PERFORMANCE AND EMISSION CHARACTERISTICS OF CI ENGINE USING DIETHYL ETHER AND BIODIESEL BLENDED WITH DIESEL

S.RAJESWARAN[1],R.RAJEV[2],M.VADIVAZHAGAN[3],P.VIGNESH[4], V.SANTHOSH KUMAR[5],M.MANIMARAN[6]

1,2,3&4 - STUDENT, DEPARTMENT OF MECHANICAL ENGINEERING,K.RAMAKRISHNAN COLLEGE OF ENGINEERING.

5&6 – ASSISTANT PROFESSOR, , DEPARTMENT OF MECHANICAL ENGINEERING,K.RAMAKRISHNAN COLLEGE OF ENGINEERING,TRICHY,TAMIL NADU,INDIA.

ABSTRACT

The abstract of our project is to improve performance and limiting the harmful exhaust gases of diesel engine as much as possible.This may be done by the use of blending of diesel with oil extracted from spirulina algae and diethyl ether additive.Biofuels are renewable, can supplement fossil fuels, reduce green house gas emissions and mitigate their adverse effects on the climate resulting from global warming. The main candidates for transport are currently bioethanol, a petrol additive/substitute made from starchy materials like cereals, sugar beet or fodder beet and biodiesel, a diesel alternative made from a range of animal and vegetable sources, including recycled vegetable oils and fats from the food chain.

KEYWORD: *BLENDING,BIO DIESEL,BRAKEPOWER,POLLUTANTS,FUEL,LOADING, EMISSION, SPIRULLINA ALGAE OIL,PERFORMANCE.*

INTRODUCTION

Concerning the environmental aspects, rational and efficient end use technologies are identified as key options for achieving the Kyoto targets of greenhouse gas emissions reduction. For the transport sector of the European Union, energy savings of 5-10% in the medium term and an aggregate of 25% in the long term(2020) are targeted, with an expected cut of CO_2 emissions by 8% by the year 2010. Thus, the necessity to reduce the engine emissions further becomes a major researching task in developing an engine. Recently, biodiesel has become more attractive because of its environmental benefits and the facts that it is non-toxic, biodegradable and can be made from renewable resources. It requires little water and fertilizer. It has high-seed yield and continuously produced for the past 30–40 years. Oil content in the spirulina algae is around 30–40%. India has about 80–100 million hectare of wasteland, which can be used for the spirulina algae cultivation. In fact, implementation of biodiesel in India will lead to many advantages like provision of green cover to wasteland, support to agricultural and rural economy, reduction of dependency on imported crude oil, and reduction in air pollution.

1.1 BIOFUELS

Biofuels can be defined broadly as any fuel derived from biomass. They include biodiesel, bioethanol, a product of bioethanol i.e. Ethyl tertiary butyl ether (etbe), biogas, biomethanol, biodiethylether and bio-oil. The main candidates for transport are currently bioethanol, a petrol additive/substitute made from starchy materials like cereals, sugar beet or fodder beet and biodiesel, a diesel alternative made from a range of animal and vegetable sources, including recycled vegetable oils and fats from the food chain.
It is intended that the growth of biofuels will:

- Reduce carbon dioxide (co_2) emissions.
- Provide income and employment opportunities.
- Contribute to overall energy security.
- Improve air quality, especially in congested areas.
- Be possible within the existing distribution infrastructure.

1.2 ADVANTAGES OF BIODIESEL

To run any engine there is no need of technical modifications for biodiesel engines. It can be used in any conventional, unmodified diesel engine. Biodiesel can be stored anywhere that petroleum diesel fuel is stored. All diesels fueling infrastructure including pumps, tanks and trucks can use biodiesel without modifications. In France, B5 (Diesel with 5% biodiesel) is in use with the same engines and diesel tanks. Biodiesel reduces carbon dioxide emissions, the primary cause of the Greenhouse Effect, by up to 100 %. Since biodiesel comes from plants and plants breathe carbon dioxide, there is no net gain in carbon dioxide from using biodiesel. Overall biodiesel emissions are lower than gasoline or diesel fuel emissions.

