ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

To Estimating the Overall Performance and Efficiency of C I Engine on Multi-Cylinder Engine (6&V8-cylinders) By using WVO and Biodiesel Blended oil

Mr.J.Murali Naik
Research scholar,
JNTUA, Anantapuramu,
Andhra Pradesh, India.

Dr.B.Anjaneya Prasad
Director of Evaluation,
JNTUH, Kukatpally,
Hyderabad-500078, India.

Dr.R.Ramachandra
Principal,
Sri Krishna devaraya Engineering College,
NH-7 Gooty, Anantapur (Dist),
Andhra Pradesh -515401, India.

ABSTRACT:

Currently, alternative fuels are being investigated in detail for application in compression ignition (CI) engines resulting in exciting potential opportunities to increase energy security and reduce emissions The purpose of this research is to study the result of various blends of an environmental friendly alternative fuel "methyl ester" on the performance of a heavy load compression ignition engine. The biodiesel is obtained from a chemical process: the transesterification of waste oils. Due to the concern on the availability of recoverable fossil fuel reserves and the environmental problems caused by the use those fossil fuels, Tests were conducted on an engine test bench in accordance to DIN 2020 standards.(Deutsches Institut for Normung.2020)Results obtained demonstrate that the biodiesel gives very interesting ecological advantages but engine working performance was reduced slightly comparatively to obtained with a pure diesel fuel. We had noted about 5% decrease in power and torque and about 2% in Nox emission for every 10% of biodiesel blend added comparatively to pure diesel. However, the use of biodiesel has slightly increased specific fuel consumption (about 6% for every 10% of biodiesel blend added

Keywords:
multi-cylinders, biodiesel, blended oils, c i engine, performance, efficiency, emission analysis. WVO (waste vegetable oil).

INTRODUCRTION:

Vegetable oils and their derivatives (especially methyl esters), commonly referred to as "biodiesel," are prominent candidates as alternative diesel fuels. They have advanced from being purely experimental fuels to initial stages of commercialization.

They are technically competitive with or offer technical advantages compared to conventional diesel fuel. Besides being a renewable and domestic resource, biodiesel reduces most emissions while engine performance and fuel economy are nearly identical compared to conventional fuels. Several problems, however, remain, which include economics, combustion, some emissions, lube oil contamination, and low-temperature properties. An overview on all aspects of biodiesel is presented. In contrast to gasoline which is spark-ignited, DF after injection is ignited by the heat of compression in a diesel engine. The diesel engine is therefore also termed a compression-ignition (CI) engine. The differences in the ignition processes entail significant differences in chemical composition and physical properties of the fuels.

The use of vegetable oils in diesel engines is nearly as old as the diesel engine itself. The inventor of the diesel engine, Rudolf Diesel, reportedly used groundnut (peanut) oil as a fuel for demonstration purposes in 1900 (1). Lower emissions are produced and other advantages include higher thermal efficiency and low engine noise compared to the diesel engine operating with conventional diesel fuel.It is recognized that petroleum resources are exhaustible and the world's present oil reserves may be wiped out in about 40 yr. Also the use of petroleum as a fuel generates several environmen-tal problems.The use of vegetable oils in diesel engines is not new; rather it is as old as the diesel engine itself. Rudolph Diesel, the inventor of the compression ignition engine presented an engine fuelled with peanut oil at the Paris exposition in 1900 [2]. However, the increased availability and low cost of petroleum derived diesel fuel, at that time, caused the use of vegetable oils to fade. During the Second World War era, research using vegetable oils was revived [3,4]. Conclusions from this research were very promised, demonstrating that vegetable oils have very similar characteristics

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

to diesel fuel and can be used in the same condi-tions as this fuel in all types of diesel engines [5]. Many studies on the performance and emissions of compression ignition engines, fuelled with pure biodiesel and blends with diesel oil, have been performed and are reported in the literature [12–18]. An excellent method to rapidly characterize the combus-tion and emission properties of these liquids was presented by Love et al. [19]. A good review on the use of biodiesel as alterna-tive fuel for compression ignition engines was done by Van Gerpen et al. [1].Biodiesels are obtained, in general, from transesterification which refers to a catalyzed chemical reaction involving vegetable oil origin, and an alcohol, usually methanol, to yield fatty acid alkyl esters and glycerol (i.e., crude glycerin) [9–11].with an enhancement of carbon deposits. But engine thermal effi-ciencies vary little comparatively to that obtained with diesel fuel [6,7]. Research has shown that these problems could be solved using dilution of diesel vegetable oils, especially methyl or ethyl esters. These fuels are called biodiesels [6,8].

