Heating Value

(Heat of combustion or Calorific value or heat of reaction).

Heating value is the energy released per unit quantity of fuel when the combustible materials are burned and the products of combustion are cooled back to the initial temperature of combustible mixture. Unit is BTU or kJ/kmol or kJ/kg. Standard temperatures to which products are cooled after combustion to determine heating values is 25 C, 20 C (or 0 C)

These are measured in Bomb Calorimeters (constant volume) and in Constant Pressure Calorimeters.

Higher Heating Value (HHV)/ Gross Calorific Value and Lower Heating Values (LHV)/ Net Calorific Value

When, in a calorimeter test, products of combustion are cooled in the standard test method to 25 C, practically all the water vapor resulting from the combustion will be condensed. So the latent heat of evaporation will also be given off to the water jacket surrounding the calorimeter.

The energy found in this cooling water, which is the heating value for that reaction, is the higher (or gross) heating value. The lower (or net) heating value is that which would be obtained if the water vapor in the products of combustion could be cooled to 25 C without condensing. (for calculation involving hot flue gases this value is of course realistic). **The water vapor formation due to condensation is the result of the reaction of hydrogen in the fuel and oxygen in the air and the MOISTURE in the fuel. Hence the MOISTURE content greatly affects the Net calorific Value of firewood.**

LHV = HHV - Latent Heat of vaporization of that amount of water

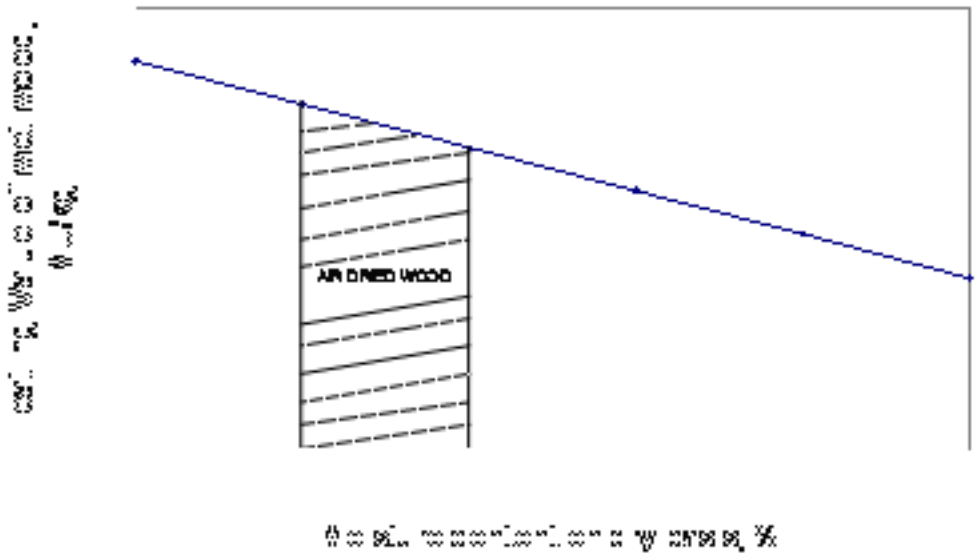

Fig1: Heating value of pinewood as a function of moisture content

The gross calorific value (GCV, MJ/kg, d.b.) of biomass fuels usually varies between 18 and 21 MJ/kg (d.b.), and can be calculated using following empirical formula

GCV = 0.3491*XC + 1.1783*XH + 0.1005*XS - 0.0151*XN - 0.1034*XO - 0.0211*Xash [MJ/kg d.b.] (click here)

Where, xi is the content of carbon (C), hydrogen (H), sulfur (S), Nitrogen (N), oxygen (O) and ash in wt% (d.b.).

The net calorific value (NCV, MJ/kg, w.b.) can be calculated from GCV taking into account the moisture and hydrogen content of the fuel using following empirical formula **(Source: ??)**

NCV = GCV*(1-w/100)-2.447*w/100-2.447*(h/100)*9.01(1-w/100) [MJ/kg w.b.]

Where,

w moisture content of the fuel in wt% (w.b.)

h concentration of hydrogen

Guiding values

for woody biomass fuels: 6.0 wt % (d.b.)

for herbaceous biomass fuels: 5.5 wt% (d.b.)

Conversion

1 Btu/lb = 0.5556 kcal/kg = 0.0224

1 kcal/kg = 1.8 Btu/lb

1 J/g = 0.2388 kcal/kg = 0.4299 Btu/lb