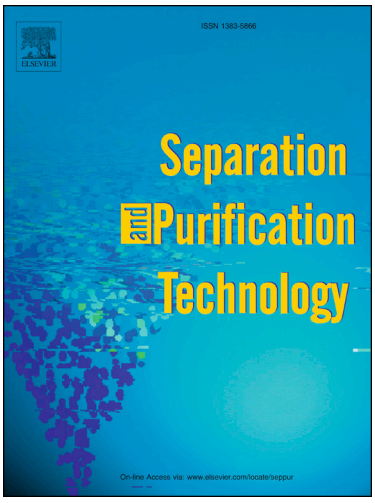


Novel SO_3H-functionalized dicationic ionic liquids – A comparative study for esterification reaction by ultrasound cavitation and mechanical stirring for biodiesel production

Asiah Nusaibah Masri, M.I. Abdul Mutalib, Noor Fathanah Aminuddin, Jean–Marc Lévêque

PII: S1383-5866(17)32811-3
DOI: http://dx.doi.org/10.1016/j.seppur.2017.08.061
Reference: SEPPUR 14003

To appear in: *Separation and Purification Technology*

Received Date: 29 May 2017
Revised Date: 14 August 2017
Accepted Date: 16 August 2017

Please cite this article as: A. Nusaibah Masri, M.I. Abdul Mutalib, N. Fathanah Aminuddin, J. Lévêque, Novel SO_3H-functionalized dicationic ionic liquids – A comparative study for esterification reaction by ultrasound cavitation and mechanical stirring for biodiesel production, *Separation and Purification Technology* (2017), doi: http://dx.doi.org/10.1016/j.seppur.2017.08.061

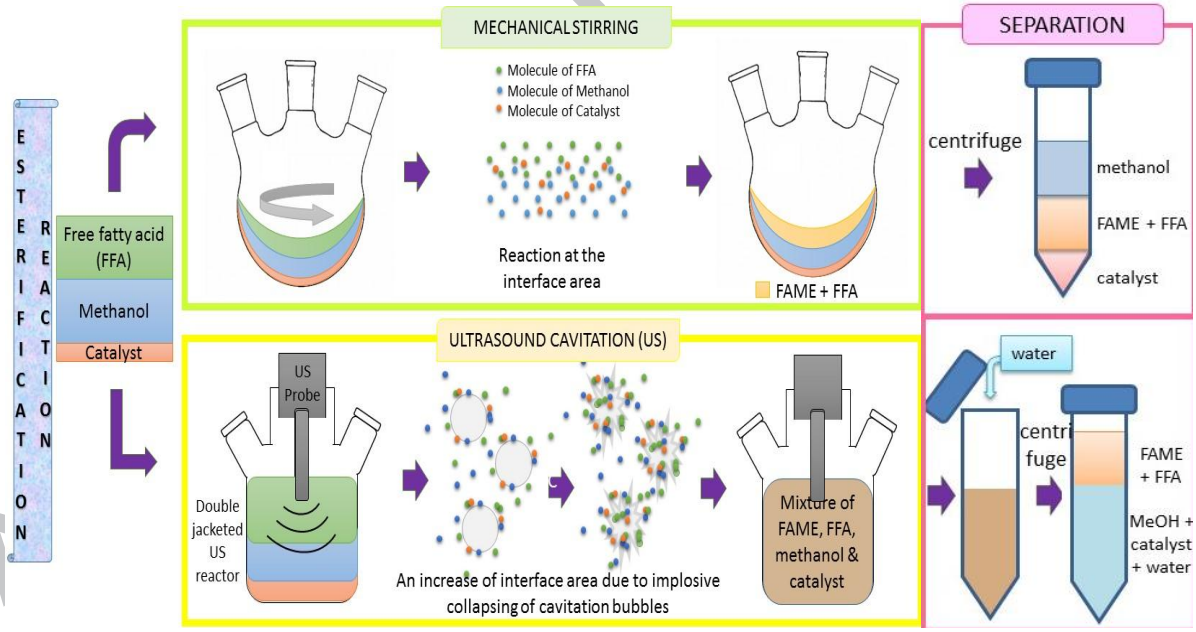
Novel SO_3H-functionalized dicationic ionic liquids – A comparative study for esterification reaction by ultrasound cavitation and mechanical stirring for biodiesel production

Asiah Nusaibah Masri*[1,2], M.I. Abdul Mutalib[1,2], Noor Fathanah Aminuddin[2] , Jean–Marc Lévêque[3]
[1]Department of Chemical Engineering, Universiti Teknologi PETRONAS, Malaysia
[2]Centre of Research in Ionic Liquids, Universiti Teknologi PETRONAS, Malaysia
[3]LCME/CISM, Universite Savoie Mont-Blanc, 73000 Chambéry, France
* Corresponding author: asiahnusaibah88@gmail.com

Abstract

This present article covers a comparative study of esterification reaction using either ultrasound cavitation or conventional mechanical stirring with a series of newly developed SO_3H-functionalized dicationic ammonium- and DABCO-based acidic ionic liquids. As a baseline for performance evaluation, esterification reaction was also conducted with a series of SO_3H-functionalized monocationic ammonium-based acidic ionic liquids and several conventional mineral acids (H_2SO_4, etc.). Their efficacy as catalyst towards perceptive esterification for the synthesis of biodiesel from free long-chain fatty acids with methanol were appraised. The Hammett acidity of these conventional acids and acidic ionic liquids were also assessed using UV-visible spectroscopy. Four factors were studied in the process of optimizing the reaction conditions, which are methanol to oil molar ratio (3 to 15), catalyst amount (0.2 – 1.0%), temperature (25 - 60°C) and time (0 to 60 minutes). Whereas esterification under mechanical stirring leads to formation of a triphasic system (methanol, ionic liquids and esters) easing final separation of components, the same reaction under ultrasonic irradiation leads to formation of one phase layer at the end of reaction but the esters were simply isolated using centrifugation. The results showed that whatever ultrasound or mechanical stirring, the use of dicationic ionic liquids authorized better conversion yields of free fatty acid (FFA) into fatty acid methyl esters (FAME) with better yields than with either monocationic ionic liquids or mineral acids. The novel ionic liquids together with the design of a clean procedure offers advantages including short reaction time, good yield, operational simplicity, and environmentally benign characteristics.

Graphical Abstract



Keywords: Ionic liquids, dicationic, ultrasound, mechanical stirring

1. Introduction

The future exhaustion of petroleum reserves and concern over global warming issue suggest an urgent requirement of exploring alternative, renewable energy sources that are environmentally more acceptable. Biodiesel derived renewable resources such as vegetable oils and animal fats are alternatives to the use of highly polluting petroleum-based fuels [1]. The production of biodiesel is usually conducted by esterification/transesterification reactions whose proved to be very accessible in reason of their simplicity and economic viability by reacting free fatty acids or triglycerides with alcohol. However, the immiscibility of the