University of Alicante — *Department of Chemical Engineering*

USAGE OF HYDROTALCITE IN BIODIESEL PRODUCTION

http://iq.ua.es/polimeros/

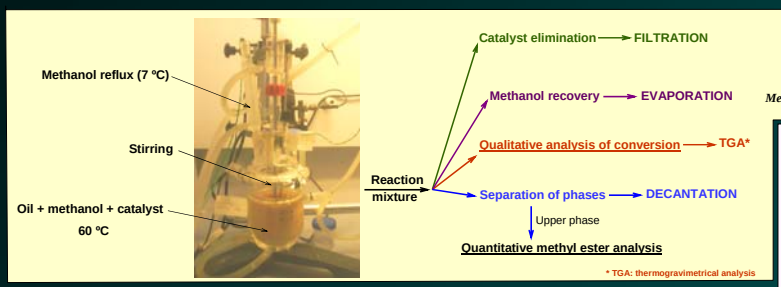
J.A. Reyes-Labarta, M.R. Hernández, N. Guilló, F. Valdés*

*Chemical Engineering Department, University of Alicante, P. Box 99, 03080, Spain, *e-mail: ja.reyes@ua.es*

At the present time, if we look the global energy system in a long term time, it will be unsustainable as consequence of the environmental impact generated, the geopolitics dependencies and the inequity distribution. In this context, the investigation of mechanisms are necessary to get new alternative energy sources which would be a low cost energy and would reduce the adverse environmental impact in its generation and usage. The sustainable use of bio-mass is able to contribute to the advance in this direction resolutely [1,2].

This work is orientated in the use of bio-mass as an energy source in the biodiesel production through vegetal and frying oil transesterification using hydrotalcites as heterogeneous catalyst at 60 ºC, in their pure state or modified for increasing its basicity and its reactivity lately. The main objective is the analyse of the principal variables that will let us improve their knowledge and to achieve the optimum design of the necessary equipments and processes.

The use of heterogeneous catalyst besides introduces new issues to be showed as the correct dispersion of the catalyst and the need of higher reaction temperatures, includes also some advantages such as the easy recovery of the catalyst used by simple filtering and the lower need of water to clean the biodiesel obtained [3].



Values in graphs:

$$\text{Oil conversion (\%)} = \frac{\text{Upper phase weight (g)}}{\text{Oil weight (g)}}$$

$$\text{Methyl ester yield (\%)} = \frac{\text{Amount of methyl ester (g)}}{\text{Upper phase weight (g)}}$$

Parameters evaluated:

Commercial pure hydrotalcite:

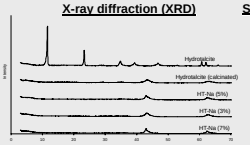
- Calcinations
- Re-hydration
- Use and amount of co-solvent (THF)
- Methanol:oil ratio
- Amount of catalyst

Commercial modified hydrotalcite:

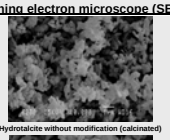
- Methanol:oil ratio
- Amount of catalyst
- Reaction time
- Stirring
- Amount of Na in catalyst

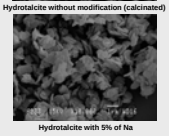
Catalyst characterization

X-ray diffraction (XRD)



Scanning electron microscope (SEM)

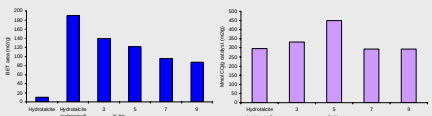

Hydrotalcite without modification (calcinated)


Hydrotalcite with 5% of Na

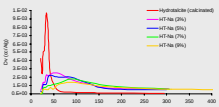
X-ray fluorescence (XRF)

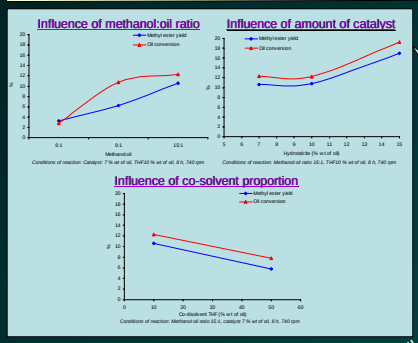
Sample	Real amount of Na measured as % Na_2O
Hydrotalcite	0
Hydrotalcite (calcinated)	0
HT-Na (3%)	3.521
HT-Na (5%)	4.881
HT-Na (7%)	7.009
HT-Na (9 %)	10.647

