Koya University

Faculty of Engineering

Chemical Engineering Department

Reactor Design Laboratory

Preparation of Solutions & Measuring Conductivity

Prepared by:

Dhuha luqman

Rezhin rzgar

Ali hiwa

Muhamad kazm

Twana dler

Supervised by:

mr. Blnd zrar

Table of content :

Aim:

To prepare solutions with specified volumes, and to measure their electrical conductivity .

Introduction :

In chemical engineering, solution preparation with precise concentrations and volumes is fundamental to ensuring accuracy and consistency in experimental outcomes. The preparation of solutions involves dissolving a specific amount of solute in a solvent to achieve a desired concentration, a process that requires careful measurement and thorough mixing to achieve uniformity. Accurate solution preparation is essential, as variations in concentration can significantly impact the properties and behaviors of the solution, including its electrical conductivity.

Conductivity measurement, which reflects the solution's ability to carry an electric current, is directly influenced by the concentration and types of ions present. In this experiment, solutions with a constant concentration will be prepared in specified volumes, focusing on achieving accurate and reproducible results. Conductivity measurements will then be taken to assess how the controlled preparation of solutions contributes to reliable and consistent data. This process is vital for applications ranging from quality control in industrial processes to environmental monitoring and water treatment.

Types of Solutions prepared in this experiment:

1. Sodium Hydroxide (NaOH) Solution

Characteristics: Sodium hydroxide, commonly known as lye or caustic soda, is a strong base that readily dissociates in water to form sodium (Na^+) and hydroxide (OH^-) ions. NaOH is highly soluble in water, making it an excellent source of OH^- ions, which significantly increases the solution's pH and conductivity. NaOH solutions are typically highly alkaline, corrosive, and reactive, requiring careful handling and precise preparation to ensure safety and accuracy.

Importance as a Solvent: NaOH is an essential solvent in chemical studies involving bases. Its high degree of ionization when dissolved allows it to conduct electricity well, making it ideal for experiments related to conductivity. In solution, NaOH enables researchers to study the behavior of strong bases and the interactions of OH^- ions with other substances.

2. Ethyl acetate (CH_3COOH) Solution

Characteristics: Acetic acid, also known as ethanoic acid, is a weak acid that partially ionizes in water, forming acetate (CH_3COO^-) and hydrogen (H^+) ions. Unlike NaOH, which dissociates fully, acetic acid only partially dissociates, leading to a lower concentration of ions in solution. As a result, CH_3COOH solutions have a lower pH than NaOH but are also less conductive. Acetic acid is a colorless liquid with a distinctive sour odor, known for its lower reactivity compared to strong acids.

Importance as a Solvent: CH_3COOH is a crucial solvent for studying weak acids, as its partial ionization allows researchers to observe the conductivity of solutions where ion availability is limited. Acetic acid's moderate dissociation and conductivity make it a useful standard for experiments that involve comparing the behavior of weak and strong electrolytes.

Equipment :

1- Cylinder
2- Two Big bottle for solutions
3- Conductivity meter
4- Hot plate
5- Laboratory Digital Weighting Scale

3- Conductivity meter

4- Hot plate

3 – Conductivity meter :

A **conductivity meter** is an instrument used to measure the **electrical conductivity** of a solution, which indicates its ability to conduct electricity. The measurement is often used to determine
The concentration of ions in a solution (e.g., salts, acids, or bases),
Water purity levels (e.g., in drinking water or industrial applications),
Process control in industries like wastewater treatment or chemical production.
It works by applying an electrical current between two electrodes in the solution and measuring the resulting voltage, which is proportional to the solution's conductivity. Conductivity is typically expressed in **microsiemens per centimeter (µS/cm)** or **millisiemens per centimeter (mS/cm)**.

4 – Hot plate :

A hot plate is a laboratory device used to heat substances. It consists of a flat, usually metal or ceramic surface that can be electrically heated to a specific temperature. Hot plates are commonly used in chemical laboratories for

Heating solutions in beakers, flasks, or other containers,

Supporting reactions that require a controlled temperature and

Boiling water or preparing substances for experiments.

Hot plates often include a temperature control knob and, in advanced models, digital displays for precise temperature adjustments.

Procedure :

Preparation of NaOH :

1- Prepare the Container Take a clean bottle or container suitable for the solution and Ensure it is dry and free from contaminants.

2- Add Distilled Water to the Bottle Using a measuring cylinder, pour the desired volume of distilled water into the bottle.

3- Weigh the NaOH Calculate the required amount of NaOH using the formula:
Mass of NaOH (g)=Molarity (M)×Volume (L)×Molar Mass of NaOH (40 g/mol) and Weigh the exact amount of NaOH using a weighing scale.

4- Dissolve the NaOH in the Extracted Water form distillated water Place the beaker containing the water on a hot plate, Slowly add the NaOH pellets to the water while stirring continuously and wait till the NaOH dissolved.

5-transfer the NaOH solution to the big bottle and shake the bottle .

6-measure the electrical conductivity and Temperature of NaOH solution using Conductivity meter .

Preparation of Ethyl acetate:

1- Prepare the Container Take a clean bottle or container suitable for the solution and Ensure it is dry and free from contaminants.

2- Add Distilled Water to the Bottle Using a measuring cylinder, pour the desired volume of distilled water into the bottle.

3- pour an amount of CH3COOH into a cylinder based on the volume of the distilled water which is 2 Litters at this experiment.

4- after that pour the CH3COOH to the water bottle and shake it.

5-measure the electrical conductivity and Temperature of CH3COOH solution using Conductivity meter .

Safety Precautions:

Safety Precautions for Sodium Hydroxide (NaOH)

NaOH is highly corrosive and can cause severe burns and eye damage. Always add NaOH to water, not the reverse, to avoid violent reactions. Handle with gloves, goggles, and a lab coat. Work in a well-ventilated area, and avoid contact with skin or eyes. Store it in a dry, sealed container away from moisture. In case of contact, rinse thoroughly with water and seek medical attention if necessary.

Safety Precautions for Ethyl acetate (CH_3COOH)

Acetic acid can cause irritation or burns, especially in concentrated forms. Always dilute by adding acid to water, not the other way around. Use gloves, goggles, and a lab coat when handling it. Ensure good ventilation to avoid inhaling fumes, and store it in a cool, well-ventilated area away from bases and flammables. If contact occurs, rinse thoroughly with water and seek medical help for severe cases.