Class: 2nd stage

Subject: Physical Chemistry

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(Physical Chemistry lab)

Experiment No.7
(Hydrolysis of methyl acetate)

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Theory:

The hydrolysis of methyl acetate by water gives methanol and acetic acid according to the following equation:

$$CH3COOCH3 + H2O \rightarrow CH3COOH + CH_3OH$$

The above reaction does not take place at a speed that can be measured in pure water, but hydrogen ions act as a catalyst that increases the speed of the reaction. Despite the presence of more than one type of molecules involved in the above reaction, the reaction is of the first order, because water is present in the reaction in a large increase compared to the ester. Moreover, the following mathematical equation is used to solve the practical problems:

$$Ln\ (V_\infty - V_t) = -k_1 t + ln\ (V_\infty - V_0)$$

where:

- v_0 = is the original volume
- v_t = the volume after time t
- v_∞ = the volume after 24 hours (the end of the reaction)
- k = the reaction velocity constant

- **Half-life** is the time required for a quantity to reduce to half of its initial value. The term is commonly used in nuclear physics to describe how quickly unstable atoms undergo radioactive decay or how long stable atoms survive.

$$t_{1/2} = \ln 2/K$$

- **The speed of the reaction (reaction velocity (rate) constant) is** a change in the concentration of the reactants, or the resultant, per unit of time, where the concentration of the resulting substances increases and the concentration of the reactants decreases with the passage of time based on the law of preservation of the substance. In this article, we will talk about the law of reaction speed, and the factors affecting it.

$$\text{Slope} = -K$$

Aim of the experiment:

To Find:

- The order of the reaction
- The reaction velocity constant k
- The half-life of t1/2

Experimental procedures:

1. Prepare 100 ml of water and HCL (0.1 N HCl) in a flask.
2. Put 0.05 N NaOH in burette.
3. Transfer the whole amount of acid into a flask, and add about 3ml methyl acetate to the flask. Now start time recording.

4. After about 5min withdraw 5 ml of the solution, run into about 2 drops of phenol-phthalein as indictor and 20 ml ice-cooled water to arrest the reaction (the mix is colorless).
5. Titrate the solution rapidly with 0.05 N NaOH. With the appearance of the light pink color, close the burette and record the reading. The reading here represents Vt.
6. Repeat the process every 5 min until making about five determinations over a period extending for about 25 min.
7. Carry out one similar determination after asufficiently long time, say 24 hour, when hydrolysis is complete. The reading here represents V∞.

Calculation:

1. Fill the following table to find the value of Ln(V∞ - Vt).

tmin	Vt	V∞	V∞ - Vt	Ln(V∞ - Vt)
5				
10				
15				
20				
25				

2. Plot Ln(V∞ - Vt) against t.
3. From the graph, calculate the rate constant K and the half -life period t(1/2).

Discussion:

1. What hydrolysis means?
2. What is hydrolysis of methyl acetate?
3. What is the order of hydrolysis of methyl acetate?
4. What is the equation for the formation of methyl acetate?
5. What is the role of HCl in hydrolysis of methyl acetate?