Kinetic Studies of Free Fatty Acid Esterification using Cation Exchange Resins as Catalyst

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Abstract

Objective: The aim of this work is to study the kinetics of Free Fatty Acid (FFA) esterification using cation exchange resins with different polymer structure arrangement as catalysts. **Methods/Statistical Analysis:** In this current work, cation exchange resins (i.e. Sulphonated Hypercrosslinked Exchange Resin (SHER), RCP160M and SK104H) were employed as catalysts in free fatty acid (FFA) esterification of Simulated Used Cooking Oil (SUCO). The kinetic models, pseudo-homogenous (PH), Langmuir-Hinshelwood-Hougen-Watson (LHHW) and Eley-Rideal (ER) model were used to correlate the experimental data. The kinetic parameters i.e., the rate constant, adsorption coefficients and activation energy were determined using the non-linear regression analysis in POLYMATH 6.10 program. **Findings:** The kinetic results revealed that the esterification reaction of SUCO using SHER was successfully fitted with LHHW model, whereas for RCP160M and SK104H the experimental data was well fitted by the ER model (Case II) and ER model (Case I) respectively. The activation energy, Ea was observed to be 48.8, 37.2 and 45.3 kJ mol-1 for SHER, RCP160M and SK104H, which the reaction step were governed by chemical step (Ea> 15 kJ mol-1) and there is no mass transfer limitation occurred during the reaction. **Application/Improvements:** From the findings, the newly synthesized SHER was found to be a promising catalyst in the esterification of FFA.

Keywords: Cation Exchange Resin, Esterification, Free Fatty Acid, Kinetics, Simulated used Cooking Oil