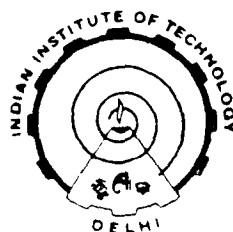


STUDIES ON BIOMASS GASIFICATION

THESIS SUBMITTED IN
PARTIAL FULFILMENT OF REQUIREMENTS
FOR THE AWARD OF
DOCTOR OF PHILOSOPHY
IN CHEMICAL ENGINEERING

by

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1989

**Dedicated to
My
Parents**

CERTIFICATE

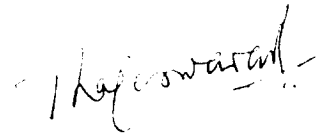
This is to certify that the thesis entitled, 'STUDIES ON BIOMASS GASIFICATION' being submitted by Mr. Siddhartha Gaur, to the INDIAN INSTITUTE OF TECHNOLOGY, DELHI, for the award of the degree of 'Doctor of Philosophy', is a record of bonafide research work carried out under our guidance and supervision and has fulfilled the requirements for the submission, which to our knowledge, has reached the requisite standard.

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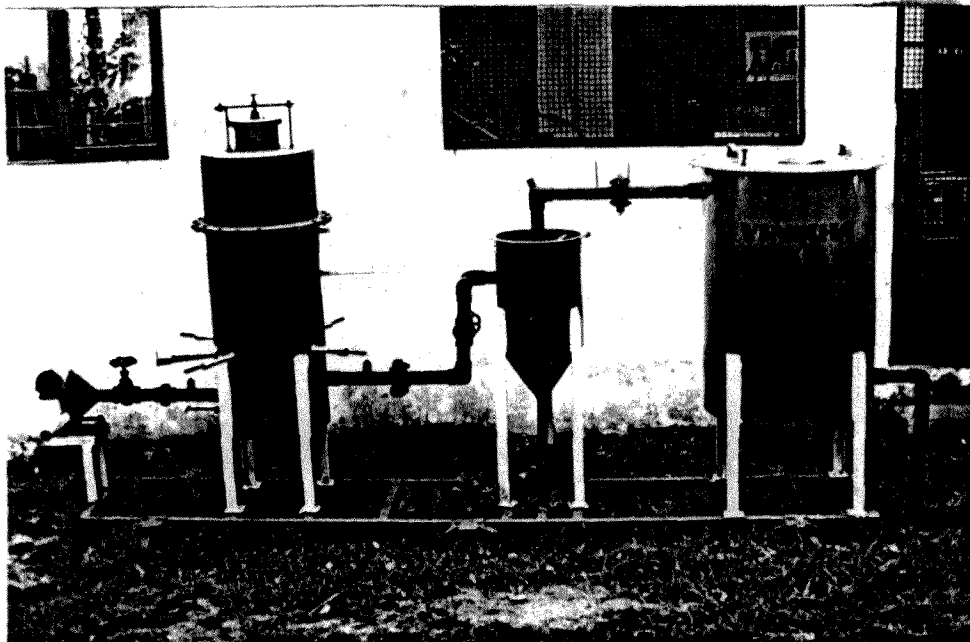
April, 1989



Professor P.D. Grover
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(Co-supervisor)



**Commercial Model (VG-45) of Biomass Gasification System
developed during the course of this work.**

ABSTRACT

The rapid depletion of conventional sources of energy with their ever increasing demand has significantly affected the global energy economics. In the Third World nations like India, oil price rise wiped out half of its foreign exchange (\$ 7 billion) in the year 1979. Since then serious efforts have been made to exploit regenerable sources of energy so as to decrease dependence on the conventional sources.

Biomass utilization for the production of electrical and mechanical energy through gasification and use in I.C engines forms the text of this work.

The chronological development of gasification technology has been presented in Chapter Two. Part A of this chapter is devoted to the technology evolution while Part B analyses the fundamental and technical aspects of the relevant work on gasification.

The influence of fuel on gasifier performance and hypothesis in the favour of use of partially pyrolysed biomass as against raw biomass for small scale applications is brought out in Chapter Three.

