C.F. NIELSEN

C.F Nielsen A/S
a member of
RUF BRIQUETTING SYSTEMS

WHITE PAPER

TORREFACTION TECHNOLOGY

THE PROCESS

Torrefaction of biomass can be described as a mild form of pyrolysis at temperatures typically ranging between 200-320 °C. It is carried out under atmospheric pressure in the absence of oxygen, i.e. with no air. During the torrefaction process, the water contained in the biomass as well as superfluous volatiles are released, and the biopolymers (cellulose, hemicellulose, and lignin) partially decompose, giving off various types of volatiles.

The final product is the remaining solid, dry, blackened material that is referred to as torrefied biomass or bio-coal. Thus, the torrefaction process changes the biomass properties obtaining a much better fuel quality for combustion and gasification applications. During the process, the biomass typically loses 20% of its mass and 10% of the heating value. This energy can be used as a heating fuel for the torrefaction process.

THE ADVANTAGES

Torrefied and densified biomass offers several advantages in different markets, which makes it a competitive option compared to conventional biomass:

- Higher energy density – with an energy density of 20-22 GJ/ton the densified fuel comes close to the energy density of coal and torrefied densified fuel has a 25-30% higher energy content than normal pellets and much more than raw biomass such as wood chips. The reduction in transportation costs is considerably as more energy is transported per ton of material.

- More homogeneous composition – Torrefied biomass can be produced from a wide variety of biomass, and since the process reduces the number of volatiles, the torrefied material becomes homogenous, as most biomass fuels, regardless of origin will produce torrefied products with similar properties.

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- Hydrophobic behaviour – Torrefied biomass has hydrophobic properties, especially when densified, which enables it to repel water, which makes bulk storage in open air feasible
- Elimination of biological activity – During the torrefaction process all biological activity is stopped, reducing the risk of fire, and stopping biological decomposition like rotting.
- Improved grind ability – Torrefaction of biomass leads to improved grind ability of biomass. This leads to more efficient co-firing in existing coal-fired power stations.

All the mentioned leads to the main advantage, which is that densified torrefied material can replace coal in power plants as the properties are like coal. Torrefied densified fuel is a sustainable energy resource, which can be used in existing coal fired power plant without rebuilding the plants, thus saving large investments for power companies.

C.F. NIELSEN AND TORREFIED WOOD

C.F. Nielsen is one of the pioneers in supplying equipment for densifying torrefied fuel. The company obtained grants from the Danish Government to develop specialized briquetting equipment.

The development includes high-capacity briquetting machines producing briquettes in diameters from 50 to 90 mm. The presses can densify torrefied material with moistures as low as 2% without additives and achieve a density as high as 1,2 resulting in a bulk density between 500 and 650 kg/m3. Furthermore, the presses can down-size the raw material in the process and the whole process has a considerably lower energy consumption per ton than other alternatives.

The developments have taken place in close contact with different customers and production plants all over the world, resulting in sales of several presses.