1.3 TRANSESTERIFICATION

In organic chemistry, transesterification is the process of exchanging the alkoxy group of an ester compound by another alcohol. The reactions are often catalyzed by an acid or a base. Transesterification is crucial for producing biodiesel from biolipids. The transesterification process is the reaction of a triglyceride with a bio-alcohol to form esters and glycerol. Possible reason may be additional lubricity properties of the biodiesel; hence reduced frictional losses. The energy thus saved increases thermal efficiency, cooling losses and exhaust losses from the engine. The thermal efficiency starts reducing after a certain concentration of biodiesel. Flash point, density, pour point, cetane number, calorific value of biodiesel comes in very close range to that of mineral diesel.

2.DIETHYL ETHER

Diethyl ether, also known as ethyl ether, simply ether, or ethoxyethane, is an organic compound in the ether class with the formula $(C_2H_5)_2O$. It is a colorless, highly volatile flammable liquid with a characteristic odor. It is commonly used as a solvent and was once used as a general anesthetic.

2.1 HISTORY

The compound may have been created by either Matthew Gosen in the 8^{th} century or Raymundus Lullus in 1275, although there is no contemporary evidence of this. It was first synthesized in 1540 by Valerius Cordus, who called it "sweet oil of vitriol" (oleum dulce vitrioli)—the name reflects the fact that it is obtained by distilling a mixture of ethanol and sulfuric acid (then known as oil of vitriol)—and noted some of its medicinal properties. At about the same time, Theophrastus Bombastus von Hohenheim, better known as Paracelsus, discovered ether's analgesic properties in chickens. The name ether was given to the substance in 1730 by August Sigmund Frobenius.

2.2 APPLICATIONS

It is particularly important as a solvent in the production of cellulose plastics such as cellulose acetate. As a fuel Diethyl ether has a high cetane number of 85-96 and is used as a starting fluid for diesel and gasoline engines because of its high volatility and low auto ignition temperature. or the same reason it is also used as a component of the fuel mixture for carbureted compression ignition model engines.

2.2.1 LABORATORY USES

Diethyl ether is a common laboratory solvent. It has limited solubility in water (6.9 g/100 ml) and dissolves 1.5 g/100 ml water at 25 °C. Therefore, it is commonly used for liquid-liquid extraction. When used with an aqueous solution, the organic layer is on top as the diethyl ether has a lower density than the water. It is also a common solvent for the Grignard reaction in addition to other reactions involving organ metallic reagents. Due to its application in the manufacturing of illicit substances, it is listed in the Table II precursor under the United Nations Convention against Illicit Traffic in Narcotic Drugs and Psychotropic Substances.

