Influence of Biomass Pellet Composition on the Pulverised Pellet Flame Propagation and Minimum Explosion Concentration

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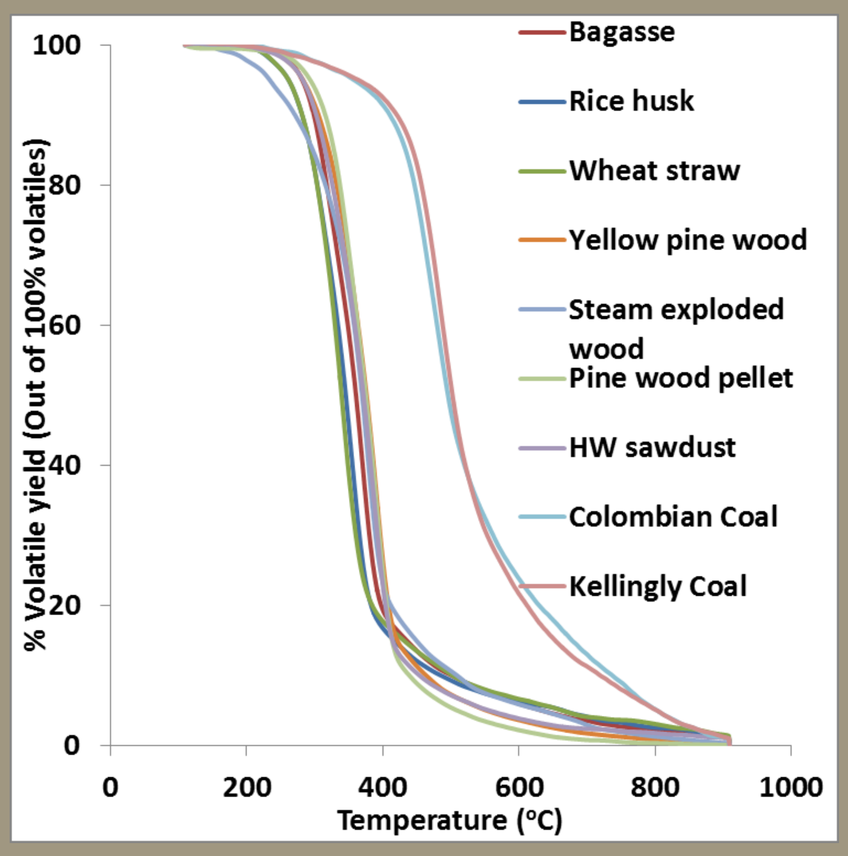
Introduction

- Biomass is a sustainable and effective solution to CO_2 emission reduction.
- Pelletisation results higher energy density, ease of handling and transportation.
- For efficient combustion pellets need to be pulverised.
- Finer particles of <63µm release more volatiles contributiing almost 100% in flame propagation without formation of char.
- Inerts like ash+moisture act to reduce the reactivity that is more severe for wood as compared to crop residues.

