IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684, p-ISSN: 2320-334X
PP 55-60
www.iosrjournals.org

Performance and Emission Characteristics of Biodiesel using with Tamanu Oil in Single Cylinder Four Stroke Diesel Engine

Murugan K, Udhayakumar K
Internal Combustion Engg, Department of Mechanical Engineering, University College of Engineering Villupuram , Villupuram 605103, India
muruganauto@gmail.com, Udhayakumar.kb@gmail.com

ABSTRACT: Tamanu oil (calophyllum inophyllum oil), a non-edible vegetable oil is native for northward of northenmarians islands and the ryukyu island in sarthen japan and westward throughout Polynesia. It has remained as an untapped new possible source of alternative fuel that can used in diesel engine. The present work examined the use of a Tamanu oil, a new possible source of alternative fuel for direct injection diesel engine. The blend of 20% Tamanu oil with 80% diesel can be used in unmodified diesel engine. The Brake thermal efficiency increases the engine. The emission like CO and HC and NOx emission reduced.

Key words: Tamanu oli, Performance, Emission.

I. INTRODUCTION:

Our economy and lifestyle rely on the use of fossil resources for the transportation fuels and materials; however there has been rising concern over their cost, sustained availability, and impact on global warming and pollution [1]. This has led to a search for technologies that generate fuels and materials from renewable carbon sources, such as plant biomass. Depending on the component of the biomass used as feedstock and the technology employed to transform component into desired product, at least three general platforms have been envisioned: the sugar [2], synthesis gas [3], and oil [4] platforms. The sugar and oil platforms are the best established today, with bio ethanol and biodiesel being the examples of their commercial products respectively. Bio ethanol is produced through microbial fermentation of sugar derived from corn, sugarcane or sugar beet [5]. Biodiesel is produced by the transesterification of vegetable oils with alcohols to produce esters. [4]. Given the increasing demand for bio fuels [6], there is an urgent need to investigate new and more efficient alternatives for their production. For example, the conversion of lignocelluloses biomass to ethanol and the use of oil accumulating algae in the production of biodiesel are being investigated [7, 8]. These approaches are very promising and will provide abundant non food feedstock for the production of bio fuels with environmental benefits and large net energy gains. However, an outstanding issue in both current and future biofuel production platforms is economic viability. The implementation of bio refineries has been proposed as a means to increase the economic viability of the biofuel industry [9]. In its 'conventional' form, a bio refinery would make use of a fraction of the feedstock to co – produce a higher value, small – market chemical along with the biofuel. The higher revenue from the co – product, which benefits itself from economies of scale available in a large bio fuels plant, would improve the economics of biofuel production. A more economically viable model for a bio refinery, however should consider the use of byproducts or waste streams generated during the production of biofuel. Glycerol-rich streams generated by the bio fuels industry have the potential to be used in this context. As its name suggests bio diesel is a fuel oil derived from biological Sources. Bio-diesel is a domestically produced, renewable fuel that can be manufactured from vegetable oils, animal fats, or recycled restaurant greases and it can replace fossil fuel [10]. Bio-diesel has become more attractive recently because of its environmental benefits and the fact that it is made from renewable resources [11]. Biodiesel has demonstrated a number of promising characteristics, including reduction of exhaust emissions [12]. Although short term tests using neat vegetable oil showed promising results, longer tests led to injector coking, more engine deposits, ring sticking and thickening of the engine lubricant. These experiences led to the use of modified vegetable oil as a fuel. Although there are many ways and procedures to convert vegetable oil into a Diesel like fuel, the trans-esterification process was found to be the most viable oil modification process [13]. More than 100 years ago, Rudolph Diesel tested vegetable oil as the fuel for his engine [14].Although vegetable oils can be used in diesel engines but due to high viscosity, low volatility and poor cold flow properties it causes many problems [15].There are more than 350 oil bearing crops identified, among which only sunflower, soybean, cottonseed, rapeseed and peanut oils are considered as potential alternative fuels for Diesel engines [16]. Trans-esterification was well known as early as 1864, when Rochleder described glycerol preparation through ethanolysis of castor oil [17-18]. Trans-esterification is the process of using an alcohol (e.g. methanol, ethanol or butanol), in the presence of a catalyst, such as sodium hydroxide or potassium hydroxide, to break the molecule of the raw renewable oil chemically into methyl or ethyl esters of the renewable oil, with glycerol as a byproduct. Glycerol is the major value-added byproduct produced from oil and fat from transesterification reactions performed during biodiesel manufacturing processes. Glycerol is liberated at levels of around 10% of the oil or fat and approximately one ton of glycerin is produced for every ten tons of biodiesel. The global amount of glycerin generated from biodiesel is increasing rapidly. Glycerin is most commonly used without modification, or very basic structural modifications, as an additive to materials. Its uses number in the thousands with large amounts being used in the manufacture of food and beverages, tobacco, pharmaceuticals, personal care products, urethane foams, and synthetic resins. Although the personal care industry has seen an increasing demand for glycerin due to consumer desire for eco-friendly “natural” products, the majority of these markets are relatively mature. Absorbing excess glycerin into these markets by replacing petro chemically derived polyols such as ethylene glycol, propylene glycol, and pentaerythritol used in automobile antifreeze, aircraft deicers and alkyd resins may partially alleviate glycerin surpluses. Currently, industry and government are increasing their efforts to develop new and improve existing glycerol chemistry.

