International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 08 | Aug 2021 www.irjet.net p-ISSN: 2395-0072

MODELING AND OPTIMIZATION STUDY ON DI DIESEL ENGINE FOR THE TRANSESTERIFICATION OF SARDINE FISH OIL TO BIODIESEL

[1]B. MOUNIKA, [2]MR. P. RAJU, [3]DR. P. SRINIVASULU

[1]Student at Department of Mechanical Engineering, in Vaagdevi College of Engineering (Affiliated to JNTU Hyderabad).
[2]Assistant Professor at Department of Mechanical Engineering, in Vaagdevi College of Engineering (Affiliated to JNTU Hyderabad).
[3]Professor and Head of the Department at Department of Mechanical Engineering, in Vaagdevi College of Engineering (Affiliated to JNTU Hyderabad).

ABSTRACT

With the effective usage of fuels like sardine fish oil methyl esters as an alternative to diesel gas, u.s. like India which is spending big debts for oil imports may be decreased. furthermore deforestation, usage of land for cultivation of biofuel crops and environmental pollutants caused due. to dumping of low price and coffee price fish may be substantially decreased. This biofuel used on my own or in blends with diesel has the advantage of contributing to cleanser exhaust environmental greenhouse pollution and reduced requirement of fossil gas sources of petroleum derivatives. Improvement of an effective and optimized approach of biodiesel manufacturing and extra efficient DI diesel engine is sort of based totally on experimental research. along with experimental investigations and with the advancement of computing techniques, the theoretical, simulation, modeling and optimization studies are implemented to are expecting and optimize the output parameters concerned in experimentation. on this context, response floor method is applied for the optimization of the reaction parameters inside the transesterification of sardine fish oil to biodiesel. With the effective utilization of low fee, low value sardine fish as a feedstock for producing biodiesel, a country like India wherein utilization of plant.

Key terms: Diesel engine, fish oil, biodiesel.

1. INTRODUCTION

The sector's fossil gas sources are fatly depleting every day aside from power sources including nuclear, hydroelectricity and wind energy. The continuation of this trend and the present consumption fee of petroleum, the fossil fuel can be exhausted at the stop of this century and become economically unfeasible to gain at any time. Oil, the made from the burial and transformation of biomass during the last 200 million years has historically had no identical as an electricity source for its intrinsic qualities of extractability, transportability, flexibility and fee. however, the total quantity of oil underground is finite. the amount of oil remaining in the ground is rather indeterminate and a number of the oil available inside the ground can be accessed handiest by using the use of complicated and high-priced technologies that present extra environmental challenges than the technologies used for maximum of the oil produced to date. the opposite essential sources of insecurity about future oil production are doubtlessly unfavorable political and funding situations in countries where oil is available.

India is importing all varieties of fossil fuels; the percentage proportion of general import inside the overall apparent intake of such fuels has been increasing all through the past two a long time and touched 35% in 2011-2015. as a result of the fee upward push and the growing imports of all of the fossil fuels as targeted above, India's total bill of net import of strength has grown at a distressing fee near to twenty% according to yr, leading to an increase of just about 55 instances over the past a

long time. As a problem, the share of total energy import invoice as a percent of India's total export earnings has also been growing over the years, and has now reached almost 43% in 2011-2015 that's a supply of difficulty for financial viability of such pattern of boom of energy use in India. The modern pattern of usage of fossil fuel is likely to create monetary pressure on the front of the balance of payments and the stability of India's foreign money cost [1-4].

1.1 Issues allied with Present Biodiesel

In current years, a study has been directed to discover plant based totally fuels and plant oil, fat as fuels. inside the manufacturing of biodiesel, extra than 95% of feedstocks come from both safe to eat and non-edible oils because they may be in particular produced in many regions of the world and the residences of biodiesel constructed from those oils are lots appropriate for use as diesel gas replacement.

