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Biodiesel-A Fuel from Nature and for Nature

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ABSTRACT

In the quest for renewable energy resource, efforts are made to find out options to alternative fuels. Biomass derived vegetable oils are very suitable alternative fuels for diesel engine. Blending of different vegetable based fuels becomes a necessity and is gaining the attention of many researchers because the properties of biodiesel prepared from vegetable oils are very close to that of diesel. In this work, different types of biodiesel can be prepared and the best suits to diesel engine is preferred .diesel engine is evaluated using Hybrid biodiesel i.e. mixture of Cotton seed and Eucalypus i.e. Nilgiri oil biodiesel in equal proportion as fuel. Comparative performance study gives the best blend for the diesel engine. The results shows that engine performance when fuelled with the biodiesel are comparable to that when fuelled with petroleum diesel.

Keywords: Engine performance; Emission; Transesterification; feedstocks oil.

1.INTRODUCTION:

Biodiesel is simply a liquid fuel derived from vegetable oils and fats, which has similar combustion properties to regular petroleum diesel fuel. Biodiesel can be produced from straight vegetable oil, animal oil/fats, tallow and waste cooking oil. Biodiesel is biodegradable, nontoxic, and has significantly fewer emissions than petroleum-based diesel when burned. Biodiesel is an alternative fuel similar to conventional or "fossil/petroleum" diesel. The process used to convert these oils to biodiesel is called transesterification. This process is described in more detail below. The largest possible source of suitable oil comes from oil crops such as soybean, rapeseed, corn, and sunflower. At present, oil straight from the agricultural industry represents the greatest potential source, but it is not being used for commercial production of biodiesel simply because the raw oil is too expensive. After the cost of converting it to biodiesel has been added, the price is too high to compete with petroleum diesel. Waste vegetable oil can often be obtained for free or already treated for a small price. One disadvantage of using waste oil is it must be treated to remove impurities like free fatty acids (FFA) before conversion to biodiesel is possible. In conclusion, biodiesel produced from waste vegetable/animals oil and fats can compete with the prices of petroleum diesel without national subsidies.

OBJECTIVES:

- To obtain homogeneous mixture and prepare hybrid biodiesel of 2 non edible oils.
- To suggest best blend of hybrid biodiesel for diesel engine.

2. BIODIESEL PREPARATION: The various methods that can be used for production of biodiesel are as shown in the table below.

Biofuel type	Specific name	Feedstock	Conversion Technologies
Pure vegetable oil	Pure plant oil (PPO),Straight vegetable oil (SVO)	Oil crops (e.g. rapeseed, oil palm, soy, canola, jatropha, castor, …)	Cold pressing extraction
Biodiesel	-Biodiesel from energy crops: methyl and ethyl esters of fatty acids -Biodiesel from waste	-Oil crops (e.g. rapeseed, oil palm, soy, canola, jatropha, castor, …) - Waste cooking/frying oil	-Cold and warm pressing extraction, purification, and transesterification -Hydrogenation
Bioethanol	Conventional bio-ethanol	Sugar beet, sugar cane, grain	Hydrolysis and fermentation
Biogas	Upgraded biogas	Biomass (wet)	Anaerobic digestion
Bio-ETBE		Bioethenol	Chemical Synthesis
Bioethanol	Cellulosic bioethanol	Lignocellulosic biomass and biowaste	Advanced hydrolysis & fermentaion
Biogas	SNG (Synthetic Natural Gas)	Lignocellulosic biomass and residues	Pyrolysis/Gasification
Biodiesel	Biomass to Liquid (BTL), Fischer-Tropsch (FT) diesel, synthetic (bio)diesel	Lignocellulosic biomass and residues	Pyrolysis/Gasification & synthesis
Other biofuels	Biomethanol, heavier (mixed) alcohols, biodimethylether (Bio-DME)	Lignocellulosic biomass and residues	Gasification & synthesis
Biohydrogen		Lignocellulosic biomass and biowaste	Gasification & synthesis or biological process

Table-1: Bio fuel Production Technologies

MAKING BIODIESEL:

TRANSESTERIFICATION

Transesterification of natural glycosides with methanol to methyl esters is a technically important reaction that has been used extensively in the soap and detergent manufacturing industry worldwide for many years. Almost all biodiesel is produced in a similar chemical process using base catalyzed transesterification as it is the most economical process, requiring only low temperatures and pressures while producing a 98% conversion yield. The transesterification process is the reaction of a triglyceride (fat/oil) with an alcohol to form esters and glycerol. A triglyceride has a glycerin molecule as its base with three long chain fatty acids attached. The characteristics of the fat are determined by the nature of the fatty acids attached to the glycerine. The nature of the fatty acids can, in turn, affect the characteristics of the biodiesel.

