World Academy of Science, Engineering and Technology
International Journal of Bioengineering and Life Sciences
Vol:16, No:05, 2022

Esterification Reaction of Stearic Acid with Methanol Over Surface Functionalised PAN Fibrous Solid Acid Catalyst

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Abstract : High-lipid Fats, Oils and Grease (FOGs) from wastewater are underutilized despite their potential for conversion into valuable fuels; this work describes a surface-functionalized fibrous Polyacrylonitrile (PAN) mesh as a novel heterogeneous acid catalyst for the conversion of free fatty acids (FFAs), via a catalytic esterification process into biodiesel. The esterification of stearic acid (SA) with methanol was studied over an acidified PAN solid acid catalyst. Disappearance of the carboxylic acid (C=O) peak of the stearic acid at 1696 cm-1 in the FT-IR spectrum with the associated appearance of the ester (C=O) peak at 1739 cm-1 confirmed the production of the methyl stearate. This was further supported by 1H NMR spectra with the appearance of the ester (-CH_2OCOR) at 3.60-3.70 ppm. Quantitate analysis by GC-FID showed the catalyst has excellent activity with >95 % yield of methyl stearate (MS) at 90 ◦C after 3 h and a molar ratio of methanol to SA of 35:1. To date, to our best knowledge, there is no research in the literature on the esterification reaction for biodiesel production using a modified PAN mesh as a catalyst. It is noteworthy that this acidified PAN mesh catalyst showed comparable activity to conventional Brönsted acids, namely H_2SO_4 and p-TSA, as well as exhibiting higher activity than various other heterogeneous catalysts such as zeolites, ion-exchange resins and acid clay.

Keywords : fats oil and greases (FOGs), free fatty acid, esterification reaction, methyl ester, PAN
Conference Title : ICABBEA 2022 : International Conference on Advanced Biofuels, Biodiesel Engineering and Applications
Conference Location : London, United Kingdom
Conference Dates : May 26-27, 2022