1.2 Ratio for Alcohol to oil

The stochiometric transesterification requires three moles of the alcohol per mole of the triglyceride to yield three moles of the fatty esters and 1 mole of the glycerol. however, the transesterification response is an equilibrium reaction wherein a large extra of alcohol is needed to force the response close to result in a forward course. The molar ratio of 6:1 or higher generally offers the most yield (better than 98% with the aid of weight). lower price of molar ratios calls for a longer time to complete the response. better molar ratio will increase the conversion charge but ends in problems in the separation of the glycerol. The foremost molar ratios rely upon the type and high-quality of the oil used and at optimum molar ratio best the manner offers higher yield and less difficult separation of the glycerol.

1.3 Fish Oil as the Supply of Biodiesel

Fish oil is one of the non-conventional feedstock for the manufacturing of biodiesel. India has a coastline of 8210 kms having an distinct financial zone (EEZ) of 3 million sq. kms consisting of 0.3 million sq. kms of continental shelf. The estimated sustainable resource potential within the marine area is 37 million tonnes fish consistent with annum. Of this, 52% of the assets are allotted in in-shore waters, 33.7% in off-shore areas and the remaining 6% in deep sea.

The usage of the term "Trash Fish" varies from united states to usa and can trade each seasonally and with places. One category of trash fish is the one no longer used for direct human intake, which can be either landed or discarded at the ocean itself. the alternative category is low cost, low fee fish used for human consumption. General landing of by means of catch (trash) fish is predicted to be around 1.7 Million Tonnes yearly. The estimate of discarded trash fish in India in line with the meals and Agriculture business enterprise (FAO) file, it is predicted that the sector fish production turned into round 133 MT and 21 MT of the global trap are discarded annually. about 71% of this manufacturing is used for direct human consumption. The remaining 25% is destined for non-food merchandise [15, 16]. In 2006, the expected global fish manufacturing was 142 MT.

2. LITERATURE SURVEY

Mashad et al (2008) have investigated on Salmon oil, a salmon processing waste for biodiesel manufacturing via transesterification in a two-step procedure. Distinctive forms of salmon oil have been tested: salmon oil extracted from acidified salmon hydrolysate and salmon oil extracted from salmon by means of-products. ideal quantities of chemical compounds required to provide the very best biodiesel yield from oil were determined the usage of batch manufacturing processes. It became located that due to the excessive acid fee of salmon oil, alkaline catalyzed transesterification turned into not an effective technique for generating biodiesel from the salmon oil.

Ragavan & Roy has investigated the transesterification of rubber seed oil with the support of sonication come within reach of, for the

synthesis of biodiesel. Since the alkali-catalysed transesterification could not produce methyl esters from high FFA rubber seed oil, the two-step esterification procedure turn into followed to make over the equal oil to a greater appropriate shape of gasoline for diesel engine. Ultrasonic assisted transesterification has been used for the above and proved to be an effective technique with an excellent yield (80.7%) even at 32°C, while the temperature requirement is higher for magnetic stirring technique.

Roberto et al (2007) have studied the production of fatty acid ethyl esters from fish oil using ultrasonic strength and alkaline catalysts dissolved in ethanol. The feasibility of fatty acid ethyl ester production was determined the use of an ultrasonic bath and probe, and between 0.5 and 1% KOH (brought to the fish oil). furthermore, factors inclusive of ultrasonic tool (bathtub and probe), catalyst, temperature, and period of exposure (10–ninety min) were assessed. Sodium ethoxide become discovered to be a extra green catalyst than KOH while transesterifying fish oil. Ultrasonic energy carried out for more than 30 minutes at 60°C the usage of 0.7% as a catalyst transesterified over 92 % fish oil triglycerides to fatty acid ethyl esters.

Pinyaphong et al (2011) have investigated the manufacturing of biodiesel from discarded components of fish with the assist of enzymatic catalyst. in this observe clearly immobilized lipase carica papaya lipase become used as the catalyst for the production of biodiesel from fish oil. The refined fish oil, extracted from the discarded parts of fish, became used as a starting fabric for biodiesel manufacturing. The effects of molar ratio of oil: methanol, lipase dosage, initial water hobby of lipase, temperature and solvent had been investigated. It become found that carica papaya lipase become suitable for methanolysis of fish oil to provide methyl ester.