II. EXPERIMENTAL SECTION

The setup consists of single cylinder, four strokes, Diesel engine connected to rope brake dynamometer for engine loading. The setup has stand-alone type independent panel box consisting of air box, fuel tank, and manometer, fuel measuring unit, digital speed indicator and digital temperature indicator. Engine jacket cooling water inlet, outlet temperature is displayed on temperature indicator. Rota meter are provided for cooling water flow measurement. The setup enables study of engine for brake power, BMEP, brake thermal efficiency, volumetric efficiency, specific fuel consumption, air fuel ratio. Performance and emission readings were tabulated and graph to be drawn and it is compared with diesel. Exhaust emissions were measured with an AVL DiGas 444 exhaust gas analyzer.

Table:1 **Engine Specification**

Engine Make	Kirloskar, Model TV1, Type 1 cylinder, 4 strokeDiesel, water cooled, power 5.2 kW at 1500 rpm, stroke 110 mm, bore 87.5 mm. 661 cc, CR 17.5
Dynamometer	Type Rope brake
Fuel tank	Capacity 15 lit with glass fuel metering column
Temperature sensor	Thermocouple, Type K (T_1,T_2,T_3)
Spring balance	Type Dial, range 0-10 Kg

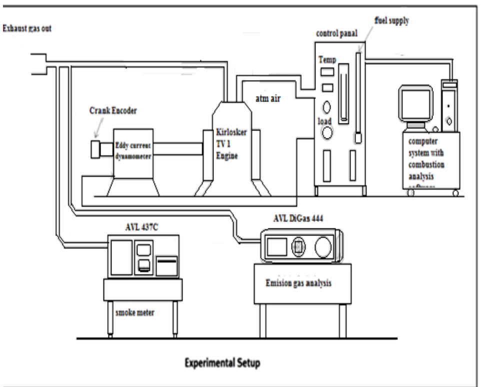


Fig:1 **Schematic of Experimental setup**

III. TAMANU OIL:

A. Seed Selection:

We selected Calophyllum inophyllum oil because it is easily available. The yield period of this seed is two times in a year, April to June and October to December. Annual yield of this seed is 20 to 100 kg/tree. Other names of this seed are Alexandrian laurel, Punnai, Tamanu, Kamani.Non–preferred scientific name Balsamaria Inophyllum. It belongs to Clusiaceae (Mangosteen) family. Kamani is a useful

IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684, p-ISSN: 2320-334X
PP 55-60
www.iosrjournals.org

