IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

Experimental Investication of DI Diesel Engine Using Biodiesel Blends With Different Injection Pressures

M.Varathavijayan[*1], T.Ponvel Murugan[2], DR.S.Mohanamurugan[3]
[*1,2] Department of Mechanical Engineering, C.R.Engg College, Madurai, India
[2] Ph.D.,Department of Mechanical Engineering, G.K.M College of Engineering, Chennai, Tamilnadu, India
vijimohan_2000@yahoo.com

Abstract

The increasing industrialization and modernization of the world has led to a steep rise for the demand of petroleum products. Therefore, countries not having these resources are facing a foreign exchange crisis, mainly due to the import of crude oil. Hence it is necessary to look for alternative fuels, which can be produced from materials available within the country. Non-edible vegetable oils such as Pongamia, Jatropha, Madhuca Indica, etc can either be fully or partially substituted with diesel oil. The high viscosity of vegetable oils can be reduced by using trans-esterification process. The concept of trans-esterification process of non-edible oil with an alcohol provides a clean burning fuel (Commonly known as Biodiesel) having less viscosity.

The result of this investigation shows that the neat biodiesel from Madhuca Longifolia oil gives slightly higher efficiency than diesel fuel. The biodiesel substantially reduces unburned hydrocarbons, carbon monoxide and particulate matter in exhaust gases, and slightly higher NO than diesel fuel but it is found that there is no significant difference between diesel and biodiesel in regard of NO and exhaust gas temperature.

Keywords: DI Diesel Engine, Biodiesel Blends

Introduction

Bio-diesel is an environment friendly liquid fuel similar to petro-diesel in combustion properties. Increasing environmental concern, diminishing petroleum reserves and agriculture-based economy of our country are the driving forces to promote bio-diesel as an alternate renewable transportation fuel. Bio-diesel derived from vegetable oil and animal fats is being used in USA and Europe to reduce air pollution, reduce dependence on fossil fuel, whose resources are limited and localized to some specific regions. In USA and Europe, the surplus edible oils like soybean oil, sunflower oil and rapeseed oil are being used as feedstock for the production of bio-diesel.

Since India is the net importer of vegetable oils, therefore these oils cannot be used for the production of bio-diesel. India has the potential to be a leading world producer of bio-diesel, as bio-diesel can be ‘‘harvested,’’ and sourced from non-edible oils like Jatropha Curcas, Pongamia Pinnata, Madhuca Indica plants etc.

Future Diesel Requirements

India consumes about 9 MMT of petrol and 47 MMT of diesel during the year 2005-06 out of which diesel consumption in various sectors Road, Transport and Agriculture about 73-75%, Railways about 4-5 %, Manufacturing Industry about 13-14% and other end users about 5%. Due to the rapid increase in the demand for diesel and other petroleum products India’s dependence on oil import is expected to rise to 92% by the year of 2030 (World Energy Outlook, 2000)

Diesel demand and future bio-diesel requirements (in MT)

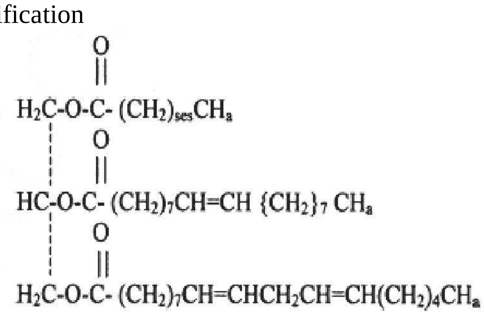
	Diesel requirement	Bio-diesel @ 5%	Bio-diesel @ 10%	Bio-diesel @ 20%
2005	46.97	2.3485	4.697	9.394
2006	49.56	2.478	4.956	9.912
2007	52.33	2.6165	5.233	10.466
2010	66.07	3.3035	6.607	13.214
2020	111.92	5.596	11.192	22.384
2030	202.84	10.142	20.284	40.568

Comparing the Structure of Diesel and Vegetable:

Ordinary diesel fuel is a mixture of HC molecules of differing lengths and structures. These molecules contain no oxygen atoms. Some HCs consist of long, straight carbon chains, others branch like a tree or form rings. They may have double-bonded carbons that cause the chains to bend. On the other hand, vegetable oils are generally composed of Triglycerides whose molecular structures are branched and complex. As a result, the viscosity of vegetable oils is very high compared to diesel. Vegetable oils have oxygen molecules present in them. This explains the higher combustion efficiencies of vegetable oils compared to that of diesel. However, the presence of oxygen molecule also has an effect of lowering the calorific value. Hence, the calorific value of vegetable oils is lower than that of diesel. The figure 1.1 shows the structure of a typical Triglyceride molecule.