3. INSTRUMENTATION

The bomb calorimeter is a kind of constant-volume calorimeter used to degree the combustion of oxygen-burnable samples. 4 vital elements are wanted in each bomb calorimeter. The bomb calorimeter is a laboratory instrument used to degree the quantity of a sample's combustion heat or warmth power whilst extra oxygen combustion happens. The purpose of this studies is to decide the impact of using the bomb calorimeter at the capacity of physics students to method technology. influences contain the efficacy of the usage of the gadgets and gaining knowledge of the way to increase the capabilities of the scientific method of college students before and after using substances. If the heat of the capacity calorimeter Ccal of to the calorimeter is known, then one determines the warmth generated via a best needs to word the trade in the temperature manner. Calorimetry is extensively used in present-day laboratories.

Infrared spectroscopy is a non-destructive technique used for materials analysis. Infrared absorption spectroscopy is the study of interaction of infrared radiation with matter as a function of photon frequency. Fourier Transform Infrared Spectroscopy (FTIR) provides specific information about the vibration and rotation of the chemical bonding and molecular structures, making it useful for analyzing organic materials and certain inorganic materials.

3.1 Rheometer

A viscometer (also called viscosimeter) is an tool used to degree the viscosity of a fluid. For liquids with viscosities which range with waft situations, an device known as a rheometer is used. thus, a rheometer can be taken into consideration as a

unique type of viscometer. Viscometers simplest measure beneath one waft condition. In fashionable, either the fluid remains stationary and an object actions through it, or the item is stationary and the fluid actions beyond it. The drag resulting from relative motion of the fluid and a surface is a degree of the viscosity. The drift situations ought to have a small enough cost of Reynolds quantity for there to be laminar flow.

"Cup and bob" viscometers paintings via defining the exact quantity of a sample to be sheared within a test mobile; the torque required to gain a certain rotational velocity is measured and plotted. There are two classical geometries in "cup and bob" viscometers, known as either the "Couette" or "Searle" structures, outstanding with the aid of whether or not the cup or bob rotates. The rotating cup is preferred in some instances because it reduces the onset of Taylor vortices at very high shear costs, but the rotating bob is extra generally used, as the tool design can be more bendy for different geometries as nicely.

"Cone and plate" viscometers use a slender-angled cone in near proximity to a flat plate. With this gadget, the shear fee between the geometries is regular at any given rotational speed. The viscosity can without problems be calculated from shear stress (from the torque) and shear fee (from the angular pace).

If a take a look at with any geometries runs through a desk of numerous shear rates or stresses, the information can be used to plot a waft curve, that may be a graph of viscosity vs shear rate. If the above take a look at is done slowly enough for the measured cost (shear pressure if rate is being managed, or conversely) to reach a constant value at each step, the statistics is said to be at "equilibrium", and the graph is then an "equilibrium waft curve". that is top-rated over non-equilibrium measurements, because the information can typically be replicated throughout multiple different contraptions or with different geometries.

4. RESULTS AND DISCUSSIONS

Fig 4.1: Mixing the sample of magnetic stirrer.

Fig 4.2: Separating funnel separating the sediments at the bottom

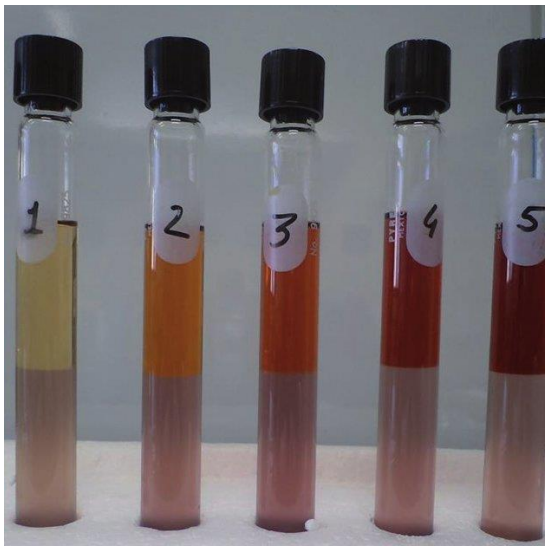

Fig 4.3: After transesterification process there are a separation and the sediments getting settled at the bottom.

