SUSTAINABLE BIODIESEL PRODUCTION THROUGH AN INTEGRATED PERSPECTIVE

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ABSTRACT

Biofuels are renewable solutions to replace the environmentally pollutant fossil liquid fuels. They are produced from low cost sustainable feedstocks. In the la last years, biodiesel production had increased exponentially. This is generating high quantities of glycerol as by-product. Significant economic benefits to the industry of biodiesel, is to research in a green processes through enzyme immobilized and to add value of a byproduct generated in abundance, the glycerol.

One of the objective of this work is to develop a catalyst for its use in the biofuels production from renewable raw materials using an enzymatic immobilization on solid supports nano-structured. In fact, the main purpose is to immobilize the lipase of Pseudomonas fluorescens in the mesoporous material SBA-15 (Santa Barbara Amorphous) pure, synthesized by hydrothermal treatment. In addition, by comparing their activity for the biodiesel production, from vegetable oils, with the enzyme immobilized on materials SBA-15 modified with metals (Ca, Na, Fe, Cu, Al, K) by the wet impregnation method. The physicochemical properties of the synthesized mesoporous materials were determined by Small-angle X-ray scattering (SAXS), Transmission electron microscopy (TEM) and UV-visible. The enzyme was immobilized by mixing each mesoporous material with an enzyme solution to achieve immobilization by physical adsorption. The effective incorporation of the enzyme in the materials was confirmed determining the amount of protein in the soluble fraction after immobilization by the Bradford method. The optimal conditions for the catalytic activity of the biocatalyst were determined: oil / ethanol ratio,% water, amount of immobilized enzyme / mg of SBA-15 materials, reaction time and activity of the biocatalyst respect to the metal impregnated in the solid used .

Simultaneously, glycerol value-added products such as monoglycerides were produced via transesterification reaction of methyl stearate. Monoglycerides derived from glycerol are compounds employed as emulsifiers in food, cosmetic and pharmaceutical products. This green and selective process involved catalysis from hydrotalcite-like compounds. Nano-structured materials from layered double hydroxides are industrially used in heterogeneous catalysis processes. They offer great advantages compared to homogeneous catalysis, since not only favors the environment, but also allows the use of separation operations less complex.

The proposal is to use derivatives nano-clays mixed metal oxides with different metals incorporated (Li, K or Cs) to improve their basic properties. The presence of

metal ions, hydroxyl groups on the surfaces of the sheets and anions interchangeable makes them ideal compounds for preparing functionalization products allowing the design of new nanoscale materials. The materials physicochemical properties were characterized. The correlation between their properties and the catalytic activity in the transesterification reaction was investigated. The highest activity was found for the catalyst with Li incorporated by the co-precipitation method with yield values around 80% for monoglycerides. The catalyst with Li incorporated also showed the greatest Lewis medium basic sites density, a 31% more than the rest of the materials.

The production of biodiesel and the revalorization of glycerol to minimized costs, through selective heterogeneous catalytic way, which encourages the use of energy and renewable raw materials with less environmental cost, shows the road to sustainability.