Decomposition of sodium hydrogen carbonate biology essay

Science, Biology

Salman NassimiChemistry-IBCandidate no. 00139-053Topic: Decomposition of Sodium hydrogen carbonateLab: 12 (DCP/CE)Criteria: DCPLevelAspect123GradeCriteria: CELevelAspect123GradeAim: To Investigate the Enthalpy of decomposition of Sodium hydrogen carbonateProcedure: The objective of this experiment is to determine the enthalpy change for the decomposition of sodium hydrogen carbonate: $2NaHCO$ $Na_2CO_3 + CO_2 + H_2O$The enthalpy change for this decomposition reaction is difficult to measure directly. By determining the enthalpy changes for the reactions between sodium carbonate and sulphuric acid, and between sodium hydrogen carbonate and sulphuric acid, it is possible to determine, indirectly, the enthalpy change for the decomposition of sodium hydrogen carbonate. Hypothesis: $NaHCO_3$ will give out heat during the reaction because it is breaking up and decomposing to smaller compounds. Equipment: Measuring cylinder 25cm3Sulphuric acidSodium Hydrogen CarbonateSodium CarbonateCircular dishWeighing scalePlastic cup x1Beaker x1Method: Use a measuring cylinder to transfer 25. 0cm3 of 2moledm-3 sulphuric acid into a clean dry plasticPlace the plastic cup into the beakerWeigh out accurately between 2. 50g and 3. 50g of anhydrous sodium carbonate. Record your mass in a suitable table. Record the temperature of the acid in the cup every half a minute for two minutes. At the third minute add sodium carbonate to the acid. Stir the mixture carefully and record the temperature every thirty second until the mixture has been turning to room temperature for at least four minutes. Repeat steps 1-4 but 3. 50-4. 00grams of anhydrous Sodium hydrogen carbonate. Table of Mass for the first experiment: Mass±0. 005gDish7. 39Dish+Na2CO310. 54Na2CO33. 15Table for the reaction of Na_2CO_3 with H_2SO_4: SolutionTime+0. 5sTemperature+0. 5oCH2SO40. 024. 030. 025. 060. 025. 090. 025. 0Adding Na2CO3120. 030. 0150. 035. 0180. 033. 0210. 032. 0240. 032. 0270. 031. 0300. 031. 0330. 030. 0360. 029. 0390. 029. 0420. 029. 0Table of mass for the second experiment: Mass±0. 005gDish7. 40Dish+NaHCO311. 22NaHCO33. 82Table for the reaction of $NaHCO_3$ with H_2SO_4: SolutionTime+0. 5sTemperature+0. 5oCH2SO40. 024. 030. 024. 060. 025. 090. 025. 0Adding NaHCO3120. 020. 0150. 018. 0180. 017. 0210. 017. 0240. 017. 0270. 018. 0300. 018. 0330. 018. 0360. 019. 0390. 019. 0420. 019. 0Enthalpy Change for $NaHCO_3$: $2NaHCO_3(s) + H_2SO_4 (aq) \rightarrow Na_2SO_4 (aq) + 2H_2O (l) + 2CO_2 (g)$Moles of $NaHCO_3$ = mass/Mr = 3. 82/84 = 0. 045mole25. 0cm3 of 2moledm-3 sulphuric acidMoles of H_2SO_4 = (25x2)/1000 = 0. 05molesQ= mc(tm-to)= 28. 82x4. 18 (16-25) = -1084. 2JEnthalpy = Q/n = -1084. 2/0. 045 = -24094J/molUncertainty = 1%+0. 12%+6. 25% = 7. 4%= -24. 09 KJ/mol ± 7. 4%The absolute uncertainty = 7x24. 09/100 = 1. 69Enthalpy Change for Na_2CO_3: Mole of Na_2CO_3 = mass/Mr = 3. 15g/106 = 0. 030moles$Na_2CO_3(s) + H_2SO_4 (aq) \rightarrow Na_2SO_4 (aq) + H_2O (l) + CO_2 (g)$Q= mc(tm-to= 28. 15x4. 18x (37-25) = 1412JEnthalpy = Q/n= 1412/0. 030 = 47067J/molUncertainty = 1%+0. 12%+10 = 11. 12%= 47. 07 KJ/mol ± 11. 12%The absolute uncertainty = 11x47. 07/100 = 5. 18Hess law: $2NaHCO_3(s) \rightarrow Na_2CO_3(s) + H_2O (l) + CO_2 (g)$ H1=? $2NaHCO_3(s) + H_2SO_4 (aq) \rightarrow Na_2SO_4 (aq) + 2H_2O (l) + 2CO_2 (g)$ H2=-24. 09KJ/mol$Na_2CO_3(s) + H_2SO_4 (aq) \rightarrow Na_2SO_4 (aq) + H_2O (l) + CO_2 (g)$ H3= 47. 07 KJ/molInverse H3= -47. 07$Na_2SO_4 (aq) + H_2O (l) + CO_2 (g) \rightarrow Na_2CO_3(s) + H_2SO_4 (aq)$ H3= - 47. 07 KJ/molH1= H2 + H3 = -24. 09-47. 07= -71. 16KJ/molConclusion:

The investigation of the enthalpy of sodium hydrogen carbonate turned out to be an exothermic reaction as seen from the second graph that the temperature is decreasing while adding the acid. It can also be seen from the first graph that the trend is first increased and then becomes constant at a particular time. This is said to be endothermic as the reaction takes in heat. As the temperature comes to a constant level it is said that the reaction has come to a completion and the reaction has reached dynamic equilibrium. It can be seen in both graphs a sudden increase/decrease in temperature because a powdered form of both sodium compounds have been used, so that means that the rate of reaction is increased due to the large surface area of the both the sodium compounds. It has also been found that the decomposition of sodium hydrogen carbonate is an exothermic reaction as it releases heat and has a negative sign for it. Now to find the error in my experiment. %error =[(experimental)-(accepted)/accepted] x100 = [(71. 16–57) / 57] x100 = 24. 8%The main error is a systematic error because the % error is more than the % uncertainty. Systematic error = %error –uncertainty = 24. 8- 11. 12 = 13. 7%The percentage error is not that high and the results are not off balanced. The results that were determined were little bit low due to some factors which affected the experiment. Limitations: One of the main problems of getting a lower result is because the experiment was not done in a closed container thus the gasses produced from the reactants escaped making the calculations wrong. Another main reason is that the containers which the reaction took place were not properly insulated thus having a great effect in the results due to heat lost or gained from the environment. The air conditioners were one, which might have affected the experiment slightly. Solutions: One of the simple solutions is that the experiment should be repeated as many times as possible in order to get an average out of all of them. Using a sealed lid and an insulator such as a rubber cover for the cup will reduce the chances for anything to enter or exit the reaction thus making the results more accurate. Controlling the environmental temperature; such as closing the window, monitoring the room’s temperature to be constant, etc. The preferable temperature of a room would be around 25 degrees Celsius,