Fig 4.4: Probe Sonication for sample preparation

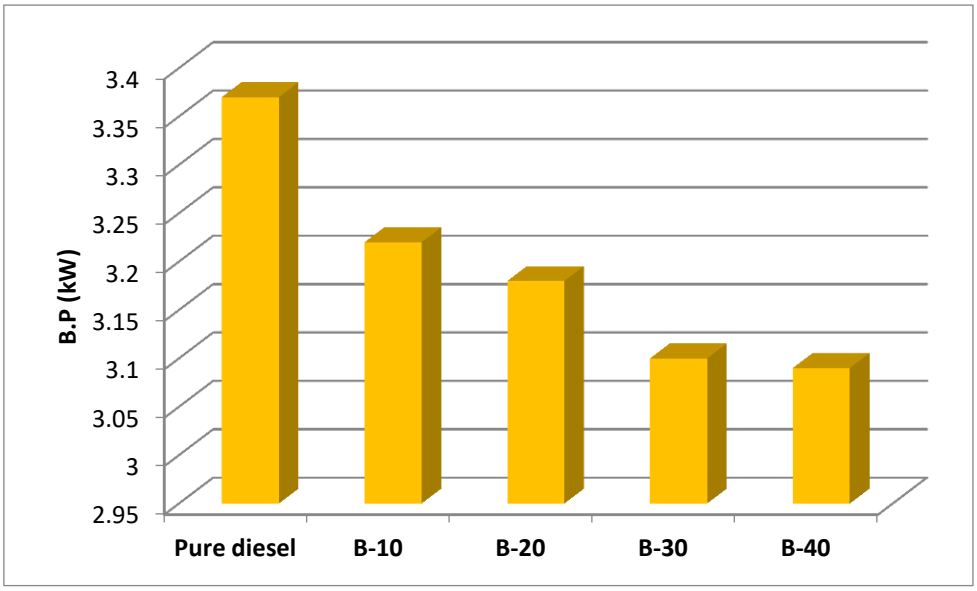

Fig 4.5: Brake Power of the samples

Power available in the engine cylinder due to combustion of fuel is indicated power. In reciprocating engine mechanism the piston which reciprocates tends to develop friction between the cylinder and piston and there is a loss of power due to friction. The power which is induced at the crankshaft is the brake power which is the net difference of Indicated power and friction power. The brake power induced using different samples of fuels were plotted in graph. The results clearly indicate that the brake power was reduced. There was 8.30% reduction in brake power when B-40 sample fuel was used. Generally the brake power induced for fish oil blends is very low, however with the addition of 2-Ethyl hexy nitrate additive the reduction was negligible which is evident from the test results. The reduction might be due to the calorific value. However the reduction in brake was negligible.