The complex structure of vegetable oils also imparts high flash and fire points to them. Because of this, these can be transported and stored easily without any fire hazards. Another important parameter is the Cetane number. Cetane numbers of oils are less compared to diesel due to their complex structure. As a result, when vegetable oils are used directly, the engine will have bad starting characteristics and will also knock while running. Rich mixtures of diesel give high CO emission. CO is a dangerous pollutant which combines with the red blood pigment, hemoglobin forming a complex compound called carboxyhemoglobin. Carboxyhemoglobin has lower oxygen carrying capacity compared to hemoglobin. Thus, if carboxyhemoglobin levels of blood are more, it will result in oxygen starving which may ultimately lead to the death of a person. On the other hand, vegetable oils do not give CO in their emissions. Since they contain oxygen molecule in them, they oxidize carbon directly into carbon-di-oxide.

Due to the presence of double bonds in the molecular structure of vegetable oils, their structures can be modified easily as per requirement by treating with alcohols which is the usual process done in trans-esterification



Structure of a typical Triglyceride molecule

Need for the Biodiesel:

- Required fuel with sulphur less than 350 ppm and cetane number greater than 51.
- Flash point of biodiesel > 100° C is favorable from safety point of view.
- Availability of finite-biodiesel from renewable energy sources ensures security of the country.
- Biodiesel production generates employment opportunities for the rural masses thereby providing them livelihood support.
- Reduction in import of petroleum and thus trade deficit.
- Plantation of oil yielding plants for biodiesel will result in greening of waste and fallow land. It thus helps in Eco-restoration, drought proofing and environmental security.

Madhuca Longifolia An Overview

Description of madhuca longifolia:

Botanical Name	:	Madhuca Longifolia
Family	:	Sapotaceae
Geenus	:	Madhuka
Spceuss	:	Longifolia

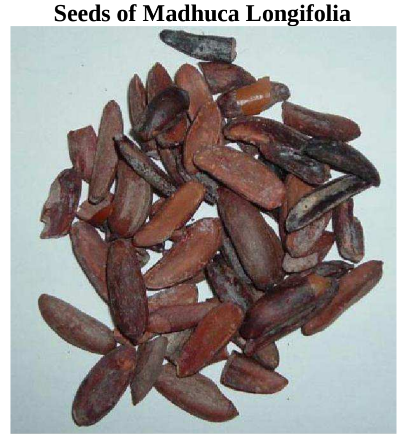
Common names:

Sanskrit	:	Madhukha
Kannada	:	Eppimara
Malayalam	:	Ireppa
Tamil	:	Iluppai
Telugu	:	Ippa

Properties of madhuca longifolia:

Refractive index: 1.452
Fatty acid composition (acid, %):
Palmitic (c16:0): 24.5
Stearic (c18:0): 22.7
Oleic (c18:1): 37.0
Lionoleic (c18:2): 14.3

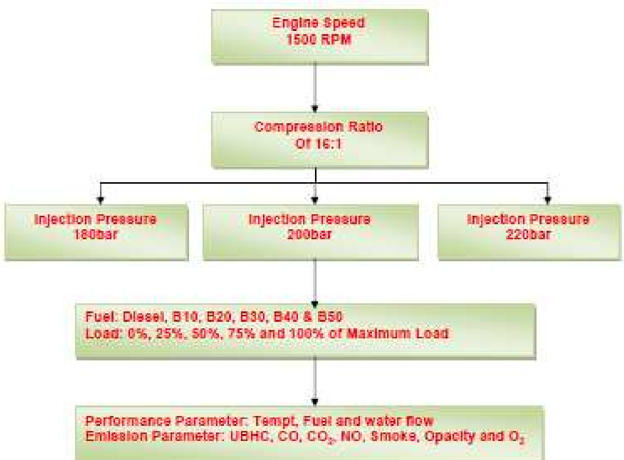
Seeds of Madhuca Longifolia



Madhuca Longifolia oil

ISSN: 2277-9655
Impact Factor: 1.852

Scheme of the Experiment



Comparison of Properties of Raw Madhuca Longifolia oil, its Methyl Ester and Conventional Diesel Fuel

Properties	**Diesel**	**Raw Madhuca**	**MEML**
Density	828	971	867
Specific	0.828	0.971	0.867
KV (cSt) 40˚C	4.4	34	4.539
Calorific Value	43.9	32	38
Flash Point (˚C)	45	220	130
Fire Point (˚C)	63	230	170
Cetane Number	40	-	48

