J Fundam Renewable Energy App 2016, 6:6(Suppl)
http://dx.doi.org/10.4172/2090-4541.C1.021

Efficient biodiesel production via solid superacid catalysis: A critical review on recent breakthrough

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Biodiesel produced from triglycerides and/or free fatty acid (FFA) by transesterification and esterification has attracted immense attention during the past decades as a biodegradable, renewable and sustainable source of energy. Homogeneous basic catalysis has been developed for this process due to their high biodiesel yield. However, post-production processes and soap formation due to inefficiency in processing high FFA feedstock are drawing this process back. Recently, homogeneous acid catalysis towards biodiesel production has been more attractive, since they support both esterification and transesterification simultaneously. The foremost impediment to this commercialization is associated with corrosion, purification slower reaction and higher reaction temperature. Currently, solid superacid catalysts has proved more efficient and "green" approach due to avoidance of environmental and corrosion problems, and reduce product purification procedures. Therefore, this study gives a critical review on recent breakthrough towards efficient and a "greener" production of biodiesel via solid superacid catalysis. The advances includes: Alkyl-Bridged Organosilica Moieties Functionalized Hybrid Catalysis; pre- and *in situ* water removal and process intensification: Temperature profile reduction.

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Factor interactions, optimization and modelling of biodiesel production from *Jatropha curcas* oil by the application of central composite design – response surface methodology

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Biodiesel is a fuel that is produced from biological sources. In this work, optimization, factor interactions and modelling of biodiesel production from *Jatropha curcas* oil were investigated. The biodiesel was produced via a batch-process base-catalyzed transesterification reaction of the oil with methanol. The process was optimized by the application of 3^3 (three factors at three levels) central composite design and response surface methodology (CCD-RSM) while keeping reaction temperature constant at 60°C. A second order polynomial regression model of the form $Y = 92.30 + 3.84X_1 - 2.83X_2 - 3.15 X_3 - 3.95X_1^2 - 5.46X_2^2 - 10.94X_3^2 - 2.44X_1X_2 + 5.46X_1X_3 + 1.73X_2X_3$ was obtained to predict the biodiesel yield (Y) as a function of reaction time (X_1), NaOH catalyst concentration (X_2) and methanol to oil molar ratio (X_3). There was no significant interaction between X_2 and X_3 ($p>0.05$), whereas significant interactions existed between X_1 and X_2 on the one hand and X_1 and X_3 on the other hand ($p<0.05$). The model can adequately be used for theoretical prediction of biodiesel yield in the range studied (R^2 value of 0.9583). Optimal factor levels obtained were reaction time (2.28h), NaOH catalyst concentration (1.62%), methanol: oil ratio (5.92:1) and a maximum biodiesel yield of 94.03%. Catalysis and reaction time were vital factors in the transesterification reaction.

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