The investigation of different blends of biodiesel (obtained from soybean, rapeseed or sunflower) and diesel oil (i.e., 100%, 80%, 70%, 50%, 30%, 20%, and 0% volume of biodiesel, respec-tively) on six cylinders direct injection diesel engine has been car-ried out by Carraretto et al. [20]. All the tests showed a slight reduction of the performance (e.g., 5% decrease of the power over the entire speed range) and a significant increase of fuel consump-tion (þ15%). The presence of oxygen in biodiesel leads to more complete combustion processes, resulting in lower emissions of carbon monoxide (CO), particulates and visible smoke. However, an increase in nitrogen oxides (NOx) emissions has been meas-ured, due to higher temperatures. The same result was obtained by Moreno et al. [21] who investigates the torque, power, specific fuel consumption, and emission of pollutant of both pure diesel fuel and by mixing it with 0%, 25%, 50%, 75%, and 100% sun-flower methyl ester (SME).

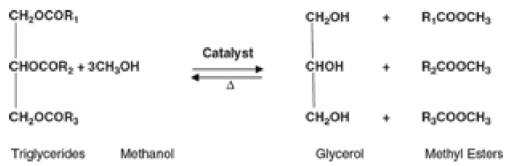
In this study, we investigated the effect of various blends of "methyl ester" biodiesel fuel, obtained from the transesterification of waste oils, on an eight cylinder Diesel Engine performance. This study was performed as a part of our main research to assess ecological and economic effects of biodiesel on heavy diesel engine vehicles. The effect of various biodiesel feedstocks (coconut, soybean, rapeseed, mustard, and safflower) on regulated emission has been reported by Peterson et al. [22].

The result demonstrated that lower iodine numbers correlate closely with reduced NOx.It is clear that the performance and characteristics of engine is strongly affected by fuel quality. However, the fuel quality varies in a wide range as a function of the process, raw material properties, etc.Our results agree well with many experimental results reported in literature. These tests demonstrated a significant environmental advantage of the methyl ester biodiesel (lower emissions of CO and smoke), however, a slight reduction of the engine perform-ance (a decrease of the engine power and torque, and an increase of fuel consumption) are observed.

BIODIESEL PRODUCTION AND CHARACTRISTICS:

Vegetable oil esters are obtained from a chem-ical process called transesterification. This process produces also glycerin, which is used in pharmaceutical and cosmetic industries. Transesterification is a reversible reaction of fat or oil (triglycer-ide) with a primary alcohol to form esters and glycerol. Alcohol combines with the triglycerides to form glycerol and esters [23].

The reaction is shown below.Biodiesel is a clean burning mono-alkyl, ester-based oxygen-ated fuel made from vegetable oils or animal fats. Biodiesel has similar physical and thermal properties compared to conventional diesel fuel. Biodiesel is compatible with conventional diesel and can be blended in any proportion with petroleum diesel to produce a stable blend [23].



A catalyst (alkalies, acids, or enzymes) is usually used to improve the reaction rate and yield. Several researchers have investigated the effect of different parameters like temperature, molar ratio of alcohol to oil, catalyst, reaction time, on transesteri-fication process [24–27].The biodiesel was blended with mineral diesel (B0) in various concentrations ranging from 15% to 40%. These biodiesel blends (B15–B40) were used as a fuel in the compression ignition (CI) engine for conducting various experiments.

