Scientific Journal of Impact Factor (SJIF): 5.71
e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406
International Journal of Advance Engineering and Research Development
Volume 5, Issue 04, April -2018

PERFORMANCE AND EMISSION IMPROVEMENT OF SINGLE CYLINDER DIESEL ENGINE USING DUAL FUEL

Kirankumar B. Vaghela[1], Jainesh D. Patel[2], Ritesh Kumar Ranjan[3], Narendra H. Gothi[4]

[1]*Mechanical Engineering Department, Ipcowala Institute of Engineering & Technology- Dharmaj*
[2]*Mechanical Engineering Department, Assistant Professor, Ipcowala Institute of Engineering & Technology- Dharmaj*
[3]*Automobile Engineering Department, H.O.D, Ipcowala Institute of Engineering & Technology- Dharmaj*
[4]*Automobile Engineering Departments, Assistant Professor, Ipcowala Institute of Engineering & Technology –Dharmaj*

Abstract — *increasing demand of fuel day by day its consumption and hazards cause serious intensive attention is required for this problem. Also an Improvement of fuel properties is essential for suppression of pollutant and optimization of engine performance. One way is use of additives. Oxygenated additives were conventionally recommended for gasoline. But now days oxygenated additives are widely considered for diesel fuel. These additives can also be used in combination with diesel. There are number of additives are available for diesel fuel. On the basis of different experimental investigations by the researchers ,this paper reviews about Di-ethyl Ether (DEE) as oxygenated additives mixed with diesel blends and compares its effect on performance and exhaust gas emission of compression ignition engine.*
Engine performance can be significantly improved when the di ethyl ether is blended diesel. Hence diesel can be blended with di ethyl ether to increase the brake power, thermal efficiency, volumetric efficiency as well as mechanical efficiency and reduce the emissions. Experiment is carried on COMET PPW-5A a vertical, single cylinder, water-cooled, four stroke Diesel engine for experimental set-up. Then diesel engine will be converted into dual fuel engine by modification in engine and using different percentage of blend. We Had measure performance and emissions of dual fuelled engine with various speeds and loads. The experiment had carried on 10%, 20%, and 30% blending of DEE with diesel.

Keywords*-Diesel Engine, Di-Ethyl Ether DEE,COMET PPW-5A, tachometer, rope brake dynamometer, emission control*

I. INTRODUCTION

Diesel engine plays a dominant role in the field of power, propulsion and energy. The diesel engine is a type of internal combustion engine; more specifically it is a compression ignition engine, in which the fuel injected by fuel injection system is ignited solely by the high temperature created by compression of the air during the compression stroke. The engine operates on the diesel cycle. The working of the cycle is as follows:

Compression-Ignition (Diesel) Engine:
Compression-ignition (C.I.) engines burn fuel oil which is injected into the combustion chamber when the air charge is fully compressed. Burning occurs when the compression temperature of the air is high enough to spontaneously ignite the finely atomized liquid fuel. In other words, burning is initiated by the self-generated heat of compression. Just like the four-stroke-cycle petrol engine, the C.I. engine completes one cycle of events in two crankshaft revolutions or four piston strokes. The four phases of these strokes are: suction, compression, expansion, exhaust stroke Amidst ever decreasing fuel resources and constantly increasing air pollution, the fundamental sustainability of present energy system has been put into question. The present reserve of Petroleum products is slowly dying out, widening the gap between global energy supply and energy consumption. As per 2008, energy used on a global scale is about 142.3 Terawatt-Hour, which is about 39% higher than that of 1990. Moreover, in order to meet the stringent EURO-VI standards, automobile manufacturers are compelled to try out emission, more precisely NOx and smoke reducing alternatives like DEE (Die-Ethyl Ether). As a result a lot of the research studies are now oriented toward finding a cleaner burning fuel with satisfactory combustion and performance signatures. We have developed a Dual fuel system without additives in conventional C.I. engine to increasing the performance and to reduce emission of pollutants.

