Asian Journal of Chemistry Vol. 10, No. 2 (1998), 364–366

NOTE

Kinetics of Ion Exchange Resin Amberlite IRA 400

R.S. LOKHANDE* and PRAVIN U. SINGARE
Department of Chemistry, University of Mumbai
Vidyanagari, Mumbai-400 098, India

^{131}I has been employed as a tracer to study kinetics of first order reaction. The study was carried for different concentrations of KI solution [electrolyte], different temperatures and different amounts of ion exchange resins. Reaction rates were calculated by using first order reaction rate equation. From the reaction rates the energy of activation was calculated. The energy of activation was found to decrease with increase in concentration of the electrolyte. For concentration of 0.0025 KI solution, energy of activation is found to be 4.95 kJ/mole which decreases to 4.08 kJ/mole for 0.020 M solution.

Although radioactive tracer isotopes like Cs-137 and Sr-90 in multicurie quantities are used in food irradiators and in systems for nuclear plants[1,2], the major application of tracers is in the study of migration problems[3] other than self-diffusion particularly when the movements of very small amounts of materials are involved, which is due to the fact that tracer isotope serves as a relatively convenient analytical tool. In the present investigation, ^{131}I has been successfully used as a tracer isotope to study kinetics of first order ion exchange reaction for different temperatures and particularly at low concentration of electrolyte.

Amberlite IRA-400 which is a strongly basic anion exchanger in chloride form is used in the entire study by converting it into iodide form using 10% potassium iodide solution, in a conditioning column. These conditioned resins were air dried and used for further study. For calculating first order ion exchange reaction rate, kinetic study was carried between labelled potassium iodide solution of different concentrations and resin in iodide form. Such kinetic study was carried on for different temperatures ranging from 27.0°C to 48.0°C and for different amounts of ion exchange resins. Kinetic study was also performed between labelled ion exchange resins and potassium iodide solutions of different concentrations. For labelling ion exchange resins and potassium iodide solution, ^{131}I was used as a tracer isotope.

In kinetic studies for analysis of first order ion exchange reaction, it was observed that as the temperature of electrolyte increases the number of collisions between reacting molecules increases and hence the reaction rates increases

(Table-1). With increase in amount of ion exchange resins the number of exchangeable ions increases and hence the reaction rate increases much more rapidly (Table-2). From the reaction rates calculated at various temperatures, energy of activation for ion exchange reaction in kJ/moles is calculated by Arrhenius equation. It was observed that as the concentration of iodide ion solution increases the number of effective collisions between the reactants increases and hence the energy of activation decreases with increasing concentration of iodide ion solution (Table-3). The amount of iodide ion exchanged in millimoles is calculated for different concentrations of iodide ion solution (Table-4). It is interesting to note that this increase takes place for the same reaction rate and the same temperature of iodide ion solution.

TABLE-1
EFFECT OF TEMPERATURES ON ION EXCHANGE REACTION RATES

Concentration of potassium iodide solution	0.010 M
Amount of ion exchange resins	1.0 g

Temperature (°C)	Reaction rate (min^{-1})
27.0	0.123
32.0	0.143
38.0	0.155
43.0	0.166
48.0	0.175

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

Concentration of potassium iodide solution	0.010 M
Temperature	27.0°C

Amount of ion exchange resin/g	Reaction rate min^{-1}
0.250	0.080
0.500	0.092
0.750	0.115
1.000	0.122
1.250	0.150
2.000	0.173

TABLE-3
VARIATION OF ENERGY OF ACTIVATION WITH CONCENTRATION OF ELECTROLYTE

Concentration of iodide ion solution [M]	Energy of activation kJ/Mole
0.0025	4.95
0.0050	4.72
0.0100	4.50
0.0200	4.08

TABLE-4
VARIATION OF AMOUNT OF IODIDE ION EXCHANGED WITH CONCENTRATION OF IODIDE ION SOLUTION

Amount of ion exchange resin 1.0 g
Temperature 27.0°C

Concentration of iodide ion solution [M]	Reaction rate min^{-1}	Amount of iodide ion exchanged [milimoles]
0.005	0.121	0.680
0.010	0.123	1.164
0.020	0.129	1.650
0.040	0.127	2.693
0.100	0.126	5.537

REFERENCES

1. *Isotopes and Radiation Technology*, **1** (4), 325–339 (1964).
2. Large scale production and application of radio isotopes, Proceedings of American Nuclear Society, National Topical Meeting, U.S.A. DP-1066 (1960).
3. G. Friedlander and J.W. Kennedy, Nuclear and Radiochemistry, 2nd printing, John Wiley and Sons Inc., New York, p. 312. (1956).

(*Received:* 1 September 1997; *Accepted:* 14 November 1997) AJC-1395