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VEGETABLE OILS USING NANOADDITIVES AS FUEL FOR AUTOMOBILES - A REVIEW

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ABSTRACT

The energy demand has been increasing every day in the global market. The petrol, diesel resources are non-renewable and pollute the environment because of their emissions. So there is in need of alternative sources of energy. The vegetable oil is a good alternative fuel for diesel because it is renewable and potentially inexhaustible. This paper reviews conversion of vegetable oil into bio-diesel by transesterification method and influence of biodiesel mixed with nano additives. Using nano additives the brake thermal efficiency was increased where as specific fuel consumption was decreased. The emission analysis shows that the NO_X emission was increased and CO, HC and smoke emissions were decreased. Biodiesel mixed with nano additives shows increase in performance and decrease in NOx emission.

Keywords: Vegetable oil. Biodiesel, Transesterification, Emissions, Nano additives

INTRODUCTION

Biodiesel is an alternative fuel which is made from vegetable oil and animal fats. Because of increase in price of petroleum-fuels, it has been focused on vegetable oil make biodiesel. Biofuels are non-polluting and virtually inexhaustible. United States Environmental Protection Agency (US EPA) has done a comprehensive analysis of biodiesel impacts on exhaust emissions mentioning that pure biodiesel can reduce HC as high as 70% and particulate matters (PMs) and CO about 50% when compared with conventional diesel fuel.

Energy security of a country depends on the availability of fuel resources. Several attempts are being made for the development of alternate fuels to substitute/ supplement petro-based fuels. Biofuels can satisfy the energy needs in an environmentally benign manner while reducing dependence on import of fossil fuels.

Development and utilization of new indigenous biomass feedstock for production of biofuel and development of next generation more efficient biofuel conversion technologies are the need of the hour. In this context, biodiesel production from vegetable oil offers new scope as a potential means to stimulate rural development, lower emission of harmful pollutants and decrease greenhouse gas emission. This paper reviews the conversion of vegetable oil into biodiesel by transesterification method, effect of nano additives in biodiesel.

Biodiesel Preparation by Transesterification Method

Vegetable oil is made up of one mole glycerol and three moles of fatty acids commonly referred to triglycerides. The vegetable oils were extracted by mechanical press and these oils have phosphates, water and free fatty acids. These impurities were removed by refining process. The direct usage of vegetable oil is a major problem in diesel engines because of its high viscosity and high flash point. The reaction that converts vegetable oil into biodiesel is known as transesterification.

Murat Karabektas (2008) et al., investigated the effects of cottonseed oil on the performance and exhaust emissions of a diesel engine and reported that the major problem in the vegetable oil is the high viscosity, low volatility and high density. The above problems in the vegetable oil were reduced by transesterification process. The transesterification process is affected by molar ratio, reaction time, reaction temperature and free fatty acid content. Md. Nurun Nabi (2009) et al used cottonseed oil with NaOH and methanol heated upto 40-50°C to produce cotton seed oil methyl ester by transesterification process.

Ayhan Demirbas (2009) et al investigated the production of biodiesel fuels from linseed oil using methanol and ethanol in non-catalytic scf conditions and reported that the linseed oil was added to supercritical fluids such as methanol and ethanol without catalyst during the temperature of 523 K. Christos (2010) et al has studied the optimization of cotton seed biodiesel quality (critical properties) through modification of its FAME composition by highly selective homogeneous hydrogenation and reported that the cottonseed oil (321g) was mixed with CH_3OH(209 g) and NAOH(3.2 g) as a catalyst to produce biodiesel by transesterification process.

Hu seyin Aydin et al developed cottonseed oil methyl ester and reported that the cottonseed oil was mixed with methanol in the molar ratio of 6:1 and 0.3% KOH as a catalyst. The above transesterification process carried out in the temperature of 60°C shows maximum yield of biodiesel. Rajeev Kumar et al investigated the alkali transesterification of linseed oil mixed with methanol in the molar ratio of 9:1 and temperature of 60°C and 1% NAOH as a catalyst for biodiesel production. During this biodiesel conversion 95.45% of linseed oil methyl ester was produced. L Ranganathan et al reported that 77% of biodiesel is produced from the cottonseed oil in the mixture of 20% methanol and 0.5% sodium hydroxide and reaction temperature of 55°C. Rafael Guzatto et al investigated the biodiesel production by two step transesterification process. The first step was modification of catalyst and reaction time had been carried out and the second step was mixing oil with methanol- acid solution.