II. LITERATURE REVIEW

M. Pugazhvadivu et. al. Investigates performance a diesel engine fuelled with biodiesel blends and diethyl ether as an additive [1].With B25 blend, the NOX emission was reduced by the addition of DEE at all load conditions. With B50, B75 and B100 blends, the NOx emission was lowered by the addition of DEE at low and medium loads. However, at high loads the NOX emission was higher relative to diesel; but lower compared to the corresponding fuel blend. The addition of 15% to 20% DEE was more beneficial in reducing NOX compared to 10% DEE the biodiesel blends tested showed a significant reduction in smoke emission. Further improvement in smoke emission was obtained by the addition of DEE. The addition of DEE resulted in a marginal deterioration of thermal efficiency. It is concluded that the addition of 15% - 20% DEE to biodiesel blends would result in reduction of both NOx and smoke emission. [2]

S.K. Mahla et al. Studied The Performance Characteristics of Acetylene Gas In Dual Fuel Engine With Diethyl Ether Blends [3]. Experiments were conducted to study the performance characteristics of DI diesel engine in dual fuel mode by aspirating Acetylene gas in the inlet manifold, with diesel- diethyl ether blends (DEE) as an ignition source. Fixed quantity of Acetylene gas was aspirated and Blend of diethyl ether with diesel (DEE10, DEE20 and DEE30) was taken and then readings were taken at various loads. From the detailed study it has been concluded that the blending ratio of DEE20 gives better performance. Dual fuel operation along with addition of diethyl ether resulted in higher thermal efficiency when compared to neat diesel operation. Acetylene aspiration reduces smoke and exhaust temperature.

Y. V. V. Satyanarayanamurthy investigates effects of real time secondary co-injection of water – diethyl ether solution in diesel engine fuelled with palm kernel methyl ester. At Full load running of the engine the Specific fuel consumption for the flow rate of 15% vol. Water-DEE solution coincided with that of injection, indicating that the mass flow rate of 5% vol. Water-DEE solution (thresh hold percentage) in the duel fuel operation is beneficial in view of other advantages from the exhaust pollution angle especially in the case on "NO" emission. Exhaust gas temperatures at all loads in the case of 15% vol. Water-DEE solution injection are almost equal to the temperatures emitted during neat diesel operation. There is a straight reduction of approximately 500 ppm in NO level when the flow rate of saturated water-DEE solution is increased from 5% vol. to 15% vol. Water-DEE solution. The emission of HC with the injection of saturated 15% vol. Water-DEE solution is closely tallying and proximate to the neat diesel operation. [4]

- The main objective of our project is to reduce the emission of diesel engine using dual fuel. It can be done by proper combustion in the engine.
- To increase the performance of the diesel engine.
- To introduce alternating fuel for IC Engine.
- To reduce or eliminate cold starting problem.

III. MATERIAL

➢ DI-ETHYL ETHER (DEE)

Diethyl ether can be made from renewable feedstock and waste. When used as a CI engine fuel, DEE offers HC emission benefits. DEE can be obtaining by dehydration of Ethanol. DEE has the formulaCH3-CH2-O-CH2.-CH3. The list of properties of diesel and DEE is shown in below table.

Table 1. Properties of diesel and Di-Ethyl Ether

Properties	Diesel	DEE
Density(Kg/m^3)	823	713
Calorific value (MJ/Kg)	43000	33890
Viscosity @40°C (cst)	3.9	0.23
Cetane number	48	125
Auto ignition temperature °C	315	160
Oxygen content %	0	21.6
Flash point	56	-40
Boiling point	188	34

IV. EXPERIMENT SET-UP

➢ Technical Specification of the Test Engine:

We have selected a vertical, single cylinder, air-cooled, cold starting, four stroke, diesel engine, which we are going to use for the experiment. The details of technical specification of PPW-5A engine are as under:

Table 2. Technical Specification of the Test Engine.

Make	COMET
MODEL	PPW-5A
Bore (mm)	87.5
Stroke (mm)	80
Displacement (cm^3)	481
Compression ratio	16.7:01
RPM	1500
H.P.	5.0
Max. Torque – kgm	Hp
Consumption of Fuel (S.F.C)- gm./h.p./hr.	230
Lub. oil consumption-kg/hr.	0.008
Capacity of oil sump- Liter	1.3
Dry weight-Kg.	115 kg

The practical set-up for testing performance and emission is shown above figure. We use single cylinder water cooled diesel engine for testing of fuel. The Name of Manufacturer is COMET (PPW-5A Model). The water is used as coolant in this engine. The different components used in our project are Diesel engine, Manometer, burets, Thermometer, Temperature sensor, Economizer.

