



# Lab of Organic Chemistry 1nd stage

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**Lecture 4**

**\*Extraction\***

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## Extraction

### Purpose of experimental

To purify samples of organic compounds that are solids at room temperature

### Theory part of experimental

Extraction is a commonly used method among organic chemists for the rapid and approximate separation of mixtures containing acidic and/or basic compounds, often in the presence of neutralizing agents. This separation relies on the interaction of acids and bases, and two immiscible solvents (water and tert-butylmethyl ether).

**Extraction** is the recovery of a substance from a mixture by contact with a solvent, resulting in the dissolution of the desired substance.

Like recrystallization and distillation, extraction is a commonly used laboratory separation technique for isolating one or more components from a mixture. Unlike recrystallization and distillation, extraction does not produce a pure product; therefore, the former techniques may be necessary to purify the product isolated by extraction. Technically, extraction is based on the principle of the balanced distribution of a substance (solute) between two immiscible phases, one of which is usually the solvent. The solvent need not be a pure liquid. It may be a mixture of several solvents or a solution of a chemical that reacts with one or more components of the mixture to be extracted to form a new, soluble substance. The substance to be extracted may be a liquid, a solid, or a mixture of both.

The ratio of the solute concentration in each solvent at equilibrium is constant and is called the distribution ratio (d) or distribution coefficient (Kd).

$$K_d = [\text{Organic Solute}] / [\text{Aqueous Solute}] = C_{org.} / C_{aq.}$$

The higher the value of Kd, the greater the amount of solute transferred to the ether with each extraction, and the less ether is required to almost completely remove the solute.

### **Properties of an Organic Extraction Solvent:**

- (1) It must readily dissolve the substance to be extracted but not significantly dissolve in it in the solvent from which the desired substance is extracted.
- (2) It must not extract impurities or other substances present in the original mixture.

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(3) It must not react with the substance to be extracted.

(4) The extraction solvent must be easily separated from the material after extraction, often because it has a low boiling point and is removed by evaporation or distillation.

Some of the most common solvents used include:

**diethyl ether**

**methylene chloride**

**chloroform**

**benzene**

**pentane and hexane**

### **Chemical and Apparatus**

benzoic acid,  $\text{CH}_2\text{Cl}_2$  (dichloromethane), water, separatory funnel, beaker,  $\text{CaCl}_2$ , boiling chip, hotplate, balance, filter paper, funnel

### **Procedure of experimental**

- 1- Weigh out 0.5 mg of benzoic acid and dissolve it in separatory funnel containing 1.6 mL  $\text{CH}_2\text{Cl}_2$ .
- 2- Add 1.6 mL distilled water and mix thoroughly.
- 3- Alternatively, you may shake the separatory funnel after sealing with a stopper.
- 4- Set the separatory funnel aside and allow the layers to separate.
- 5- Remove the aqueous layer without removing any organic layer.
- 6- Add anhydrous  $\text{CaCl}_2$  to the  $\text{CH}_2\text{Cl}_2$  layer

- ~~7- After 5 minutes of drying time, remove the organic layer and place in~~
- 8- a clean, dry, pre-weighed 10 mL Erlenmeyer flask with a boiling chip. 8-Evaporate the solvent on a hotplate in the hood to dryness.
- 9- Weigh the flask with boiling chip and benzoic acid. Use this mass to determine the weight of benzoic acid.

### **Questions for discussion**

1. What is the main purpose of extraction?

- A) Heating substances
- B) Measuring mass
- C) Separating a substance from a mixture using a solvent
- D) Changing color

2. Extraction mainly depends on:

- A) Density only
- B) Boiling point only
- C) Difference in solubility between two immiscible solvents
- D) Pressure

3. In extraction, we use:

- A) One solvent only
- B) Two miscible solvents
- C) Two immiscible solvents
- D) Solid and gas

4. Which of the following is a common extraction solvent?

- A) Water
- B) Ethanol
- C) Diethyl ether
- D) Glucose

5. Why is ethanol usually not used in aqueous extraction?

- A) It is toxic
- B) It cannot dissolve substances
- C) It is miscible with water
- D) It is expensive

6. What is the distribution coefficient ( $K_d$ )?

- A) Mass/volume ratio
- B) Ratio of solute concentration in organic phase to aqueous phase
- C) Boiling point
- D) Number of moles