Polar Compounds and Acidity as Determinants on the Efficiency of the Transesterification of Waste Frying Oils

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The cost of the raw material represents almost about 75% of the price of biodiesel when it is produced from refined oils. Thus, it is of major interest to study the optimal condition for the conversion of cheap raw materials like waste frying oils (WFO) to biodiesel and the effect of their quality (e.g. acidity and percentage of polar compounds) on the efficiency of the process.

In this work, oils from different origin (sunflower oil, SFO, high oleic sunflower oil, HOSFO and rice bran oil, RBO) were thermo-oxidized at 180 ºC for 15, 30 and 45 hours in order to promote the formation of polar compounds. Additionally, they were aditivated with different percentages of free fatty acids (1, 2 and 5% FFA) obtained from the original oils. Oils with different content of polar compounds and acidity, simulating WFO from different qualities, were later destined to the transesterification process. Transesterification was performed using a molar ratio methanol/oil of 6:1, 1.5% of KOH as catalyst, a temperature of 65 ºC and 90 min of reaction period. When the starting HOSFO (0.1% FFA, 3.1 % polar compounds) was transesterified an ester content of 97.6 % was achieved. The exposition of HOSFO to 180 ºC for 15, 30 and 45 h resulted in the increase in the polar compounds to 12.1, 22.4 and 28.5%, respectively. When these oils were transesterified as described above, the ester content in the products was 94.9, 91.4 and 88.2%, respectively. Additionally, if 5% FFA was added to HOSFO, after transesterification the ester content in the product dropped to 92.7%.

Results suggest that both polar compounds and acidity are the major parameters determining the efficiency of the chemically catalyzed transesterification of vegetable oils. Work also discusses the effect of these quality parameters on the efficiency of the process when using oils from different origin (RBO and SFO) and the minimum oil quality required for achieving an ester content higher than 96.5%.