Chapter Four presents the details of the design, development and testing of Co-current moving bed gasifier operating on partially pyrolysed biomass fuels to power 3.5KW I.C. engine-pump and generator system. This includes the field trial testing, performance analysis and economics of the system.

Chapter Five deals with single pellet kinetic studies on major gas-solid reactions taking place inside this gasifier. These studies have been carried out on thermogravimetric analyser under

various operating conditions. The experimental data has been analysed to develop kinetic equations for these reactions.

A predictive mathematical model for Co-current moving bed gasifier has been developed by using kinetic free and kinetic dependent approach to modelling. The objective is to evolve design procedures for this type of gasifiers in terms of the reactor dimensions, gas concentration profile and the temperature distribution.

Discussion of results obtained and recommendations for future work emerged during the span of this work are presented in Chapter Seven.

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To Sir, - With love is what I would like to say when everything seems to come to an end for my guided tour into the ocean of scientific research and human development. From now onwards, I am to choose my path for which Professor Prem Dutt Grover has very meticulously laid this stepping stone. I hope and pray to carry on his efforts.

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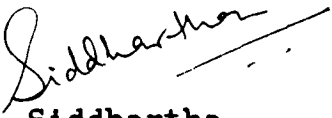
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When the last word of this thesis was typed I heard Vibha addressing to herself 'I have done it.' She thanked me for completing her work. This was the extent of her involvement. The minute details and the major ones all have been worked out by her.


Siddhartha

C O N T E N T S

Chapter I	Non-Conventional Sources of Energy-A Prologue	1
Chapter II	Literature Survey	9
Part A	Quest for knowledge-Progress analysis	10
Part B	Review of Gasification science and technology	19
2.1	Introduction	19
2.2	Chemistry of gasification	20
2.2.1	Direct combustion	22
2.2.2	Pyrolysis	24
2.2.3	Gasification	30
2.3	Thermodynamics of gasification	31
2.4	Kinetics of gasification reactions	33
2.4.1	Char-CO ₂ -CO system	36
2.5	Heat effects in gasification process	41
2.6	Physics of gasification	46
2.6.1	Internal surface areas of coal and coalchar	46
2.7	Gasification routes	47
2.7.1	Gasification involving nuclear process heat	49
2.7.2	Underground gasification	50
2.8	Gasification systems	52
2.8.1	Fluidized bed gasifier	53
2.8.2	Entrained bed gasifier	55
2.8.3	Counter current (updraft) moving bed gasifier	56
2.8.4	Co-current (downdraft) moving bed gasifier	57
2.8.5	Rotary bed gasifier	59
2.8.6	Moving zone gasifier	60
2.8.7	Cyclone gasifier	61
2.8.8	Tubular gasifier	62
2.9	Comparative analysis of various gasifier design concepts	62
2.10	Recent trends in biomass gasification	64

Chapter III Gasification --- Fuel Influence	68
3.1 Introduction	69
3.2 Type of biomass fuels suitable for gasification purposes	70
3.3 Hypothesis for the selection of pyrolysed briquetted biomass materials as fuel to gasifiers	76
3.4 Pretreatment process for the fuel	79
3.5 Corn cob---fuel selected for the study	80
3.5.1 Properties of corn cob sample	83
3.6 Carbonisation studies	84
Chapter IV Development of the Gasification System operating on partially pyrolysed biomass materials	88
4.1 Introduction	89
4.2 Schematics of wood based gasifier developed by 'GROW'.	91
4.2.1 Experiences with GROW gasifier	91
4.2.2 Deductions from the operation of GROW gasifier	95
4.3 Design of co-current moving bed (CCMB) gasifier (G-45)	95
4.3.1 Design basis	96
4.3.2 Design calculations and their basis	90
4.4 Constructional features of G-45 gasifier	109
4.5 Description of other units of the gasification system	113
4.5.1 Thermosteparator	113
4.5.2 Filter cum Surge tank	115
4.6 Operation of G-45 gasification system	117
4.7 Analysis of the initial trial testing of G-45	119
4.7.1 Formation of fused ash lumps	122
4.7.2 Low concentration of energy carrier gases	127
4.7.3 Improper fuel flow through the throat opening	129
4.8 Performance evaluation of G-45 gasifier	130
4.9 Limitations of gasifier operation	142
4.10 Performance evaluation of the gas purification unit of gasification system	143

