Lab N °03: The extraction of Caffeine from Cola drinks

Objective

Acquire knowledge regarding a novel separation technique: liquid-liquid extraction.

Isolation of caffeine from a Cola drink

Caffeine

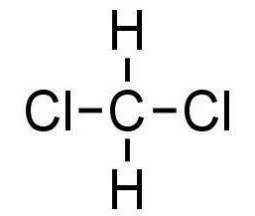
Caffeine is a natural stimulant found in coffee, tea, chocolate, and other products. Its chemical formula is $C_8H_{10}\,N_4O_2$. Caffeine works by blocking adenosine receptors in the brain, leading to increased alertness and improved cognitive function. While moderate consumption is generally safe for most people, excessive intake can lead to negative side effects.

liquid-liquid extraction.

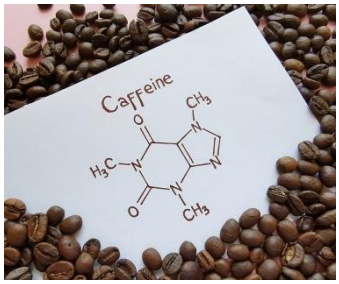
These are performed by transferring a dissolved substance (solute) from one solvent into another. It is a separation technique used to separate compounds or elements from a mixture by distributing them between two immiscible liquid phases. This process takes advantage of differences in solubility and distribution coefficients of the components in the two phases. By adding a solvent (extractant) that selectively interacts with one component of the mixture, the desired compound is transferred from one liquid phase into the other, facilitating its isolation.

Solvent, Temperature	Caffeine Solubility (g / 100g solvent)
Water, 25°C	2.26
Water, 80°C	20
Water, 100°C	67
Methylene Chloride, 25°C	8.45

The solubility of caffeine varies substantially based on the temperature of the solvent and the solvent identity.



Methylene Chloride or Dichloromethane (CH_2Cl_2), Boiling point 39.6 °C



Caffeine $C_8H_{10}\,N_4O_2$

Materials & Equipment

Materials	Equipment	
100 mL of COCA COLA.	Electronic Balance	Büchner
Calcium carbonate $CaCO_3$.	Refrigerant	Filter papers
sodium sulfate Na_2SO_4 (or $MgSO_4$ *or* $CaSO_4$)	Double necked flask	Separatory funnel
	Hot plate magnetic stirrer	PH paper
Dichloromethane or chloroform.	Magnetic stirring bar	Fume Hood
Water	100 mL Erlenmeyer	

Procedure

1. Pour 100mL of Coca-Cola into an Erlenmeyer flask.
2. Add dropwise a solution of sodium carbonate, monitoring the pH. Stop when pH reaches the value of 9.
3. Pour the sample into a 250 mL beaker and then add 100 mL of dichloromethane.
4. Stir under a fume hood with a magnetic stirrer.
5. Transfer the mixture into a separatory funnel.
6. Shake everything (remember to degas from time to time).
7. Let it settle (let it rest for 30 seconds).
8. Retrieve the organic phase (colored dichloromethane, it's the bottom phase)
9. Dry the organic phase with sodium sulfate. There are no defined quantities to add.
10. Filter everything using a funnel containing a piece of cotton.
11. Retrieve the juice and evaporate the solvent using a rotary evaporator.
12. At the bottom of your flask, there remains a powder, which is almost pure caffeine.

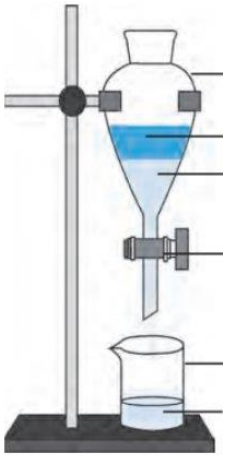


Figure.1

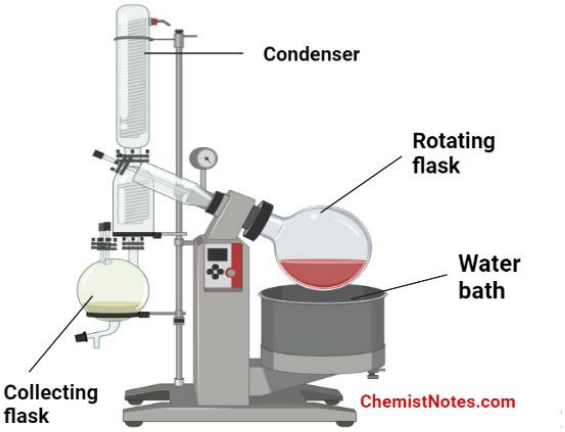


Figure.2 rotary evaporator

Questions

1. Is caffeine a natural or artificial substance?
2. Provide a name for Figure.1 and label all its parts.
3. Which phase is at the bottom? Please provide an explanation
4. why energetically shake the mixture inside the separating funnel
5. Why is it necessary to degas after shaking?
6. What does $K_D, the\ partition\ coefficient$ represent?
7. What is the point of adding calcium carbonate?
8. What is the interest in adding sodium sulfate ($Na_2SO_4/MgSO_4$ / $CaSO_4$)/?
9. What it the role of the rotary evaporator
10. What distinct separatory methods were explored during this lab?