International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

Performance and Emission Analysis on Compression Ignition Engine Using MTBE and TBA

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***Abstract*—*Many researchers indicated that the performance of diesel engine can be improved by adding additives. The performance of the diesel engine is increased with the addition of oxygenates to the fuel prior to the combustion. In this paper compare the performance and emission on CI engine using the blending of methyl tert butyle ether (MTBE) and blending of tert butyl alchol with diesel at various proportions (5%, 10% and 15%). The performance parameters include the brake thermal efficiency, specific fuel consumption, total fuel consumption etc..,.*

Keywords*— *MTBE, TBA, emission, performance, additive.

I. INTRODUCTION

In an IC engine the chemical energy of the fuel is released inside the engine and used directly for mechanical work. The I C engine has been the foundation for the successful development of many commercial technologies. Combustion chemistry in I C engine is very complex and depends on the type of fuel used in combustion process. The higher compression ratio can be achieved in the diesel engine by improving its fuel conversion efficiency relatively high. The injection timing is used to control combustion timing and shortens delay period. It is always desired to develop high specific power output, accompanied by good reliability and longer engine life. The maximum power output can be obtained if maximum amount of fuel can be burnt efficiently and effectively. The control of pollutant emissions is a major factor in the design of modern combustion systems. Pollutions affect our ainty about itswhich can convert maximum energy into useful work through adiabatic process.

Methyl Tertiary Butyl Ether

The blending of methyl tertiary butyl ether (MTBE) into motor gasoline has increased dramatically since it was first produced 20 years ago. MTBE usage grew in the early 1980's in response to octane demand resulting initially from the phase out of lead from gasoline and later from rising demand for premium gasoline. The oxygenated gasoline program stimulated an increase in MTBE production between 1990 and 1994. MTBE demand increased from 83,000 in 1990 to 161,000 barrels per day in 1994. The reformulated gasoline (RFG) program provided a further boost to oxygenate blending. The MTBE contained in motor gasoline increased to 269,000 barrels per day by 1997. Unfortunately, because of leaking underground storage tanks or spills and because MTBE is soluble in water and does not biodegrade easily, there have been increasing detections of MTBE in ground waters and reservoirs. Because of the occurrence of MTBE in water supplies, the EPA formed the *Blue Ribbon Panel On Oxygenates in Gasoline*. In September 1999, the Panel issued its final report that included the following recommendations on MTBE use: (1)

- "Reduce the use of MTBE substantially (with some members supporting its complete phase-out), and action by Congress to clarify federal and state authority to regulate and/or eliminate the use of gasoline additives that threaten drinking water supplies."
- "The current Clean Air Act requirement to require 2 percent oxygen, by weight, in RFG must be removed in order to provide flexibility to blend adequate fuel supplies in a cost-effective manner while quickly reducing usage of MTBE and maintaining air quality benefits."

Tertiary Butyl Alcohol

Tertiary butyl alcohol is a simple organic compound that contains only carbon (C), hydrogen (H) and oxygen (O). The chemical formula for TBA is C4H10O. As its name suggests, this chemical contains a *tertiary* butyl group that consists of three methyl groups (-CH3), each separately attached to a central (*tertiary*) carbon. TBA also contains an alcohol group (-OH) that is also attached to the central *tertiary* carbon Organic chemicals often have several different names. Some of the other commonly used names for TBA are *tert*-butanol, *tert*-butyl alcohol, *t*-butanol, 2-methyl-2-propanol, 2-methylpropan-2-ol, trimethylcarbinol, and trimethyl methanol. Each chemical has a unique CAS (Chemical Abstracts Service) Registry Number. The CAS number for TBA is 75-65-0. This number can be used to obtain specific information about TBA from a wide variety of sources.

Alternative fuel

1. Alternative fuels, known as non-conventional and advanced fuels, are any materials or substances or substances that can be used as fuel, other conventional fuels like; fossil fuels(petroleum, coal, and natural gas), as well as nuclear materials such as uranium and thorium, as well as artificial radioisotope that are made in nuclear reactor.
2. Some well-known alternative fuels include biodiesel, bio alcohol, (methanol, ethanol, butanol), refuse derived fuel, chemically stored electricity (batteries and fuel cells), hydrogen, non-fossil methane, non-fossil natural gas, vegetable oil, propane and other biomass sources.
3. The transport sector is the single largest consumer of petroleum products. Engine emissions are the main contributors to air pollution problems. Vehicles contribute about 50% of the total emissions worldwide. In India vehicles in major metropolitan cities are estimated to account for 70% of CO, 50% of HC, 30–40% of NOx, 30% of solid particulate matter(SPM), and 10% of sulphur dioxide (SO2) of the total