4.10.1	Thermoseparator	143
4.10.2	Filter cum surge tank	146
4.11	Gasifier performance by applying mass and energy balance	148
4.12	Gasifier engine pump operation	152
4.12.1	Compression ignition engine and its characteristics	152
4.12.2	Coupling of the gasifier with the engine pump system	153
4.12.3	Engine operation on dual fuel mode	155
4.12.4	Performance evaluation	155
4.13	Test operation of gasifier engine pump system under field conditions	159
4.14	Test operation of gasifier engine alternator system	161
4.15	Thermal efficiency of the gasifier engine pump system	167
4.16	Spark ignition engine operation on G-45 gasifier	169
4.17	Comparative economic analysis of engine operation on diesel oil and dual fuel mode	170
4.18	Modifications on CCMB gasifier-Improved version	172
4.19	Operation of G-45 gasifier on various partially pyrolysed biomass fuels	175
Chapter V	Kinetic Studies for Partially Pyrolysed Biomass Fuels Relevant to CCMB Gasifier	178
5.1	Introduction	179
5.2	Reaction kinetic studies for gas-solid reaction involved in char gasification	180
5.3	Corn cob char - fuel for reaction kinetic study	181
5.3.1	Sample preparation	182
5.4	Experiment aids and arrangement	183
5.4.1	Description of TGA	183
5.5	Kinetic studies for char gasification through Boudouard's reaction	185
5.5.1	Experiment planning	185
5.5.2	Non-isothermal condition experiment	186

5.5.3	Isothermal condition experiments	186
5.6	Discussion on the decreasing reaction rate Phenomena	201
5.6.1	Effect of volatiles	201
5.6.2	Effect of ash	201
5.6.3	Extent of reaction zone in the pellet	202
5.6.4	Effect of particle size	202
5.6.5	Conclusions	204
5.7	Development of reaction kinetic equation	206
5.7.1	Boudouard's reaction	206
5.7.1.1	Optimum reaction temperature	207
5.7.1.2	Reaction order	207
5.7.1.3	Selection of reaction model	209
5.7.1.4	Activation energy and frequency factor	217
5.7.1.5	Conclusive form of the rate equation	219
5.7.1.6	Comparision of kinetic parameters obtained by different investigators	219
5.8	Kinetic studies on char gasification through heterogeneous water shift reaction	219
5.8.1	Steam injection	220
5.8.2	Experiment planning	222
5.8.3	Discussion on the observations	223
5.8.4	Reaction order, Activation Energy and Frequency factor	224
5.8.5	Conclusive form of the rate equation	225
5.9	Partial oxidation reaction	227
5.9.1	Partial oxidation reaction in the case of partially pyrolysed biomass fuel	228
5.9.2	Experimental planning	229
5.9.3	Observations	229
5.9.4	Reaction order, Activation energy and Frequency factor	231
5.9.5	Conclusive form of the char oxidation reaction	234
5.10	Conclusions	234

Chapter VI	Predictive Mathematical Model-A Design Aid for CCMB Gasifier Operations on Partially Pyrolysed Biomass Fuel	235
6.1	Introduction	236
6.2	Model formation	239
6.2.1	Approach to modelling	239
6.2.2	Kinetic free modelling	240
6.2.3	Kinetic dependent modelling	240
6.3	Model reactor-CCMB gasifier	241
6.4	Assumptions for model validity	242
6.5	Kinetic free approach of modelling	245
6.5.1	Reduction zone	245
6.5.2	Oxidation zone	247
6.6	Kinetic dependent approach of modelling	248
6.6.1	Oxidation zone	249
6.6.2	Reduction zone	250
6.7	Results	251
6.8	Conclusions	253
Chapter VII	Conclusions and recommendations for future work	254