# Thermodynamics of borax lab report assignment

This experiment was inducted to determine the standard entropy and enthalpy of the dissolving reaction of borax in water. The thermodynamic properties of the reaction helped to determine the change in heat and spontaneity within the system. Entropy is said to be the tendency for the universe to move towards disorder. If the value of entropy is positive, then the amount of disorder would increase within the system, causing the reaction to occur spontaneously.

However, if the value of entropy is negative, the amount of disorder would decrease, this could cause a spontaneous or non-spontaneous reaction, depending on the value of enthalpy. Enthalpy is the total energy within a system in relation to work and heat. If the value of enthalpy was negative, then the reaction is exothermic. But, if the value of enthalpy was positive, then the reaction will be endothermic. A doctor by the name of J. Gibbs came up with an equation, which combined contributions from enthalpy and entropy.

This equation provided a way to measure the energy content within a system which allows one to evaluate the spontaneity of a reaction. If there is a lot of stored heat energy, then the substance has a lot of free energy. But, the more disorder and disruption the substance has, the less free energy it has. The borax was tested to see what would happen when different temperatures of heat were applied. Thermodynamics then came into play when trying to explain what was happening with the borax solution as the temperature steadily increased.

The higher the temperature was, the more disorder there was within the system. The more the temperature increased, the further away it was from reaching its equilibrium. The standard entropy and enthalpy of the dissolving reaction borax in water was later determined. The properties of thermodynamics n this reaction helped to determine the change in heat and spontaneity within the system. Experimental Details To begin this experiment, 15-20 grams of borax was collected and added to a 100 millimeter beaker which contained 75-85 millimeters of water.

A stirring bar was used to allow the borax to dissolve and reach saturation. Once the stirrer was turned off, the solution was given time to allow any solid to settle to the bottom so that the aliquot retrieved was only of the saturated solution, (if less energy were used, temperatures would decrease, causing larger amounts of solid to arm, enabling one to retrieve aliquots). 5-7 millimeters were removed from the beaker and placed into a clean and dry 10 millimeter graduated cylinder, the volume and temperature of the aliquot was recorded.

Immediately, the aliquot was transferred to a 125 millimeter Erlenmeyer flask, warm distilled water was used to ensure all of the borax had been transferred out of the graduated cylinder and into the flask. Then a few drops of processes green indicator was added to the solution to indicate the endpoint during titration. A standardized hydrochloric acid solution with a 0. 082 military was titrated with the borax solution. Once the borax solution reached its endpoint, this was indicated by a change in color to a light green.

If a yellow color appeared it meant the endpoint was surpassed and needed to be noted. After this, the final volume and dispensed volume was calculated and recorded. While the titration was being conducted, the beaker with the saturated borax was placed back onto the hot plate. The stirrer and heat were turned back on. This was put on a low setting so the temperature of the borax solution would heat up by 5-ICC. Once the solution maintained a stable temperature, the steps taken earlier were repeated for a total of 5 times.

Results and Discussion Upon completing the experiment, the standard entropy was found to be 334. 82 Joules/mol with an 1 1. 9% error in comparison to the literature value, and the standard enthalpy was 108. 82 kilojoules/mol with a 1. 07% error in comparison to its literature value. Since both of the results found were positive, it confirmed the class's earlier hypothesis of it being an endothermic reaction. In addition, the value of Gibbs free energy was calculated (see Figure 1). Since both entropy and enthalpy were positive, the spontaneity of the solution was temperature dependent.

This experiment showed to have a non-spontaneous reaction, due to the heat that was applied to the system in order for the borax to dissociate into an aqueous solution. Looking at the RE value on Figure 2, one will notice how relatively small the number is, as well as how close to one the value is. This number indicates how close or precise the experimental results are. Also shown in this table are solubility products or SSP, which is the equilibrium constant for a lid dissolving in water.

Solubility products do change with temperature, so it is important to always note the temperature at which the solubility is measured because more of the borax solid is dissolving. When titrating aliquots of a stock solution of borax at different temperatures, it will yield the experimental data to determine the values of entropy and enthalpy. Looking at the values from this experiment, the results were fairly low, which shows that it is not very soluble. Conclusion The main idea of this experiment was to show the results of borax under different temperatures.