Experimental and Modeling Studies on Black Liquor Droplet Combustion Reactivity

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Objectives

Obtain self-consistent experimental data of black liquor droplet combustion in newly designed setup, and to develop a transient droplet model.

Background

Black liquor is a byproduct from the paper pulping process. It is concentrated and burned in a recovery boiler. Black liquor burns in droplet form. Understanding the combustion process and being able to model the process are significant.

Approach

A softwood/hardwood mixed liquor with about 60% solids was used for the experiment. The droplet was inserted into a newly designed 3D-viewport furnace and burned at 700, 800, and 900°C. Temperature inside the droplet and the mass loss were recorded with time. Cameras recorded the shape and size.

Equipment

The current setup: a preheater, the 3D viewport furnace, and the balance with the data logger

Acknowledgement

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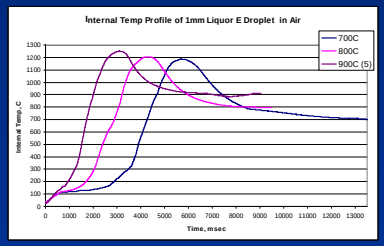
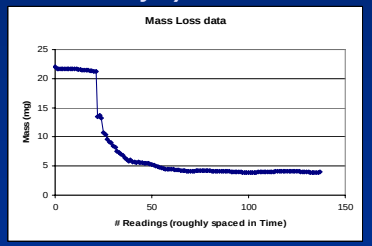
Results

Size and shape

Interior Temperature Profile



Mass Loss Profile (buoyancy not considered yet)

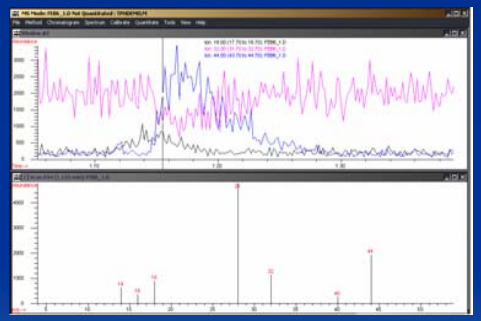


Composition Profile -Mass Spectrometry

Combustion gases were analyzed using molecular beam mass spectrometry

Composition profiles with respect to time of O_2, CO_2, and H_2O are shown in the graph

An instantaneous spectra is shown also for these compounds in the lower graph



Conclusion

- Internal temperature at different furnace temperatures were obtained
- Transient mass loss data were obtained, but buoyancy needs to be considered
- Off-gas compositions were obtained, and more species need to be identified