STUDIES ON CHARACTERISATION OF BIOMASS FOR GASIFICATION

by

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C E R T I F I C A T E

This is to certify that the thesis entitled **'Studies on Characterisation of Biomass for Gasification'** being submitted by **Mrs. ANURADHA GANESH** (Nee: N. Anuradha) to the Indian Institute of Technology, Delhi, for the award of the degree of **'Doctor of Philosophy'** is a record of bonafide research work carried out under our guidance and supervision and has fulfilled the requirements for the submission, which, to our knowledge, has reached the requisite standard.

The results obtained in this thesis have not been submitted in part or in full to any other University or Institute for the award of any degree.

Prof. P.D.Grover
(Supervisor)
April, 1990

Dr.P.V.R. Iyer
(Supervisor)

Dedicated

to my dear parents

ACKNOWLEDGEMENTS

The Biomass Conversion Laboratory at the Chemical Engineering Department, Indian Institute of Technology, Delhi, was being established by the time that I had been completing Bachelor of Engineering (Chemical Engineering) at the Panjab University, Chandigarh. Given the scenario towards the closing years of the 80s and the decade of the 90s, 'wealth from waste' had become the inevitable slogan. But mere status of a slogan would have left it perhaps only meaningless; and the said Laboratory has been one among the few to give substance to that slogan in India.

Picking up from the abiding benevolence of Mr. M.S. Vishwanathan, the most elderly member in the Department, Prof. P.D. Grover, the architect and the spirit of the above Laboratory, inducted me into the details of the studies forming the text of this dissertation with great potential for multi-directional follow up in eventual sets of studies in consonance with the above slogan. The indefatigable enthusiasm with which Prof.Grover sustained the efforts, big and small, throughout the studies and even thereafter has been the running thread throughout the fabric of this work.

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ABSTRACT

Decisions on use of biomass for gasifiers need a study of their thermochemical properties and ash content and its deformation and fusion temperatures. The variability of devolatilisation rates with increasing temperatures holds the clue for several decisions. The maximum rates of devolatilisation (except for Bamboo dust) of most biomass occur in the temperature range of 320^{o}C to 500^{o}C. Lignin is the main component in the biomass decomposing in this temperature range and hence these vapours can be called Potential Tar Forming Volatiles (PTFV). Ash content, ash fusion temperatures, peak devolatilisation rates and the PTFV fractions, within them, provide a comprehensive categorisation of biomass. Such categorisation would help in assessing any biomass as gasifier feed. Partial pyrolysis to reduce the PTFV, consistent with retaining a good portion of the raw biomass and with restricting the ash percentage in the char, is highly worthwhile before biomass char is used in any gasifier. The influence on pyrolysis characteristics of different atmospheres (carbondioxide, steam and nitrogen) is explainable.

Unsuitability of Rice husk for a gasifier arises because of its high silica content, which, in its crystalline form at higher temperatures, embeds the carbon and prevents carbon reactions. Reduction under steam would, however, aid the carbon conversions along with yielding valuable amorphous silica.

Rice straw is infested with problems not only due to silica but also high potash contents leading to early ash fusion, rendering it unsuitable for gasification except if suitably impregnated.

Two empirical correlations have been developed which could jointly predict the Ultimate analysis from Proximate analysis.

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