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Effects of Different Catalyst on the Production of Biodiesel From Jatropha Oil and Comparative Analysis

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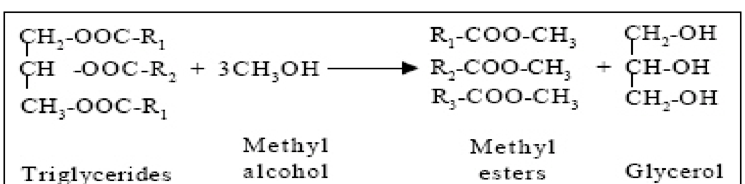
Abstract:
The use of oils and fats of vegetable or animal origin as a fuel dates back to the late nineteenth century, when Rudolph Diesel, inventor of the internal combustion engine (named after him), used crude and peanut oil in his essays. As per the current seen of limitations of conventional energy resources, biodiesel has been a eye stars of the scientist of the world for the coming future. Bio-diesel is a renewable fuel for diesel engines derived from natural oils like vegetable oils. Bio-diesels can be used as fuel at varying concentrations with petroleum based diesel with little or no modification in existing diesel engines (Sanjib and Anju, 2005; Heywood, 1998). Currently, there is a diversity of plants that can be used to obtain oil for biodiesel production. Among them are sunflower oil (42%) with yield of 1600 kg ha-1 and canola and crambe oil (38%) with yield of 1800 and 1200 kg ha-1, respectively. Soybeans have on average 18% oil from grains and yield of 2600 kg ha-1; it is the crop most used for biodiesel production in Brazil (Santos et al., 2008).

1. Introduction

The potential for application of biomass, as an alternative source of energy in India is large. We have plenty of agricultural and forest resources for production of biomass. Biomass is produced in nature through photosynthesis achieved by solar energy conversion. As the word clearly signifies Biomass means organic matter. In simplest form, the process of photosynthesis is in the presence of solar radiation. Biomass energy co-generation programme is being implemented with the main objective of promoting technologies for optimum use of country's biomass resources and for exploitation of the biomass power generation potential, estimated at 19500 MW. The technologies being promoted include combustion, gasification and cogeneration, Either for power in captive or grid connected. It is produced from raw vegetable oil by a chemical process, which removes glycerol from the oil. Jatropa is a low cost seeds with high oil content, small gestation period, which grows on good and degraded soils, as well as areas with low and high rainfall. The seeds are harvested in dry season. Jatropha can yield up to 10 times the amount of
oil as other sources of biodiesel. The Jatropha plant bears fruit from the second year after its plantation and the economic yield stabilizes from the fourth or fifth year onwards. The plant may Vegetable oils typically have large molecules with carbon, hydrogen, and Majority of the world energy needs are supplied through petrochemical sources, coal, and natural gases, with the exception of hydroelectricity and nuclear energy. Of all these sources that are finite, the current usage rates will be consumed shortly. Non-renewable energy sources such as petroleum are related to several drawbacks including; increase green house emission, high cost of processing the crude petrol and energy demand during the process, non-renewable etc.
When methanol is used for transesterification, $R^{/}$ is CH_3 and the process is called methanolysis. Methanolysis of jatropha oil requires three moles of methanol and can be represented by the following equation:



Trasesterification of triglycerides

Where, R_1, R_2, R_3 are three moles of the fatty acids constituents of jatropha oil which are recorded in. Methanolysis of jatropha fatty acids using 100 % excess methanol to force the reaction to the forward direction, produced the corresponding fatty acids methyl esters and release glycerol.

2. Material and Method

2.1. Equipment

The reaction was carried out in a three neck round bottom flask of capacity 500 ml equipped with reflex condenser, temperature indicator and water bath heater. Two different types of the catalyst NaOH and KOH were used with a known amount of Alcohal (CH_3OH). The mixture was then heated to the desired temperature (50^0C) in a controlled temperature water.

2.2. Procedure

Transesterification of jatropha Oil was carried out in a three neck round bottom flask of capacity 500 ml equipped with reflex condenser, temperature indicator and water bath heater. Two different types of the catalyst NaOH and KOH were used with a known amount of Alcohal (CH_3OH). The mixture was then heated to the desired temperature(50^0C)in a controlled temperature water bath then jatropha oil was added into the mixture under vigorous stirring (400 rpm). Transesterification reaction was carried out for 3-6 hours. Then the mixture was allowed to settle for 8 hours. After that glycerin and biodiesel layer were separated out. The biodiesel phase was washed with water (ratio of wash water to biodiesel was 2:1), decanted and heated upto 110^0C to remove water and methanol. Two different types of catalyst NaOH and KOH were used for the production of biodiesel. It was concluded that the yield of biodiesel production was better produced through NaOH catalyst. The other physical properties were also studied.

3. Result and Discussion

3.1. Calculation with ASTM and americal Oil Chemist Society (AOCS) Properties of Jatropha Oil

Property	**JME (Methyl Ester of Jatropha Oil)**
Density (gm/cm^3)	0.84
Kinematic Viscosity (Kg/m^3)	875
API Gravity	4.81
Cloud Point(^{0}C)	-11 to -16
Pour Point (^{0}C)	3 to 6
Flash point (^{0}C)	179
Calorific Value (MJ/ Kg)	38.10
Cetane No.	47
Saponification Value (mg KOH/ gm of Oil)	185-190
Iodine Value	65

Table 1

3.2. The Effects of Different Catalytic Concentration of NaOH biodiesel production

Yield of biodiesel can be influenced by types of catalyst used in the reactions. In this experiment, the concentration of NaOH is vairied . The reactions were carried out by using 0.5% of catalysts, 1:1 oil to methanol molar ratio for 2 hours mixing time at room temperature. Figure shows the yield percentage of biodiesel using different concentration of NaOH catalyst. The results showed that NaOH gave the better yield at 1.2% concentration.