The properties of these fuels are listed in Table 1.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Table 1 Properties of the fuels used in this research

Fuel method	Cetane number EN ISO 4264	Density (kg/m^3) @ 15 –C EN ISO 3675	Viscosity (cSt) @ 40 –C EN ISO 3104
B0 (pure diesel)	46.0	820.0	2.0
B15	54.2	842.3	2.8
B20	55.3	845.1	3.1
B25	56.6	847.5	3.5
B30	57.8	851.0	3.9
B35	59.1	854.8	4.4
B40	60.7	857.0	4.8

Table 2.Technical specifications and the test of diesel engine

Manufacturer	Deutz
Engine model	BF8L413F
Engine type	Eight Cylinders, V type
Compression ratio	16.5:1
Bore	125 mm
Stroke	130 mm
Total displacement	12.763 l
Advertised power/speed	190 kW/2300 rpm
Peak torque/speed	1050 N.m/1550 rpm
Cooling method	Air cooling
Aspiration	Turbo chargered

EXPERIMENTAL SET-UP:

The study was performed on SCHENCK D400 engine test bench (Fig. 1). Two four-stroke diesel engines were tested: the first is a six cylinders, direct injection engine (model OM 352), manufactured by Mercedes Benz and the second is a V8 cylinders (model BF8L413F) manufactured by Deutz (see Table 2). Results presented through this research are for the second engine.NOx emission measurements were done by the TESTO 350 gas analyzer. To measure the smoke opacity of exhaust gas, we used the Texa diesel smoke meter.The performance and emission tests were conducted under engine full load condition.

RESULT AND DISCUSSIONS:

Engine Performance Preliminary bench-tests have been per-formed to evaluate the variation of engine performances and emis-sions versus the percentage of biofuel. Figures 2 and 3 show torque and power evolution versus engine speed for different blends; the curves represent average results of different test series reported to International Organization for Standardization (ISO) conditions. No modification has been done on engine set-points, in order to allow complete fuel interchangeability. You can notice that the drop in diesel engine maximum performance is simply due to the limitation of the engine technology. The increase of biodiesel percentage in the blend involves a slight decrease of both power and torque over the entire speed range. We have noted about 5% decrease in power and torque for every 10% of biodiesel blend added comparatively to pure diesel. This decrease is probably due to the lesser heating value.The power and torque losses may be somewhat less important because biodiesel's higher viscosity reduces fuel system leakage and allows the fuel system to inject a greater volume of fuel.

