ETIP Bioenergy
European Technology and Innovation Platform

Torrefied pellets

LAB SCALE → BENCH SCALE → PILOT PLANT → DEMONSTRATION → PRODUCTION

DEFINITION AND PROPERTIES

Torrefied pellets, also called black pellets, are a densified biofuel, made from thermally treated solid biomass, with or without additives. They usually have a cylindrical form, a length of 5 to 40mm, a diameter up to 25mm and broken ends. The common raw material of torrefied pellets is sawdust, but every feedstock which can be pelletized can be torrefied. Alternative feedstocks include bark, miscanthus or agricultural residues. There is a European standard (DIN EN ISO 17225-8:2016: Solid biofuels – Fuel specifications and classes – Part 8: Graded thermally treated and densified biomass fuels) which defines specifications of torrefied pellets. Table 1 shows properties of torrefied pellets in medium quality (TW2a). Compared to white pellets, torrefied pellets have lower moisture content and a higher heating value, but higher ash content. Properties vary depending on the feedstock, especially when using low-quality feedstocks. Research on improving the properties of torrefied pellets from different feedstocks is ongoing.

Properties of torrefied pellets (TW2a)	
Bulk density (kg/m³)	≥ 650
Moisture (w-%)	≤ 8
Lower heating value (MJ/kg)	≥ 20.2
Mechanical durability (w-%)	≥ 96
Ash content (w-%, dry)	≤ 3

Table 1: Properties according ISO/TS 17225-8:2016

THE TORREFACTION PROCESS

Torrefaction is a thermochemical process (Figure 1). In the first step, biomass with a humidity of about 20 to 50% is dried. It is possible to use gases from the torrefaction process, in order to increase efficiency. Subsequently, the biomass is torrefied, which means it is heated up to between 200 to 350°C, under atmospheric pressure, without oxygen, for 30 to 60 minutes. The high temperature leads to decomposition of biomass components. Low-energy components are transferred to the gas phase. The water is expelled first and then hemicellulose and partly also lignin decompose. The partly decomposed (torrefied) biomass is grinded and afterwards pelletized. It is also possible to interchange the torrefaction and pelletization steps. In that case ready-made pellets are subsequently torrefied. The whole production can be stand-alone or integrated in e.g. a large power plant boiler, a sawmill, or a bio-oil production (pyrolysis).

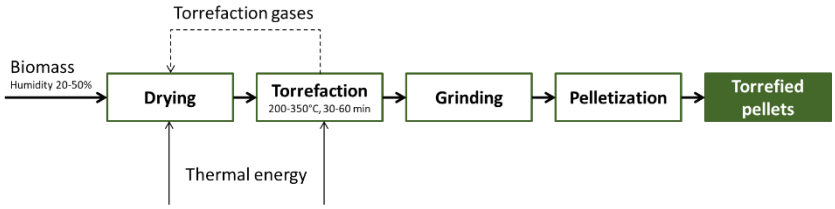

Figure 1: Scheme of torrefaction process

ETIP Bioenergy
European Technology and Innovation Platform

ADVANTAGES AND APPLICATIONS

Torrefaction improves the combustion properties of the pellets. Torrefied pellets have higher energy density and heating value compared to white pellets. Additionally, problems during storage (e.g. soaking or outgassing) are mitigated, because of increased resistance to water absorption and decreased biological activities. This enables outdoor storage of torrefied pellets. Furthermore, there is less energy needed for grinding in comparison to white pellets. Therefore torrefied pellets are suitable for co-combustion in coal power plants. The application of torrefied pellets is mainly at industrial scale. The increased energy density also reduces transport costs.

At present, torrefied pellets are mainly produced for large-scale co-firing in pulverized coal power plants. Co-firing of torrefied pellets decreases share and amount of fossil fuels, reduces CO_2 emissions and is therefore fully in line with green energy support mechanisms. Torrefied pellets can also fully substitute for coal in new-built facilities.

EXAMPLES OF TORREFIED PELLET PLANTS

Operator: Baltania
Tallin, Estonia

Commercial plant (under construction)
Location: Vägari, Estonia
Funding: € 25 million
Feedstock: Woody biomass (bark, harvesting residues, firewood, by-product chips, pulpwood)
Capacity: 157.000 tons/a
Technology: CEG, The Netherlands

Operator: Futerra Fuels
Valongo, Portugal

Commercial plant (under construction)
Location: Valongo, Portugal
Investment: € 38 million
Feedstock: Eucalyptus, biomass residues
Capacity: 120.000 tons/a torrefied pellets, 55,000 tons/a white pellets
Technology: Yilkins, The Netherlands

ETIP Bioenergy
European Technology and Innovation Platform

SOURCES

- https://www.vtt.fi/inf/pdf/technology/2014/T163.pdf
- http://task40.ieabioenergy.com/wp-content/uploads/2013/09/IEA_Bioenergy_T32_Torrefaction_review.pdf

FURTHER INFORMATION

- https://baltania.ee/
- https://ibtc.bioenergyeurope.org/ceg-delivers-200-tonnes-of-ceg-biocoal-for-a-european-customer-trial/
- https://futerrafuels.com/en/our-production-plant
- https://yilkins.com/