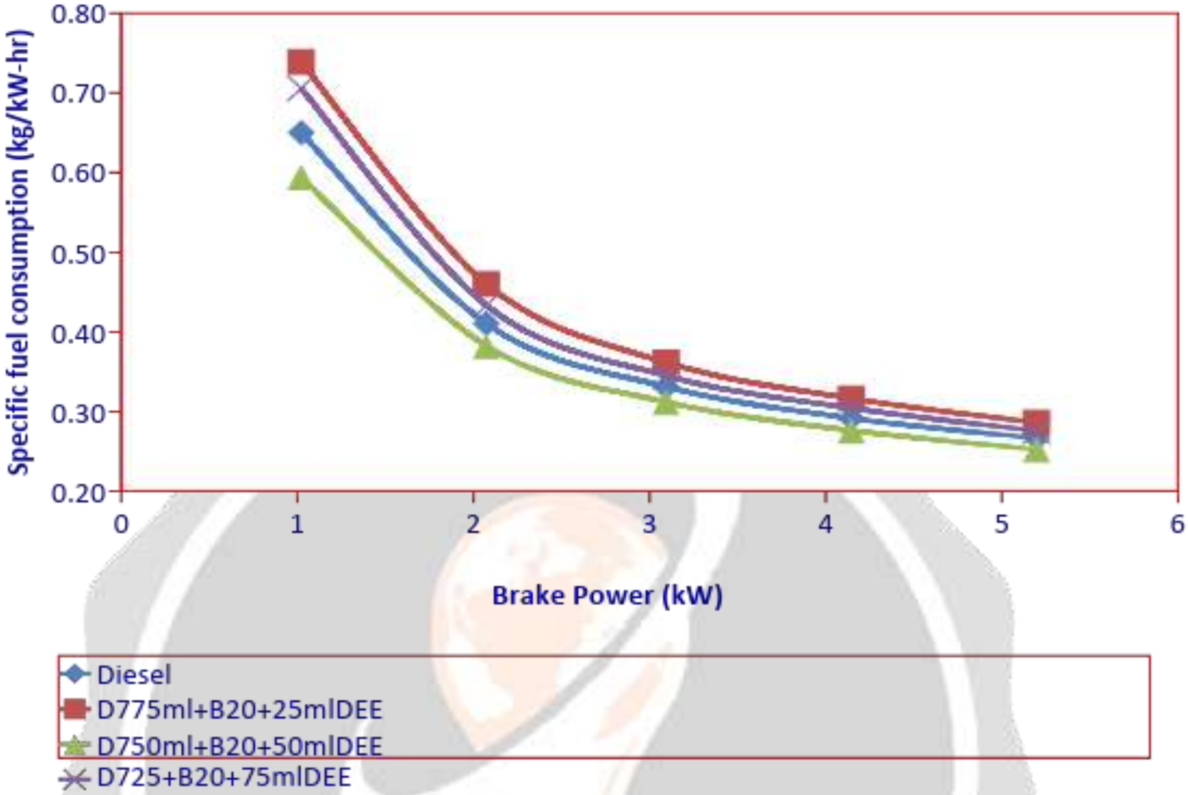
2.2.2 ANESTHETIC USE

William T.G. Morton participated in a public demonstration of ether anesthesia on October 16, 1846 at the Ether Dome in Boston, Massachusetts. However, Crawford Williamson Long, M.D., is now known to have demonstrated its use privately as a general anesthetic in surgery to officials in Georgia, as early as March 30, 1842, and Long publicly demonstrated ether's use as a surgical anesthetic on numerous occasions before 1846.British doctors were aware of the anesthetic properties of ether as early as 1840 where it was widely prescribed in conjunction with opium. Diethyl ether was formerly sometimes used in place of chloroform because it had a higher 'therapeutic index, a larger difference between the recommended dosage and a toxic overdose.