During the etherification process, the triglyceride is reacted with alcohol in the presence of a catalyst, usually a strong alkaline like sodium hydroxide. The alcohol reacts with the fatty acids to form the mono-alkyl ester, or biodiesel, and crude glycerol. In most production, methanol or ethanol is the alcohol used (methanol produces methyl esters, ethanol produces ethyl esters) and is base catalyzed by either potassium or sodium hydroxide. Potassium hydroxide has been found more suitable for the ethyl ester biodiesel production, but either base can be used for methyl ester production.

The figure below shows the chemical process for methyl ester biodiesel. The reaction between the fat or oil and the alcohol is a reversible reaction, so the alcohol must be added in excess to drive the reaction towards the right and ensure complete conversion.

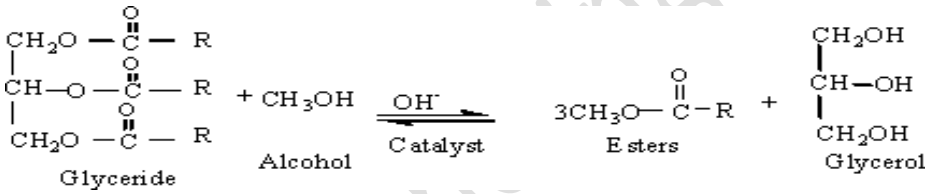

Fig.no.1-Reaction for oil transesterification.

EXPERIMENTAL SETUP: TRANSESTERIFICATION

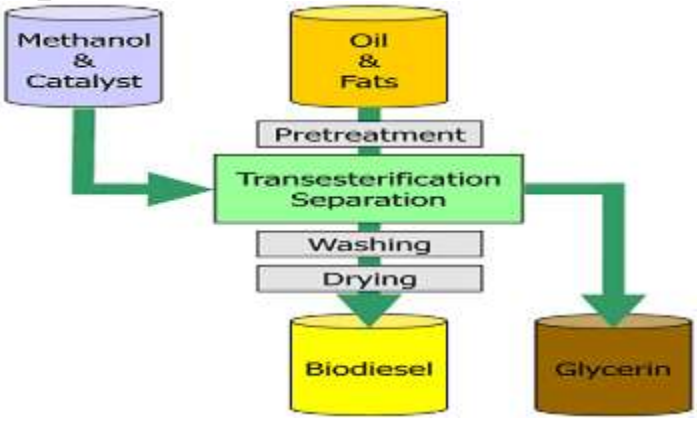

Fig.no.2-Transeterification Process

The products of the reaction are the biodiesel itself and glycerol. A successful transesterification reaction is signified by the separation of the methyl ester (biodiesel) and glycerol layers after the reaction time. The heavier co-product, glycerol, settles out and may be sold as is or purified for use in other industries, e.g. pharmaceutical, cosmetics, and detergents. After the transesterification reaction and the separation of the crude heavy glycerin phase, the producer is left with a crude light biodiesel phase. This crude biodiesel requires some purification prior to use. Biodiesel has a viscosity similar to petroleum diesel and can be used as an additive in formulations of diesel to increase the lubricity. Biodiesel can be used in pure form (B100) or may be blended with petroleum diesel at any concentration in most modern diesel engines. Biodiesel will degrade natural rubber gaskets and hoses in vehicles (mostly found in vehicles manufactured before 1992), although these tend to wear out naturally and most likely will have already been replaced with Viton type seals and hoses which are nonreactive to biodiesel. Biodiesel's higher lubricity index compared to petroleum diesel is an advantage and can contribute to longer fuel injector life. Biodiesel is a better solvent than petroleum diesel and has been known to break down deposits of residue in the fuel lines of vehicles that have previously been run on petroleum diesel. Fuel filters may become clogged with particulates if a quick transition to pure biodiesel is made, as biodiesel "cleans" the engine in the process. It is, therefore, recommended to change the fuel filter within 600-800 miles after first switching to a biodiesel blend. Biodiesel's commercial fuel quality is measured by the ASTM standard designated D 6751. The standards ensure that biodiesel is pure and the following important factors in the fuel production process are satisfied: Complete reaction, Removal of glycerin, Removal of catalyst, Removal of alcohol, Absence of free fatty acids, Low sulphur content. Biodiesel is, at present, the most attractive market alternative among the non-food applications of vegetable oils for transportation fuels. The different stages in the production of plant/seed oil methyl ester generate by-products which offer further outlets. Oil cake, the protein rich fraction obtained after the oil has been extracted from the seed, is used for animal feed. Glycerol, the other important by-product, has numerous applications in the oil and chemical industries such as the osmetic, pharmaceutical, food, and painting industries.

