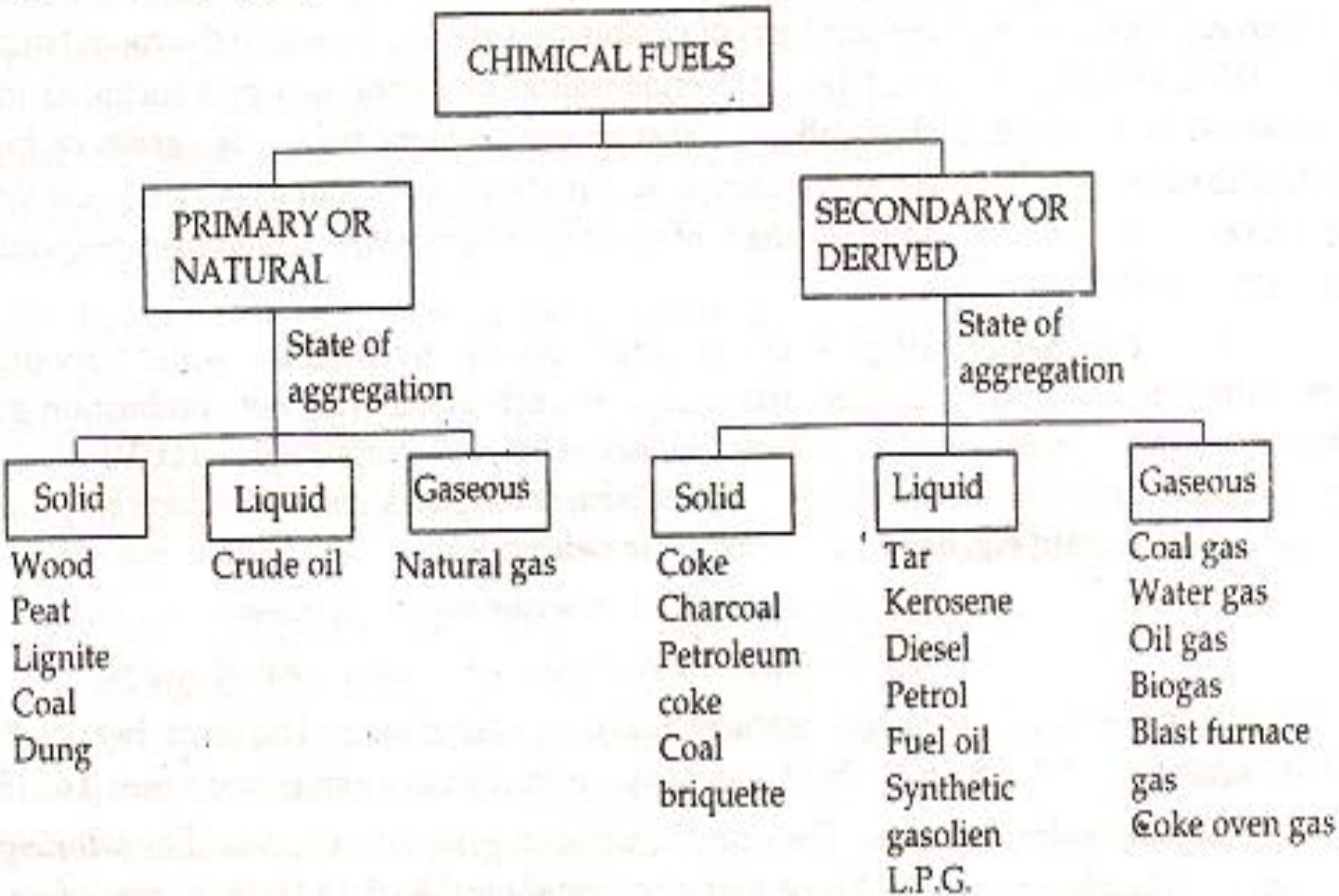
CLASSIFICATION OF FUELS

The fossil fuels have been classified according to their : (1) *occurrence* (and preparation), and (2) *the state of aggregation. According* to the first classification, we have : (*a*) **natural or**



primary fuels, *which are found in nature* **as such,** *e.g.*, wood, peat, coal, petroleum, natural gas, etc. ; (*b*) **artificial or secondary fuels** *are those which are* ***prepared*** *form the primary fuels.* For example, charcoal, coke, kerosene oil, diesel oil, petrol, coal gas, oil gas, producer gas, blast furnace gas, etc.

The second classification is based upon their *state of aggregation* like : (*a*) **solid fuels** ; (*b*) **liquid fuels**, and (*c*) **gaseous fuels**. The classification of fuels is summarized as on page 74.

