PRACTICAL WORK N° 5

THE ACIDIC VINEGAR DEGREE DETERMINATION

I.INTRODUCTION

Vinegar is an aqueous solution with a low content of acetic (ethanoic) acid. which is used as a condiment or food preservative.

2.THE ACIDIC VINEGAR DEGREE (d°) OR (%):

The acidic vinegar degree is indicated on each commercial bottle, and noted **(d°)** or **(%)** is: **the mass (g)** of pure acetic (ethanoic) acid, **contained in 100g of solution (100g vinegar)**. Therefore, the percentage of acidity corresponds to a percentage by mass.

Example: vinegar at 6° or 6% contains 6g of pure acetic (ethanoic) acid per 100g of vinegar solution.

Calculation example:

For a volume of 100g of vinegar (Ac: acetic acid)

$m_{Ac} = n_{Ac}*M_{Ac} = C_{Ac}*V_{Ac}*M_{Ac}$ ….(1) (from the formula $n = C*V$)

We have also : $d_{Ac} = \rho_{Ac}$ (from the formula $d_{solution} = \rho_{solution} / \rho_{water}$ ($\rho_{water} = 1$))

$= m_{Ac}/V_{Ac}$

$V_{Ac} = m_{Ac}/\rho_{Ac}$ ..... **(2)**

We replace (2) on (1): $m_{Ac} = m_{Ac} / \rho_{Ac} * C_{Ac}*M_{Ac}$. So , $m_{Ac} = 100 / \rho_{Ac}*C_{Ac}*M_{Ac}$

The acidic vinegar degree (d°) or (%) = $100 / \rho_{Ac} * C_{Ac}*M_{Ac}$ (g)

The determination of the acidic degree of vinegar can be followed by:

2.1 An acid-base titration (as seen on PW3)

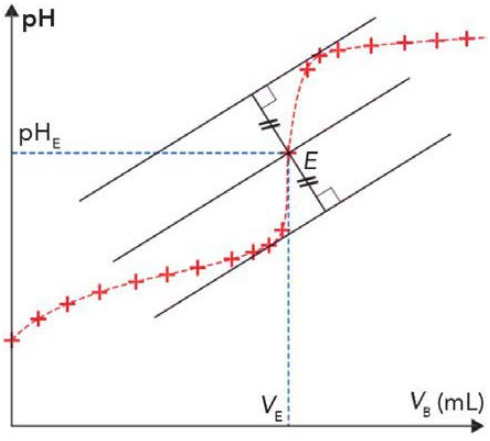
A titration reaction is used to determine the concentration of a species in solution (**C_{Ac} = …?)** (Ac: Acetic acid)

A first solution of unknown concentration **"titrate solution C_{Ac}"** is brought into contact with a second solution of known concentration **"titrant solution C_B"** (B=NaOH). The titrant solution is gradually poured into the titrate solution **drop by drop** until the equivalence point is reached.

At the equivalence point
$n_{eq.g}$ (Ac) = $n_{eq.g}$ (NaOH)

2.2 A pH metric titration:

During a pH-metric titration, the pH of the **"titrate solution C_{Ac}"** is measured for each volume of **"titrant solution C_B"** poured. In order to be able to represent regularly the experimental points, the titrant solution must be added milliliter by milliliter.



The pH-metric titration curves (pH = f (V_{Badded}) gives the variations in pH as a function of the volume of titrant solution poured show sudden jumps in pH at the equivalence.

The identification of the equivalent volumes, consists of drawing two tangents to the curve pH = f(V_{Badd}), parallel and placed on either side of the inflection point; then drawing a straight line parallel to these two tangents, equidistant from them. This last straight line intersects the titration curve at the equivalence point, with abscissa V_{eq} and ordinate pH_{eq}.

3.OBJECTIVES:

The main objective of this practical work is :
Determination of the acidic degrees of commercial vinegar solution.

4.PRINCIPAL OF MANIPULATION:

This titration is based on a colorimetric acid-base dosage. And also, on pH metric analysis.

5.MATERIAL AND PRODUCTS:

-Burette (25-50 mL)
-Graduated or volumetric pipettes (10 mL)
-Pro-pipette
-Volumetric flasks (100 mL)
-Erlenmeyer flask (100 mL)
-Sodium hydroxide solution (0.1M NaOH)
- Commercial vinegar solution
-pH meter or pH-paper
-Colored indicator
-Beakers

6. PREPARATION OF THE DILUTE COMMERCIAL VINEGAR SOLUTION:

1. Take a clean beaker, and pour a small quantity of vinegar solution of unknown concentration S_{Ac} .
2. Take a volume of 10 ml of the solution S_{Ac} (use the rinsed pipette).
3. Introduce this test portion into the 100 ml volumetric flask, complete with distilled water, close it with the stopper and shake.

You obtain a solution C_{Ac} (vinegar solution of unknown concentration).

7.TITRATION OF THE DILUTE COMMERCIAL VINEGAR SOLUTION:

7.1Rapid titration (mL by mL) :

1- Rinse and Fill the burette with the NaOH solution (N_B= 0.1N).
2- Take (V_{Ac}=10 ml) of the dilute vinegar solution and place it in a 100 mL erlenmeyer flask.
3- Add 2 drops of the colored indicator.
5- Make a rapid titration (mL by mL) to estimate the equivalent volume (V_B).
6- At the same time, using a pH paper or pH meter, read the pH of the solution C_{Ac} every mL NaOH until the equivalent volume.
7- The solution change color when you added the equivalent volume of titrant solution **(Veq)** . Indicate approximately this volume (by a frame):

……. V_1 mL < Veq < ……. V_2 mL

Table1 : Volumes equivalents

$V_{NaOH\ titrant}$ (mL)	1	2	3	4	5	6	7	8	9	10
Color solution										

7.2 Precis titration (drop by drop):

1- Fill the burette with the NaOH solution (N_B= 0.1N).
2- Take (V_{Ac}=10 ml) of the dilute vinegar solution and place it in a 100 mL erlenmeyer flask.
3- Add 2 drops of the colored indicator.
4- Make precise titration (drop by drop) to estimate the exactly equivalent volume (V_{eqB}).
5- Indicate the exactly equivalent volume

Table2 : Equivalents volumes :

	1st test	2nd test	$V_{eqB(average)}$
V_B (mL)			
Color solution			

8.QUESTIONS:

1-Write down the reaction equation between acetic acid and NaOH.

2- Note the exactly equivalent volume V_{eqB} of (NaOH) added and determine the concentration C_{Ac} of (dilute vinegar solution).

3- Calculate the initial molar concentration S_{Ac} of the acetic acid (commercial vinegar).

4- Calculate the degree of acidity of the vinegar (d°) and compare this result with that on the sticker on the commercialized bottle.

5- Draw the graph representing the value of pH= f(V_B) added on the rapid titration (on millimetric paper).

6- Determine the equivalent volume V_{eqB} and the pH at equivalence using the graph.