3. ADVANTAGES OF BIODIESEL

It's safer to handle and has virtually the same energy efficiency as petroleum diesel. In addition it has lubricity benefits that fossil fuels do not. Biodiesel blends as low as B2 have been found to significantly reduce the amount of toxic carbon-based emissions. Bio fuels produce less greenhouse gases overall than fossil fuels when they are burned.

4. FUTURE SCOPES

The biodiesel based on non-edible oil stocks has been emerging as a technically feasible, economically competitive, environmentally sustainable and socially beneficial substitute automotive fuel for diesel. Comparing the results and stating best blend that gives higher efficiency. Significantly in next coming year's petroleum diesel will replace by biodiesel.

5. CONCLUSIONS

Emissions of O_2 and CO and NOx is also less as compared to pure diesel. Transesterification method is useful for producing biodiesel. Biodiesel blends of different grades can be made and trail can be done on experimental setup. Through results best blend can be used along with Bio diesel. So biodiesel is good for nature over diesel fuel.

REFERENCES

Feng Guo,Ning-Ning Wei, Zhi-Long Xiu , Zhen Fang Transesterification mechanism of soybean oil to biodiesel catalyzed by calcinedsodium silicate. Fuel 93 (2012) 468–472

N. Viriya-empikul , P. Krasae , W. Nualpaeng , B. Yoosuk , K. FaungnawakiBiodiesel production over Ca-based solid catalysts derived from industrial wastes Fuel 92 (2012) 239–244

HamedMootabadi, BabakSalamatinia, Subhash

Bhatia, Ahmad ZuhairiAbdullah,Ultrasonic-assisted biodiesel production process from palm oil using alkaline earth metal oxides as the heterogeneous catalysts Fuel 89 (2010) 1818–1825

Hong-yanZeng , Zhen Feng, Xin Deng, Yu-qinLiActivation of Mg–Al hydrotalcite catalysts for transesterification of rape oil. Fuel 87 (2008) 3071–3076

ErtanAlptekin, Mustafa CanakciOptimization of transesterification for methyl ester production from chicken fat ,
Fuel 90 (2011) 2630–2638

Rubi Romero, Sandra Luz Martínez and Reyna NatividadBiodiesel Production by Using Heterogeneous Catalysts.
SirichaiChantara-arpornchai, Biodiesel Production from Palm Oil using Heterogeneous Base catalyst, International Journal of Chemical and Biological Engineering 6 2012

Alexandre C. Dimian, "Interrelation of Chemistry and Process Design in Biodiesel Manufacturing by Heterogeneous Catalysis," Top Catal (2010) 53:1197–1201

[9]R.K. Mandloiet. al. / International Journal of Engineering Science and Technology Vol.2(10), 2010, 5902- 5906The Effect of Bio-Fuel Blends and EngineLoad on Diesel Engine Smoke Density forSustainable Environment

[10]Nanthagopal K.,ThundilKaruppa Raj R. and VijayakumarT. Journal of Petroleum Technology and Alternative Fuels Vol. 3(4), pp. 36-41, April 2012, Performance and emission characteristics of karanja methyl esters: Diesel blends in a direct injection compression-ignition (CI) engine

[11]S.Antony Raja, D.S.Robinson smart, and C.Lindon Robert Lee. Biodiesel production from jatropha oil andits characterization. Research Journal of Chemical Sciences Vol. 1 (1) April (2011)

[12] KaziMostafijur Rahman, Mohammad Mashud, Md. Roknuzzaman and Asadullah Al Galib. Biodiesel from Jatropha Oil as an Alternative Fuel for Diesel Engine.International Journal of Mechanical & Mechatronics Engineering IJMME-IJENS Vol:10 No:03

[13]V.R. Sivakumaret. al. Statistical Analysis On The Performance Of Engine With Jatropha Oil As An Alternate Fuel . International Journal of Engineering Science and Technology Vol. 2(12), 2010, 7740-7757.

[14]S.Hawash, G.ElDiwani, E.Abdel Kader. Optimization of Biodiesel Production from Jatropha Oil By Heterogeneous Base CatalysedTransesterification.JESTVol. 3 No. 6 June 2011

[15]IttiponWorapun,KulachatePianthong and PrachasantiThaiyasuit, Synthesis of biodiesel by two-step transesterification from crude jatropha curcus L.oil using ultrasonic irradiation assisted KKU Engineering Journal Vol.37 No.3 (169-179) July 3 September 2010