

FUELS AND COMBUSTION

QUESTION

Calculate the stoichiometric (kg) amount of air required for the complete combustion of 1 kg pf liquid fuel with the following properties:

Constituents	% By weight
Carbon (C)	85.9
Hydrogen (H)	12
Oxygen (O ₂)	0.7
Nitrogen (N)	0.5
Sulphur (S)	0.5
Moisture (H ₂ O)	0.35
Ash	0.05
Total	100

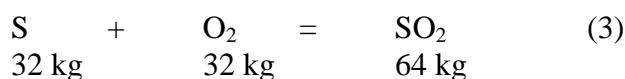
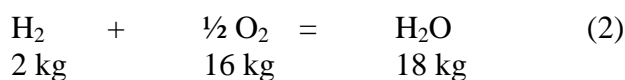
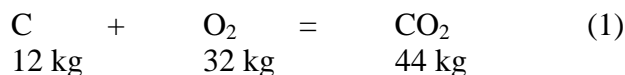
The gross calorific value (GCV) of the liquid fuel is 10200 kCal/kg.

SOLUTION

1. Write down what you already know and assumptions

- Air = 23% O₂ (gravimetric)
- H₂O does not react during combustion to form O₂
- N₂ remains inert and does not form NO_x

2. Write the combustion reactions based on 100 kg of fuel



3. Calculate the O₂ required for complete combustion of 100 kg of fuel using combustion reactions (1), (2) and (3)

Note: for example, if 85.9% of the fuel is C, then 100 kg of fuel will contain 85.9 kg C

Constituent	Calculation using equations	O ₂ formed
85.9 kg C =	85.9 kg C x (32 kg O ₂ ÷ 12 kg C)	= 229.07 kg O ₂
0.5 kg S =	(0.5 kg S x 32 kg O ₂) ÷ 32 kg S	= 0.5 kg O ₂
12 kg H ₂ =	(12 kg H ₂ x 16 kg O ₂) ÷ 2 kg H ₂	= 96.0 kg O ₂

Total amount of oxygen required for stoichiometric combustion:
 = 229.07 kg + 0.5 kg + 96.0 kg
 = **325.57 kg O₂**

But oxygen is present in Fuel = **0.7 kg**

Therefore the additional oxygen required = 325.57 kg O₂ – 0.7 kg O₂ = **324.87 kg O₂**

4. Calculate the air required to provide the additional O₂ for complete combustion of 1 kg fuel:

Stoichiometric amount of air required
 = 324.87 kg O₂ / 0.23
 = 1412.48 kg air per 100 kg fuel
 = **14.1248 kg air per 1 kg fuel**