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NOTE

Kinetic Study of First Order Ion Exchange Reaction by the Application of Tracer Technique

R.S. LOKHANDE* and M.V. GANDHE
Department of Chemistry, University of Mumbai
Kalina, Vidyanagari, Santacruz, Mumbai-400 098, India

Analysis of the kinetic study of first order ion exchange reaction rate varying from 26 to 48°C and also at different concentration of potassium iodide solution (0.005 M to 0.1 M) was carried but by the application of a tracer isotope ^{131}I. The specific reaction rate for the change in temperatrue as well as the amount of resin was calculated. It was observed that as the temperature increases, *i.e.*, from 26 to 48°C at 0.005 M there is an increase in the specirfic reaction rate, but there is an pronounced increase when the amount of resin increases from 1g to 5g at 0.005 M at 26°C. The energy of activation was also calculated for various temperatures at different concentrations. It was observed that there is decrease in the energy of activation as the concentration increases.

Radioactive tracers[1] have gradually become integrated in to process analysis as a measuring tool. As a result, radiotracers are used to study numerous migration problems[2] of ions other than self diffusion, particularly when very small amount of material is involved. Radiotracers are also used in industrial process plants. Fission products[3, 4] like ^{137}Cs and ^{90}Sr having long half life, find a variety of application in food irradiators and also in systems for nuclear power.

The present investigation is the kinetic study of first order ion exchange reaction with the application of an radioactive tracer isotope ^{131}I on Duolite A-113 a strongly basic anion exchanger.

The ion exchange resin Duolite A-113 which was supplied by the manufacturer Auchtel Products Ltd. Mumbai in chloride form was converted into iodide form by conditioning it with 10% potassium iodide. The conditioned resin is then air dried and used for further experimental study.

In the present investigation different concentration of potassium iodide ranging from 0.005 M and 0.1 M was prepared by using diluted tracer isotope ^{131}I. These solutions of different concentrations were labelled, such that 1.0 mL of this labelled solution will have known initial activity between 16,000 to 17,000 cpm (counts per minute), when measured on a γ-ray Spectrometer (Electronics Corporation of India Ltd.)

To these solutions known amount of conditioned resin (1.0 g) was added and the activity of the solution was measured at an interval of every minute. Initially the activity goes on decreasing very rapidly and then continuous to decrease very slowly. When a graph of log activity (cpm) against time (min) is plotted a composite curve is obtained and by resolving the graph, specific reaction rate (min^{-1}) was calculated for rapid process. Similar experiments are carried out for different temperatures ranging from 26 to 48°C and also experiments are carried out for varying the amount of resin from 1 g to 5 g at an constant concentration and temperature.

The kinetic study on the strongly basic anion exchanger Duolite A-113 reveals many interesting features.

The specific reaction rate (min^{-1}) when observed, revealed that as the temperature increases the specific rate increases (Table 1) which is due to increase in the collisions between the molecules when temperature is increased. But the increase is more sharp when the amount of resin is increased (Table 2). In this exchangeable counter ions increases resulting an increase in the specific reaction rate. Energy of activation is also calculated from specific reaction rate calculated at different temperatures, which is given by the Equation $E = \text{slope} \times -2.303 \times R$, where R is a gas constant. (Table 3). It was seen that the energy of activation decreases as the temperature goes on increasing. This is the because as the temperature increases, number of collisions in the solution increase utilising more energy.

TABLE-1
EFFECT OF TEMPERATURE ON THE REACTION RATES OF ION EXCHANGE REACTION

Concentration of labelled iodide ion solution : 0.005 M; Amount of ion exchange resin : 1.0 g

Temperature(°C)	25	32	37	43	48
Specific Reaction Rate (min^{-1})	0.112	0.136	0.149	0.168	0.184

TABLE-2
EFFECT OF AMOUNT OF RESIN ON ION EXCHANGE REACTION RATE

Concentration of iodide ion solution : 0.005 M at 26°C

Amount of ion exchange resin (g)	1	2	3	4	5
Specific Reaction Rate (min^{-1})	0.112	0.161	0.204	0.221	0.253

TABLE-3
EFFECT OF CONCENTRATION OF IODIDE ION SOLUTION ON ENERGY OF ACTIVATION ON ION EXCHANGE REACTION

Amount of ion exchange resin : 1 g; Volume of labelled iodide ion solution : 200 mL

Concentration of labelled iodide ion in solution (M)	0.005	0.01	0.02	0.04	0.1
Energy of activation (E kJ/M)	4.456	4.208	3.825	3.347	3.175

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