

## Determination of Concentration of Acetic Acid in Commercial Vinegar



### General Aim

To determine concentration of acetic acid in a commercial vinegar sample of vinegar by titrating it with a standard solution of NaOH.

### Method

Determination of acetic acid by acid- base titration.

### Learning Objectives (ILOs)

- Identify the difference between acid and base.
- Define the meaning of a standard solution.
- Predict how a certain sample could be analyzed.
- Determine accurately the concentration of acetic acid in vinegar via volumetric analysis, making use of the reaction of acetic acid with a strong base, sodium hydroxide.
- Acquire the correct techniques of titration.

### Theoretical Background/Context

- Quantitative analysis deals with the determination of the quantity of the substance to be analyzed. Methods of quantitative analysis may be classified into:
  1. **Gravimetric analysis:** It depends on isolating and weighing of the final product with known pure, stable and definite form.
  2. **Instrumental analysis:** It depends on measuring some physical properties which change quantitatively with changing concentration of sample.
  3. **Volumetric analysis (Titration):** It depends on measuring volume of standard solution (titrant) used for complete reaction with the sample.
- Titration is the capacity of the sample to combine with the suitable standard quantitatively through quantitative reaction. A quantitative reaction is the reaction that proceeds forward to produce stable product(s) such as weakly ionizable compounds, e.g. H<sub>2</sub>O, weak acids & base, sparingly soluble salts (precipitate), complex ion, etc. The types of quantitative Reactions can be:
  1. Neutralization Reactions
    - a. H<sub>2</sub>O formation
    - b. Displacement: Formation of weak acid or weak base
  2. Complexometric reactions
  3. Redox reactions (Electron transfer)
  4. Precipitometric reactions

## Theoretical Background/Context

- Any sample is a solution of unknown concentration and a Standard is a solution of exactly known concentration. The requirements of titrimetric reactions are:
- The reaction must be simple and expressed by a chemical equation
  - A single reaction must occur between the sample and titrant
  - The reaction must be instantaneous (rapid).
  - Suitable standard solutions must be available.
  - The end point should be easily detected.

Oxidation is loss of electrons and increase in valency number, gain of oxygen or loss of hydrogen



Reduction is gain of electrons and reduction in valency number, loss of oxygen or gain of hydrogen



Oxidizing agent or oxidant is the substance that gain electrons

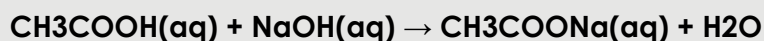


Reducing agent or reductant is the substance that donate (lose) electrons



## Principle of Work

- Vinegar is a common household item containing acetic acid as well as some other chemicals. This experiment is designed to determine the molar concentration of acetic acid in a sample of vinegar by titrating it with a standard solution of NaOH.



- By adding the sodium hydroxide, which is a basic solution, to the acetic acid, which is an acidic solution, a neutralization reaction occurs. An indicator known as phenolphthalein, is also added to the vinegar. This indicator turns the solution to a dark pink when excess NaOH is added to make the solution more basic.