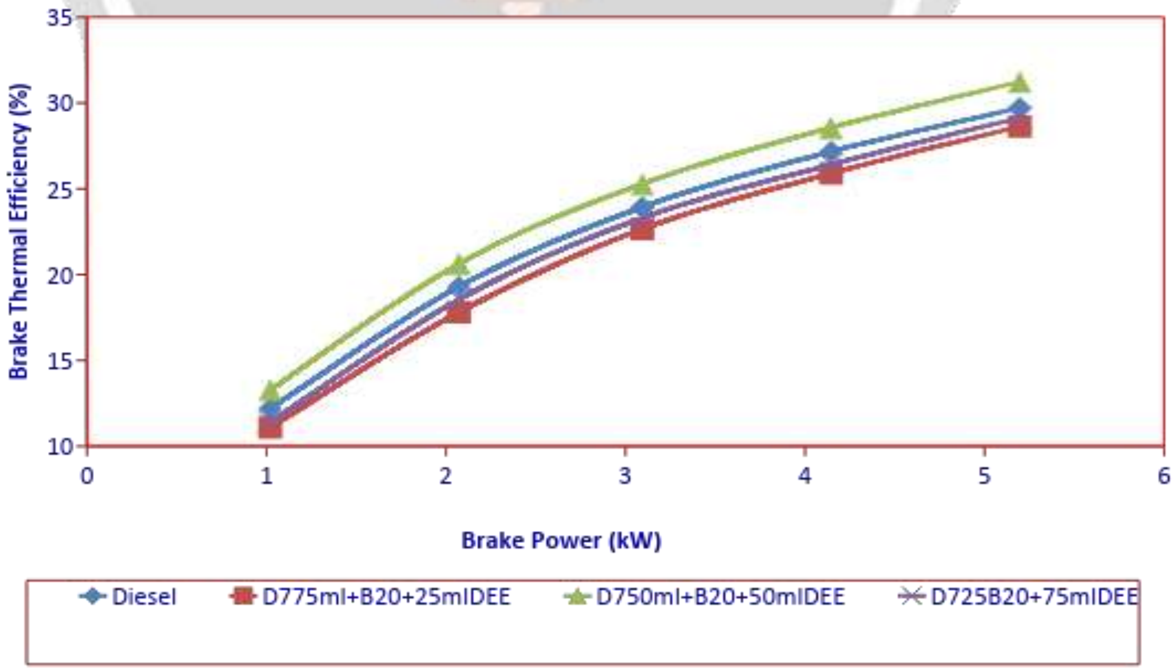
2.2.3 **SAFETY**

Diethyl ether is susceptible to peroxide formation, and can form explosive diethyl ether peroxide. Ether peroxides are higher boiling and are contact explosives when dry. Diethyl ether is typically supplied with trace amounts of the antioxidant butylated hydroxytoluene (BHT), which reduces the formation of peroxides. Storage over sodium hydroxide precipitates the intermediate ether hydroperoxides. Water and peroxides can be removed by either distillation from sodium and benzophenone, or by passing through a column of activated alumina.Diethyl ether is extremely flammable.The auto ignition temperature of diethyl ether is 160°C (320°F), therefore it can be ignited by a hot surface without a flame or spark. A common practice in chemical labs is to use steam (thus limiting the temperature to 100°C (212°F) when ether must be heated or distilled). The diffusion of diethyl ether in air is $0.918 \cdot 10^{-5}$ m 2 /s (298K, 101.325kpa) .

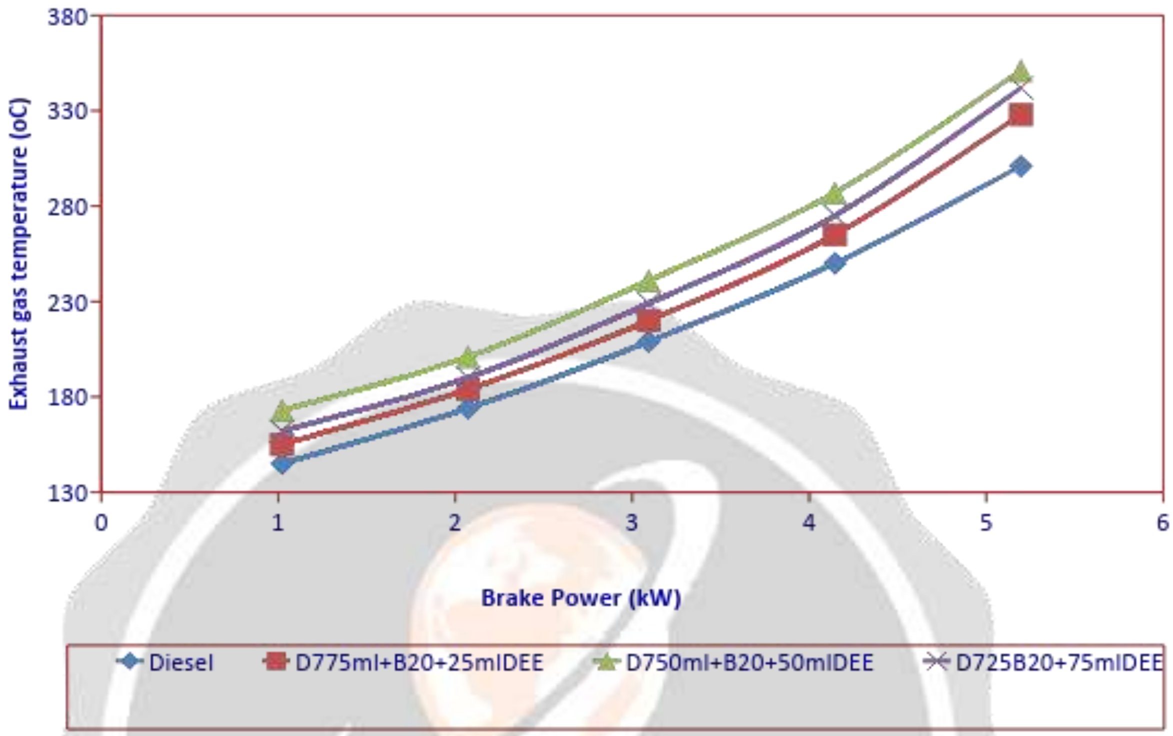
GRAPH FOR COMPARISON:



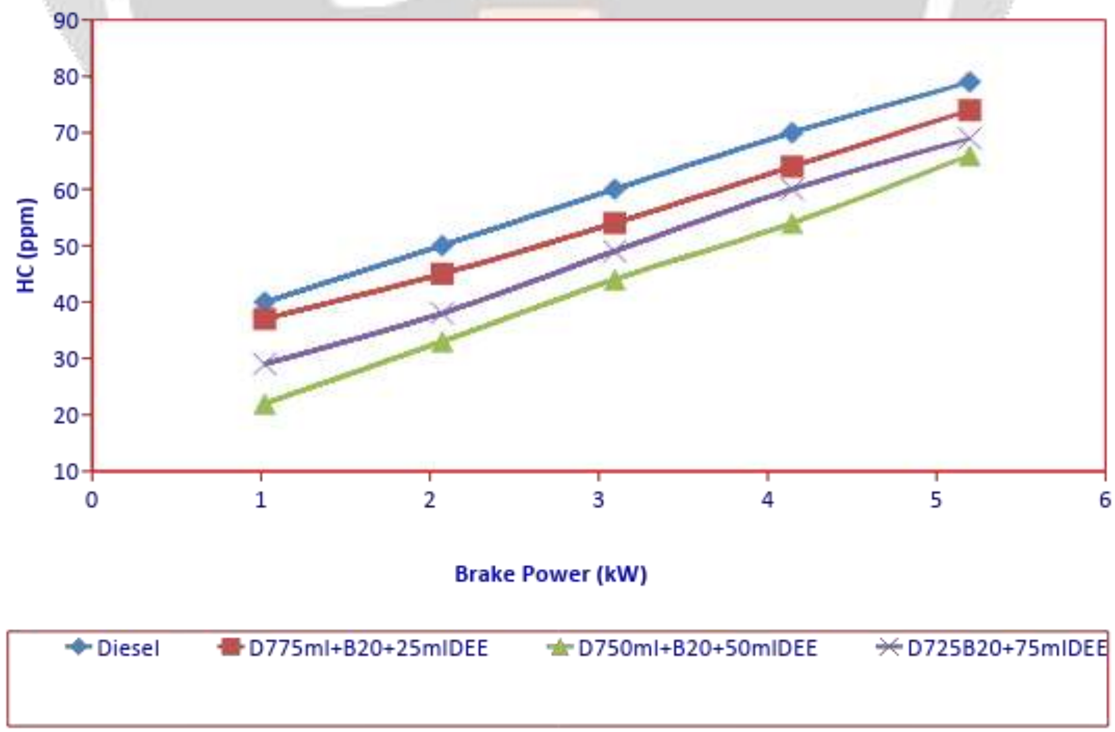
BRAKE POWER VS FUEL CONSUMPTION



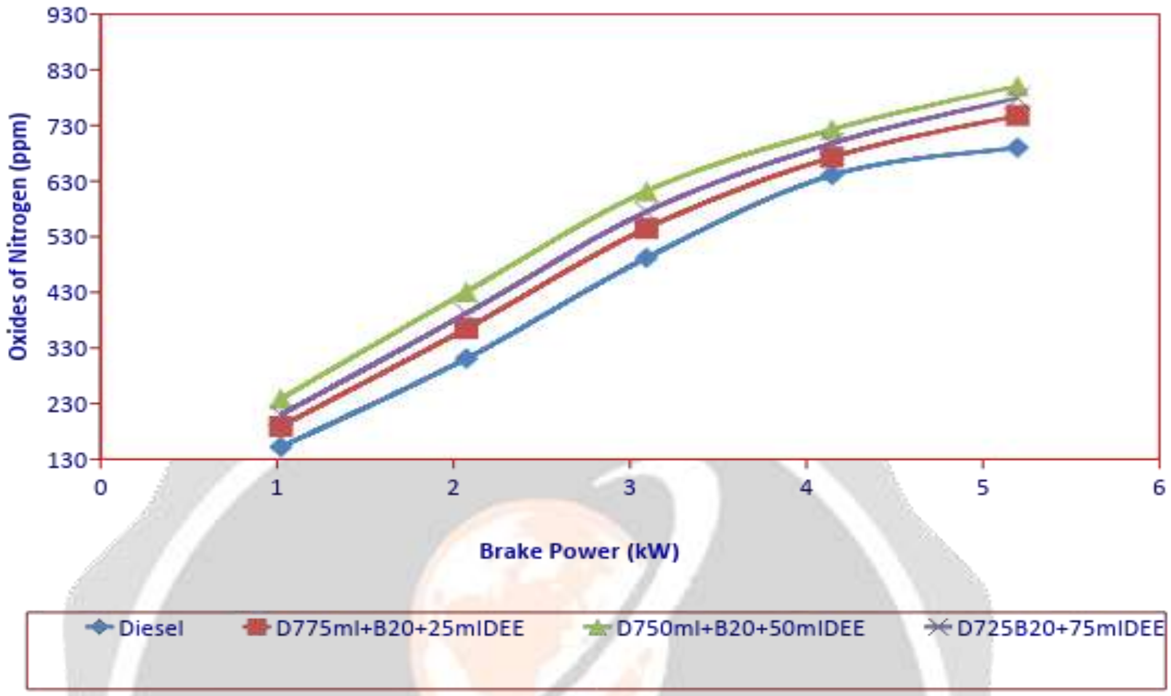
BRAKE POWER VS BRAKE THERMAL EFFICIENCY



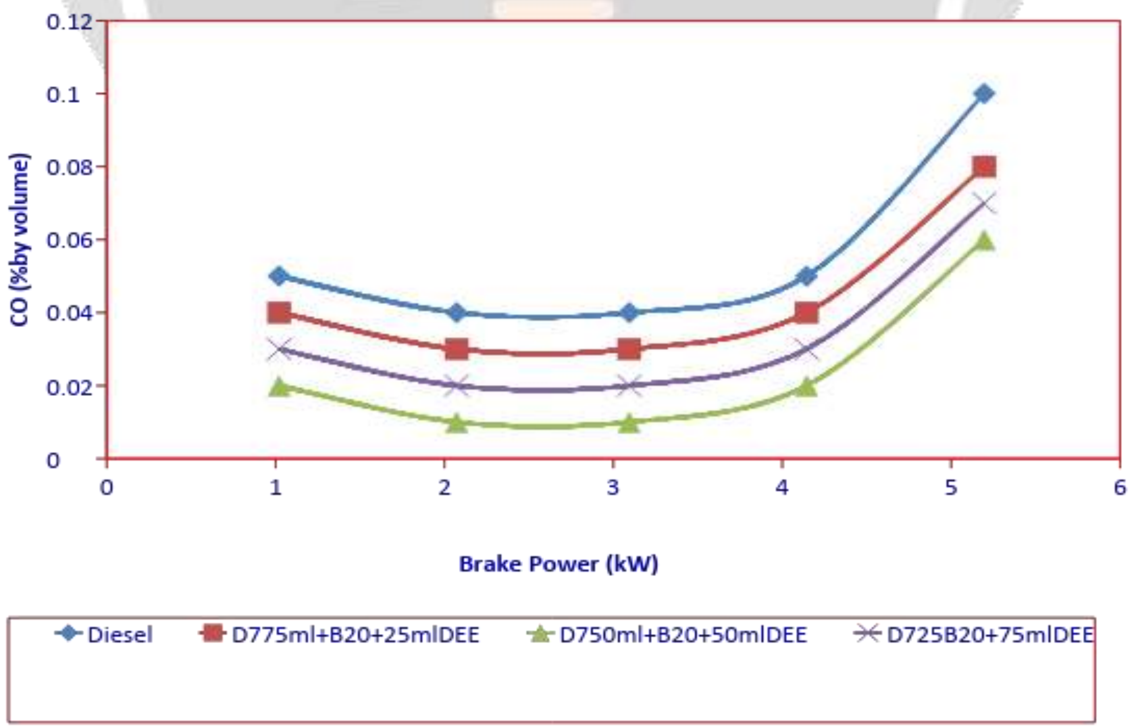
BRAKE POWER VS EXHAUST GAS TEMPERATURE



BRAKE POWER VS HC



BRAKE POWER VS OXIDES OF NITROGEN



BRAKE POWER VS CO

TABLES

SPECIFIC FUEL CONSUMPTIN (kg/kW-hr):

BP	Diesel	D775ml+B20+25mlDEE	D750ml+B20+50mlDEE	D725ml+B20+75mlDEE
1.02113271	0.650291629	0.739063688	0.594454263	0.705844576
2.072298735	0.410539264	0.460333419	0.382451685	0.433427579
3.093431445	0.331206703	0.361903365	0.312137404	0.345138247
4.14459747	0.291711393	0.316537395	0.276367627	0.304467613
5.195763495	0.266799969	0.286303369	0.252686195	0.276023132

BRAKE THERMAL EFFICIENCY (%):

BP	Diesel	D775ml+B20+25mlDEE	D750ml+B20+50mlDEE	D725ml+B20+75mlDEE
1.02113271	12.18707269	11.09144092	13.27511505	11.39191207
2.072298735	19.30424696	17.80726947	20.63384486	18.55193284
3.093431445	23.92811282	22.65046978	25.28197081	23.29767688