Experimental procedure:

- The engine is started by hand cranking and is allowed to run for about 10min. to reach steady state conditions
- After attaining the steady state, readings of exhaust gas temperature, time taken for 15ml. of fuel consumption are noted down.
- The exhaust gas was made to pass through the probe of exhaust gas analyzer and smoke meter and readings of HC, CO, CO2, NO, O2 and smoke opacity are noted down
- The whole set of experiment was conducted at the constant engine speed of 1500rpm at the designed injection pressure of 180bar for 0%, 25%, 50%, 75% and 100% of full load for diesel, Madhuca Longifolia methyl ester and its blends viz., B10, B20, B30, B40 and B50

Observation:

The performance and emissions characteristics of diesel blends of Madhuca Longifolia methyl ester and diesel viz., B10, B20, B30, B40 and B50 at 3 different injection pressure are shown in tables from table 6.1 to 6.18. In these tables the performance parameters that are listed are load (% of full load), exhaust gas temperature (0C), fuel consumption (kg/hr), brake power (kW), brake mean effective pressure (bar), brake specific fuel consumption (kg/kWh), brake thermal efficiency (%). The emissions parameters that are tabulated are hydro carbon (HC) in ppm, carbon monoxide (CO) in %, carbon dioxide (CO2) in %, oxygen in %, oxides of nitrogen (NO) in ppm, smoke opacity in %, and Absorptivity in m-1.

Figure 7.1 Brake Power v/s Brake Thermal Efficiency at 180 bar

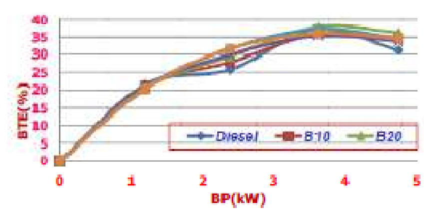


Figure 7.2 Brake Power v/s Brake Thermal Efficiency at 200 bar

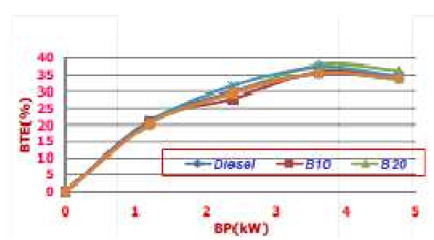


Figure 7.3 Brake Power v/s Brake Thermal Efficiency at 220 bar

Conclusions

The results of the investigations carried out in this project work, described in detail in the previous

ISSN: 2277-9655
Impact Factor: 1.852

chapter are briefly summarized as concluding remarks below:

1. After trans-esterification of Madhuca Longifolia oil, the kinematic viscosity, specific gravity is reduced and calorific value is increased.
2. The diesel engine performed satisfactorily with biodiesel as fuel, so that the MEML and diesel blend can be used as an alternative fuel in existing diesel engine without any modification in the system.
3. For B10, B20, B30, B40 and B50 fuel blends, the BTE is improved compared to diesel fuel.
4. The emission such as smoke density, CO, UBHC and NO were lower for biodiesel.
5. The injection pressure 200 bar was found to be the optimum injection pressure and better performance results obtained for biodiesel and blends at 200 bar injection pressure.

References

[1] Ramadhas A.S., Jayaraj S. and Muraleedharan C., 2004, "Use of Vegetable Oils as I.C.engine fuels – A review", Renewable Energy, Vol. 29, pp. 727-742.

[2] Stalin N and Prabhu H.J, 2007," Performance Test Of I.C. Engine Using Karanja Biodiesel Blending with Diesel", Engineering and Applied Science, Vol.2, pp.32-34.

[3] Sendzikiene E., Makareviciene V. and Janulis P., 2006, "Influence of fuel oxygen content on diesel engine exhaust emissions", Renewable Energy Vol.31, pp. 2505-2512.

[4] Deepak Agarwal, Shailendra Sinha and Avinash Kumar Agarwal, 2006, "Experimental investigation of control of NOx emissions in biodiesel-fueled compression ignition engine", Renewable Energy, Vol.31, pp.2356-2369.

[5] Sukumar Puhan N., Vedaraman and Sankaranarayanan G., 2005, "Performance and emission study of Mahua oil (Madhuca Indica oil) ethyl ester in a 4-stroke natural aspirated direct injection diesel engine", Renewable Energy, Vol.30, pp.1269-1278.