Note : Colloidal fuel *is a suspension finely powdered coal in fuel oil (or any other liquid fuel), generally, in the ratio of 3 : 2 by weight.* Usually, some *stabilizing agent* is added during the preparation of colloidal fuel in order to avoid the separation of coal from the liquid fuel. In general. Such fuels possess higher calorific values and it is easy to handle them compared with powdered coal and these such fuels find applications in industrial furnaces for cement manufacture, brick firing, ceramic firing, metal processing, etc.

CALORIFIC VALUE

Calorific value of a fuel is *"the total quantity of heat liberated, when a unit mass (or volume) of the fuel is burnt completely."*

Units of heat

The units of heat generally employed are calories, kilogram calories, British thermal units and centigrade heat units.

(*a*) **Calorie (cal) or gram calorie (g cal)**

For all practical purposes, the calorie or gram calorie may be defined as the "amount of heat required to raise the temperature of 1 g of water through 1°C (more precisely from 15°C to 16°C)"

$$1 \text{ calorie} = 4.185 \text{ Joules} = 4.185 \times 10^7 \text{ ergs.}$$

(*b*) **Kilocalorie or kilogram calorie or kilogram centigrade unit (KCal or Kg cal or K.C.U.)**

This is equal to 1000 calories and is, thus, the amount of heat required to raise the temperature of 1 kg of water through 1°C (more precisely from 15°C to 16°C).

$$1 \text{ K cal} = 1000 \text{ Cal}$$

(*c*) **British thermal unit (B.Th.U. or B.T.U.)**

A British thermal unit is the amount of heat required to raise the temperature of 1 lb of water through 1°F (more precisely from 60°F to 61°F).

$$1 \text{ B.Th. U.} = 1{,}054.6 \text{ Joules} = 1{,}054.6 \times 10^7 \text{ ergs}$$

$$1 \text{B.Th.U.} = 252 \text{ Cal} = 0.252 \text{ KCal}$$

(*d*) **Centigrade heat unit (C.H.U.)**

The centigrade heat unit is the amount of heat required to raise the temperature of 1 lb of water through 1°C.

$$1 \text{ K cal} = 3.968 \text{ B.Th.U.} = 2.2. \text{ C. H. U.}$$

Interconversion of the various units of heat

The various units described above can be easily interconverted on the basis that 1 kg = 2.2 lb and 1°C = 1.8°F. Accordingly,

1 K cal = 1000 Cals = 3.968 B.Th. U. = 2.2. C. H. U.

1 B.Th.U = 252 Cals

100,000 B.Th.U. = 1 Therm.

Units of calorific value

Calorific values of solid and liquid fuels are usually expressed in calories per gram (Cals/g) or Kilocalories per kilogram (K cals/Kg) or British Thermal Units per pound (B.Th.U./lb.); whereas the calorific values of gases are expressed as Kilocalories per cubic metre (K cals/m^3) or British Thermal units per cubic foot (B.Th.U./ft^3) or C.H.U./lb or C.H.U./ft^3.

These units can be inter-converted as follows :

1 cal/g = 1 K cal/Kg = 1.8 B.Th.U./lb

1 K cal/m^3 = 0.1077 B.Th.U./ft^3

1 B.Th.U./ft^3 = 9.3 Kcals/m^3

Gross calorific value and net calorific value

The Gross Calorific Value or Higher Calorific Value is the total heat generated when a unit quantity of fuel is completely burnt and the products of combustion are cooled down to 60°F or 15°C (room temperature).

When a fuel containing hydrogen is burnt, the hydrogen present undergoes combustion and will be converted into steam. As the products of combustion are cooled to room temperature, the steam gets condensed into water and the latent heat is evolved. Thus the latent heat of condensation of steam so liberated is included in the gross calorific value.

The calorific value determination by Bomb calorimeter gives the Gross or Higher Calorific Value.

The Net Calorific Value or Low Calorific Value is the net heat produced when a unit quantity of fuel is completely burnt and the products of combustion are allowed to escape. Thus,

Net Calorific Value = Gross Calorific Value — Latent heat of Condensation of the water vapour produced.

= Gross Calorific Value—(Mass of Hydrogen per unit weight of the fuel burnt × 9 × latent heat of vapourization of water).

1 Part of weight of hydrogen gives 9 parts by weight of water as follows :

$$H_2 + O \longrightarrow H_2O$$

2g	16g	18g
1g	8g	9g

The latent heat of steam is 587 Cal/g (or Kcal/Kg) or 1060 B.Th.U./lb of water vapour produced.

Thus,

$$\text{Net C.V.} = \text{Gross C.V.} - 9 \times \frac{H}{100} \times 587$$

$$= \text{Gross C.V.} - 0.09 \times H \times 587$$

where H = % of hydrogen in the fuel.

In actual practical use of a fuel, it is rarely feasible to cool the combustion products to the room temperature to allow the condensation of water vapour formed and utilise that latent heat; hence the water vapour formed also is allowed to escape along with the hot combustion gases.