00-08: Properties of wood briquettes…

Wood briquettes consist mainly of stem wood either from conifer trees or from deciduous trees, with or without bark. The difference between fresh wood and briquettes is only the physical properties – not the chemical properties or the composition and not the energy content.

The heating value for stem softwood in northern Europe – mainly pine and spruce – is typically about 20 MJ/kg$_{DAF}$ (Dry, Ash-Free) substance while the heating value for hardwood trees is about 5 % lower, around 19 MJ/kg. In the stem wood, the ash content is low, generally less than 1 % by weight and the ash also has a high melting point. If bark is mixed into the material the actual ash content may be significantly higher and also may the ash melting point be lowered.

Since wood briquettes are an upgraded and dry fuel is the combustion temperature high, theoretically above 1600 ºC, and low ash-melting point may result in slagging and fouling problems in the combustion chamber.

The mechanical durability and the density with a compacted body made up from pure stem wood are mainly determined by the particle size distribution of the material prior to pressing, the moisture content and by the pressure obtained in the press matrix:

- A wide particle size span will result in a weak product.
- The water content in the solid feed material prior to the press may not exceed 15 % and should preferably not be below 10 %.
- A low pressure in the compression process will lower the durability of the product.

Briquettes are mainly produced from shavings obtained during planning, most often mixed with saw dust. To maintain a low price, the material is usually not milled prior to pressing but it is taken “as it is” from the ventilation air cyclone separators.

Again for economic reasons are briquettes commonly produced using excenter presses with pressures not exceeding 200 bar.

Hence, briquettes are brittle compared to pellets and can not withstand mechanical wear. The bulk density with briquettes scarcely exceeds 500 kg/m^3 but is still significantly higher that the bulk density for the saw dust and cutter shavings that are typically the raw material. Briquetting may thus significantly lower the cost to transport the residual fuel fractions (*saw dust and shavings*) from planery to an energy plant.

From a transport point of view – though – is a higher bulk density not an advantage. The limiting value is set by the load capacity of the vehicle divided by the load volume, and that is about 4-500 kg/m^3 for railroad cars as well as for lorries and trucks. Hence, any density above this limit will hit the *weight* limit for the carrier before it hits the *volume* limit and it makes no difference for the carrier how high the density becomes as long as it exceeds approximately 500 kg/m^3.

The combustion equipment for briquettes must be flexible enough to handle saw dust and shavings since the briquettes will most probably break before they actually enter into the combustion chamber. Hence, briquettes are not suitable for small-scale units like single-family houses but find their market in applications from larger buildings and up.

The moisture content in briquettes is similar to that of pellets and hence the heating value is also similar.

The actual heat content of wood fuels (ΔH) – as of any fuel – can be calculated if the heating value for the dry, ash-free substance (ΔH_{DAF}), the fraction of ash in the dry substance ($f_{ASH,DRY}$) and the moisture content (f_{WATER}) are known. The equation is

$$\Delta H = \Delta H_{DAF} \cdot (1 - f_{ASH,DRY}) \cdot (1 - f_{WATER}) - f_{WATER} \cdot 2.45 \quad \text{MJ/kg}$$

As an example, let's calculate the energy content in pine pellets (ΔH_{DAF}=20.2 MJ/kg) with an ash content in the dry substance of 0.7 % ($f_{ASH,DRY}$=0.007) and 12 % water (f_{WATER}=0.12):

$$\Delta H = 20.2 \cdot (1 - 0.007) \cdot (1 - 0.12) - 0.12 \cdot 2.45 =$$
$$= 20.2 \cdot 0.993 \cdot 0.88 - 0.12 \cdot 2.45 = 17.652 - 0.294 = 17.36 \text{ MJ/kg or } 4.82 \text{ kWh/kg.}$$

(*to obtain kWh from MJ, divide by 3.6*)

Briquettes are in many respects similar to pellets and the most relevant standards (see the FOREST StandardGuide) are EN 14961-3, EN 15210-2:2010, EN 16127 and EN 15234-3 for quality assurance.