PROPERTIES	DIESEL	BIO-DIESEL
Density @ 15 °C in gm/cc	0.840	0.876
Specific gravity @ 15° /15°C	0.82	0.875
Kinematic viscosity @ 40 °C (mm^2/s)	3.8	4.25
Flash point (°C)	70	162
Fire Point (°C)	76	166
Cloud Point (°C)	-10 to -15	26
Calorific value (kJ/kg)	42390	39000
Cetane Number	45 to 55	53

Table:2 **Properties of the fuel**

tree for coastal shelterbelts, windbreaks, and strand reforestation because it grows well despite the wind, salt spray, drought, and occasional flooding common to

beach environments. It even withstands typhoons. Seeds are prepared by cleaning off the skin and husk from the shell of the seed; there are 100–200 seeds/kg (45–90 seeds/lb), with shells intact but husks removed.

IV. RESULT AND DISCUSSION:

A. Performance

1. Brake Specific Fuel Consumption

The variation of brake specific fuel consumption with load for different fuels is presented in Fig.2 For all fuels tested, brake specific fuel consumption is found to decrease with increase in the load. This is due to the higher percentage increase in brake power with load as compared to the increase in fuel consumption. Using lower percentage of biodiesel in biodiesel–diesel blends, the brake specific fuel consumption of the engine is lower than that of diesel. Hence, the specific fuel consumption of the biodiesel in blends increases as compared to that of diesel. The specific fuel consumption of Calophyllum inophyllum oil is higher than that of diesel. This is caused due to the combined effect of higher viscosity and lower calorific value of the Calophyllum inophyllumoil.

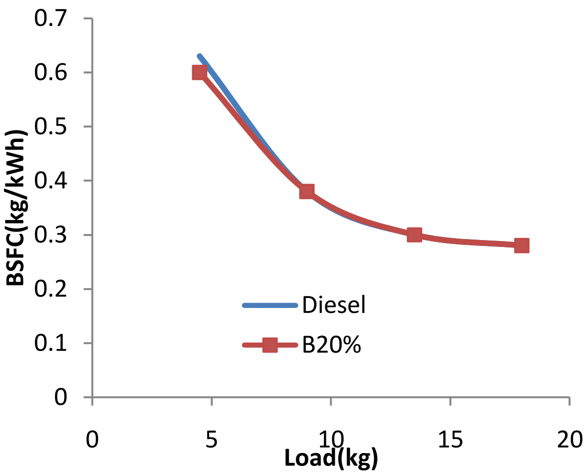
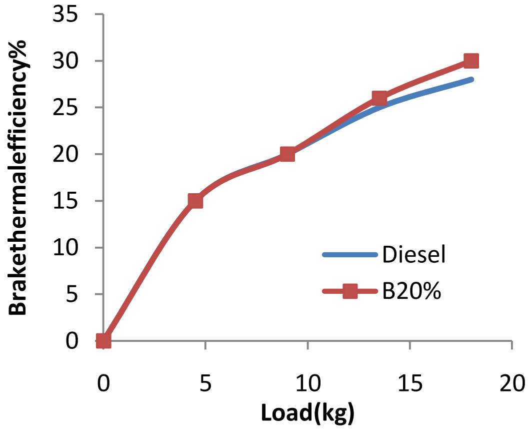


Fig :2 **Load vs Brake Specific Fuel Consumption**

2. Brake Thermal Efficiency

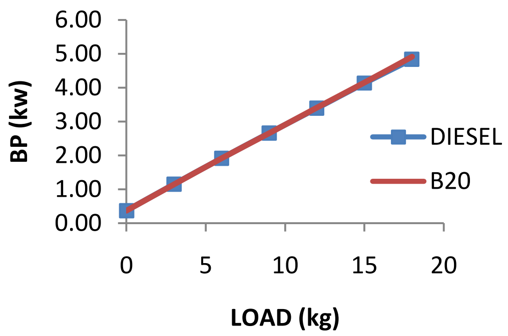
The variation of brake thermal efficiency with respect to load for different fuels considered for the present analysis is presented in Fig.3. Brake thermal efficiency has the tendency to increase with increase in applied load. This is due to the reduction in heat loss and increase in power developed with increase in load. The maximum brake thermal efficiency obtained is about 28% for B20, which is quite higher than that of diesel.