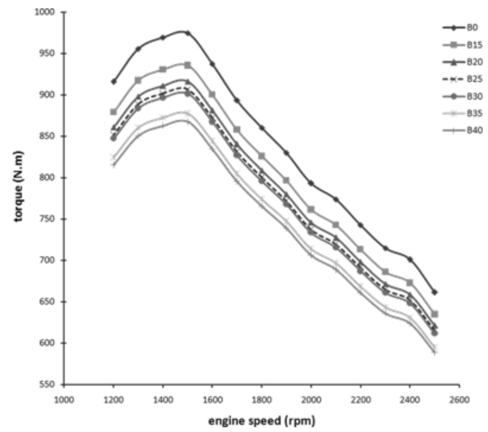


Fig. 2 Torque versus speed

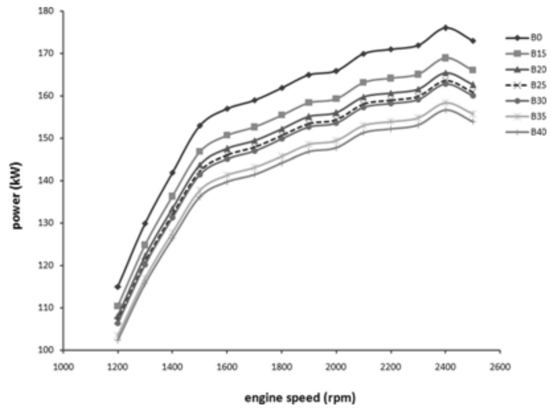


Fig. 3. Power versus speed

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

The Effect of Biodiesel Blend on Emissions and Fuel Consumption. Figures 4 and 5 show the effect of the biodiesel blend on emission of NOx and particulate matter (PM) called here the smoke opacity.Figure 4 demonstrates that the NOx emission decreased linearly with the increasing concentration of the biodiesel blend.Lower NOx emission at higher biodiesel blend concentration is contradictive with those generally found in previous biodiesel studies (generally for non palm biodiesel fuels) [20,28,29].In these studies, NOx formation is higher in biodiesel fuels due to higher temperatures during combustion in diffusion burning Whereas, the formation of NOx emission is very complex pro-cess, which depends on fuel, engine technology, and test cycle factors, it is known also that NOx formation is strongly influenced by the combustion temperature and oxygen availability. There-fore, our results seem to be acceptable and in agreement with some reported studies [31,32]. phase and better access to oxygen. Biodiesel blends contain about 3% of oxygen, have more density and more amount of fuel is injected. Mixture preparation is delayed, peak temperatures are higher in diffusion burning phase which imply faintly more of NOx produced with biodiesel blends [30].

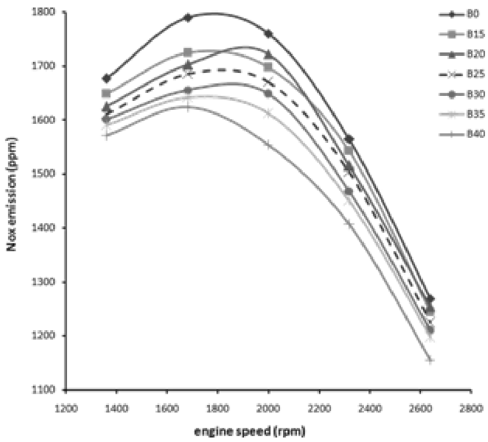


Fig. 4. NOx emission versus speed

Actually, biodiesel fuel has a faster ignition ability, decrease the combustion chamber temperature and pressure, which would finally minimize the NOx formation. Chemical and physical properties of the fuel, such as cetane number, also determine NOx emission. There is a strong link between increasing cetane numbers and reducing NOx emissions, but the response varies from engine to engine [22,31].Gro¨ss [32] reported that the low NOx emission potential of bio-diesel was believed to be due to the possibility to burn the fuel at high equivalence ratios. The combination of low injection pres-sure, large nozzle hole diameters, and fast vaporization led to worse spray penetration and fuel/air mixing than that of diesel, which resulted in high local values of equivalence ratios. Sincemost of the NOx was formed in the early burning zones, it was suggested that rich initial burning resulted in low NOx formation. In Fig. 5, we present the smoke opacity versus different biodie-sel blends. The smoke opacity of the exhaust gas is measured to quantify the PM present in the exhaust gas.We can see clearly that smoke opacity decreases for biodiesel blends lower than 15%. But beyond this value, the smoke opacity increases significantly.

It is known that there is a close relationship between fuel vis-cosity and atomization [33]. Higher viscosity of the fuel (the case of high blended biodiesels) tends to reduce the quality of fuel atomization, which could potentially lead to the higher smoke opacity and also fuel consumption.But at low blends (<20%), the presence of oxygen in biodiesel and the not very high viscosity (see Table 1) lead to more com-plete combustion processes, resulting in lower emissions of PM.Specific fuel consumption (SFC) is an important parameter to analyze the performance of the engine and fuel efficiency. SFC is the ratio between mass of fuel consumption and effective power, and for a given fuel, it is inversely proportional to thermal efficiency.

Graboski et al. [34] affirmed that if the thermal efficiency is unchanged for a fixed engine operation mode, the specific fuel consumption when using a biodiesel fuel is expected to increase by around 14% in relation to diesel fuel, corresponding to the increase in heating value in mass basis. In other words, the loss of heating value of biodiesel must be compensated with a higher fuel consumption. Figure 6 shows that the use of biodiesel has notably increased specific fuel consumption (about 6% for every 10% of biodiesel blend added). Many researchers [34–36] have reported increases in SFC ranging from 2% to 10%.

Most of the authors have explained these increases by the loss of heating value, although some others attributed them to the different densities of biodiesel and diesel fuels [37].Monyem et al. [38] showed that biodiesel had higher specific fuel consumption when compared to fossil diesel. This reflects its lower heating value (about 12% lower than diesel).

