

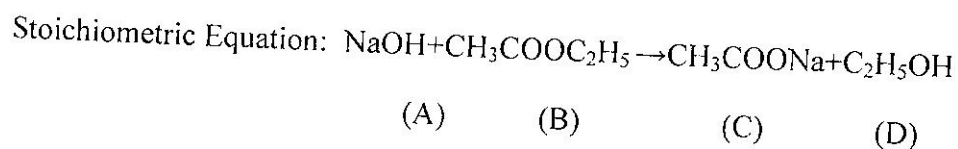
EXPERIMENT NO. 4

Kinetics Study in a Batch Reactor

Object:

- (1) To determine the order of reaction between sodium hydroxide and ethyl acetate.
- (2) To find the rate constant at three temperatures.
- (3) To determine the activation energy and the frequency factor.

Theory:



Rate Equation:

$$r_A = -\frac{dC_A}{dt} = k_2 C_{A_0} (1 - X_A)(M - X_A) \quad (\text{assuming } 2^{\text{nd}} \text{ order})$$

Where $M = \frac{C_{B_0}}{C_{A_0}}$; t = time in min; X_A = conversion of A; k_2 = rate constant in $\text{lit}/(\text{gmol})(\text{min})$

The integrated form: $\ln \frac{M - X_A}{M(1 - X_A)} = C_{A_0} (M - 1) k_2 t$, where $M \neq 1$

Apparatus:

- (i) A stainless steel batch reactor fitted with stirrer
- (ii) Constant temperature bath
- (iii) Stop watch
- (iv) Titration flask

Chemicals:

- (i) NaOH(N/20) solution
- (ii) Succinic acid(N/50) solution
- (iii) Ethyl acetate pure

(iv) Phenolphthalein solution

Procedure:

- (i) One liter of (N/20) NaOH solution is poured in the batch reactor. 9 ml of pure ethyl acetate (as supplied) is added and at the same time start the stop- watch.
- (ii) Then 5 ml of solution is pipette out in each one minute interval and titrated against standard (N/50) succinic acid solution with indicator as quickly as possible. Take at least 5 samples at definite time interval.
- (iii) Repeat the experiments for three temperatures at room temperature, 45° and 10°C for low temperature samples are to be taken at 2-minutes interval.
- (iv) Titrate 5ml of supplied NaOH solution with succinic acid solution using phenolphthalein indicator.
- (v) Find rate constant k_2 from the plot $\ln[(M-X_A)/M(1-X_A)]$ VS. t
- (vi) Determine k_2 at three temperatures and plot $\ln k_2$ against $1/T$.
- (vii) Take 5 ml of the supplied NaOH solution by the standard succinic acid solution to get $C'A_0$ gmol/lit.