Extraction of caffeine from tea leaves argumentative essay

Extraction of Caffeine from Tea Leaves Introduction Caffeine is soluble in boiling water and as a result it is easily extracted from tea bags by steeping in hot water. This process leaves behind the water insoluble portions of the tea bag. However, water extracts more than just caffeine, so a final separation is done with an organic solvent that will dissolve primarily caffeine. The organic solvent used in this experiment is Dichloromethane (CH? Cl?). Dichloromethane is less polar than water and this difference in polarity allows the separation.

Extraction of the tea with the Dichloromethane, followed by evaporation of the organic solvent leaves crude caffeine, which on sublimation yields a relatively pure product. Sublimation is the transition of a substance from the solid phase directly to the gas phase without undergoing intermediate liquifications. This process is preferred over recrystallization because it is better at removing impurities. Experimental For this extraction experiment two bags of tea were used, which is approximately 4 grams of tea. Water was heated in a small beaker until it began to boil.

It was then removed from heat and 2 grams of Na2CO3 was added and dissolved. Finally the loose tea was added to the water and allowed to steep for 5 minutes. After 5 minutes the mixture was put through a suction filtration. A suction funnel was secured on top of the suction flask with the vacuum tubing. No filter paper was used because the tealeaves were very course. Then 400mg of NaCl was added and dissolved. The solution was then cooled in an ice bath. The solution was then transferred into a separatory funnel and was washed 3 times using 5 ml portion of CH2Cl2.

CH_2Cl_2 formed a separate layer on the bottom of the flask and was drained into a 25 ml flask after each wash. Each wash was gently swirled to prevent emulsion. The combined washes were then dried using small portions of Na_2SO_4 two times to remove any water. A suction flask was weighed and the CH_2Cl_2 was poured into the flask and the Na_2SO_4 was left behind. A small sample was taken for comparison with pure caffeine on a TLC plate. Then the suction flask with the CH_2Cl_2 was placed in a low temperature hot water bath with a boiling stick to boil all the CH_2Cl_2 away eaving only caffeine. The suction flask was then reweighed to determine the weight of the caffeine extracted. The flask was then covered with parafilm and the sublimation was done one week later. The Sublimation apparatus was assembled consisting of the filtration flask with our caffeine extract in it, with a test tube securely inserted 10-15mm from the bottom of the flask. It was secured with a rubber stopped and parafilm. A pippet bulb was inserted over the arm of the suction flask. The flask was then placed in a sand bath with a temperature between 200-220 degrees Celsius.

The test tube was filled with solid ice and water was removed and more ice was added periodically throughout the sublimation process. As the sublimation took place the caffeine extract from the bottom of the flask began to collect as a film on the bottom of the test tube. The process was completed when no more caffeine was left in the flask. The test tube was removed and the collected caffeine was scraped off and weighed. The melting point of the pure caffeine was also measured. Results and Discussion During the extraction experiment 0. 12 grams of impure caffeine extract remained in the suction flask. This value could be lower than expected

because during the extraction there was some emulsion in the seperatory funnel during each wash. Some of our extract could have been lost due to this. Also while boiling the CH2Cl2 a tiny amount of the solid extract remained on the boiling stick. On the TLC plate our tea extract traveled almost the same distance as pure caffeine. The Co-spot traveled the exact same distance as the pure caffeine. The Rf values for caffeine and the Co-spot were 0. 66. The Rf value of the tea extract was 0. 133. The differences in the spots could be due to some impurities in the tea extract and differences in concentration of each spot. After the sublimation 0. 003g of pure caffeine was scraped from the test tube. The melting point range of the pure caffeine was tested and found to be 237-239 degrees Celsius. The actual melting point of caffeine is 238. Conclusion The results of the TLC plate showed that the tea extract was very close to the sample of pure caffeine.

It was slightly off possibly due to impurities that remained in the tea extract. The caffeine weighed in the flask after the liquid-liquid extracted was 0. 012g, which was different from the weight of the caffeine obtained after the sublimation. This difference was likely due to impurities in the caffeine before being purified by sublimation. The caffeine that was extracted from the sublimation experiment had a melting point of 237-239 degrees Celsius, which is the same as the reported value for caffeine.

The sublimation resulted in having a totally pure extract of caffeine. Questions 1. Why is sodium chloride added to the tea solution before extraction with CH? Cl?? Sodium chloride pulls the water from the organic layer and also helps force the organic compound into the organic layer. 2.

Could you have used ethanol instead of CH? Cl? to extract the caffeine? Why or why not? No, because ethanol and water are miscible in one another. They will not separate into distinct layers, so a less polar solvent like CH? Cl? is better at separation and extraction of caffeine from water. . What is the purpose of adding sodium carbonate to the flask in the brewing step? Sodium carbonate is a base and if added a precipitate will form and the solid material can then be removed. 4. At 25 degrees Celsius, 1. 0 g of caffeine will dissolve in 47 mL of water, in 8. 1 mL of chloroform, in 86 mL of benzene, or in 370 mL of diethyl ether. Calculate the solubility (in grams/ 100mL) of caffeine in these four solvents. Calculate the partition coefficient of caffeine between water and each of the other three solvents.