ISSN No: 2348-4845
International Journal & Magazine of Engineering,
Technology, Management and Research
A Peer Reviewed Open Access International Journal

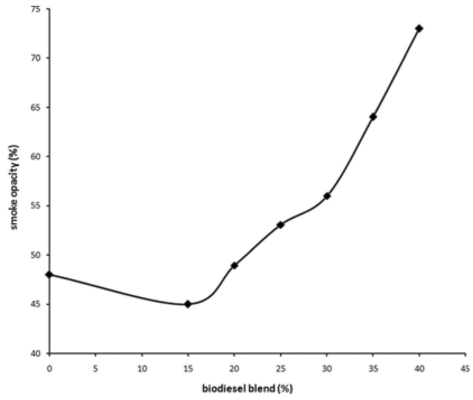


Fig. 5.Smoke opacity versus biodiesel blend

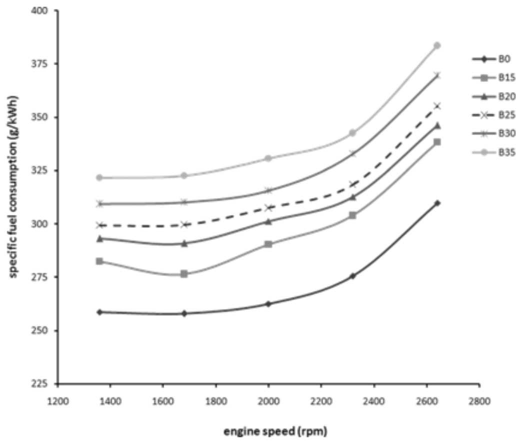


Fig. 6.Specific fuel consumption versus speed

CONCLUSIONS:

Investigation on engine test bench has been carried out to obtain comparative measurement of engine performance (torque, power, specific fuel consumption) and emission of pollutants, and to evaluate the behavior of a diesel engine running on vegetable oil biodiesel blend. The biodiesel was obtained from the transes-terification of waste oils (frying oils).Tests demonstrated many interesting results: The emission of particle matter decreased notably at 10%–20% biodiesel blend. From this value it enhances sharply with the increase in biodiesel blend.

The results also show lower NOx emission (about 2.5% of reduction for every 10% of biodiesel blend added) as well as lower torque and power (about 5% of reduction for every 10% of biodiesel blend added) for biodiesel blend compared to that of pure petrodiesel fuel. This result could be as a consequence of the properties of tested biodiesel, which has higher cetane number and lower viscosity value compared to the petrodiesel fuel sample.

Tests showed that the use of biodiesel has slightly increased spe-cific fuel consumption (about 6% for every 10% of biodiesel blend added). This is due to the fact that the loss of heating value of bio-diesel is compensated with a higher fuel consumption.

REFERENCE:

[1]Nitske, W.R.; Wilson, C.M. Rudolf Diesel: Pioneer of the Age of Power; University of Oklahoma Press, 1965, p.139..

[2]Nitschke, W. R., and Wilson, C. M., 1965, Rudolph Diesel: Pioneer of the Age of Power, University of Oklahoma Press, Norman, OK.

[3]Walton, J., 1938, "The Fuel Possibilities of Vegetable Oils," Gas Oil Power, 33, pp. 167–168.

[4]Seddon, R. H., 1942, "Vegetable Oils in Commercial Vehicles," Gas Oil Power, 37, pp. 136–146.

[5]Aggarwal, H. D., Chowdhury, S. N., Mukerji, and Verman, L. C., 1952, "Indian Vegetable Oils as Fuel for Diesel Engine," Bull. Indian Ind. Res., Council of Scientific and Industrial Research, New Delhi, India.

[6]Goering, C., Schrock, M., Kaufman, K., Hanna, M., Harris, F., and Marley, S., 1987, "Evaluation of Vegetable Oil Fuels in Engines," ASAE Paper No. 87-1586.

