Title:

Biodiesel synthesis through heterogeneous catalysis using organic bases supported on magnetic silica nanoparticles

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Abstract:

Basic catalysis is the main option for biodiesel (FAME) production through the transesterification of triglycerides and alcohols. Homogeneous basic catalysts require large volumes of water to eliminate them, their corrosiveness affects downstream processing and they can't be reused for multiple reaction cycles. The use of heterogeneous catalysis offers a suitable alternative for a greener biodiesel synthesis route, facilitating catalyst separation and reutilization thus reducing the amount of waste produced. Nevertheless, efficient recovery and long lifetime of the catalyst remain challenges that need to be addressed. A good strategy to simplify the catalyst separation is to endow it with magnetic properties.

The aim of this study was the synthesis and characterization of heterogeneous catalysts involving organic bases chemically grafted on silica coated Fe_3O_4 nanoparticles. The catalytic activity in conventional and MW-assisted conditions and catalysts lifetime for biodiesel production were also evaluated.

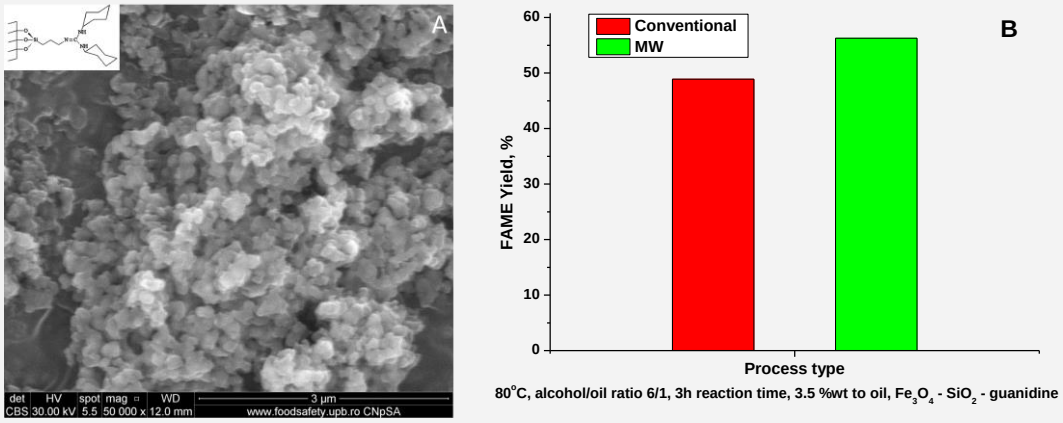

Fig.1 A) SEM images of catalyst; B) FAME yield for conventional and MW conditions;

The synthesis of the catalyst involved generation of magnetite nanoparticles and their coating using the simultaneous hydrolysis of tetraethyl orthosilicate and 3-(N, N'-dicyclohexylguanidine) - propyltriethoxysilane (GPES). GPES was obtained by reacting dicyclohexylcarbodiimide with 3-aminopropyl triethoxysilane. The morphology analysis confirmed quasi-spherical nanoparticles with an average diameter of 200 nm.

In order to improve the reaction yield a process intensification strategy based on MW-irradiation was exploited. The use of MW-irradiation provided a 20% increase in FAME yield. The reusability and lifetime of the catalysts was evaluated and an efficient pretreatment of the catalyst between each reaction cycle was identified.

Acknowledgement

The authors acknowledge the financial support received from the Competitiveness Operational Programme 2014 - 2020, Action 1.1.4: Attracting high-level personnel from abroad in order to enhance the RD capacity, ID project: P_37_471, MY SMIS 105145, Ultrasonic/Microwave

nonconventional techniques as new tools for nonchemical and chemical processes, financed by contract: 47/05.09.2016.