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Combustion Behavior of Single Particles of Raw Wood and Pelletized Wood

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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

Swelling during devolatilization
a) Beech pellet (75 C, 100 MPa)
b) Raw beech

Example: Raw beech cube

Particle conversion process

Char combustion

Total conversion of raw beech vs. pelletized beech

Conclusions

- Pine can be densified more than beech
- 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)

Total conversion of pelletized pine vs. pelletized beech

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