Performance Analysis in Diesel Engine

Metin Guru et al., carried out experiments with Mn, Mg, Cu and Ca metals and reported that the biodiesel with additives exhibited a reduction in freezing point of 12.4^o C. The cetane number was also increased up to 48.24 %. V. Sajith et al., experimentally investigated the effect of cerium oxide on bio-diesel and observed an increase in flash point and thermal efficiency by 1.5 % at the dosing level of 20 to 80 ppm. Hem Joshi et al., studied the performance of cottonseed oil methyl ester in diesel engine and observed that the properties like energy content, lubricity, cold flow properties were enhanced.

Hu Seyin Aydin et al., reviewed cottonseed oil in diesel engine and reported incomplete combustion and reduced torque with increase in cottonseed oil blend due to high viscosity and lower heating value of fuel. Finally reported that the BSFC as minimum for B50, B75, B100 at 2500 rpm. Ekrem Buyukkaya(2010) et al., investigated the effects of biodiesel on diesel engine and reported the BSFC as 8.5% minimum than that of diesel at minimum torque and power rated conditions. The ignition delay was also found to be minimum. Lei Zhu(2011) et al., examined the ethanol–biodiesel blends in diesel engine and reported an increase in calorific value which in turn increased the brake thermal efficiency .Ali keskin (2011) et al., used manganese and magnesium abietateas a nano additives and observed an increase in fuel properties like pour and cloud point.

Rafael Guzatto et al., (2011) reviewed linseed oil as a potential source of biodiesel in diesel engine and reported an increment in calorific value with the addition of linseed oil . The fuel properties and thermal efficiency of diesel with cottonseed oil and nano additives were studied by G. Anastopoulos (2012) et al., and reported as incremented. Anbarasu angustine (2012) et al., investigated the diesel engine by preheated cottonseed oil methyl ester and reported that the brake thermal efficiency was increased and brake specific fuel consumption was decreased when cottonseed oil was heated upto 80°C. W.M.Yang (2013) et al., introduced glycerin additive into noval emulsion fuel and reported that the brake thermal efficiency was increased by 14.2% .B. L. Salvi (2013) et al., performed a comparative study on linseed oil and reported that the BSFC decreases with increasing the biodiesel blend. S K Sharma (2013) et al., reviewed Jatropha Oil mixed with Mno - nanomaterial and observed an enhancement in the properties of biodiesel. M.A.Lenin(2013) et al., analyzed the Manganese oxide and copper oxide in diesel engine and reported that the engine performance was increased by 4% due to mixing of diesel with nano additives .A.M. Ashrafu (2014) et al., reviewed the properties of variable oils. For cottonseed oil BSFC decreases with lower percentage of biodiesel present in the diesel, but BTE increases. The use of high injection pressure and preheated biodiesel blend with result in engine power has decreased and for linseed oil during high biodiesel blend had high BTE and low BSFC.

S Karthikeyan (2014) et al., experimented canola oil methyl ester with zinc oxide nano particles in diesel engine and reported that the ignition delay was reduced when canola oil was mixed with zinc oxide nano particles. In addition to that engine performance was also enhanced. Orkun Ozener(2014) et al., studied soybean oil on diesel and reported that the BSFC was increased due to low heating value of biodiesel and BTE was reduced.V. Arul Mozhi Selvan (2014) et al., analyzed cerium oxide nano particles and carbon nanotubes additives in Diesterol blends. The cylinder gas pressure was increased with addition of CERIA and CNT in Diesterol blend. Due to the usage of catalyst, the heating value was increased which impacted with reduction in ignition delay.

