Studies on free fatty acid esterification of used cooking oil: investigation on the performance of sulphonated cation exchange resins

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ABSTRACT

Used cooking oil (UCO) is one of the potential substitutes for conventional biodiesel feedstock. In this study, different types of macroporous cation exchange resins, namely RCP160M, RCP145H, PK228LH, PK216LH, PK208LH, SK104H and SK1BH, were used as catalysts in the UCO esterification process. These resins were characterised using Fourier transform infrared spectroscopy (FT-IR), nitrogen physisorption, scanning electron microscopy (SEM), an elemental analyser (CHNS), titration and a particle size distribution (PSD) analyser to determine their physicochemical properties. These catalysts were screened and RCP160M resin was found to give the best catalytic performance. RCP160M was used in subsequent studies focusing on the effect of different esterification variables. A conversion rate of 95% of free fatty acid (FFA) was achieved at the optimum condition with catalyst loading of 4 wt. %, reaction temperature of 60°C, and methanol-to-oil mass ratio of 18:1. RCP160M shows great potential as a catalyst in the biodiesel pre-treatment process as it outperformed the other catalysts and yielded maximum FFA conversion. This may be attributed to its higher specific surface area and total pore volume. The kinetic results revealed that the experimental data was best fitted to the Eley-Rideal model (Case II) with the activation energy of 37.2 kJ mol^{-1}.