Molar ratio Alcohol: Oil :: 3:1

Catalyst (NaOH) Concentration (%)	**Yield Biodiesel (%)**
0.5	72.30
1.0	73.50
1.5	72.90
Catalyst (KOH) Concentration (%)	**Yield Biodiesel (%)**
0.5	69.82
1.0	71.25
1.5	70.5

Molar ratio Alcohal: Oil :: 6:1

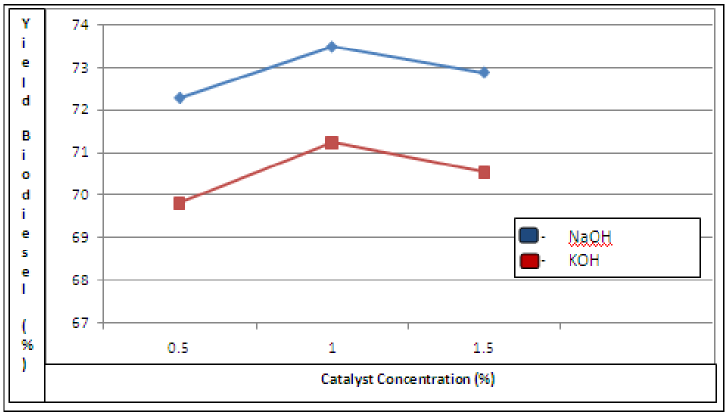


Figure 1

Catalyst (NaOH) Concentration(%)	Yield Biodiesel (%)
0.5	80.15
1.0	81.35
1.5	81.20
Catalyst (KOH) Concentration (%)	**Yield Biodiesel (%)**
0.5	78.50
1.0	79.25
1.5	78.90

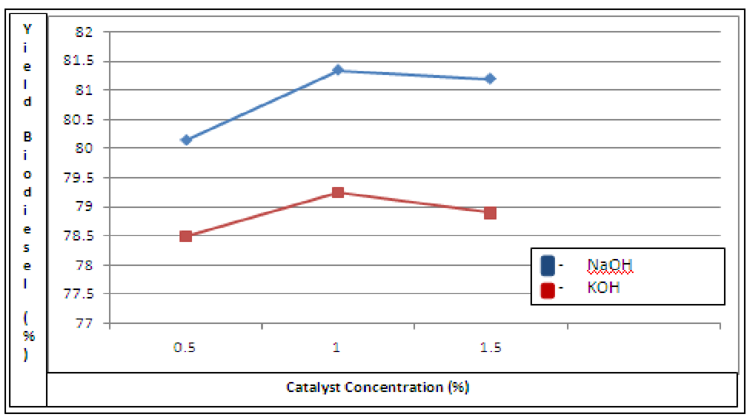


Figure 2

4. Conclusion

The results showed that the highest biodiesel rate of 73.5% was achieved after 3h of reaction at 60^0C having molar ratio constt. (1:1)of methanol to jatropha oil and 1.0 % catalyst of sodium hydroxide. The optimal values of these parameters for achieving maximam conversion of oil to esters depended on the chemical and physical properties of these oils. The NaOH having 1% concentration can be recommended to complete conversion of triglycerides into esters based on higher yield.

5. References

1. Technical and economic feasibility of biodiesel production by family farmers : Augustinho Borsoi1et al. AJAR Vol 8 (42), pp 5204-5210, 2013
2. Technical aspects of biodiesel production by transesterification—a review L.C. Meher, D. Vidya Sagar, S.N. Naik* Centre for Rural Development and Technology, Indian Institute of Technology Delhi, New Delhi 110016, India
3. Optimization of biodiesel production from edible and non edible vegetable oils: Prafulla D. Patil, Shuguang Deng , Elsevier Fuel 88 (2009) 1302-1306
4. Development and evaluation of biodiesel fuel by product from jatropha oil : G.E.I Diwani, N.K. Attia, S.I. Hawash, IJEST Vol 6, No-2, PP 219-224
5. Effects of catalyst types and concentration on biodiesel production from waste soyabean oil as renewable energy and environment recycling process- A.B.M.S. Hossain and M.A.Mazen AJCS 4 (7): 555(2010)
6. Biodiesel production from Jatropha caucus oil in a batch reactor using zinc oxide as catalyst : B.K. Highina, I.M.Bugaje and B.Umar JPTAF Vol 2 (9), pp 146-149, Sept 2011
7. Abdullah AZ Razali N, Mootabadi H, Salamatinia B (2007). Critical Technical areas for Future Improvement in Biodiesel Technologies. IOP Publishing, Environ. Res. Lett., p.2.

8. Malhotra RK, Das LM (1999). Biofuel as blending components for Motor Gasoline and Diesel fuels. J. Sci. Ind. Res., 61: 91.
9. Shah S, Sweta S, Gupta MN (2004). Biodiesel Preparation by Lipase Catalysed Transesterification of Jatropha oil, India Energy and Fuels,18: 154-159.
10. Gupta AK, Sastry SR (2006). Developing The Rate-Equation For Biodiesel Production Reaction, Department of Chemical Engineering, Indian Institute of Technology, New Delhi-110016, E-mail: svarsastry@yahoo.com. Advances in Energy Research (AER).
11. Jatropha–Palm biodiesel blends: An optimum mix for Asia Rakesh Sarin *, Meeta Sharma, S. Sinharay, R.K. Malhotra; Fuel 86(2007) 1365-1371
12. Process optimization for biodiesel production from Jatropha, Karanja and Polanga oils P.K. Sahoo, L.M. Das * Fuel 88(2009) 1588-1594