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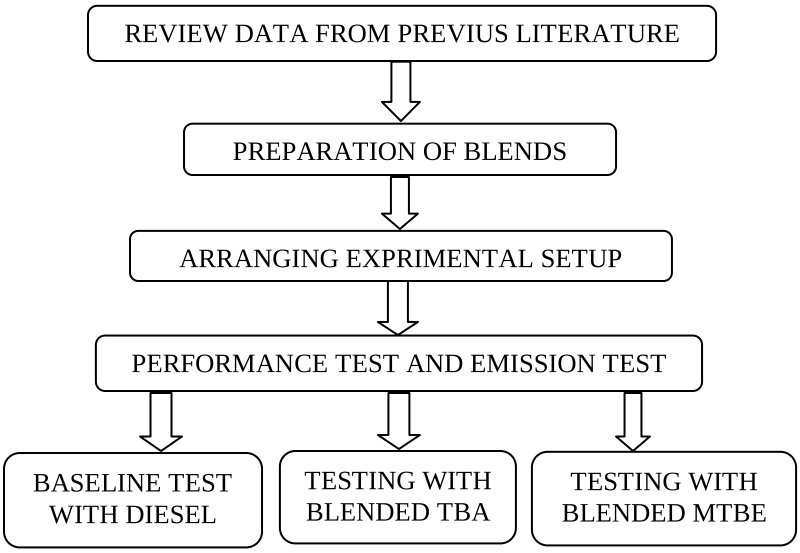
pollution load of these cities, of which approximately 67% is contributed by two wheelers alone.

4. To reduce the contributions made by spark ignition engines we use oxygenates as additives with gasoline in variable ratios in order to reduce the emission.

II. Methodology

Step by step process involved in our project is showed in the form of flow chart. It show what are the produced and test are conducted in project



Performance and emission analysis of diesel with ether and alcohol in the following Proportions

BASE LINE DIESEL	- DIESEL
5%TBA+95% DIESEL	-5%TBA
10%TBA+90% DIESEL	-10%TBA
15%TBA+85% DIESEL	-15%TBA
5%MTBE +95% DIESEL	-5%MTBE
10%MTBE +90% DIESEL	-10%MTBE
15%MTBE +85% DIESEL	-15%MTBE

III. Experimental Procedure

The compact and simple engine test rig consisting of a four stroke, single cylinder, water-cooled, constant speed diesel engine coupled to an alternator by flexible coupling. The engine is loaded using electrical resistive loading bank. Continuous water supply arrangement is provided to the engine for cooling. An a.c alternator coupled with engine by flexible coupling and electrical bulb loading panel connected with alternator. The panel consists of Ammeter, Voltmeter, Main switch and halogen bulbs with various ranges of watts and MCB switches for each bulb are mounted. An orifice plate of size is fixed to the air tank to measure the air consumption the engine.

Experimental Approach

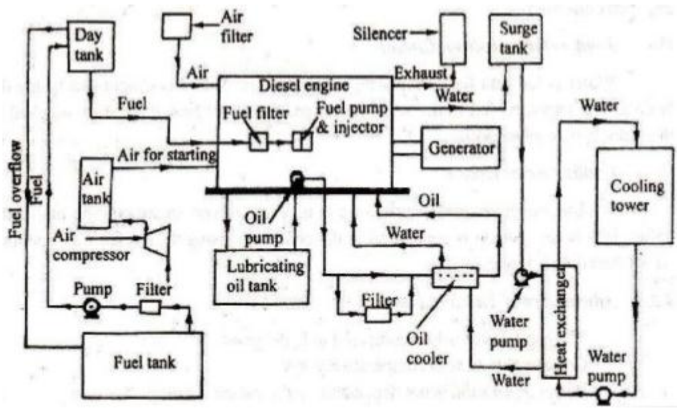
We create the two phases experimental approach, first phase is produces the blend of MTBE and TBA with diesel, using method. Second phase is measure the performance characteristic by experimental using appropriate formulae. And calculate the emission

Process of Blending

Diesel is blended with MTBE and TBA by bottal mixing process. MTBE is mixed with diesel at 5%, 10%, 15% proportions. By using the blended fuel and clear the diesel and TBA is mixed with diesel at 5%, 10%, 15% proportions. By using the blended fuel and clear the diesel, engine test is done.

Engine Test Setup

All thetests were conducted using the four stroke single cylnde diesel engine which connected by coupling to an eddy current dynamometer for loading. The gas analyser avl digs 444 type is connected pipe after the muffler to take readings of the exhaust gas emission.



