SNS COLLEGE OF TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

19MEB203 -THERMAL ENGINEERING

UNIT 1-Fuels & Combustion

Type 1 Problems

Ex.1 A sample of coal has following composition on mass basis Carbon 82%, Hydrogen 8%, Sulphur 2%, Oxygen 4% and Ash 4%.

Calculate using Dulong's formula higher and lower calorific value of fuel. **(S-08,09,W-10,11)**

Sol^n : Given

Composition of coal on mass basis.

Carbon (C)	=	0.82
Hydrogen (H_2)	=	0.08
Sulphur (S)	=	0.02
Oxygen (O_2)	=	0.04
Ash	=	0.04

We know Dulong's formula.

H.C.V. of Coal = 33800 C+144000 (H_2 - O_2/8) + 9270 S KJ/Kg.

Putting above values in formula.

= 33800 x 0.82 + 144000 (0.08 – 0.04/8) + 9270 x 0.02

H.C.V. of coal = 27716 + 10800 + 185.4 = <u>38701.4 KJ/Kg.</u>

L.C.V. = H.C.V. – 9 H_2 x 2466

= 38701.4 – 9 x (0.08) x 2466

= 38701.4 – 1775.52

L.C.V. =<u>36925.88 KJ/Kg.</u>

Type 2 Problem

Ex.1 The following is the percentage composition of a sample of coal on mass basis.

C = 85, H_2 = 4, O_2 = 10 and remaining is ash find minimum mass of air required for complete combustion of 1 Kg. of coal.

Sol^n : Given

Composition of coal on mass basis.

Carbon (C)	=	0.85
Hydrogen (H_2)	=	0.04
Oxygen (O_2)	=	0.10

Minimum mass of air required for complete combustion of 1 Kg. of fuel.

= 100/23 (2.67 C + 8 H_2 + S – O_2) Kg.

= 100/23 (2.67 x 0.85 + 8 + 0.04 + 0 – 0.10)

= 100/23 (2.2695 + 0.32 – 0.1)

= 40.82 Kg. per Kg. of Coal burnt.

Type 3 Problem

Ex.3 During a boiler trial the coal analysis on mass basis was reported as C = 62.4%, H_2 = 4.2%, O_2 = 4.5%, Moisture = 15% and Ash 13.9%. Calculate minimum air required to burn 1 Kg. of coal also calculate H.C.V. & L.C.V.

Sol^n : Given

Composition of coal on mass basis.

Carbon (C)	=	62.4	=	0.624
Hydrogen (H_2)	=	4.2%	=	0.042
Oxygen (O_2)	=	4.2%	=	0.045
Moisture	=	15%	=	0.15
Ash	=	13.9	=	0.139

Now

Minimum mass of air required for complete combustion of 1 Kg. of fuel.

= 100/23 (2.67 C + 8 H_2 + S – O_2) Kg.

= 100/23 (2.67 x 0.624 + 8 x 0.042 + 0 – 0.044)

= 100/23 (2.136 + 0.264 + 0.009 – 0.004)

= 100/23 (1.666 + 0.336 – 0.045)

= 8.613 Kg. per Kg. of Coal burnt.

We know Dulong's formula.

H.C.V. of Coal = 33800 C +144000 (H_2 - O_2/8) + 9270 S KJ/Kg.

= 33800 x 0.624 + 144000 (0.042 – 0.045/8) + 9270 X 0

H.C.V. = <u>26329.2 KJ/Kg.</u>

L.C.V. of Coal = H.C.V. – 9 H_2 x 2466 KJ/Kg.

= 263329.2 – 9 x 0.042 x 2466

= 26329.2 – 932.148

= <u>25397.052 KJ/Kg</u>