

PRODUCTION OF ETHYL ACETATE USING CATALYTIC REACTION METHOD

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ABSTRACT

Chemical industries drive towards heterogeneous catalysts which meet generation of nearly zero waste chemicals and less energy utilization. Ethyl acetate synthesis by esterification of acetic acid with ethyl alcohol occurs very slowly in the absence of catalyst. In order to make the reaction faster, both homogeneous and heterogeneous catalysts can be employed.

In this work ethyl acetate production using homogeneous and heterogeneous catalysts are studied. Two types of inexpensive cation exchange resins locally available in the market are used for the heterogeneous reaction. The homogeneous catalyst study for the ethyl acetate production is done using sulphuric acid catalyst.

The study of esterification reaction over heterogeneous catalysts showed maximum conversions of acetic acid in the range 62% to 58% at varying reaction conditions. The heterogeneous reaction experiments carried out within the temperature range 325K to 355K showed second order reversible reaction kinetics. Low activation energy values are observed in the heterogeneous catalyst reactions compared to that of homogeneous experiments. Heterogeneous reaction kinetics study done by examining the effect of initial concentration of acetic acid, ethanol and water on initial reaction rate indicated that the reaction follows Eley-Rideal mechanism. The reusability of the solid catalyst and the reactive distillation of ethyl acetate are also looked at briefly.

Keywords: Esterification, Ethyl acetate, acid catalyst, cation exchange resin



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NOMENCLATURE

A- Carboxylic acid
 B- Alcohol
 E - Ester
 W - Water
 C_{A0} – Initial concentration of carboxylic acid
 C_{B0} - Initial concentration of alcohol
 C_{E0} - Initial concentration of ester
 C_{W0} - Initial concentration of water
 X_A - Equilibrium conversion of carboxylic acid
 k_1 – Forward reaction rate, l/mol/min
 k_2 – Backward reaction rate, l/mol/min
 K_{eq} -Equilibrium constant
 C_{Ae} – Concentration of carboxylic acid at equilibrium
 C_{Be} - Concentration of alcohol at equilibrium
 C_{Ee} - Concentration of ester at equilibrium
 C_{We} -Concentration of water at equilibrium
 X_{Ae} – Conversion of carboxylic acid at equilibrium
 t – Time
 E – Activation energy
 k_0 - Pre-exponential factor
 R – Real gas constant
 T - Reaction temperature
 θ_A – Fractional coverage of component A
 θ_B – Fractional coverage of component B
 θ_C – Fractional coverage of component C
 θ_D – Fractional coverage of component D
 θ_V – Fraction of vacant adsorption sites on resin surface
 r – Reaction rate
 r_{ads} – Rate of adsorption
 r_{des} – Rate of desorption
 K_{SA} – Adsorption equilibrium constant of reactant A

