

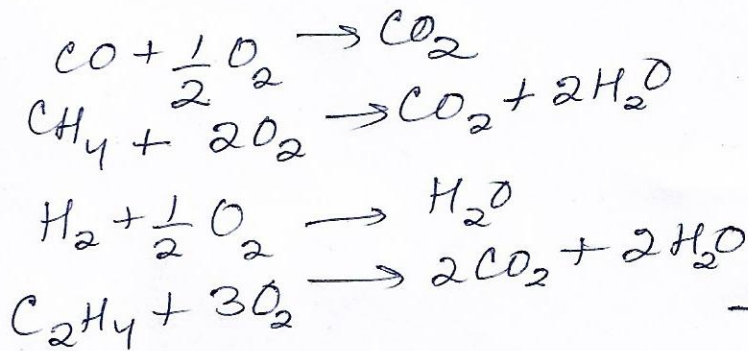
Some questions on oxidation of fuel and calorific value

1. Calculate the volume of air required for complete combustion of 1 m^3 of gaseous fuel having the composition CO 46%, CH_4 10%, H_2 40%, C_2H_4 2%, N_2 1% and remaining CO_2 .

(Assume air contains 21% O_2 .)

Amount of CO in 1 m^3 fuel = 0.46 m^3
 " " CH_4 " " " = 0.1 m^3
 " " H_2 " " " = 0.4 m^3
 " " C_2H_4 " " " = 0.02 m^3

CO_2 will not burn.
 Combustion reactions
 O_2 required
 as per
 stoichiometric
 ratio.



$\text{O}_2 (\text{m}^3)$
$0.46 \times \frac{1}{2} = 0.23$
0.2
0.2
0.06
<u>0.69 m^3</u>

% of O_2 in air = 21%

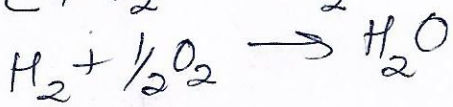
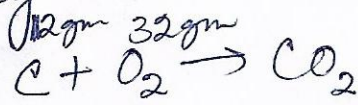
\therefore ~~21~~ $21 \text{ m}^3 \text{ O}_2$ present in 100 m^3 air
 \therefore 0.69 m^3 " " " $\frac{100 \times 0.69}{21} = 3.286 \text{ m}^3$ air

Ans: Volume of air required = 3.286 m^3 .

% composition: C 75%, H 5.2%, O 12.1%, N 3.2% and ash 4.5%. Calculate the min. amount of air necessary for complete combustion of 1kg of coal sample. (Assume air contains 23% O₂).

1kg coal contains $1000 \times \frac{75}{100} = 750$ gm C, 52 gm H, 121 gm O and 32 gm N.

Only C & H will burn.



Weight of O₂ needed
12 gm C needs O₂ 32 gm

∴ 750 gm " " " $\frac{32 \times 750}{12}$

$$= 2000 \text{ gm}$$

2 gm H needs O 16 gm

∴ 52 gm " " " $\frac{16 \times 52}{2} = 416 \text{ gm}$

Total O₂ needed = 2416 gm.

O available in fuel = 121 gm.

∴ Net O needed

$$= 2416$$

$$- 121$$

$$\hline 2295 \text{ gm}$$

~~100~~ 23 gm O₂ present in 100 gm air

∴ 2295 " " " " $\frac{100 \times 2295}{23} = 9978.3$ air gm.

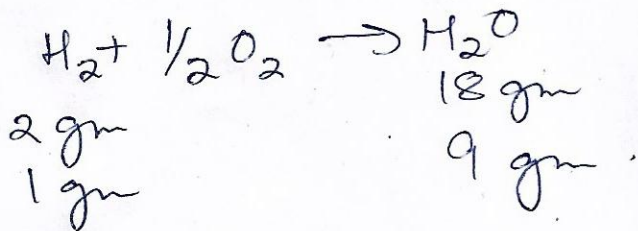
Ans: Minimum amount of air needed for complete combustion of coal = 9978 gm.

fuel of 0.9 gm is burnt. It is observed that increase of temp. is 3.8°C of 4000 gm. The fuel contains 1% of H. Calculate HCV and LCV values. Equivalent wt. of $\text{H}_2\text{O} = 385 \text{ gm}$, latent heat of steam = 587 cal/gm .

wt. of fuel (x) = 0.9 gm
 wt. of water in calorimeter (W) = 4000 gm
 Eq. wt. of water (w) (for apparatus) = 385 gm.
 Rise in temp. ($T_2 - T_1$) = 3.8°C .

$$\therefore \text{High calorific value or gross calorific value} = \frac{(4000 + 385) \times 3.8}{0.9} = 18514.4 \text{ Cal/gm.}$$

For net calorific value H content = 1% = y



If y is % of H in fuel

$$\frac{y}{100} \times 1 = 0.0y \text{ gm H present}$$

$\therefore 0.0y \text{ gm}$ hydrogen produces $9 \times 0.0y \text{ gm}$ ~~oxygen~~ ^{water}

Heat taken by H_2O in forming steam

$$= 0.0y \times 9 \times 587 \text{ Cal.}$$

(latent heat = 587 cal/gm of steam)

Here y = 1%
 \therefore heat taken up by H_2O in forming steam = $0.09 \times 587 = 52.83 \text{ Cal}$

\therefore LCV or net calorific value

$$= 18514.4 - 52.83 \text{ Cal/gm}$$

$$= 18461.6 \text{ Cal/gm}$$

Calorimeter, the temp. of 3500 gm of H_2O rises from $26.5^\circ C$ to $29.2^\circ C$. Water equivalent of calorimeter and latent heat of steam are 385 gm and 587 Cal/gm respectively. If the fuel contains 0.7% hydrogen, calculate its gross and net calorific value.

$$x = 0.83 \text{ gm}$$

$$W = 3500 \text{ gm}$$

$$w \text{ (for apparatus)} = 385 \text{ gm}$$

$$\Delta T = 2.7^\circ C$$

$$HCV = \frac{(3500 + 385) \times 2.7}{0.83}$$

$$= 12637.95 \text{ Cal/gm}$$

$$LCV = (12637.95 - 0.007 \times 9 \times 587)$$

$$= 12637.95 - 36.981 = 12600.97 \text{ Cal/gm}$$

$$\approx 12601 \text{ Cal/gm}$$

