Combustion Behavior of Single Particles of Raw Wood and Pelletized Wood

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Combustion Behavior of Single Particles of Raw Wood and Pelletized Wood

M. Masche¹, M. Puig-Arnavat¹, J. K. Holm², P. A. Jensen¹, J. Ahrenfeldt¹,
S. Clausen¹, U. B. Henriksen¹

¹ DTU Chemical Engineering, 2800 Kgs. Lyngby, Denmark
² Bioenergy and Thermal Power, Ørsted, Nesa Allé 1, 2820 Gentofte, Denmark

What were our motivation and research objectives?

We present a single particle combustion (SPC) study examining the relationship between combustion behavior and particle density.

- There are limited data on the combustion behavior of raw and pelletized wood at suspension-fired conditions.
- Understanding the effect of pelletizing conditions (temperature, pelletizing pressure) on the combustion behavior of pine and beech pellets compared to raw wood in a SPC reactor.
- SPC studies allow to predict the particle combustion behavior in full-scale furnaces.

How was the SPC study performed?

Feedstock
Austrian pine
European beech

Pelletizing conditions
- Particle sizes: 0.25-0.50 mm
- Pressure: 100 and 200 MPa
- Temperature: 75 and 125°C

SPC reactor conditions
- Temperature: 1260°C
- Oxygen: 5 % (d.b.)
- Gas velocity: 1.5 m/s

Sample Preparation
i. 3 mm pellets using a heatable cubic die and hydraulic press
ii. 3 mm raw cubes

Combustion behavior
- Devolatilization time
- Char burnout time
- Swelling

Main findings

Sample Density [kg/m³] vs. Normalized devolatilization time [s/mg]

- Pine can be densified more than beech

Conclusions

- SPC study shows that weak inter-particle bonds in pellets
  - Cause swelling during devolatilization, facilitating faster burnout of internal pellet particles compared to single raw wood
  - Affect the conversion process (i.e., faster char burnout of beech pellets due to weaker particle adhesion than pine pellets)