Layout of engine

Engine Specification

Type	:	Water cooled, constant speed
Speed	:	1500 rpm
Power	:	3.73 kW
Fuel	:	H.S. Diesel
Lubrication Oil	:	SAE30/SAE 40

Engine test RIG

IV. Calculation

1. Total fuel consumption (TFC)

$$TFC = \frac{X}{t} \times \text{specific gravity of fuel} \times \frac{3600}{1000} = 0.496552 \text{ Kg / hr}$$

2. Brake power (BP)

$$BP = \frac{VICos\phi}{AE \times 1000} = 0.5375\text{kw}$$

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3. Specific Fuel Consumption, (SFC)

$$SFC = \frac{TFC}{BP} = 0.923817\left(\text{kg / kW.hr}\right)$$

4. Indicated Power =Brake power + Frictional power (kW)

Indicated Power = 1.5875 Kw

5. Mechanical Efficiency, (η_{MECH})

$$\eta_{MECH} = \frac{BP}{IP} \times 100 = 33.85\%$$

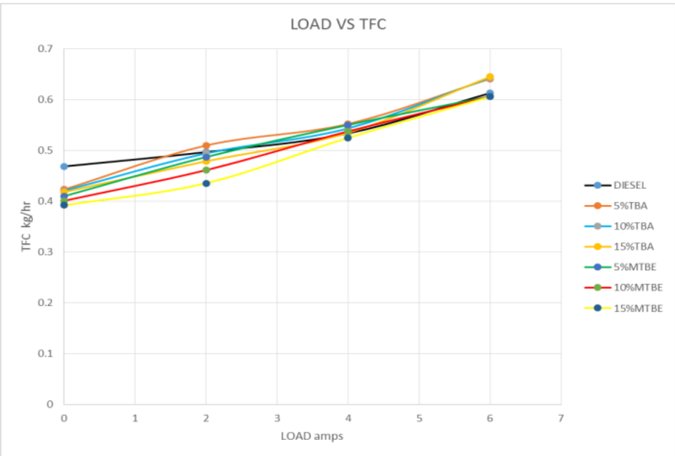
6. Brake Thermal Efficiency, (η_{BT})

$$\eta_{BT} = \frac{BP \times 3600}{TFC \times CV} \times 100 = 8.6983\%$$

V. Result and Discssions

Performance Analysis

Effect of Load vs Total Fuel Consumption

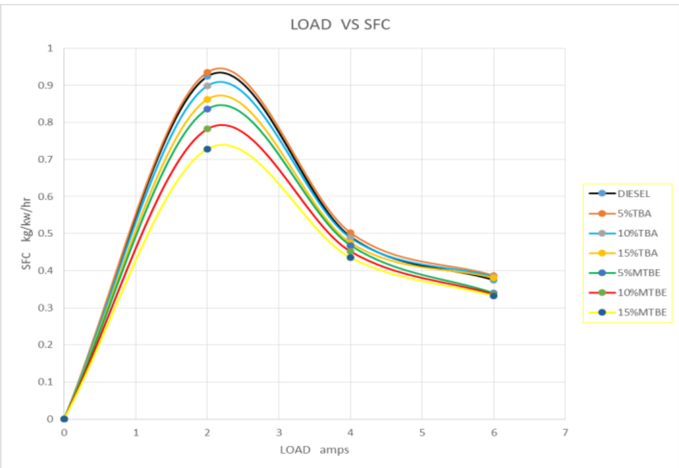


LOAD VS TFC

In the total fuel consumption the MTBE and TBA is higher than the base line diesel.in TBA is 4% increase and MTBE is 6% increase.

Effect of Load vs Specific Fuel Consumption

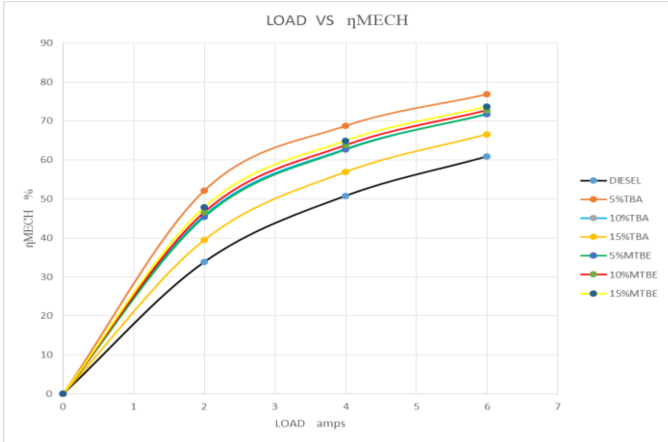
LOAD VS SFC



Specific fuel is higher in the oxygnets blends compare the base line diesel the SFC is 2% increased in the 10% MTBE.