4.14459747	27.16778138	25.89672296	28.55417196	26.40976906
5.195763495	29.70446878	28.63145223	31.23023297	29.13132418

EXHAUST GAS TEMPERATURE (°C):

BP	Diesel	D775ml+B20+25mlDEE	D750ml+B20+50mlDEE	D725ml+B20+75mlDEE
1.02113271	145	155	173	162
2.072298735	174	184	201	190
3.093431445	209	220	241	229
4.14459747	250	265	287	275
5.195763495	301	328	351	342

RESULT AND DISCUSSION

FUEL CONSUMPTION

It is observed that the fuel consumption decreases with increase in load for all blend fuels. This may be due the percent increase in brake power being more than the percent increase in fuel consumption. The lower fuel consumption is attained in D750ml+B20+DEE50ml compare to other blends.

BRAKE THERMAL EFFICIENCY

The brake thermal efficiency increases with the addition of DEE to biodiesel. Addition of DEE to biodiesel will decrease viscosity of blends and it causes improvement in the shape of fuel spray and atomization. The higher brake thermal efficiency is attained in D750ml+B20+DEE50ml compare to other blends.

HYDROCARBON

. Hydrocarbon emission was found to be higher with the increase of DEE fraction in the blends. This may be due to the due to the high latent heat of evaporation of DEE causing slower evaporation and poorer fuel air mixing, which could lead to in complete combustion of the mixture. However at low and part loads, there was no significant difference between different biodiesel DEE blends. The lower hydrocarbon emission is attained in D750ml+B20+DEE50ml compare to other blends.

OXIDES OF NITROGEN

The results show that NOx emission increases with the increase of engine load. In this study, the addition of DEE decreases NOx emission compared to biodiesel fuel. The NOx concentration increases with the increase of DEE fraction in the blends and this is due to temperature increase with the increase of DEE fraction in the blends. This will also bring short ignition delay, leading to increased premixed combustion fraction. It is found that 50ml DEE have greater effect on the increase of NOx emission than the other DEE blends.