Fig: 3 Load vs Brake thermal efficiency



3. Brake Power:

Fig: 4 Load vs Brake power



Brake power is the power output of the drive shaft of an engine without the power loss caused by gears, transmission, friction, etc. It's called also pure power, useful power, true power or wheel power as well as other terms.

B. Emission Parameter

1. Carbon Monoxide (Co) Emission

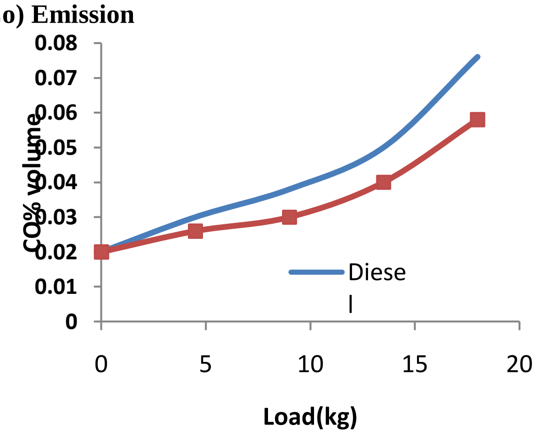


Fig:**4 Load vs Carbon Monoxide Emission**

CO emission is formed either directly or indirectly by combustion of fuels. In the ideal combustion process, carbon and oxygen combine to produce CO2. partial combustion of carbon leads to CO formation. The formation of CO takes place when the oxygen presents during combustion to form CO2 .CO emissions decrease as the load increases as shown in Fig 4. The Tamanu oil low emission main reason is that more complete combustion achieved of fuel.

2. Hydrocarbon(Hc) Emission

HC emissions consist of fuel that is incompletely burned. HCs cause serious problems at light loads in CI engines. The influence of various blends on HC emission can be clearly seen inFig.5 HC emission low for tamanu oil 8% at 18kg load.

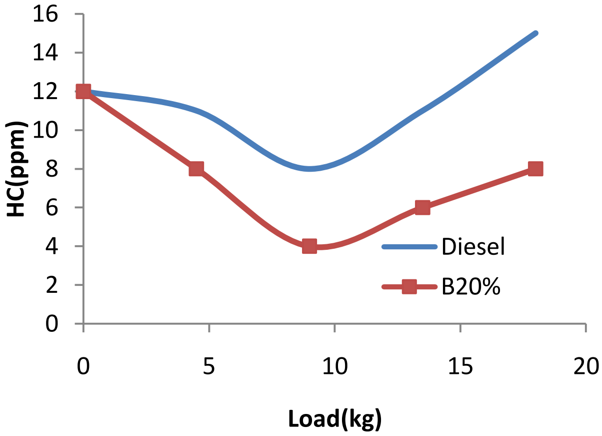


Fig :5 **Load vs Hydrocarbon Emission**

3. Nox Emission

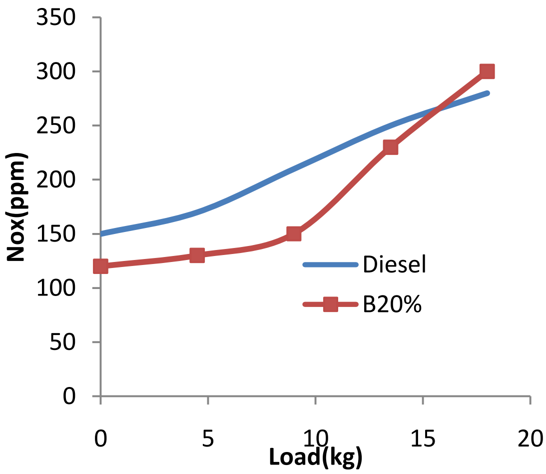


Fig : 6 **Load vs NOx Emission**

The variation of exhaust gas temperature with respect to applied load for different fuels tested is shown in Fig. 6. The biodiesel also contains some amount of oxygen molecules in the ester form. It is also taking part in the combustion. Up to B20 the exhaust gas temperature is lower. This reveals that the effective combustion is taking place in the early stages of exhaust stroke and there is saving with respect to exhaust gas energy loss.

