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

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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

Example: Raw beech cube

1. Particle insertion
2. Ignition (<1 s)
3. Devolatilization
4. Volatile flame extinction
5. Char oxidation

Swelling during devolatilization

a) Beech pellet (75°C, 100 MPa)
b) Raw beech

 DeVOLATILIZATION

CHAR COMBUSTION

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)