Figure 1. Experiment set-up

Table3. Experiment result of performance when blending of diesel and DEE fuel is used in set-up as a fuel

Sr. No.	Load (KG)	Observed Speed (RPM)	Barometer Reading (KPa)	Air-Intake Temp.(K)	Exhaust Gas Temp.(K)	Relative Humidity	Time Required for 10 ml Fuel	Manometer Difference
10%DEE,90% DIESEL	0	1444	101	311	356	0.27	180	113
	3	1431	101	311	377	0.27	165	110
	6	1424	100.8	312	379	0.24	107	111
	9	1401	100.8	312	396	0.24	88	109
	12	1372	100.8	312	422	0.24	78	105
	15	1346	100.8	312	426	024	66	102
20% DEE, 80% DIESEL	0	1448	101	309	355	0.27	183	112
	3	1435	101	309	375	0.32	170	109
	6	1427	101	309	378	0.32	109	109
	9	1405	101.1	308	396	0.34	94	108
	12	1378	101.1	308	423	0.34	78	102
	15	1370	101.1	308	427	0.34	71	98
30%DEE,70%DIESEL	0	1450	101.1	309	355	0.27	190	118
	3	1440	101.1	309	376	0.32	174	117
	6	1431	101.1	309	378	0.32	117	117
	9	1409	101.1	308	392	0.34	98	119
	12	1380	101.1	308	420	0.34	82	106
	15	1372	101.1	308	429	0.34	62	101

Table. 4. Experiment result of emission when blending of diesel and DEE fuel is used as a fuel in set-up

Sr. No.	Load (KG)	Exhaust Gas Emission				
		CO (% vol.)	HC (ppm)	CO_2 (% vol.)	O_2 (% vol.)	NOx (ppm)
10%DEE,90%DIESEL	0	2.20	176	1.3	16.3	140
	3	2.36	174	1.5	16.0	141
	6	3.75	172	2.7	13.2	148
	9	4.69	170	3.3	12.0	154
	12	5.84	168	3.6	8.3	158
	15	6.21	166	3.9	7.1	161
20%DEE,80%DIESEL	0	2.18	174	1.5	16.5	138
	3	2.26	172	1.7	16.1	140
	6	3.71	170	2.8	13.5	145
	9	4.62	169	3.5	12.2	152
	12	5.81	167	3.8	8.7	156
	15	6.18	164	4.1	7.4	159
30%DEE,70%DIESEL	0	2.15	170	1.7	16.8	135
	3	2.2	168	1.9	16.5	138
	6	3.65	165	3	14	143
	9	4.55	161	3.7	12.5	150
	12	5.75	158	3.9	9.2	154
	15	6	155	4.3	7.9	155

V. RESULT

5.1. Engine Performance parameters:

5.1.1. Volumetric Efficiency

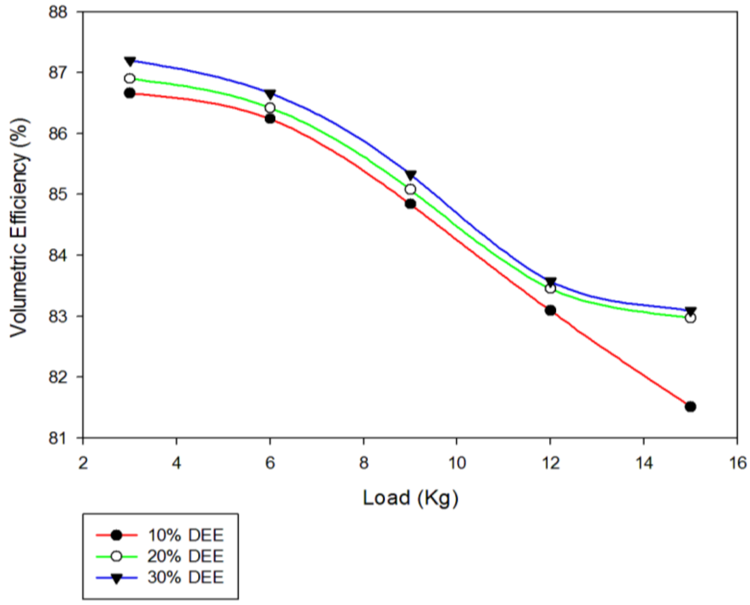

Figure 2. Load vs. Volumetric efficiency

From the load vs. volumetric efficiency diagram shows the %DEE increasing the volumetric efficiency also increasing Consider 6Kg load for 10%DEE & 90%Diesel Volumetric Efficiency 86.24%, at 20%DEE volumetric efficiency 86.42%, at 30%DEE volumetric efficiency 86.66% compare 10% & 20% DEE increasing vol. efficiency 0.00069%

