

**EFFECT OF PARTICLE SIZE ON PACKED BED  
BIOMASS COMBUSTION**

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Degree of Master of Science

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Sri Lanka

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## **Declaration**

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## **Abstract**

In this thesis, particle size effect on biomass (rubber-wood) combustion in a packed bed reactor was investigated in experimentally. Mass loss rate, bed shrinkage rate, temperature profile at different bed locations and gas compositions in the out-of-bed flue gases were measured at a constant primary air flow rate. In this study used a fixed batch of biomass. An external heat source was used to ignite the biomass initially and after ignited the biomass, removed the external heat source. Rubber-wood cubes were fired with size ranging 25mm, 38mm, 50mm and 63mm. As time pass, the height of the packed bed is decreasing due to shrinkage of the bed and also the weight of biomass is reducing with time. It is found that at the operating condition of the current study, burning rate of biomass particle is higher with smaller fuel size; and also smaller biomass particles are faster to ignite than the large biomass particles and have unique combustion stages; on the other hand, larger biomass particles produced a higher flame temperature. Larger particles also cause the combustion process becoming more transient where the burning rate varies for the most part of the combustion process. And also biomass combustion time (operational time) is increased with increasing biomass particle size. And here calculate the percentage of excess air, when increased the particle size, amount of excess air release is high. Therefore, need to control the amount of primary air supply when increased particle sizes.

*Keywords— Biomass, Combustion, laboratory scale packed bed, shrinkage of the bed,particle size, mass loss, temperature gradient, gas composition, excess air.*

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# Table of Contents

Declaration.....	i
Abstract.....	ii
Acknowledgement.....	iii
Table of Contents.....	iv
List of Figures.....	vii
List of Tables.....	ix
Nomenclature.....	x
Abbreviations.....	x
1 INTRODUCTION.....	1
1.1 Background of biomass combustion.....	1
1.2 Biomass.....	2
1.3 Biomass conversion process.....	2
1.4 Biomass combustion.....	3
1.5 Environment benefits of biomass combustion.....	3
1.6 Important to Sri-Lankan industries.....	4
1.6.1 Advantages and disadvantages.....	5
1.7 Objectives of present research.....	6
1.8 Dissertation Outline.....	6
2 LITERATURE REVIEW.....	7
2.1 Biomass energy and its scenario.....	7
2.1.1 Sri Lanka biomass energy scenario.....	9
2.2 Biomass materials.....	11
2.3 Biomass properties and selection.....	12
2.3.1 Physical properties.....	12
2.3.2 Chemical properties.....	13
2.3.3 Calorific value.....	13
2.3.4 Proximate analysis.....	13
2.4 Biomass Conversion Technologies.....	15

2.4.1	Thermal conversion process .....	16
2.5	Combustion of biomass.....	18
2.5.1	Drying .....	20
2.5.2	Pyrolysis.....	21
2.5.3	Char burnout .....	22
2.6	Biomass Combustion Technologies .....	23
2.6.1	Fixed bed Combustion .....	24
2.6.2	Fluidized bed Combustion .....	25
2.6.3	Pulverized Fuel Combustion.....	26
2.7	Fixed bed conversion .....	27
2.7.1	Underfeed stokers .....	27
2.7.2	Grate furnaces .....	27
3	METHODOLOGY .....	30
3.1	Experimental method .....	30
3.2	Experimental conditions.....	30
3.3	Experimental setup.....	31
3.4	Equipment .....	32
3.4.1	Thermocouples.....	32
3.4.2	Temperature panel .....	32
3.4.3	Air supply and velocity measuring .....	33
3.4.4	The Orsat's apparatus .....	35
3.4.5	Collecting gas sample .....	36
3.4.6	Measuring mass loss .....	37
3.4.7	Measuring moisture level.....	37
3.5	Selected biomass sample.....	37
3.6	Operational procedure .....	39
3.6.1	Flue gas analysis procedure .....	40
4	Results and Discussion .....	45
4.1	Mass loss with time .....	45
4.2	Bed Shrinkage with time .....	47
4.3	Temperatures profile .....	48
4.3.1	Flue gas temperature profile. ....	48
4.3.2	Solid gas surface temperature .....	49

4.3.3	Grate temperature profile.....	50
4.3.4	Temperature profile in the fixed bed reactor .....	50
4.4	Excess air calculation .....	53
4.4.1	Stoichiometric air to fuel ratio calculation.....	53
4.4.2	Burning rate .....	54
4.4.3	Actual air to fuel ratio calculation .....	54
4.4.4	Calculate excess air.....	56
4.5	Flue gas composition.....	57
5	Conclusion.....	59
5.1	Future Work .....	60
	References.....	61
	Appendix.....	63



