CHE 205 MASS AND ENERGY BALANCES

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COMBUSTION REACTIONS:

Combustion; is the the rapid reaction of a fuel with oxygen to produce tremendous quantities of energy and CO_2, H_2O, CO and SO_2 as the products.

The energy released in the combustion reactions is used to drive turbines to produce electrical power.

The fuels used in combustion furnaces are coal, fuel oil, gaseous fuels or liquidified petroleum gas. The carbon in the fuel reacts to form CO_2 and/or CO, hydrogen forms H_2O and sulfur forms SO_2.

When CO is formed in a combustion reaction, it is referred as partial combustion or incomplete combustion.

Composition on a wet basis; denotes the component mole fraction of the exit gas stream containing water.

Composition on dry basis; shows the mole fractions without water.

The gas produced in a combustion reaction is named as STACK gas or FLUE gas.

YOUR TURN:

1. **A stack gas contains 7% H_2O. Find the ratio of kmol stack gas/kmol H_2O.**
2. **Discuss the cost of petroleum and its long term availability. Suggest any alternative energy sources.**
3. **Make a search on the adverse effects of CO on enviromental safety.**

<u>THEORITICAL AND EXCESS AIR:</u>

Theoretical Oxygen: The amount (moles or molar flow rate) of O_2 needed for complete combustion. To calculate the theoretical O_2, it should be assumed that all C is oxidized to CO_2, all the H_2 is oxidized to H_2O and all the sulfur is oxidized to SO_2.

Theoretical Air: The air amount that includes the theoretical oxygen

Excess Air: The amount of air which is fed to the reactor exceeding the theoretical air.

$$\boldsymbol{Percent\ Excess\ Air}: \frac{(\boldsymbol{moles\ air})_{fed} - (\boldsymbol{moles\ air})_{theoretical}}{(\boldsymbol{moles\ air})_{theoretical}}\ \boldsymbol{x}\ \mathbf{100\%}$$

YOUR TURN:

A mixture of 75 mole% propane (C_3H_8) and 25 mole% hydrogen (H_2) is burned with 25% excess air. The stack gas is composed of C_3H_8, H_2, CO_2, CO, H_2O, O_2 and N_2. Calculate the theoretical oxygen and the air feed rate entering the reactor. Write all the combustion reactions taking place in the reactor.