[7]Nascimento, M. A. R., Sierra R., G. A, Silva Lora, E. E., and Rendon, M. A., 2011, "Performance and Emission Experimental Evaluation and Comparison of a Regenerative Gas Microturbine Using Biodiesel From Various Sources as Fuel," J. Energy Resour. Technol., 133(2), p. 022204.

[8]Bruwer, J. J., Boshoff, B. V. D., Hugo, F. J. C., Fuls, J., Hawkins, C., Walt, A. N. V. D., Engelbrecht, A., and Du Plessis., L. M., 1981, "The Utilization of Sunflower Seed Oil as a Renewable Fuel for Diesel Engines," Agricultural Energy, ASAE Publication, St. Joseph, MI, Vol. 2, pp. 391–396.

[9]Schwab, A. W., Bagby, M. O., and Freedman, B., 1987, "Preparation and Prop-erties of Diesel Fuels from Vegetable Oils," Fuel, 66, pp. 1372–1378.

[10]Antolin, G., Tinaut, I. V., Briceno, Y., Castano, V., Perez, C., and Ramirez, A. I., 2002, “Optimization of Biodiesel Production by Sunflower Oil Trans-esterification,” Bioresour. Technol., 83, pp. 111–114.

[11]Demirbas, A., 2002, “Biodiesel From Vegetable Oils Via Transesterification in Supercritical Methanol,” Energy Convers. Manage., 43, pp. 2349–2356.

[12]Bhattacharyya, S., and Reddy, C. S., 1994, “Vegetable Oils as Fuels for Internal Combustion Engines,” J. Agric. Eng. Res., 57, pp. 157–166.

[13]Yoon, H. Y., Park, S. H., Suh, H. K., and Lee, C. S., 2010, “Effect of Biodiesel-Ethanol Blended Fuel Spray Characteristics on the Reduction of Exhaust Emissions in a Common-Rail Diesel Engine,” J. Energy Resour. Technol., 132(4), p. 042201.

[14]Cardone, M., Prati, M. V., Rocco, V., and Senatore, A., 1998, “Experimental Analysis of Performances and Emissions of a Diesel Engine Fuelled With Bio-diesel and Diesel Oil Blends,” Proceedings of MIS–MAC V, Roma, pp. 211–225.

[15]De Vita, A., Alaggio, M., and Cavaliere, M., 1999, “Direct Injection Diesel Engines Fuelled With Diesel and Diesel Oil Blends: Performances and Emissions,” Proceedings of 54v ATI Congress, L’Aquila, Italy, pp. 547–556.

[16]Laforgia, D., and Ardito, V., 1995, “Biodiesel Fuelled IDI Engines: Performan-ces, Emissions and Heat Release Investigation,” Bioresour. Technology, 51, pp. 53–59.

[17]Singh, B., Kaur, J., and Singh, K., 2010, “Production of Biodiesel From Used Mustard Oil and Its Performance Analysis in Internal Combustion Engine,” J. Energy Resour. Technol., 132(3), p. 031001.

[18]Schumacher, L. G., Hires, W. G., and Borgelt, S. C., 1992, “Fuelling Diesel Engines With Methyl-Ester Soybean Oil, Liquid Fuels From Renewable Resources,” Proceedings of Alternative Energy Conference, Nashville.

[19]Love, N. D., Parthasarathy, R. N., and Gollahalli, S. R., 2009, “Rapid Charac-terization of Radiation and Pollutant Emissions of Biodiesel and Hydrocarbon Liquid Fuels,” J. Energy Resour. Technol., 131 (1), p. 012202.

[20]Carraretto, C., Macor, A., Mirandola, A., Stoppato, A., Tonon, S., 2004, “Biodiesel as Alternative Fuel: Experimental Analysis and Energetic Eval-uations,” Energy, 29, pp. 2195–2211.

[21]Moreno, F., Munoz, M., and Morea-Roy, J., 1999, “Sunflower Methyl Ester as a Fuel for Automobile Diesel Engines,” Trans. ASABE, 42(5), pp. 1181–1186.

