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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
- 3 mm pellets using a heatable cubic die and hydraulic press
- 3 mm raw cubes

Combustion behavior
- Devolatilization time
- Char burnout time
- Swelling

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)

Main findings

Devolatilization

Char combustion

Swelling during devolatilization

Total conversion of raw beech vs. pelletized beech

Total conversion of pelletized pine vs. pelletized beech

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Example: Raw beech cube