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Enthalpy Change of Combustion

Aim

To find out the enthalpy change of combustion by burning butanol and enthalpy.

The standard enthalpy of combustion is the enthalpy change when one mole of an element or compound reacts completely with oxygen under standard conditions. In practice it is not possible to achieve complete combustion under standard conditions measurements are taken under experimental conditions; then a value for the enthalpy change is determined. During chemical reactions when bonds break, energy is absorbed. When bonds form, energy is released. The enthalpy change of combustion is the amount of enthalpy change when one mole of an element or compound reacts completely with oxygen under standard conditions the standard conditions is the pressure of 100kPa and temperature of 298k. In using the calorimeter we need to know the specific heat capacity of water (the energy needed to raise the temperature of 1g of water by 1 ^{c}). When the flame calorimeter is used, the energy transferred is found from

Energy transferred

$$E = m\ c\ \Delta T$$

M represents mass of water
C represents specific heat capacity of H_2O
T represents temperature

Equipment

Calorimeter
Thermometer
Measuring cylinder
Ethanol/butanol
Scales

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Set up

Method

I set up the equipment and filled my burner with the butanol and weighed it I also weighed the burner. I measured out 500cm^3 of with a measuring cylinder and then I poured this into the calorimeter. I placed the thermometer in the calorimeter and then I measured the temperature of the water and then placed the burner underneath the calorimeter and lighted the burner. I used a stirrer through out to even the temperature of the H_2O When bubbles appeared in the calorimeter I put out the burner and took the temperature again. This was to make sure no H_2O were lost due to boiling thereby keeping the mass of H_2O constant. This was repeated again for the ethanol I made sure I used different burners so not to mix the ethanol and butanol.

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Results for Ethanol

Mass of burner	**112.17g**
Mass of burner and ethanol	**114.42g**
Mass of ethanol	**2.25g**
Volume of water	**500ml $\Rightarrow$ 500g**
Temp of water at start	**25 ^{o}C**
Temp of water at the end	**46 ^{o}C**
Temp rise	**21^{o}C**

E = mcΔT
= 500 x 4.2 x 21
= 44100 j = 44.1Kj

1 mol of ethanol = 46g
2.25 $\rightarrow$ 44.1Kj
$\therefore$ 46g $\rightarrow$ x

x = $\frac{44.1 \times 46}{2.25}$
= 901.6Kj
So 901.6 Kj Of any given amount by 1 mol = ΔH^{C} = 901.6 Kj mol^{-1}

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Results for butanol

Mass of burner	**109.01g**
Mass of burner and ethanol	**110.52g**
Mass of ethanol	**1051g**
Volume of water	**500ml $\Rightarrow$ 500g**
Temp of water at start	**27 ^{o}C**
Temp of water at the end	**42 ^{o}C**
Temp rise	**15^{o}C**

E = mcΔT
= 500 x 4.2 x 15
= 31500j $\rightarrow$ 31.5Kj

1 mol of butanol =74g
1.51g $\rightarrow$ 31.5Kj
$\therefore$ 74g $\rightarrow$ x Kj

$$x = \frac{74 \times 31.5}{1.51}$$

= 1543.7Kj mol^{-1}
So 1543.7Kj of any given amount by 1 mol = ΔH^{C} = 1543.7Kj mol^{-1}