BET area and measure of basicity

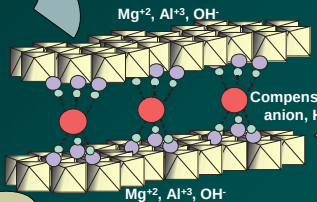


Pore size distribution





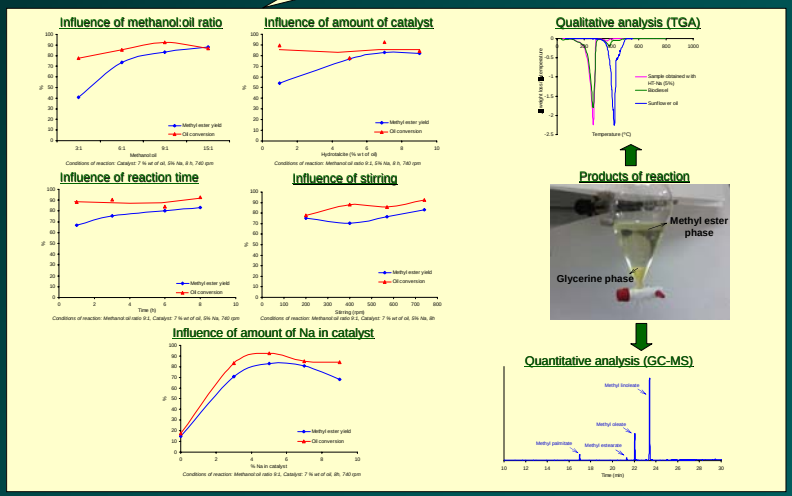
Sunflower oil, 60 ºC
THF as co-solvent
Commercial hydrotalcite (calcinated)

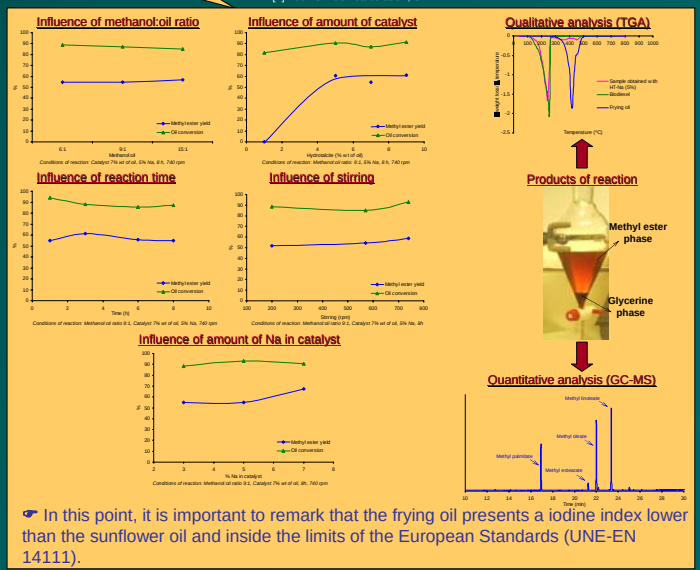


Basic hydrotalcite structure (without calcination)

Frying oil, 60 ºC
Commercial hydrotalcite+Na (calcinated)

Sunflower oil, 60 ºC
Commercial hydrotalcite+Na (calcinated)





☛ In this point, it is important to remark that the frying oil presents a iodine index lower than the sunflower oil and inside the limits of the European Standards (UNE-EN 14111).

References:

[1]. M. Mittelbach, Bioresorce Tecnology 56, 7-11, 1996.

[2]. M. Canakci, J. Van Gerpen, American Society of Agricultural and Biological Engineers 44 (6), 1429-1436, 2001.

[3]. D. M. Chapman, A.L. Roe, Zeolites, 10, 730-737, 1990.

[4]. Iodine index calculation, UNE-EN 14111.

Hydrotalcite without modification not produce the generation of biodiesel, even with the use of a co-solvent. The maximum methyl ester yield obtained is around 17 % by using the most extreme conditions used in this study (methanol:oil ratio 15:1, 15 % wt of oil weight of catalyst, 8h, 740 rpm, 10 % wt of oil weight of THF).

The catalyst modified with Na presents a similar trend in the transesterification reaction using sunflower oil or frying oil. With sunflower oil, methyl ester yields reach values around 10 % higher than with frying oil, meanwhile oil conversions show similar values with both raw materials.

The maximum methyl ester yield obtained with HT-Na and sunflower oil is 89 %, value higher than that shows in the literature with other modified hydrotalcite and employing more extreme conditions (100 ºC, methanol:oil ratio 30:1). By using frying oil, without a previous acid treatment, 67 % of methyl ester yield are obtained, showing the efficiency of this catalyst with a oil that presents an acid value higher than the 1 % established as limit for a adequate transesterification.

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