Brake Specific Fuel Consumption

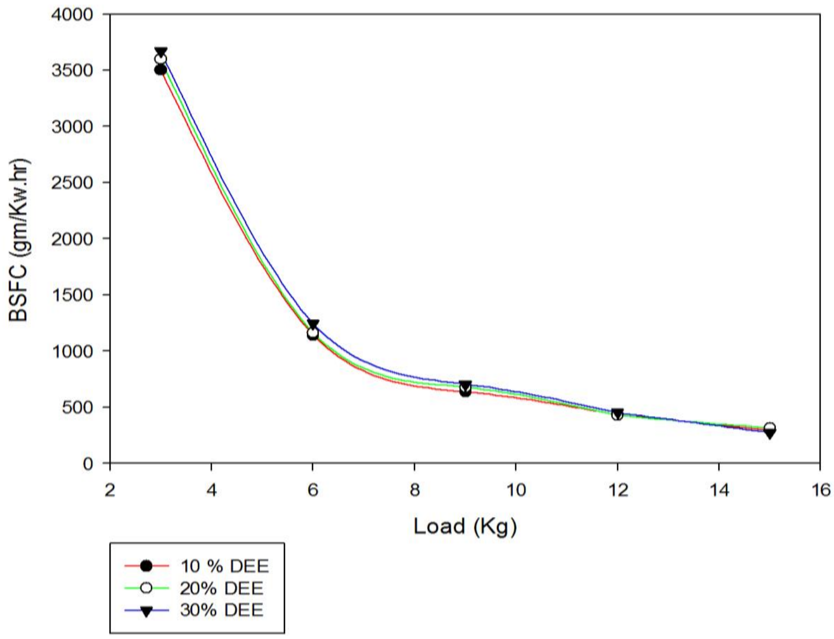

Figure 3 Load vs. BSFC

From the load vs. BSFC curve we seen for 6Kg Load increasing %DEE BSFC increasing, Load 6Kg, 10% DEE & 90% Diesel value of BSFC 1141.7572 (gm/Kw.hr), at 20% DEE 80% Diesel value of BSFC 1160.653259(gm /Kw.hr), increasing 18.9%

5.2 Engine Emissions

CO emissions: Figure 4. Shows the variation in CO emissions with load.CO emission is increase as load on engine increase at all speed. CO emission decreases as blending increase. Value of CO for tri fuel blend is 6.18 for tri fuel.

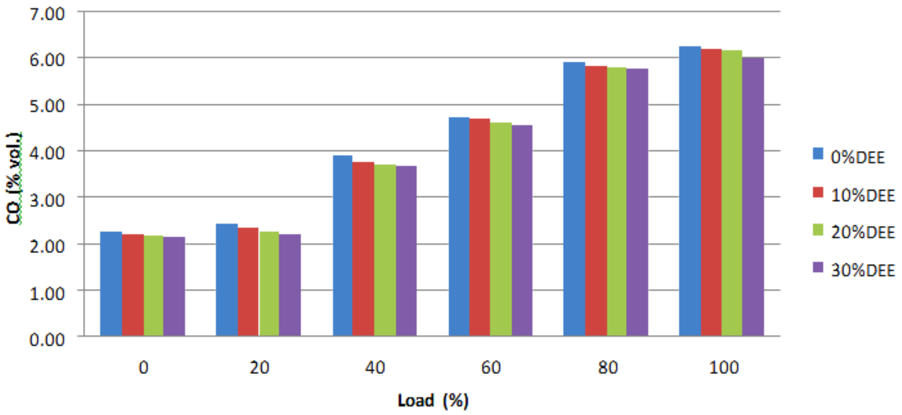

Figure 4. Variation in CO emissions with load at 3600 rpm

HC emissions:

igure- 5 Shows that the variation in HC emission with different load. The result shows that, as blending increase, HC emission was continuously decreased As compare to diesel fuel, HC emission from blends fuels was drastically decreased due to proper mixing of fuels and air, high rate of burning characteristics of blends air mixture reduce the time of combustion duration which lead to complete combustion and reduce unburned hydrocarbon in emission.

