

Enthalpy of neutralisation - lab report example

[Science](#), [Chemistry](#)



Enthalpy of Neutralisation

Experiment 4: Neutralization reaction Using a calorimeter, the experiment sought to determine the heat of enthalpy for two reactions; NaOH to HCl and NaOH to CH₃COOH. Temperature measurements were taken at intervals of 30 seconds and were used to generate graph time against temperature in each case. It was established that the heat of enthalpy for NaOH to HCl was higher as compared to NaOH to CH₃COOH, a factor attributed to the fact that in one case, a strong acid was used while in another case, a weak acid was used.

Neutralization reaction

Introduction

Conventionally, enthalpy changes when a strong base is mixed with a strong acid substantially differ for the case when a strong base is mixed with a weak acid. As a matter of fact, this variation is attributed to the fact that when a strong acid is used, full ionization takes place while with a weak acid; ionization is incomplete (Jarvis, 2011). In this experiment, NaOH is mixed with HCl and later with CH₃COOH.

Methodology

Place 500 mL of water into the calorimeter and add 150 mL of 1.0 M sodium hydroxide. Measure 160 mL (an excess) of 1.0 M hydrochloric acid into a 400 mL beaker. Start the stopwatch and stir the two solutions with separate stirring rods and measure their temperatures (use separate thermometers) at 30 s intervals as above. (DO NOT stir the solutions with the thermometers.) After 5 min (do not reset timer to zero) rapidly, but quantitatively, pour the HCl into the calorimeter. Replace the stopper.

Continue stirring and record the temperature of the reaction mixture at 30 s intervals for the next 5 min.

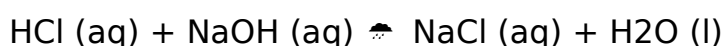
After the experiment is completed, test the solution with two drops of phenolphthalein. If the reaction mixture is alkaline, insufficient acid has been added and the results are worthless - start again.

Repeat the procedure above using 1.0 M acetic acid (in place of 1.0 M HCl) and 1.0 M sodium hydroxide solutions.

Results and calculations

The enthalpy of neutralization of HCl (aq) and NaOH (aq)

The reaction is given by the equation,



The data is shown in figure below,

The total volume of solution is 300.0 mL (150.0 mL + 150.0 mL) and hence mass of solution is 300.0 g.

From the graph,

The enthalpy of neutralization of CH₃COOH (aq) and NaOH (aq)

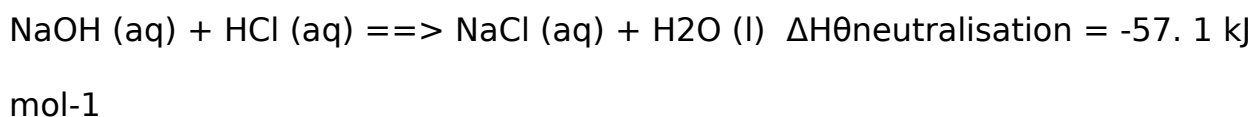


The data is shown in figure below,

The total volume of solution is 300.0 mL (150.0 mL + 150.0 mL) and hence mass of solution is 300.0 g.

Discussion

The first part of the experiment is about reactions between fully ionized strong acids and strong bases and the sole real chemical change is formation of water molecule from hydrogen ions and hydroxide ions. This is given as follows,



The second part of the experiment is neutralization of a strong base, sodium hydroxide and weak organic carboxylic acid, ethanoic acid. This is given by the equation below,



Conclusion

Evidently, the reaction between NaOH and HCL yields a higher enthalpy of neutralization as compared to the reaction between NaOH and CH₃COOH. This is attributed to the fact that the enthalpy of neutralization of a NaOH with a HCL involves complete ionization of the dilute aqueous solutions and hence the reaction involves higher energy. In the case of CH₃COOH, while NaOH undergoes complete ionization, CH₃COOH only partly ionizes and as a result the enthalpy of neutralization is lower.

There are various methods used in measurement of such heat. Initially measurements were premised on simple thermometric methods, however, in more recent times, electronic advances and control have resulted into a new dimension to calorimetric measurements, and enabled users to not just collect data but also maintain samples under conditions previously not achievable. The proposed alternative is therefore differential scanning calorimetric measurement which provides rapid, simplified approach for determination of specific heat capacities of substances.

Reference

Jarvis, A. (2011). Enthalpy of neutralization. New York: McGraw Hill