INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: PARAMETRIC STUDIES OF DOWNDRAFT GASIFIER ALONG WITH TAR CRACKING

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SHORT ABSTRACT

The world reserve of the fossil fuel is drastically reducing and there is a need for replacing the same with alternative fuel to meet the demand of electricity and thermal power. With rapid industrialization and improvement in standard of living, demand of energy is increasing rapidly. The supply and demand of energy is mismatching in major energy generating systems.

Amongst all the renewable sources of energy, use of biomass for power generation is gaining attention by researchers as biomass is abundantly available and is compatible to the environmental pollution. Considering country like India whose economy is based on agriculture with more than 70% of the population engaged in the sector, enough biomass is generated to produce electricity and thermal power. However, state of the technology to convert biomass into power is limited. Power obtained from biomass gasification is a promising technology but limited with generalized design.

In the present investigation the feasibility of loose biomass in the form of briquette and pellets in an existing downdraft gasifier designed to operate with woodchips is tested. Performance evaluation of the gasifier in terms of temperature profile, gas quality and gas yield are carried out with various equivalence ratios. Comparison is made for the aforementioned parameters for biomass briquettes, pellets and woodchips as feedstock. Further, an innovative study is carried out on the in-situ treatment of the tar using the biomass-dolomite pellets.

The parametric studies of downdraft gasifier are carried out with the various equivalence ratios and feedstock. It is observed that performance at equivalence ratio of 0.32 is comparatively good for all the three feedstock used in the experiments. The pellets with 20% dolomite give good gas composition.

A liquid gas bubbling fluidized bed set-up is developed for thermal cracking of tar obtained from the biomass gasification. Tar is a heavy hydrocarbon. It is cracked using fluidization under high temperature and using dolomite as catalyst.

The performance analysis of the tar cracking unit is carried out using various percentage of dolomite as catalyst. The cracked gas composition is found to be better with 10-15 % dolomite mixture by weight. In the present experiments tar is converted into cracked gas by fluidizing with air at flow rate 0.0015 m^3/h and followed by heating at temperature above 800^0 C and converted into cracked gas. The tar cracking unit can be retrofitted in conventional gasifier system to get better performance and yield of gas.

Thus the present methodology with in-situ tar cracking in downdraft gasifier and novel liquid-gas bubbling fluidized bed technique is found effective for cracking of tar coming out from gasification.