Combustion Behavior of Single Particles of Raw Wood and Pelletized Wood

Masche, Marvin; Puig Arnavat, Maria; Holm, J. K. ; Jensen, Peter Arendt; Ahrenfeldt, Jesper; Clausen, Sønnik; Henriksen, Ulrik Birk

Publication date:
2018

Document Version
Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Citation (APA):
Combustion Behavior of Single Particles of Raw Wood and Pelletized Wood

M. Masche¹, M. Puig-Arnava³, 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

Particle conversion process

Main findings

Swelling during devolatilization

Example: Raw beech cube

Sample conversion process

Total conversion of pelletized pine vs. pelletized beech

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)