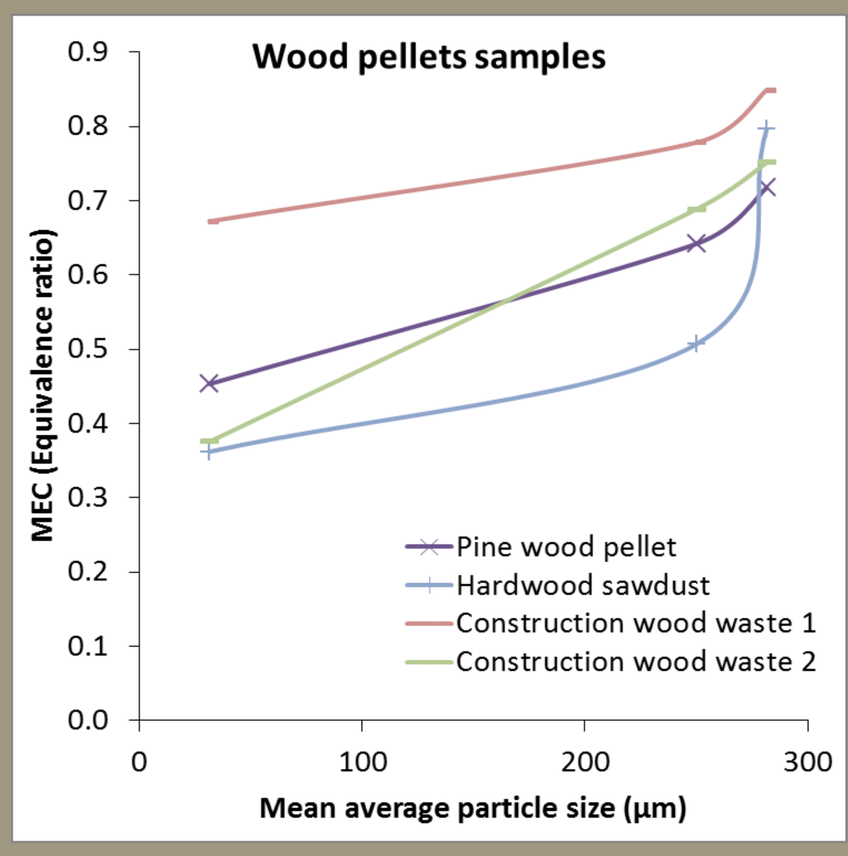
Experimental Methodology

- Modified Hartmann dust explosion tube was used for measurements of flame speed and minimum explosive concentration (MEC) [1].
- Dust is pneumatically dispersed with pre-existing spark.
- Pressure transducer and array of thermocouples recorded pressure rise and time of flame arrival (flame speed).

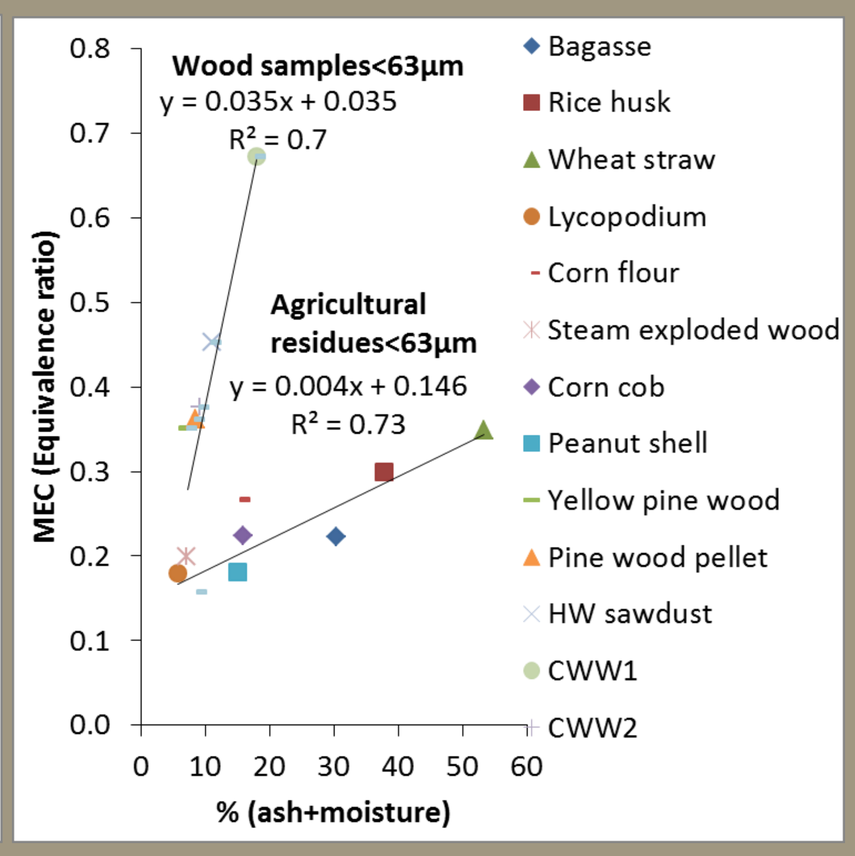
Results



- For biomass samples 90% of the volatiles released at around 450°C in contrast to coals (750°C).
- Fine particles with higher surface area release more volatiles.
- No evidence of char residue left for fine particles of biomass.



- Average particle size of different sized fractions against their respective MEC obtained from modified Hartmann tube.
- Minimum explosible concentration decreases with decreasing particle size.



- Good correlation of %ash+H_2O vs. MEC were obtained for biomass samples.
- % ash+H_2O affect MEC more for wood samples than for crop residues.

Conclusions

- Higher content and rapid release of volatiles, at lower temperatures, makes biomass more reactive than coals.
- Reactivity of biomass increased with decreasing particle size.
- Inerts (ash and moisture) showed a greater effect on MEC for biomass milled pellets than for crop residue.

References

[1]] Saeed MA, Medina CH, Andrews GE, Phylaktou HN, Slatter D, Gibbs BM. 2015 Agricultural waste pulverised biomass: MEC and flame speeds. Journal of Loss Prevention in the Process Industries.36:308-17.