V. CONCLUSION:

In the present study, it is observed that the qualities of biodiesel produced from edible and non edible oil are comparable with diesel fuel. It is also observed that the specific gravities of vegetable oil methyl esters are slightly higher than that of diesel fuel. As they are slightly heavier than diesel fuel hence their viscosities are also little higher than that of diesel fuel. The heating values of these methyl esters are slightly lower as compared to diesel fuel. The fuel properties of vegetable methyl esters are also within biodiesel specifications. This study suggests that the Calophyllum Inophyllum oils can be used increase the Brake thermal efficiency and reduced the CO, HC and NOx emission.

REFERENCES:

[1] Dalai, A.K., N.N. Bakhshi, X. Lang, M.J. Reaney, P.B. Hertz and Munson, "Production of Diesel Fuel Lubricity Additives from Various Vegetable Oils", Annual Interim Report for Canodev Research Inc.April (2000).
[2] Haas, M.J., Improving Economics of Biodiesel Production through the Use Low Value Lipids as Feedstocks: Vegetable Oil Soap stack, Fuel Processing Technology 86, 1087-1096 (2005).
[3] Zhang, Y., Dube M. A., McLean D. D. and Kates M. "Biodiesel Production Economic Assessment and Sensitivity Analysis", Bioresource Technology 90, (2003) 229-240
[4] Marchetti JM, Miguel VU, Errazu AF (2007) possible methods for Production. Renewale and Sustain Energy Review. 11, 1300 - 1311
[5] Gray KA, Zhao L, Emptage M (2006) Bioethanol. Curr Opin Chem Biol, 10
[6] Odling - Smee L (2007) Biofuels bandwagon hits a rut. Nature,446, 483.
[7] Scubert C (2006) Can biofuels finally take center stage? NatBiotechnol 24,777
[8] Xu H, Miao X, Wu Q (2006) High quality biodiesel production from a Chlorella protothecodies by heterotrophic growth in fermenters. J 126, 499.
[9] Kalmar MA and Masjuki HH, Biodiesel from palm oil — an analysis of Properties and potential, Biomass Bioenergy, 23(2002) 471-479
[10] GoudVV,PatwardhanAVandPradhanNC,StudiesontheEpoxidation oil by hydrogen peroxide, Techno, 97(2006)1365-1371.
[11] Demirbas A. Biodiesel fuels from vegetable oils via catalytic and non- Supercritical alcohol transesterifications and other methods: a survey.
[12] Graboski MS, McCormick RL. Combustion of fat and vegetable oil derived Diesel engines. Prog Energy Combust Sci 1998; 24:125-64.
[13] Carraretto C, Macor A, Mirandola A, Stoppato A, Tonon S. Biodiesel as Fuel: experimental analysis and energetic evaluations. Energy 2004; 29:2195- 211.
[14] Lin HA, Lin CY. Analysis of fuel contents and properties of biodiesel (in Combust Quart 2004; 13(4):410.
[15] S. Pinzi, I.L. Garcia, F.J. Lopez-Gimenez, M.D. Luque de Castro, G. M.P. Dorado, The ideal vegetable oil-based biodiesel composition: a review Social, economical and technical implications, Energy Fuels 23 (5) (2009),
[16] Knothe G,.Matheaus A C and Ryan T W , "Cetane numbers of branched andStraight-chain fatty esters determined in an ignition quality tester". Fuel.,
[17] Antolin G, Tinaut F V, Briceno Y, Castano V, Perez C and Ramirez A I , "Optimization of Biodieselproduction by sunflower oil Transesterification". Bioresource Technology. 2002, 83,111-114.
[18] De Oliveira JS, Leite PM, De Souza LB, Mello VM, Silva EC, Rubim JC, Meneghetti SMP, Suarez PAZ, Characteristics and composition of Jatropha Gossypiifolia and Jatropha curcas L. oils and application for biodiesel production, Biomass Bioenergy 33 (2009) 449-453.
[19] www.wikipedia.com
[20] www.science direct.com.