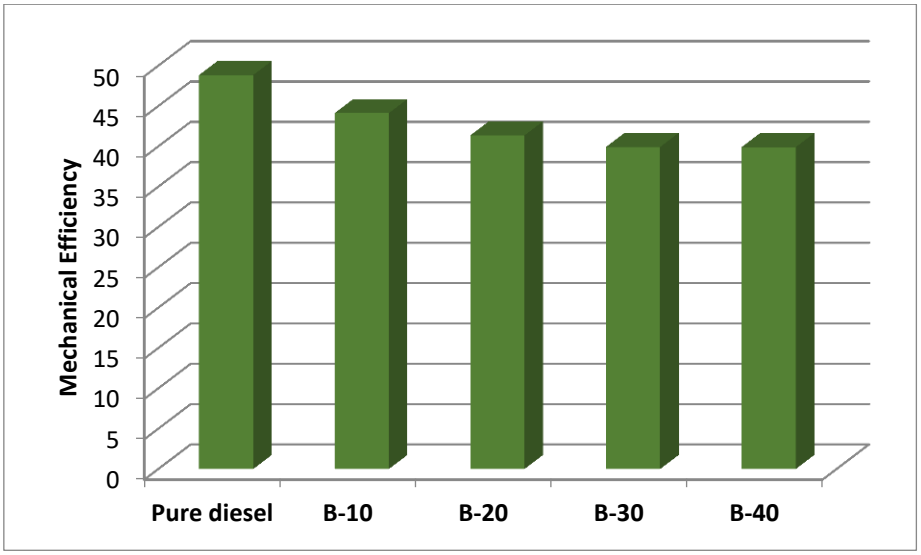

Fig 4.6: Mechanical efficiency of samples

The pure diesel and fish oil blends used in engine and the mechanical efficiency was plotted. The results clearly depicts that the mechanical efficiency is 48.84% and was gradually decreasing. The percentage drop in mechanical efficiency for B-40 sample was 18.30%, the reduction might be due to reduction in brake power and also might be variation in Indicated power.

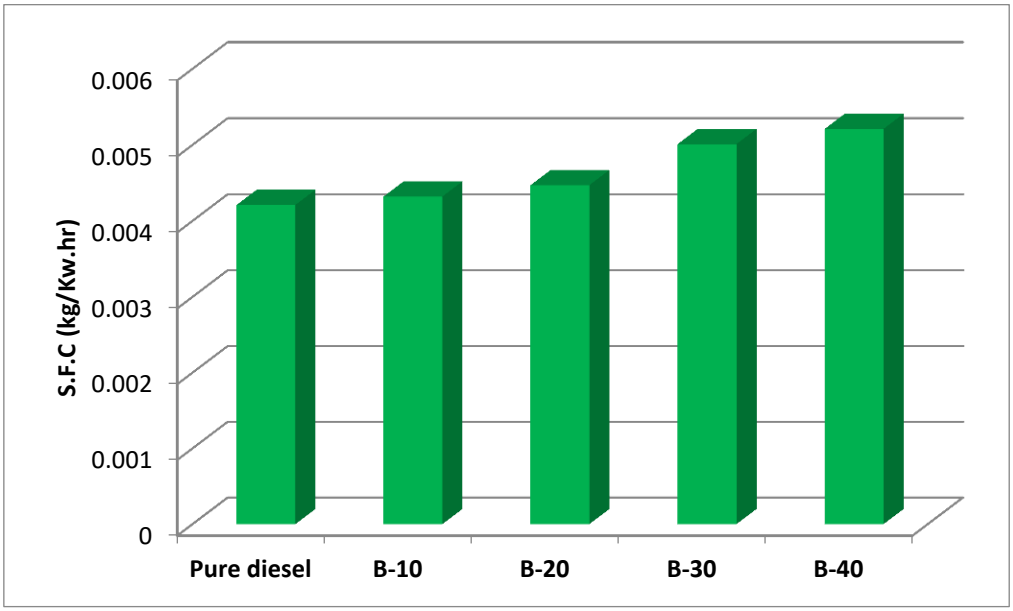

Fig 4.7: Specific Fuel consumption of samples.

The fuel consumption of TSFC is "how a great deal fuel the engine burns each hour." The precise of TSFC is a scientific time period which means "divided through mass or weight." In this example, unique way "in step with pound (Newton) of thrust." The thrust of TSFC is covered to indicate that we are speaking approximately fuel turbine engines.