## List of Figures

Figure 1-1 : primary Energy Supply 2013 .....	4
Figure 1-2 : primary energy Supply 2030.....	4
Figure 2-1: Energy shift with time [11]( Source: Ageneal. Energias renováveis [Internet]. 2006. Available from: <a href="http://www.ageneal.pt/content01.asp?BTreeID=00/01&amp;treeID=00/01&amp;newsID=8">http://www.ageneal.pt/content01.asp?BTreeID=00/01&amp;treeID=00/01&amp;newsID=8</a> ).....	8
Figure 2-2: Total world primary energy source [12] .....	9
Figure 2-3: Evolution of energy supply forms with time .....	10
Figure 2-4: Energy balance for year 2012 .....	11
Figure 2-5: Biomass Conversion Technologies .....	15
Figure 2-6 : Energy Products From pyrolysis.....	17
Figure 2-7 : Representation of the combustion approach [20] .....	19
Figure 2-8 : Separate stages of the thermal degradation of a wood particle [22] .....	20
Figure 2-9: Biomass Combustion Technologies.....	23
Figure 2-10 : Principal Combustion technology for biomass .....	24
Figure 2-11 : Fluidizing Velocity of air for various bed system[22].....	26
Figure 2-12: Classification of grate combustion technologies .....	28
Figure 3-1 : Schematic diagram of the experimental fixed bed combustion reactor. (A) Rubber wood initial bed; (B) weight scale; (C) Grate; (D) blower; (E)Temperature Reader; (F) Water bath; (G) The Orsat apparatus; (H) copper tube; (I) Ruler; (T-1, T-2, T-3) Thermocouples.....	31
Figure 3-2 : Picture of the Thermocouples with Reactor.....	32
Figure 3-3 : Picture of the Temperature Panel of Unit .....	33
Figure 3-4 : Picture of the Digital Anemometer .....	34
Figure 3-5 : Picture of the Primary air Supply Blower.....	35
Figure 3-6 : Picture of the Orsat's Apparatus.....	36
Figure 3-7 : Picture of Water Bath.....	36
Figure 3-8 : Picture of different size Rubber wood samples; (a) particle size 25mm, (b) particle size 38mm, (c) particle size 50mm, (d) particle size 63mm and (e) all particle size together. ....	38
Figure 3-9: The Orsat's Apparatus. (A) Leveling bottle; (E) Burette; (G1, G2, G3) Solutions contains; (D) Stopcock; (J) Gas sample supplier.....	43

Figure 3-10 : pictorial view of operation .....	44
Figure 4-1: Mass Loss curves for four different size biomass fuel.....	45
Figure 4-2 : Bed shrinkage curves with time for four size biomass particles.....	47
Figure 4-3 : Flue gas temperature with time .....	48
Figure 4-4 : Solid gas surface temperature .....	49
Figure 4-5 : Grate temperature with time .....	50
Figure 4-6: Bed temperature vs. reaction time at different bed heights above the grate for 25 mm particle .....	51
Figure 4-7: Bed temperature vs. reaction time at different bed heights above the grate for 38 mm particle size. ....	51
Figure 4-8: Bed temperature vs. reaction time at different bed heights above the grate for 50 mm particle size. ....	52
Figure 4-9: Bed temperature vs. reaction time at different bed heights above the grate for 63 mm particle size. ....	52
Figure 4-10 : Burning rate Vs Particle size.....	54
Figure 4-11 : Actual air to Fuel ratio vs particle size. ....	55
Figure 4-12 : Excess air vs particle sizes .....	57
Figure 4-13 : Gas composition in the flue gases out of the bed top as a function of time.....	58
Figure 4-14 : Flue gas concentration vs particle sizes .....	58

## List of Tables

Table 2-1 : Combustion Reaction Equations [21].....	19
Table 3-1 : the bulk density, bed height and operating condition for the rubber wood samples of different particle sizes.....	31
Table 3-2 : Specification of Instrument .....	34
Table 4-1 : Actual air to fuel ratio .....	55
Table 4-2 : Excess air with particle sizes.....	56

## Nomenclature

Symbol	Description
$\Omega$	Stoichiometric coefficient
$\Delta H_{\text{evap}}$	Latent Heat of Evaporation
$X_{M, \text{fsp}}$	fiber saturate moisture point
$X_M$	saturate moisture point

## Abbreviations

BFB	Bubbling fluidized Bed
CFB	Circulating Fluidized Bed
CHP	Combined Heat & Power
IEA	International Energy Agency
LHV	Lower Heating Value
HHV	Higher Heating Value
FC	Fixed Carbon
VM	Volatile Matters
CV	Calorific Value
wt	Weight
mm	millimeter (unite)
cm	centimeter (unite)
min	minutes (unite)
FG	flue gas
SGS	solid gas surface
G	grate