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Materials chemistry and applications

Biodiesel production from residual edible oils catalyzed by ionic liquid hydrogen sulfate 1-butyl-3-methylimidazolium, [BMIM][HSO_4]

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Due to the countless environmental and energy problems related to the burning of fuels from fossil resources, that is, non-renewable fuels such as oil, natural gas, or coal, leading to a significant decrease in reserves and to an increase in concern about the global warming problem, has led the scientific community to look for sustainable and renewable alternatives. Thus, biofuels have emerged as a promising way to replace non-renewable fuels, including biodiesel.[1]
Biodiesel is defined as a mixture of monoalkyl esters of long chains of fatty acids (FAME), which can be obtained by converting vegetable oils or animal fats through transesterification or esterification reactions. Due to its numerous advantages, such as biodegradability, low viscosity, high flash point and low environmental impacts, it has the potential to be used directly in diesel engines, without any modification.[2]
The objective of the present work is to evaluate the potential of the use of the ionic liquid [BMIM] [HSO4] in the catalysis of the reactions of production of biodiesel from a simulated oil, composed of used cooking oil incorporated with oleic acid, and methanol.
The operation parameters: reaction time (2, 4 and 6h), catalyst dosage (5, 10 and 15%), molar ratio of oil/methanol (1: 5, 1:10 and 1:15 mol/mol) and incorporation of oleic acid (20, 40 and 60%) were studied applying a Response Surface Methodology (RSM), from an experimental Box-Behnken planning of a 3^4 factorial. The FAME content and the acidity reduction in the biodiesel produced were selected as the studied responses. The methodology establishes a set of 27 runs for the quantification of the influence of each factor on the responses. The methodology estimates that 27 runs are adequate to understand the influence of each factor on the response. A reaction temperature of 65ºC is maintained for all experiments.
After the synthesis, the biodiesel acidity, and the reaction conversion in terms of acidity decrease were determined by volumetric titration of the light biodiesel organic phase with potassium hydroxide (KOH) solution. Also, the FAME (fatty acid methyl esters) content of the biodiesel sample was quantified by gas chromatography (GC-FID). Table 1 shows for 6 selected runs, the correspondent experimental conditions and the obtained values in terms of decrease in acidity of biodiesel and conversion of FAME.

Table 1. Experimental conditions and correspondent values obtained in terms of acidity decrease (%) and FAME (%).

Run	A: Time (h)	B: Catalyst dosage (% wt)	C: Molar ratio oil:methanol	D: Incorporation of Oleic Acid (% wt)	Conversion, acidity reduction (%)	Conversion, FAME (%)
1	2	10	1:15	40	48	28
2	2	10	1:10	60	47	29
3	2	5	1:10	40	30	16
4	2	10	1:5	40	30	14
5	2	10	1:10	20	23	8
6	2	15	1:10	40	34	12

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