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Re-esterification of high free fatty acid oils for biodiesel production

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Abstract

The high free fatty acids (FFA) in most of the non-edible oils hinders their direct application in the production of biodiesel by using the traditional homogeneous base transesterification. In this study, a low temperature re-esterification process has been applied to reduce the FFA in castor oil for base catalysed transesterification. The response surface methodology based on central composite design was used to model and optimize the re-esterification efficiency under three reaction variables: reaction time, temperature, and glycerol to oil mass ratio. The optimum conditions for the highest re-esterification efficiency of 99.01% were found to be temperature of 56°C, reaction time of 85 minutes, and 2.34 g/g glycerol to oil mass ratio. These conditions reduced the high FFA of crude castor oil from 6.50% to 0.06% which is below the 3% recommended for alkali catalysed transesterification. The re-esterified oil was then transesterified using homogeneous base transesterification, resulting into a conversion of 97.95%. Except for viscosity, most fuel properties of the produced biodiesel were found to be comparable to those of ASTM D6751 and EN 14214 standards.

Keywords: glycerolysis, re-esterification, biodiesel, feedstock, free fatty acids