World Academy of Science, Engineering and Technology
International Journal of Energy and Environmental Engineering
Vol:9, No:06, 2015

Comparative Studies and Optimization of Biodiesel Production from Oils of Selected Seeds of Nigerian Origin

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Abstract : The oils used in this work were extracted from seeds of Ricinuscommunis, Heaveabrasiliensis, Gossypiumhirsutum, Azadirachtaindica, Glycin max and Jatrophacurcasby solvent extraction method using n-hexane, and gave the yield of 48.00±0.00%, 44.30±0.52%, 45.50±0.64%, 47.60±0.51%, 41.50±0.32% and 46.50±0.71% respectively. However these feed stocks are highly challenging to trans-esterification reaction because they were found to contain high amount of free fatty acids (FFA) (6.37±0.18, 17.20±0.00, 6.14±0.05, 8.60±0.14, 5.35±0.07, 4.24±0.02mgKOH/g) in order of the above. As a result, two-stage trans-esterification reactions process was used to produce biodiesel; Acid esterification was used to reduce high FFA to 1% or less, and the second stage involve the alkaline trans-esterification/optimization of process condition to obtain high yield quality biodiesel. The salient features of this study include; characterization of oils using AOAC, AOCS standard methods to reveal some properties that may determine the viability of sample seeds as potential feed stocks for biodiesel production, such as acid value, saponification value, Peroxide value, Iodine value, Specific gravity, Kinematic viscosity, and free fatty acid profile. The optimization of process parameters in biodiesel production was investigated. Different concentrations of alkaline catalyst (KOH) (0.25, 0.5, 0.75, 1.0 and 1.50w/v, methanol/oil molar ratio (3:1, 6:1, 9:1, 12:1, and 15:1), reaction temperature (500 C, 550 C, 600 C, 650 C, 700 C), and the rate of stirring (150 rpm,225 rpm,300 rpm and 375 rpm) were used for the determination of optimal condition at which maximum yield of biodiesel would be obtained. However, while optimizing one parameter other parameters were kept fixed. The result shows the optimal biodiesel yield at a catalyst concentration of 1%, methanol/oil molar ratio of 6:1, except oil from ricinuscommunis which was obtained at 9:1, the reaction temperature of 650 C was observed for all samples, similarly the stirring rate of 300 rpm was also observed for all samples except oil from ricinuscommunis which was observed at 375 rpm. The properties of biodiesel fuel were evaluated and the result obtained conformed favorably to ASTM and EN standard specifications for fossil diesel and biodiesel. Therefore biodiesel fuel produced can be used as substitute for fossil diesel. The work also reports the result of the study on the evaluation of the effect of the biodiesel storage on its physicochemical properties to ascertain the level of deterioration with time. The values obtained for the entire samples are completely out of standard specification for biodiesel before the end of the twelve months test period, and are clearly degraded. This suggests the biodiesels from oils of Ricinuscommunis, Heaveabrasiliensis, Gossypiumhirsutum, Azadirachtaindica, Glycin max and Jatrophacurcascannot be stored beyond twelve months.

Keywords : biodiesel, characterization, esterification, optimization, transesterification
Conference Title : ICRERA 2015 : International Conference on Renewable Energy Resources and Applications
Conference Location : Paris, France
Conference Dates : June 25-26, 2015