CH2356 Energy Engineering

Unit – 0

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Energy - Units and Conversions

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Power and Energy

- Energy = Power x Time
- Energy (E) is the ability to do work.
- Power (P) is the rate at which work is performed.
- Analogies: Energy is a measurable quantity like distance. Power is a rate like speed.

Units Conversions

1 lb = 0.454 kg

1 US gallon = 3.79 litre

1 barrel of oil (1 bbl) = 42 US gallon = 159 litre

Multiples

Prefix	***Abbreviation***	***Scientific Notation***	****Number***
Kilo	k	10^3	Thousand
Mega	M	10^6	Million
Giga	G	10^9	Billion
Tera	T	10^{12}	Trillion
Peta	P	10^{15}	Quadrillion
Exa	E	10^{18}	Quintillion

* The system used in the U.S. is not the same as that used in other countries (like Great Britain, France, and Germany). In these other countries, a billion (bi meaning two) has twice as many zeros as a million, and a trillion (tri meaning three) has three times as many zeros as a million, etc. But the scientific community seems to use the American system.

Energy Units

- Calorie, Joule, BTU, Fuel equivalent, watt-hour
- 1 cal = 4.184 J
- 1 BTU = 1055 J
- 1 unit of electricity = 1 kWh
- The **tonne of oil equivalent** (**toe**) is a unit of energy: the amount of energy released by burning one tonne of crude oil, equals 42.6 GJ

Magnitudes of Energy

Energy content of fuels	MJ/kg
Hydrogen	114.0
Gasolines	44.0–45.0
Crude oils	42.0–44.0
Natural gas	33.0–37.0
Anthracite	29.0–31.0
Bituminous coal	22.0–26.0
Lignites	12.0–20.0
Air-dried wood	14.0–16.0
Cereal straws	12.0–15.0

Power Units

- W, kW, MW, GW, hp, ton of refrigeration
- 1 hp = 740 W
- 1 ton of refrigeration = 50 kcal/min = 1200 BTU/h
- Watt = volt x ampere
  = volt x ampere x power factor

Magnitudes of Power

Kitchen appliances	: 50 – 500 W
Passenger cars	: 50 – 100 kW
Wind turbine	: 0.2 – 1 MW
Large steam and water driven turbo turbines	: 500 – 800 MW
Modern fossil-fuel based thermal power plant	: 1000 MW

Power and Energy

- Many people violate the definitions of power and energy. Some people do it publicly, thereby misleading unfortunate readers.

Units Conversion - example problem

- If you turn on 4 light bulbs, each rated at 40 W, how long can they be on before you reach 1 kWh?

  4 bulbs x 40W/bulb = 160 W

  E=P x t => t=E/P = 1 kWh/160W = 1kWh/0.16 W = **6.25 h**

Units Conversion - exercise problems

1. In 2004, for the World-wide generation of 16,074 terawatt hours of electricity, 3.7 billion tons of oil equivalent was used. Calculate the efficiency of thermal energy conversion to electricity. (1 toe = 42 GJ)

2. In 2006, India had 144 GW of installed electric capacity and generated 703 billion kWh. What is the percent capacity utilization of electric power stations?