Al-Mustaqbal University
College of Engineering and Engineering Technologies
Department of Chemical Engineering and Petroleum Industries

EXPERIMENTS(2)

SECOND CLASS

1 ND SEMESTER

PHYSICAL CHEMISTRY

LABORATORY

By

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Experiment No. (2): ***Saponification of Ethyl Acetate***

Object of Experiment:

To calculate the rate constant of the reaction and half of time.

Theory:

Ester Saponification in the base solution as in the following equation: -

$$CH_3COOC_2H_5 + NaOH \longrightarrow CH_3COONa + C_2H_5OH$$

This reaction is example of second _degree order because the speed of the reaction depends on concentration of each of the ester and base and it is expressed mathematically: -

$$\frac{dx}{dt} = k (a - x) (b - x)$$

Where :-

a = molary concentration of ethyl acetate.

b = molary concentration of (NaOH).

x = volume of reactant.

t = time.

To calculate the rate constant of the reaction if a = b, the following equation can be used: -

$$\frac{1}{A_t} - \frac{1}{A_o} = K t$$

- or from equation:

$$k = \frac{1}{t} \times \frac{x}{a\,(a - x)}$$

Procedure:-

1- Place 25 ml from (0.05*N*) of ethyl acetate in conical flask (1).

2- Place 25 ml from (0.05*N*) of NaOH in conical flask (2).

1- Fill the burette with (0.025*N)* of HCl.

2- Add the solution in flask (1) to the solution in flask (2) then record the time (Timer).

3- Take 10 ml from the mixture in step (4), and add to it several drops of ph.ph. as an indicator.

4- Add (0.025*N)* of HCl drop by drop from the burette until the pink color just disappear then record the quantity in ml of (0.025*N)* of HCl solution used.

5- Repeat the step (5 and 6) every 5 minutes.

Calculation:-

1- Record readings in the table as following:-

Time (min.)	Volume of HCl (0.025 *N*)
0	1st reading from burette
5	2nd reading from burette
10	3rd reading from burette

15	4th reading from burette

2- At t = 0 min. (initial time)

HCl NaOH

$N * V_{burette} = N * V_{NaOH}$

$0.025 * V_{burette} = 0.05 * V^{?}_{NaOH} \Longrightarrow V_{NaOH} =$ ⬭

3- At t = 5 min.

➢ HCl NaOH

$N * V_{burette} = N * V_{NaOH}$

$0.025 * V_{burette} = 0.05 * V^{?}_{NaOH} \Longrightarrow V_{NaOH} =$ ⬭

➢ Calculate the rate constant of the reaction (k) theoretically at different points time by:-

$$\frac{1}{A_t} - \frac{1}{A_o} = K\,t$$

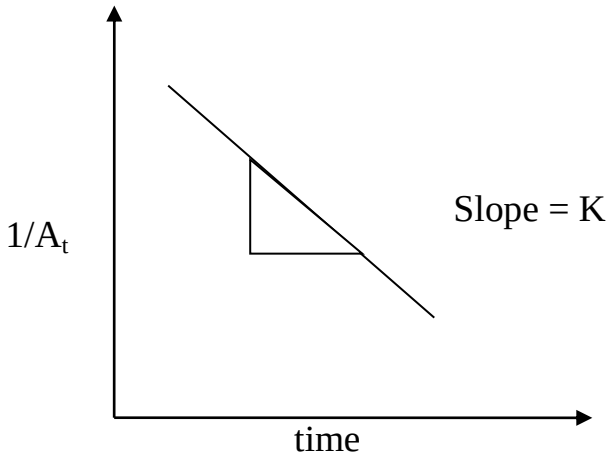
$$\frac{1}{0.05 * V_{residual}} - \frac{1}{V_{original} * 0.05} = K\,t$$

4- Calculate average rate constant of the reaction ($k_{average} = \sum k$ / no. of k).

5- Calculate the half of time ($t_{1/2}$) theoretically by:

$$t_{0.5} = \frac{1}{A_o * k_{average}}$$

6- Plot a curve between ($1/A_t$) on the y-axis and time on the x-axis, calculate (k) from the curve, where the slope = k .



7- Calculate the half of time ($t_{1/2}$) graphically by: $t_{0.5} = \frac{1}{A_o * k_{\text{from figure}}}$

Discussion:

1- Why the reaction is second order?

2- Explain the reaction between reactants and discuss the results.

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