WJEC (Wales) Chemistry A-level

SP 2.1a - Indirect Determination of an Enthalpy Change of Reaction

Methods and images taken from the WJEC practical handbook

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Aim

Indirect determination of the **enthalpy change** of reaction of magnesium oxide and carbon dioxide to form magnesium carbonate

Apparatus and Chemicals

- Access to a 3 decimal place digital balance (minimum 2 decimal place)
- Thermometer
- Simple calorimeter
- 25 cm^3 bulb/volumetric pipette with safety filler
- Stopwatch
- Spatula
- Weighing boat
- 2.0 mol dm^{-3} HCl solution
- Dry MgO
- Dry $MgCO_3$

Safety Considerations

★ 2.0 mol dm^{-3} HCl solution - irritant

Method

1. Measure 50 cm^3 of HCl solution into the **calorimeter** using the pipette to measure out 2 measurements of 25 cm^3.
2. Place the thermometer into the HCl solution and leave it in to allow the temperature reading to stabilise.
3. **Accurately** weigh out approximately 0.90 g of MgO in a weighing boat.
4. **Accurately** weigh the weighing boat and MgO. Record the mass.
5. Record the temperature of the acid. At the same time, start the stopwatch.
6. Record the temperature of the acid every 30 seconds for 2 minutes and 30 seconds.

7. When the stopwatch reaches 3 minutes, add the MgO to the HCl solution and **mix it thoroughly**. Keep the bulb of the thermometer submerged in the reaction mixture.
8. When the stopwatch reaches 3 minutes 30 seconds, record the temperature of the reaction mixture.
9. Continue to record the temperature of the reaction mixture every 30 seconds until the temperature drops for 5 **consecutive readings**.
10. Weigh the weighing boat again. Record the mass. Use this mass and the mass obtained in step 5 to calculate the mass of MgO added to the calorimeter.
11. Use the data to construct an **appropriate graph** and calculate the **enthalpy change** of the reaction between MgO and HCl.
12. Repeat steps 2 through to 12 using approximately 3.5g of $MgCO_3$.
13. Use the values of ΔH obtained for each reaction to calculate the enthalpy change for the following reaction:

$$MgO(s) + CO_2(g) \rightarrow MgCO_3(s)$$

The enthalpy change for the reaction above can be calculated using Hess's law as

ΔH3 = ΔH1 - ΔH2

where ΔH is the enthalpy change for the respective reactions shown below: