

Answer on question #79758, Chemistry-general chemistry

Question: The chemical analysis of a sample of solid fuel shows it to contain 80.6% carbon, 2.8% hydrogen and 1.1% sulphur. The remainder is incombustible material which remains as ash. Determine (i) the oxygen required for complete combustion of each of the combustible elements per kilogram of fuel and (ii) the theoretical mass of air required for complete combustion per kilogram of the fuel. The oxygen content of air by mass is 23%.

$$w(\text{C}) = 80.6\% = 0.806$$

$$w(\text{H}) = 2.8\% = 0.028$$

$$w(\text{S}) = 1.1\% = 0.011$$

$$m(\text{fuel}) = 1 \text{ kg} = 1000 \text{ g}$$

$$w(\text{O}_2 \text{ in air}) = 23\% = 0.23$$

$$m(\text{O}_2) \text{ -?}$$

$$m(\text{air}) \text{ -?}$$

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Solution:

$$m(\text{C}) = m(\text{fuel}) \times w(\text{C}) = 1000 \times 0.806 = 806 \text{ g}$$

$$m(\text{H}) = m(\text{fuel}) \times w(\text{H}) = 1000 \times 0.028 = 28 \text{ g}$$

$$m(\text{S}) = m(\text{fuel}) \times w(\text{S}) = 1000 \times 0.011 = 11 \text{ g}$$

$$806\text{g} \quad \quad \quad x \text{ g}$$



$$12 \text{ g/mol} \quad 32 \text{ g/mol}$$

$$x = (806 \times 32) / 12 = 2149 \text{ g}$$

$$28\text{g} \quad \quad \quad y \text{ g}$$



$$4 \times 1 \text{g/mol} \quad 32 \text{g/mol}$$

$$y = (28 \times 32) / 4 = 224 \text{ g}$$

$$11 \text{g} \quad z \text{ g}$$



$$32 \text{ g/mol} \quad 32 \text{g/mol}$$

$$Z = 11 \times 32 / 32 = 11 \text{ g}$$

$$m(\text{O}_2) = x + y + z = 2149 + 224 + 11 = 2384 \text{ g}$$

$$m(\text{air}) = m(\text{O}_2) / w(\text{O}_2) = 2384 / 0.23 = 10365 \text{ g}$$

Answer:

For combustion of C need 2149 g O<sub>2</sub>

For combustion of H need 224 g O<sub>2</sub>

For combustion of S need 11 g O<sub>2</sub>

$$m(\text{air}) = 10365 \text{ g}$$

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