[22]Peterson, C. L., Taberski, J. S., Thompson, J. C., and Chase, C. L., 2000, “The Effect of Biodiesel Feedstock on Regulated Emission in Chassis Dynamometer Test of a Pickup Truck,” Trans. ASAE, 43(6), pp. 1371–1381.

[23]Agarwal, D., Sinha, S., and Agarwal, A. K., 2006, “Experimental Investigation of Control of NOX Emissions in Biodiesel-Fueled Compression Ignition Engine,” Renewable Energy, 31, pp. 2356–2369.

[24]Agarwal, A. K., and Das, L. M., 2001, “Biodiesel Development and Characteri-zation for Use as a Fuel in Compression Ignition Engines,” ASME J. Eng. Gas Turbines Power, 123, pp. 440–447.

[25]Murayama, T., Fujiwara, Y., and Noto, T., 2000, “Evaluating Waste Vegetable Oils as a Diesel Fuel,” Proc. Inst. Mech. Eng., Part D (J. Automob. Eng.), 214, pp. 141–148.

[26]Siler-Marinkovic, S. S., and Tomasevic, A., 1998, “Transesterification of Sun-flower Oil in Situ,” Fuel, 77, pp. 1389–1391.

[27]Pelly, M., 2001, “Make Fuel from Used Kitchen Grease,” Countryside Mag., Jan/Feb issue.

[28]Mittelbach, M., and Remschmidt, C., 2004, Biodiesel—A Comprehensive Hand-book, Karl-Franzens University, Graz, Austria.

[29]Sequera, A. J., Parthasarathy, R. N., and Gollahalli, S. R., 2011, “Rapid Charac-terization of Radiation and Pollutant Emissions of Biodiesel and Hydrocarbon Liquid Fuels,” J. Energy Resour. Technol., 133(2), p. 022203.

[30]Ghai, S., Das, L. M., and Gajendra Babu, M. K., 2008, “Emissions and Per-formance Study With Sunflower Methyl Ester as Diesel Engine Fuel,” ARPN J. Eng. Appl. Sci., 3(5), pp. 75–80.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

[31]Wirawan, S. S., Tambunan, A. H., Djamin, M., and Nabetani, H., 2008, "The Effect of Palm Biodiesel Fuel on the Performance and Emission of the Automo-tive Diesel Engine," Agricultural Engineering International: the CIGR Ejournal, Manuscript EE 07 005, Vol. X.

[32]Gro¨ss, K., 2008, "Fuelling of an Automotive Engine on Dimethylether (DME)," Master of Science in Engineering dissertation, University of the Witwatersrand, Johannesburg.

[33]Tate, R. E., Watts, K. C., Allen, C. A. W., and Wilkie, K. I., 2006, "The Viscos-ities of Three Biodiesel Fuels at Temperatures up to 300 _C," Fuel, 85, pp. 1010–1015.

[34]Graboski, M. S., Ross, J. D., and McCormick, R. L., 1996, "Transient Emis-sions From No. 2 Diesel and Biodiesel Blends in a DDC Series 60 Engine," SAE Paper No. 961166.

[35]Hansen, K. F., and Jensen, M. G., 1997, "Chemical and Biological Characteris-tics of Exhaust Emissions from a DI Diesel Engine Fuelled With Rapeseed Oil Methyl Ester (RME)," SAE Paper No. 971689.

[36]Canakci, M., 2005, "Performance and Emissions Characteristics of Biodiesel From Soybean Oil," Proc. Inst. Mech. Eng., Part D (J. Automob. Eng.), 219, pp. 915–922.

[37]Deshmukh, S.J., and Bhuyar, L.B., 2009, "Transesterified Hingan (Balanites) Oil as a Fuel for Compression Ignition Engines," Biomass Bioenergy, 33, pp. 108–112.

[38]Monyem, A., Van Gerpen, J. H., and Canakci, M., 2001, "The Effect of Timing and Oxidation on Emissions From Biodiesel-Fueled Engines," Trans. ASAE, 44(1), pp. 35–42.

ABOUT AUTHOR:

Ch.J Murali Naik
Research scholar,
JNTUA, Anantapuramu,
Andhra Pradesh, India.