SMOKE DENSITY

Smoke is mainly produced in the diffusive combustion, the addition of oxygenated fuels leads to improvement in diffusive combustion. Addition of DEE made the lowest level of smoke at no load and part load conditions and highest level of smoke at higher and full load conditions. This may be due to decreased Air-fuel ratio at higher loads, when larger quantities of fuel are injected into the combustion chamber, much of which goes unburned into the exhaust. The lower Smoke density is attained in D750ml+B20+DEE50ml compare to other blends.

CARBON MONOXIDE

At low and part load, small difference of CO emission is observed among the tested biodiesel-DEE blends. At high load, the exhaust CO emission increases with increase of DEE fraction in the blends. The reason is that carbon monoxide emission (CO) in internal combustion engines mainly depends on the mixture concentration. The decrease of carbon monoxide emission with the addition of DEE at high loads may be due to the high latent heat of evaporation of DEE causing slower evaporation. This will increase the rich region in the cylinder and will increase the CO emission. The lower CO is attained in D750ml+B20+DEE50ml compare to other blends.

CONCLUSION

The performance and emission characteristics of diesel, Biodiesel-DEE blends are analyzed and compared. Based on the experimental results, the following conclusions are drawn.

- The Brake thermal efficiency of D750ml+B20+DEE50ml is found to be higher than that diesel fuel. The higher thermal efficiency after the addition of Biodiesel-DEE is due to its oxygen content and effect on lowering the viscosity of the blend, which led to an improvement in the combustion.
- The brake specific fuel consumption for D750ml+B20+DEE50ml lower than that of diesel at the maximum load.
- The smoke intensity is decreased with D750ml+B20+DEE50ml blends. There is no remarkable increase in smoke intensity at no load and part load conditions with Biodiesel-DEE blends.
- NOx emission is reduced by the addition of D750ml+B20+DEE50ml. The effect of D750ml+B20+DEE50ml on NOx emission is more effective when compared with other emissions.

[REFERENCE

1. **V vijayan, s aravind ''Diesel Blended with Linseed Oil and Leishmaan's Solution"** Department of Mechanical Engineering K. Ramakrishnan College of Engineering Tiruchirapalli, Tamil Nadu, India, Revised (6 January 2017) Accepted (11 February 2017).

2.Manimaran ''**Experimental Investigation Of A Diesel Engine Fueled By Emulsified B20 Biodiesel"** 2015,*Internationaljournal Of Chemical And Pharmaceutical Science*.

3. Proceeding of the **XVII National Conference on IC Engines and Combustion** (NCICEC), December 18-20, 2001, Karnataka Regional Engineering College, Surathkal, Srinivasnagar, India.

4. **Czerwinski J**. "Performance of HD-DI diesel engine with addition of ethanol and rapeseed oil. ***Transactions of Society of Automotive Engineering,*** 1994; 940545.

5. **Senthil Kumar M, Ramesh A, Nagalingam B**. Use of hydrogen to enhance the performance of a vegetable oil fuelled compression ignition engine. ***International Journal of Hydrogen Energy*** 2003; 28(10):1143–54.

6. **Humke AL, Barsic NJ**. "Performance and emission characteristics of a naturally aspirated diesel engine with vegetable oils (Part-2). ***Transactions of Society of Automotive Engineers*** 1981; 810955.

7. **Senthil Kumar M, Ramesh A, Nagalingam B**. "An experimental comparison of methods to use methanol and Jatropha oil in a compression ignition engine". ***Biomass Bioenergy*** 2003;25(3):309–18.

8. **Chang DY, Van Gerpen H**. Determination of particulate and hydrocarbon emissions from diesel engines fueled with biodiesel. ***Transactions of Society of Automotive Engineers*** 1998; 982527.

9. **Subramanian KA, Ramesh A**. "Experimental investigation on the use of water diesel emulsion with oxygen-enriched air in a di diesel engine". ***Transactions of Society of Automotive Engineers*** 2001. 2001-01-0205.

10. **Nwafor OMI.** "The effect of elevated fuel inlet temperature on Performance of diesel engine running on the neat vegetable oil at constant speed conditions". ***Journal of Renewable Energy*** 2003; 28:171–81.