EFFECT OF PARTICLE SIZE ON PACKED BED BIOMASS COMBUSTION

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Degree of Master of Science

Department of Chemical and Process Engineering

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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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Nomenclature

Symbol	Description
Ω	Stoichiometric coefficient
ΔH_{evap}	Latent Heat of Evaporation
$X_{M,\ fsp}$	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