10:45 - Torrefied Pellets for Thermal Energy

Leonel J. R. Nunes
leonelnunes@ua.pt
l.nunes@adfuelsolutions.com

Torrefied Pellets for Thermal Energy

Torrefaction Process Development

Torrefied Products
Our Location

The main reason to be in this location is...
Other important variables are:

- Particle size
- Residence time
- Heating rate

Depending on the technology used.
Some definitions...

Torrefaction is a thermal process to convert biomass into a coal-like material, which has better fuel characteristics than the original biomass. Torrefied biomass is more brittle, making grinding easier and less energy intensive. Compared to fresh biomass, storage of the torrefied material can be substantially simplified since biological degradation and water uptake is minimized.


Torrefaction of biomass, e.g., wood or grain, is a mild form of pyrolysis at temperatures typically between 200 and 320 °C. Torrefaction changes biomass properties to provide a better fuel quality for combustion and gasification applications. Torrefaction produces a dry product with no biological activity like rotting. Torrefaction combined with densification creates an energy-dense fuel carrier of 20 to 21 GJ/ton lower heating value (LHV).

https://en.wikipedia.org/wiki/Torrefaction
But are these definitions correct or at least complete?
Considering this and in my opinion...

Biomass torrefaction is a thermochemical conversion process occurring in a temperature range between 220 and 310°C, under atmospheric pressure conditions and in the absence of oxygen, where the molecular disintegration of the hemicellulose occurs, maintaining lignin and cellulose in its original structures.
But why is this definition so important?

Because will be the difference of having

or

![Image 1]

![Image 2]
Claims made for Torrefaction

- Volumetric energy densification brings significant cost reductions in transport and handling;
- Broader feedstock basis geographically and types of raw materials;
- Limited or no biodegradation of the product when stored;
- Large variety of applications;
- Reduces CAPEX and OPEX at end user because can be used as it is in coal fired plants;
- Combustion and gasification behaviour more compatible to coal than raw biomass allowing high cofiring shares;
- Can be adapted to measure clients requirements.
And in the real world?

Problems detected and occurrences

- VOC’s present during the process and in the final product
- Self-heating
- Difficulty in pelletizing due to over torrefaction
- Lower durability and final product cooling

Solutions

- Cooling system after torrefaction reactor and after pelletizing
- Temperature control and use of natural gas
- New discharge chamber and VOC’s improved extraction
VOC’s present in the material during the process and in the final product
Self-heating
Difficulty in pelletizing due to over torrefaction and extreme wear of the equipment

Wear of pelletizing equipment and parts

200 h  100 h  50 h
Large energy consumption and equipment wear

Reduced production rate

To avoid the effort in the equipment water is added...

and just bad quality pellets are obtained
But how can we have good quality torrefied biomass pellets?

Remember this?

Biomass torrefaction is a thermochemical conversion process occurring in a temperature range between 220 and 310°C, under atmospheric pressure conditions and in the absence of oxygen, where the molecular disintegration of the hemicellulose occurs, maintaining lignin and cellulose in its original structures.

And the final result is...

\[ d = 7 \text{ mm} \]
\[ C_1 = 35 \text{ mm} \]
\[ R_1 = 25 \text{ mm} \]
\[ T_1 = 60 \text{ mm} \]

and where CR is

\[ CR = \frac{C_1}{d} = 35/7 = 5 \]
European market and final user perspective

The coal “problem”

<table>
<thead>
<tr>
<th></th>
<th>Coal</th>
<th>Woodchips</th>
<th>Wood Pellets</th>
<th>Torrefied Biomass</th>
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<tbody>
<tr>
<td>Moisture content</td>
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<td>Handling and Logistics</td>
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<td>Required Investments</td>
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<td>Co-Firing Ratio with Coal</td>
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**Hardgrove Grindability Index**

The hardgrove grindability index for torrefied wood is similar to coal and substantially higher than wood pellets. Torrefied wood can typically be ground in existing coal equipment while wood pellets often require additional special equipment.
Energy to Grind (kWe/MWth)

Torrefied wood requires less energy to grind than both wood pellets and coal.

3 minutes
AFS Project

General view of AFS project. The plant occupy an area of 42,000 m², divided in production zones, storage areas, warehouses, maintenance facilities and offices.
Thank you very much for your time

Leonel Nunes
l.nunes@adfuelsolutions.com
leonelnunes@ua.pt