Magnetite as efficient catalyst for esterification reaction

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In recent years, catalytic chemical reactions have been intensively studied for obtaining biofuels with high conversion rates from esterification and transesterification reactions[1,2]. In this area, the preparation of solids for heterogeneous catalytic processes has gained prominence because, in addition to obtaining products with higher purity and ease of regeneration and reuse, they can be adapted to equipment and/or reactive systems that contribute to reaction intensification and process optimization[3]. In this work, magnetite (Fe_3O_4) was investigated as a catalytic solid in heterogeneous processes for esterification because it has low solubility in alcohols and fatty acids and it has acid properties that may lead to high conversions and ester purity. The synthesis of magnetic Fe_3O_4 particles was performed by the method of co-precipitação[4,5]. The solid obtained was characterized by scanning and transmission electron microscopy (SEM and TEM), X-ray diffraction (XRD) and vibrational spectroscopy in the infrared region. The catalytic activity of the magnetite solid was evaluated in the esterification of oleic and palmitic acids with methanol under solvothermal conditions (methanol:acid molar ratio of 12:1, 10 wt.% catalyst in relation to the fatty acid mass and 120 °C under constant pressure for 6 h). Conversion of the fatty acid to the corresponding monoesters were observed and characterized by titration of the remaining acid with a standard NaOH solution and also by gas chromatography [6]. The conversion of oleic acid to methyl oleate was 58.0% and of palmitic acid to methyl palmitate was 64.7%. Catalytic results, although under preliminary reaction conditions, showed a promising catalytic ability of the magnetite to produced monoesters that are useful for biodiesel applications since its magnetic feature allows the easy recover of the catalytic solid, enabling the study and the development of more streamlined processes. This will probably dispense additional steps for the recovery of the catalyst from the reaction solution, such as filtration and centrifugation, and enable the development of an economically viable process[2].

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