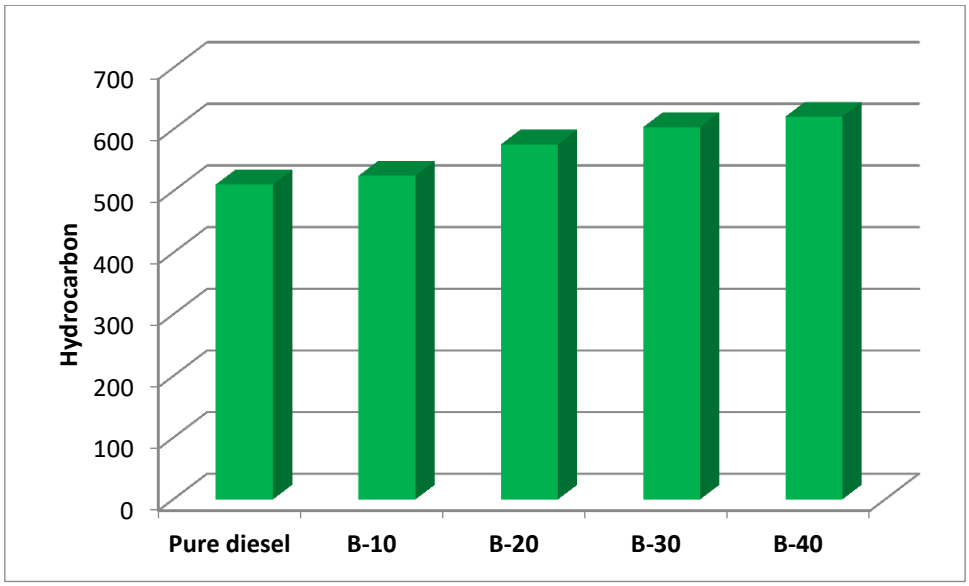

Fig 4.8: Hydrocarbon emissions for the samples

The fuels are in the form of hydrocarbon, the fuel injected by the injector into the engine cylinder. The fuel drops absorb the latent heat from the compressed air thereby the transform liquid to vapour. Further it absorbs heat from the compressed air and reaches self ignition temperature, at this stage the fuel reacts with oxygen for chemical reaction thereby it get auto ignited. During this process not all the fuel is ignited, some is partially ignited and some fuel is left as unburnt. The unburnt fuel is treated to be hydrocarbons. The result trends clearly depicts that the fish oil when blended in diesel fuel, hydrocarbon percentage is increasing. However the increment is approximately 18%.

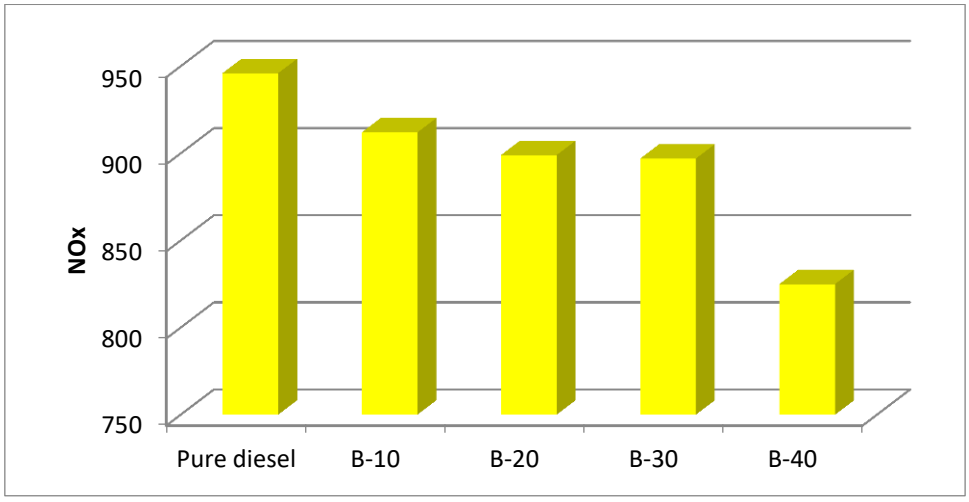

Fig 4.9: Nitrogen oxide emission for the samples

The nitrogen oxide emission is very harmful; the NOx is directly proportional to the temperatures. As the engine temperatures increases NOx level also increases. With the increased percentage of fish oil blend in the diesel fuel the NOx level was decreased. There was 13% drop in NOx level of B-40 sample in comparison with pure diesel fuel. The reasons behind decrease in NOx level are due to lower calorific value of fish oil.

CONCLUSIONS

The present investigation the fish oil was blended with varying proportions maintaining 2-Ethyl hexyl nitrate which is used as combustion enhancer. The following conclusions were drawn from the work.

