Study of transesterification of pinion oil (*Jatropha curcas*) with acetone as cosolvent at subcritical conditions

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Abstract

The use of fossil fuels has increased the greenhouse effect around the world, causing a worldwide alarm. Ecuador is dependent on petroleum derivatives, but petroleum reserves are being depleted by the day. Therefore, research about non-traditional alternative energies has increased in Ecuador. This research focused on the transesterification reaction of pinion oil with methanol at subcritical conditions to obtain biodiesel. First, transesterification without acetone was done at 1.5; 1.4 and 1.25 MPa and of 363.15; 373.15 and 378.15 K. As well, acetone was added to the reaction varying the molar ratio of methanol/acetone of 1:1, 1:1.5 and 1:2. Yield and biodiesel properties were obtained from both cases. Additionally, the reaction products were analyzed by gas chromatography. Viscosity and cetane number improved considerably the biodiesel quality. The best operating conditions to obtain biodiesel without acetone were 363.15 K and 1.5 MPa. The yield of biodiesel was 93.00 % the cetane number was 48.10 and the kinematic viscosity was 5.42 cST. Cetane number and kinematic viscosity are similar to commercial diesel properties. When methanol to acetone molar ratio was 1:1.5, the yield increased to 96.00%, the cetane number to 50.00 and the kinematic viscosity decreased to 4.41 cST. The methyl esters most abundant were pinolenic (40%) and linoleic (33%). Biodiesel properties with acetone were similar to the norm ASTM D975 for diesel fuel oils. To sum up, acetone promotes the miscibility between alcohol and oil, increasing the production of esters. Pressure was the main variable that affected considerably the quality of biodiesel, producing a fuel similar to diesel N°2 and suitable for engines. The Figure 1 shows the best operating conditions obtained statistically (1.5 MPa, 369 K), which are close to the values obtained experimentally. Furthermore, the interaction between viscosity, cetane number and yield is depicted .

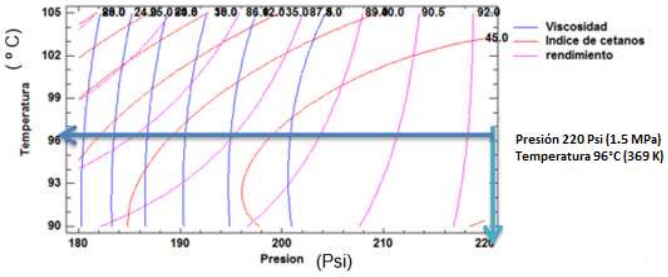


Figure 1. Statistical analysis of multiple response

Recent Publications

1. Cao, W., Han, H. y Zhang, D. (2012), Preparation of biodiesel from soybean oil using supercritical methanol and co-solvent. Fuel, 84(4), 347-351. doi:10.1016/j.fuel.2004.10.001.
2. Dermibas, A. (2008). Biodiesel from waste cooking oil via base-catalytic and supercritical methanol tranesterification. *Energy conversion and Management,* 50(50), 923-927. doi: 10.1016/j.enconman.2008.12.023
3. Guo, Y. y Leung D. (2006). Transesterification of neat and used frying oil: Optimization for biodiesel production. Fuel processing technology.87(10),883-890. doi: org/10.1016/j.fuproc.2006.06.003.
4. Liu, X., Huayang, H., Shenlin, Z., Xianglan, P. y Yujum, W. (2008). Transesterification of soybean oil to biodiesel using CaO as a solid base catalyst.Fuel, 87(2), 216-221. doi:10.1016/j.fuel.2007.04.013.
5. Pardal, A. (2012). Obtención de biodiesel por transesterificación de aceites vegetales: Nuevos métodos de síntesis. Recuperado de http://dehesa.unex.es/handle/10662/326 (Diciembre, 2015).
6. Wang, A., Xiao, M., Xiu, Z. y Yin, J. (2008). Synthesis of biodiesel from soybean oil by coupling catalysis with subcritical methanol. *Energy Conversion and Management*, 49(12), 3512-3516. doi:10.1016/j.enconman.2008.08.008



Biography

Elizabeth Camacho is a Chemical Engineer, who has been always interested in chemical process and development of new technologies. In 2016, pinion oil had only used to power generation; its potential as biofuel had not been studied in Ecuador. This problem let Elizabeth develop project to obtain biofuel without catalyst and using cosolvents. In 2017, she was part of INER I+D+I congress. Currently, she is working to produce chemical products to automotive sector, which is a personal project.

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Biography

Lorena Jaramillo holds a master in process engineering from the University of Applied Sciences in Hamburg-Germany and a master of Environmental Engineering from Escuela Politécnica Nacional (EPN), Ecuador. She has developed her master thesis on studying the thermal and catalytic liquefaction of high molecular hydrocarbon. Nowadays, she is lecturer of Plant design at r at the Chemical Engineering Faculty at EPN, she is also leading a research group related to extraction methods as well.

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