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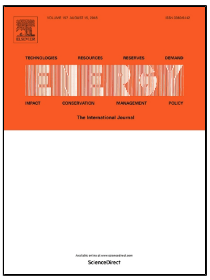

Valorisation of high acid value waste cooking oil into biodiesel using supercritical methanolysis: Experimental assessment and statistical optimisation on typical Egyptian feedstock

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Valorisation of high acid value waste cooking oil into biodiesel using supercritical methanolysis: Experimental assessment and statistical optimisation on typical Egyptian feedstock

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ABSTRACT

In this study, valorisation of high acid value waste cooking oil into biodiesel has been investigated. Non-catalytic transesterification using supercritical methanol has been used for biodiesel production. Four controllable independent process variables have been considered for analysis including methanol to oil (M:O) molar ratio, temperature, pressure and time. Uncommon effects of process variables on the reaction responses, i.e. biodiesel and glycerol yields, have been reported and extensively discussed. Response surface methodology (RSM) *via* Central Composite Design (CCD) has been used to analyse the effect of the process variables and their interactions on the reaction responses. A quadratic model for each response has been developed representing the interrelationships between process variables and responses. Analysis of Variance (ANOVA) has been used to verify the significance effect of each process variable and their interactions on reaction responses. Optimal reaction conditions have been predicted using RSM for 98% and 2.05% of biodiesel and glycerol yields, respectively at 25:1 M:O molar ratio, 265^{o}C temperature, 110 bar pressure and 20 minutes reaction time. The predicted optimal conditions have been validated experimentally resulting in 98.82% biodiesel yield, representing 0.83% relative error. The quality of the produced biodiesel showed excellent agreement with the European biodiesel standard (EN14214).

KEYWORDS

Biodiesel, Biomass valorisation, Waste cooking oil, Supercritical methanolysis, Optimisation, Response Surface Methodology.

HIGHLIGHTS

- Successful valorisation of high acid value waste cooking oil into biodiesel.
- Effect of reaction parameters on responses has been comprehensively discussed.
- Reaction optimal conditions has been predicted using Response Surface Methodology.
- Excellent correlation between predicted and experimental optimal conditions.

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