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Catalytic Hydrothermal Decarboxylation of Lipid from Activated Sludge for Renewable Diesel Production

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Abstract : Currently biodiesel is produced from plant oils or animal's fats by a liquid-phase catalysed transesterification process at low temperature. Although biodiesel is renewable and to a large extent sustainable, inherent properties such as poor cold flow, low oxidation stability, low cetane value restrict application to blends with fossil fuels. An alternative to biodiesel is renewable diesel produced by catalytic hydrotreating of oils and fats and is considered a drop in fuel because its properties are similar to petroleum diesel. In addition to developing alternative productions routes there is continued interest in reducing the cost of the feed stock, waste cooking oils and fats are increasingly used as the feedstocks due to low cost. However, use of oils and fat are highly adulterated resulting in high free fatty acid content which turn impacts on the efficiency of FAME production. Therefore, in light of the need to develop, alternative lipid feed stocks and related efficient catalysis the present study investigates the potential of producing renewable diesel from the lipids-extracted from activated sludge, a waste water treatment by-product, through catalytic hydrothermal decarboxylation. The microbial lipids were first extracted from the activated sludge using the Folch et al method before hydrothermal decarboxylation reactions were carried out using palladium (Pd/C) and platinum (Pt/C) on activated carbon as the catalysts in a batch reactor. The impact of three temperatures 290, 300, 330 °C and residence time between 30 min and 4hrs was assessed. At the end of the reaction, the products were recovered using organic solvents and characterized using gas chromatography (GC). The principle products of the reaction were pentadecane and heptadecane. The highest yields of pentadecane and heptadecane from lipid-extract were 23.23% and 15.21%, respectively. These yields were obtained at 290 °C and residence time 1h using Pt/C. To the best of our knowledge, the current work is the first investigation on the hydrothermal decarboxylation of lipid-extract from activated sludge.

Keywords : activated sludge, lipid, hydrothermal decarboxylation, renewable diesel
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