased to 220 °C, and flame temperature got increased to 703 °C. Increase in bed temperature leads to higher flame temperature due to presence of more hydrocarbons generated from more tar cracking at higher temperature. It was also found that the use of dolomite with sand bed eliminated the agglomeration in the reactor at such high bed temperature (795 °C).

Keywords : air bubbling fluidized bed gasifier, bed temperature, charcoal heating, dolomite, flame temperature, rice husk
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