Coal Conversion Facts

World Coal Institute

Basis of Analysis

Definitions

As Received (ar): includes Total Moisture **(TM)**
Air Dried (ad): includes Inherent Moisture **(IM)** only
Dry Basis (db): excludes all Moisture
Dry Ash Free (daf): excludes all Moisture & Ash

The **Proximate Analysis** of any coal i.e. the % content of **Moisture, Ash (A), Volatile Matter (VM), Fixed Carbon (FC)** – also **Sulphur (S)** and **Calorific Value (CV)** – can be expressed on any of the above bases.

Conversions

To obtain:- - *multiply*	**Air Dry**	**Dry Basis**	**As Received**
ar by:	$\frac{100 - IM\%}{100 - TM\%}$	$\frac{100}{100 - TM\%}$	–
ad by:	–	$\frac{100}{100 - IM\%}$	$\frac{100 - TM\%}{100 - IM\%}$
db by:	$\frac{100 - IM\%}{100}$	–	$\frac{100 - TM\%}{100}$

[For **daf**, multiply **db** by 100/(100-**A**)]

Example:

	ar	**ad**	**db**	**daf**
TM	11.0	-	-	-
IM	2.0	2.0	-	-
Ash	12.0	13.2	13.5	-
VM	30.0	33.0	33.7	39.0
FC	47.0	51.8	52.8	61.0
Sulphur	1.0	1.1	1.12	-

Mass

Units:

Metric ton (t) = tonne = 1000 kilograms (= 2204.6 lb)
Imperial or long ton (lt) = 1016.05 kilograms (= 2240 lb)
Short (US) ton (st) = 907.19 kilograms (= 2000 lb)

Conversions:

From **long ton** to **metric ton** multiply by 1.016
From **short ton** to **metric ton** multiply by 0.9072

Mt million tonnes
Mtce million tonnes of coal equivalent (= 0.697 Mtoe)
Mtoe million tonnes of oil equivalent

Calorific Values (CV)

Units: **kcal/kg** – kilocalories per kilogram
MJ/kg* – Megajoules per kilogram
Btu/lb – British thermal units per pound
* 1 MJ/kg = 1 Gigajoule/tonne (GJ/t)

Gross & Net Calorific Values

Gross CV or 'higher heating value' (HHV) is the **CV** under laboratory conditions.

Net CV or 'lower heating value' (LHV) is the useful calorific value in boiler plant. The difference is essentially the latent heat of the water vapour produced.

Conversions – Units

From **kcal/kg** to **MJ/kg** multiply kcal/kg by 0.004187
From **kcal/kg** to **Btu/lb** multiply kcal/kg by 1.8

From **MJ/kg** to **kcal/kg** multiply MJ/kg by 238.8
From **MJ/kg** to **Btu/lb** multiply MJ/kg by 429.9

From **Btu/lb** to **kcal/kg** multiply Btu/lb by 0.5556
From **Btu/lb** to **MJ/kg** multiply Btu/lb by 0.002326

Conversions – Gross/Net (per ISO, for As Received figures)

kcal/kg: Net CV = Gross CV - 50.6**H** - 5.85**M** - 0.191**O**
MJ/kg: Net CV = Gross CV - 0.212**H** - 0.0245**M** - 0.0008**O**
Btu/lb: Net CV = Gross CV - 91.2**H** - 10.5**M** - 0.34**O**

– where **M** is % Moisture, **H** is % Hydrogen, **O** is % Oxygen (from ultimate analysis*, also As Received).

*Ultimate analysis determines the amount of carbon, hydrogen, oxygen, nitrogen & sulphur.

For typical bituminous coal with 10% **M** and 25% **Volatile Matter**, the differences between gross and net calorific values are approximately as follows:

260 kcal/kg 1.09 MJ/kg 470 Btu/lb

Power Generation

1 **MWh** = 3600 MJ
1 **MW** = 1 MJ/s
1 **MW** (thermal power) [$\mathbf{MW_{th}}$] = approx 1000 kg steam/hour
1 **MW** (electrical power) [**MWe**] = approx $\frac{\text{MW (thermal power)}}{3}$

A 600 MWe coal-fired power station operating at 38% efficiency and 75% overall availability will consume approximately:

– Bituminous coal (CV 6000 kcal/kg NAR*): 1.5 Mt/year
– Brown coal (CV 2250 kcal/kg NAR*): 4.0 Mt/year *Net As Received

Sources: GWC Coal Handbook & IEA Clean Coal Centre

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