Comparison of catalytic performance of Novozyme 435 and Purolite D5081 for the esterification pre-treatment of used cooking oil for biodiesel production

This item was submitted to Loughborough University’s Institutional Repository by the/an author.


Additional Information:

- This is the abstract only of an oral presentation delivered at: Catalysis for Energy: IChemE’s Catalysis Special Interest Group meeting, 11th December 2012, School of Chemical Engineering, University of Birmingham.

Metadata Record: https://dspace.lboro.ac.uk/2134/10594

Please cite the published version.
This item was submitted to Loughborough’s Institutional Repository (https://dspace.lboro.ac.uk/) by the author and is made available under the following Creative Commons Licence conditions.

![Creative Commons Licence](https://creativecommons.org/licenses/by-nc-nd/2.5/)

**Attribution-NonCommercial-NoDerivs 2.5**

You are free:

- to copy, distribute, display, and perform the work

Under the following conditions:

**Attribution.** You must attribute the work in the manner specified by the author or licensor.

**Noncommercial.** You may not use this work for commercial purposes.

**No Derivative Works.** You may not alter, transform, or build upon this work.

- For any reuse or redistribution, you must make clear to others the license terms of this work.
- Any of these conditions can be waived if you get permission from the copyright holder.

Your fair use and other rights are in no way affected by the above.

This is a human-readable summary of the [Legal Code (the full license)](http://creativecommons.org/licenses/by-nc-nd/2.5/)

For the full text of this licence, please go to:
http://creativecommons.org/licenses/by-nc-nd/2.5/
Comparison of catalytic performance of Novozyme 435 and Purolite D5081 for the esterification pre-treatment of used cooking oil for biodiesel production

Kathleen Haigha, Sumaiya Zainal Abidina,b, Goran Vladisavljevića, Jim Reynoldsć, Basu Sahad

aDepartment of Chemical Engineering, Loughborough University, Loughborough, Leicestershire, LE11 3TU, United Kingdom
bOn study leave from Faculty of Chemical and Natural Resources Engineering, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Gambang, Kuantan, Pahang Darul Makmur, Malaysia
ćDepartment of Chemistry, Loughborough University, Loughborough, United Kingdom
dDepartment of Applied Sciences, Faculty of Engineering, Science and the Built Environment, London South Bank University, London, SE1 0AA, United Kingdom

Used cooking oil (UCO) can be used as a feedstock to produce biodiesel. However, this raw material contains a significant amount of free fatty acids (FFAs). Oils and fats with a high FFAs content cannot be directly used in a base-catalysed transesterification reaction. The FFAs react with the alkali catalyst to form soap. The saponification process forms a stable emulsion and leads to difficulties in process separation and reutilisation of catalyst. In this work, an esterification pretreatment process by heterogeneous catalysis has been investigated using an ion-exchange resin (Purolite D5081) and an immobilised enzyme (Novozyme 435).

The reactions were carried out in a jacketed batch reactor with a reflux condenser. An acid-base titration method was used to monitor the FFA concentration during the experiments. A gas chromatography – mass spectrometry method was used to monitor the fatty acid methyl ester (FAME) concentration. The optimum conditions for the ion-exchange resin catalyst are: a methanol to oil mole ratio of 6:1, a catalyst loading of 1.25 wt% and a temperature of 60 °C giving a conversion of 92%. The optimum conditions for the immobilised enzyme are: a methanol to oil mole ratio of 0.4:1, a catalyst loading of 1.00 wt% and a temperature of 50 °C giving a conversion of 90%. A comparison of the conversion trends for both catalysts is shown in Figure 1.
From this work it has been found that much lower concentration of methanol could be used for esterification reaction with Novozyme 435, which will improve process safety and reduce the environmental impact of the process. In addition it has been found that high conversions are possible with Novozyme 435 at 30 °C, which signify that in warmer countries it may be possible to run the process without additional heating. Novozyme 435 has also been found to catalyse additional transesterification side reactions leading to the formation of additional biodiesel which could be used to improve the process efficiency.