Ammonium chloride enthalpy lab – data collection and processing essay sample

Science, Chemistry

Information Used:

Specific Heat Capacity of Water = 4. 186J/g oC

Specific Heat Capacity of NH4Cl = 3. 95J/g oC

Trial 1:

Step 1: Calculate Moles of NH4Cl

(Mass / Molar Mass) = (3. 50 0. 01 / 53. 49) = (3. 50 0. 28% / 53. 49) = 0. 07 0. 0002 moles

Step 2: Calculate the enthalpy change

Q = n x ? H

Q = energy from water

-Q = energy transferred from water

? H = – Q / n

? H = – [(23. 40 0. 01)(4. 186)((7 0. 05) – (16 0. 05))] / 0. 07 0. 0002

= – [(23. 40 0. 04%)(4. 186)(-9 0. 1)] / 0. 07 0. 28%

= – [(23. 40 0. 04%)(4. 186)(-9 1. 1%)] / 0. 07 0. 28%

= – [(-881. 57 1. 14%) / 0. 07 0. 28%

= -(-12593. 86 1. 42%)

= 12593. 86 J/mol 178. 83 J/mol

Trial 2:

Step 1: Calculate Moles of NH4Cl

(Mass / Molar Mass) = (3. 40 0. 01 / 53. 49) = (3. 40 0. 29% / 53. 49) = 0. 06 0. 29% = 0. 06 0. 0002 moles

Step 2: Calculate the heat (enthalpy) change

Q = n x ? H

q = energy from water

-q = energy transferred from water

? H = – Q / n

? H = – [(24. 78 0. 01)(4. 186)(-8 0. 1)] / 0. 06 0. 0002

= – [(24. 78 0. 04%)(4. 186)(-8 1. 43%)] / 0. 06 0. 29%

= – [(-829. 83 1. 47%) / 0. 06 0. 29%]

= -(-13830. 50 1. 76%)

= 13830. 50 J/mol 243. 42 J/mol

Trial 3:

Step 1: Calculate Moles of NH4Cl

(Mass / Molar Mass) = (3. 51 0. 01 / 53. 49) = (3. 51 0. 28% / 53. 49) = 0. 07 0. 28% = 0. 07 0. 0002 moles

Step 2: Calculate the heat (enthalpy) change

Q = n x ? H

q = energy from water

-q = energy transferred from water

? H = – Q / n

? H = – [(23. 37 0. 01)(4. 186)(-9 0. 1)] / 0. 07 0. 0002

= – [(23. 37 0. 04%)(4. 186)(-9 1. 11%)] / 0. 07 0. 28%

= – [(-880. 44 1. 15%) / 0. 07 0. 28%]

= -(-12577. 73 1. 43%)

= 12577. 73 J/mol 179. 86 J/mol

Trial 4:

Step 1: Calculate Moles of NH4Cl

(Mass / Molar Mass) = (3. 49 0. 01 / 53. 49) = (3. 49 0. 29% / 53. 49) = 0. 07 0. 29% = 0. 07 0. 0002 moles

Step 2: Calculate the heat (enthalpy) change

Q = n x ? H

q = energy from water

-q = energy transferred from water

? H = – Q / n

? H = – [(24. 05 0. 01)(4. 186)(-7 0. 1)] / 0. 07 0. 0002

= – [(24. 05 0. 04%)(4. 186)(-7 1. 43%)] / 0. 07 0. 29%

= – [(-704. 71 1. 47%) / 0. 07 0. 29%]

= -(-10067. 33 1. 76%)

= 10067. 33 J/mol 177. 19 J/mol

Conclusion:

The average of the enthalpies is: 12267. 36 J/mol 602. 11 J/mol. Because the enthalpy is greater than zero, the reaction $NH_4Cl(s) + H_2O(l) \rightarrow NH_3(g) + H_2O(l) + Hcl(aq)$ is endothermic. The drop in temperature indicates that the system absorbed heat, so it has a positive enthalpy change.

The actual enthalpy is 14. 8 KJ/mol, while ours is 12. 67 KJ/mol. This means our result is off by about 14%. This is possible for several reasons which make this lab almost impossible to perform completely accurately. Firstly, the Styrofoam cup we used as a calorimeter absorbed some of the heat, however this was not reflected in the calculations. Also, the coffee cup lid we used was not effective in isolating the system, so heat was lost to the surroundings. When we opened the lid to add the Ammonium Chloride, we left it open for a short time, during which the energy was not retained within the calorimeter.

If the lid was made with no holes, except for the thermometer, less heat would leak out. Another large problem was the way we mixed the Ammonium Chloride into the water. We shook the calorimeter from side to side, but by doing this we inadvertently added extra momentum and therefore heat to the system. In addition, the temperature of the room was not monitored, so the temperature of the environment could have been changing, which would affect the reaction. We could remedy this by ensuring the temperature stayed at standard room temperature the entire time the reaction was taking place.