1. The fish oil blended in diesel fuel was homogeneously mixed with no separations when preserved in vessel without disturbing for long period.
2. FTIR test results depict good chemical computability when fish oil blended in diesel fuel, the change in the properties of blended fuel is due to physical interactions between them.
3. There was a performance reduction of 8.30%, 18.30%, 19.19%, 29.94% in brake power, mechanical efficiency and brake thermal efficiency respectively.
4. The specific fuel consumption was increased to 19.19% for B-40 sample when compared with pure Diesel fuel.
5. There was a appreciable drop in emission levels of carbon monoxide, the drop was 38.29% for the sample B-40 when compared with pure diesel fuel.
6. The NOx levels were reduced to 12.79% when used B-40 sample.
7. However, the hydrocarbon levels were increasing when fish oil percentage is increasing. The unburnt fuel in the cylinder is an indication of hydrocarbon.
8. Overall, fish oil blend when used in diesel fuel results in low performance, however there was very good reduction in emission levels this is mainly due to additive 2-Ethyl Hexyl Nitrate.
9. The additive 2-Ethyl Hexyl Nitrate additive helped in reducing the emissions to a appreciable level.

REFERENCES

[1] A.S. Ramadhas, S. Jayaraj, and C. Muraleedharan, 2005, Biodiesel Production from High FFA Rubber Seed Oil, Fuel. 84, 335-340.

[2] J. Krahl, A. Munack, O. Schroder, H. Stein, J. Bünger, In € fluence of biodiesel and different designed diesel fuels on the exhaust gas emissions and health effects, SAE Pap. (2003), 2003-01-3199.

[3] Demirbas. 2005. Biodiesel production from vegetable oils via catalytic andnon-catalytic supercritical methanol transesterification methods. Progress in Energy and Combustion Science 31. 466- 487.

[4] Z. Utlu, M.S. Koç ak, The effect of biodiesel fuel obtained from waste frying oil on direct injection diesel engine performance and exhaust emissions, Renew. Energ. 33 (2008) 1936e1941.

[5] Quintero JA, Montoya MI, Sánchez OJ, Giraldo OH, Cardona CA. Fuel ethanol production from sugarcane and corn: comparative analysis for a Colombian case. Energy 2008;33:385e99.

[6] Mekhilef S, Siga S, Saidur R. A review on palm oil biodiesel as a source of renewable fuel. Renewable and Sustainable Energy Reviews 2011;15: 1937e49.

[7] Demirbas Ayhan. Combustion characteristics of different biomass fuels. Progress in Energy and Combustion Science 2004;30:219e30.

[8] Veltman MK, Karra PK, Kong SC. Effects of Biodiesel Blends on Emissions in Low Temperature Diesel Combustion. SAE 2009-01-0458.

[9] N. Usta, E. Ozturk, O. Can, E.S. Conkura, S. Nas, A.H. Con, A. C. Can, M. Topcu. 2005. Combustion of biodiesel fuel produced from hazelnutsoapstock/waste sunflower oil mixture in a Diesel engine.Energy Conversion and Management. 46. 741-755.

[10] H. Raheman, A.G. Phadatare, Diesel engine emissions and performance from blends of

karanja methyl ester and diesel, Biomass Bioenerg. 27 (2004) 393e397.

[11] J.V. Gerpen. 2005. Biodiesel Processing and Production, Fuel Processing Technology. 86, 1097- 1107.

[12] Taufiqurrahmi Niken, Mohamed Abdul Rahman, Bhatia Subhash. Production of biofuel from waste cooking palm oil using nanocrystalline zeolite as catalyst: process optimization studies. Bioresource Technology 2011;102: 10686e94.

[13] Arpa Orhan, Yumrutas Recep, Demirbas Ayhan. Production of diesel-like fuel from waste engine oil by pyrolitic distillation. Applied Energy 2010; 87:122e7.

[14] Bezergianni Stella, Kalogianni Aggeliki. Hydrocracking of used cooking oil for biofuels production. Bioresource Technology 2009;100:3927e32.

[15] J.M. Encinar, J.F. Gonzales, and J.J. Rodriguez, 2005, iodiesel From Used Oil, Ind. Eng. Chem. Res. 44, 5491-5499.