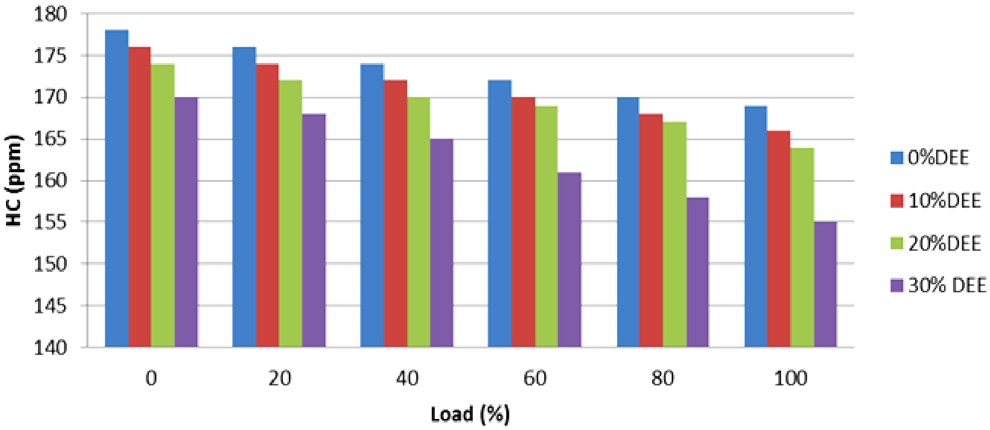

Figure 5. Variation in HC emission with load at 1400 rpm.

NOx emissions

Figures6. Shows that the variation in NO_X emission with different loads. The result shows that, as blending increases, NO_X emission were continuously decreased at all load. As compared to diesel fuel, NO_X emission from blends fuels was less.

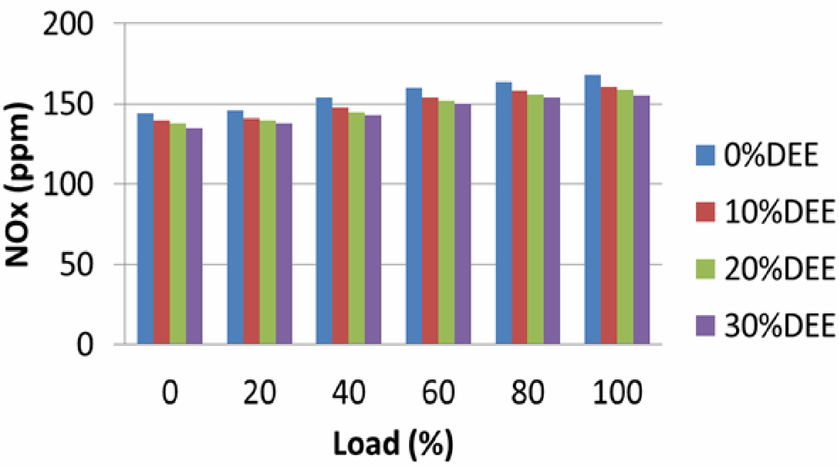

Figure 6. Variation in NO_X emissions with load

VI. CONCLUSION

Based on the values obtained from the tests conducted on a single cylinder, naturally aspirated, vertical, water cooled self-governed C.I. engine, with different proportion of DEE-Diesel emulsion under varying load condition. After performing several experimental run and based on result obtained, following conclusions are drawn.

1. %of DEE increasing with %diesel fuel reducing at that time volumetric efficiency increasing.
2. %of DEE increasing with % diesel fuel decreasing also reduce emission, control emission, but exhaust temperature increasing
3. NOX emissions found to be reduced for all types of emulsions compared to diesel.
4. %10DEE &90 DIESEL load increasing NO_x increasing, if we increasing the % of DEE & reducing % of diesel fuel we found with an average reduction of 30% at every load condition.

REFERENCES

[1] M. Pugazhvadivu, and K. Jeyachandran, “Investigations on the performance and exhaust emissions of a diesel engine using preheated waste frying oil as fuel,” Renewable energy, vol. 30(14), pp.2189-2202, 2005.
[2] SK. Mahla, L.M. Das, and M.K.G Babu, “Effect of EGR on performance and emission characteristics of natural gas fueled diesel engine,” Jordan Journal of Mechanical and Industrial Engineering, vol.4(4), pp.523-530, 2010.
[3] Y.V.V. Satyanarayanamurthy, “Experimental investigations of real time secondary co-injection of water–diethyl ether solution in di-diesel engine fuelled with palm kernel methyl ester,” Journal of Engineering Science and Technology, 7(6), pp.711-721, 2012.
[4] S.S Jawre, and S.M Lawankar, “Performance analysis of kusum methyl ester as alternative bio-fuel in diesel engine with diethyl ether as additive,” International Journal of Innovative Research and Development, vol.3 (5), 2014.
[5] J.J. Goswami , Dr. Pravin P. Rathod, J .B. Galchar, “Performance & Testing of Diesel Engine with Blends of Diesel and Karanja Biodiesel produced by Ultrasonic Technique,” IJAERD, vol. 1(12), pp. 323-331, 2014.