Emission Analysis

Metin Guru (2002) et al., carried out Mn, Mg, Cu and Ca metals as fuel additives and reported that the O2 and CO was reduced to 0.2 and 14.3 %. Murat Karabektas (2008) et al., investigated the effects of preheated cottonseed oil methyl ester on diesel engine and reported that the CO emissions was decreased and Nox emissions was increased due to higher combustion temperatures caused by preheating and oxygen content of COME .Ayhan Demirbas (2009) et al., investigated the linseed oil in diesel engine and reported that the biodiesel and biodiesel blends decrease the CO,HC and smoke emissions and increase the NO_X emission. Md. Nurun Nabi (2009) et al., investigated cotton seed oil in diesel engine and reported that for 30% biodiesel mixtures CO emission was reduced by 24% and NOx was increased by 10%. Umer Rashid (2009) et al., investigated the cotton seed oil and reported that the NOx emission was reduced because of more ignitable. The observed kinematic viscosity was 4.07 mm^2/s and atomization of fuel was increased in the combustion chamber. Md. Nurun Nabi (2010) et al., investigated the cottonseed oil methyl ester in diesel engine and reported that the CO emission was minimum for B50,B75,B100. The NOx emissions was increased only for B5. The SO2 emission was minimum. The smoke emission was minimum for D2,B5,B50 and maximum for B75,B100 [17]. V. Sajith (2010) et al., investigated the ceria oxide nano particle with biodiesel and reported that the NO_X emission was reduced when cerium oxide was mixed with fuel. Ekrem Buyukkaya (2010)et al., investigated the biodiesel on a DI diesel engine and reported that the NO_X emission was increased so further investigations are needed to reduce the NO_X emission.

Ali keskin(2011) et al., used manganese and magnesium abietateas a nano additives and reported that the maximum reduction of SFC was recorded as 4.16 %,CO emission and smoke opacity decreased by16.35% and 29.82%,respectively.Lei Zhu (2011) et al., investigated the ethanol–biodiesel blends and reported that the CO,HC,NO_X emissions were increased with the ethanol-biodiesel blends. D.Ganesh (2011)et al., carried out the jatropha bio-diesel with Magnalium (Al-Mg) , cobalt oxide (Co3O4) and reported that 60 % and 50 % reduction of HC and CO because of the catalyst acts as a oxygen buffer. Anbarasu angustine(2012) et al., investigated the COME on diesel engine and reported that the CO,HC and smoke emissions were reduced. The cottonseed oil was preheated upto 80°C and NOX emission was increased. Savita Dixit (2012) et al., reviewed

that Linseed oil as a potential resource for bio-diesel and reported that the CO was decreased but NOx was increased. M.A.Lenin(2013) et al., analyzed the Manganese oxide and copper oxide additives on diesel engine and reported that the emissions were reduced by HC-1%, NO-4%, and CO 37% due to mixing of diesel with nano additives.

B L selvi (2013)et al., analyze the linseed oil with diesel and reported that the CO,HC and smoke emissions were decreased with increasing with biodiesel blends upto LB10 and the NO_X emission was increased. S K Sharma (2013) et al., reviewed Jatropha Oil with Mno -Nanomaterial and reported that the CO emission was reduced by 37 % and NOX emission was reduced by 4 % adding of metal oxide as an additive. W.M.Yang (2013)et al., introduce a glycerin additive and report that reduced NO emission by 30.6% .Orkun Özener (2014) et al., investigated the soybean biodiesel on a diesel engine and reported that the CO,HC and smoke emissions were reduced but NO_X and CO2 emissions were increased.V. Arul MozhiSelvan (2014) et al., made Cerium Oxide Nano particles and Carbon Nanotubes in Diesterol (diesel–castor oil bio-diesel) blends. The CO, NO_X emissions were reduced because of heat release rate was minimum for catalyst present in the fuel. S karthikeyan(2014) et al., investigated the canola oil methyl ester with zinc oxide nano particles and reported that the oxides of nitrogen was reduced due to mixing of zinc oxide nano particles.A.M. Ashrafu (2014) et al., reviewed that the various non-edible vegetable oils and reported that the CO,HC, and smoke emissions were reduced but NOx emission was increased for cottonseed oil. The increased fuel injection pressure increases the NOx emission and reduces HC and smoke emission for linseed oil.

CONCLUSION

Biodiesel is produced by means of several process such as direct use and blending, microemulsion, pyrolysis and transesterification. Among these transesterification is the most preferable method. In most of the cases the performance has been increased when biodiesel is mixed with diesel. The emissions include CO, HC and smoke emissions were reduced but NO_X emission was increased. The biodiesel is mixed with nano additives means the NOx emission was reduced and increase the performance.

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