Effect of Load vs Mech

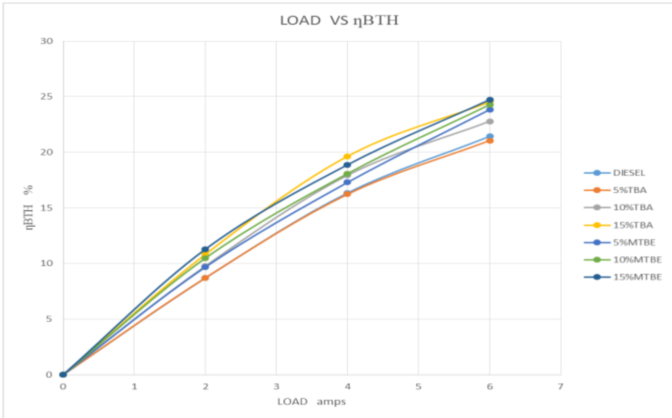
LOAD VS MECH



The mechanical efficiency is increasing the adding of oxygnets. The 5% TBA is 20% increased the mechanical efficiency and 15% MTBE is icreased 17% compare the diesel.

Effect of Load vs BTH

LOAD VS BTH

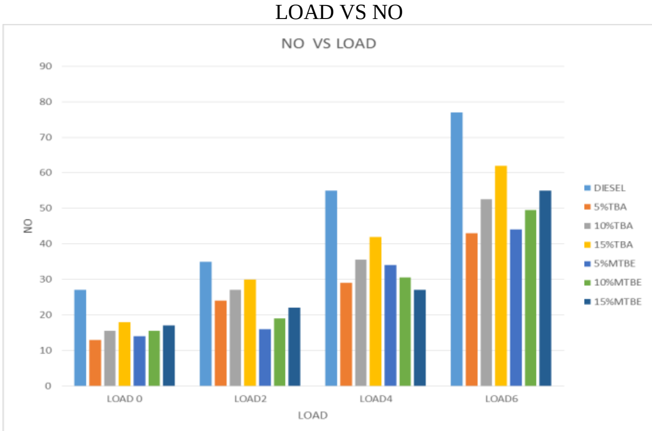


In the break thermal efficiency is increased the load increment .15% TBA is increase the 17% BTH and 15% MTBE is increased 14%.

Emission Analysis

Effect of Load vs NO

LOAD VS NO



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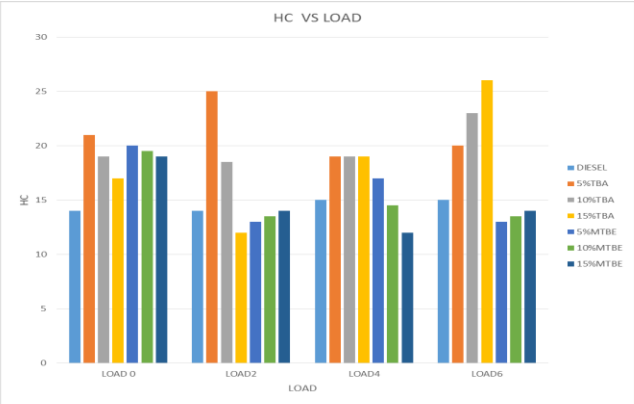
The no is produced in the engine dur to the high temperature 5% TBA is emits 6% less no and mtbe is emits 4% less nocmpare the diesel

Effect of Load vs HC

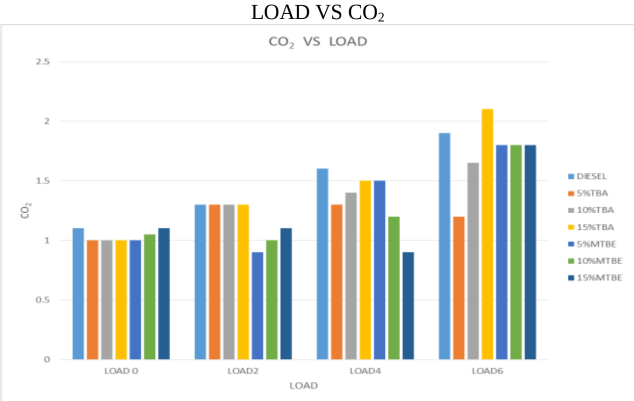
LOAD VS HC



In the HC is produced due to unburned particals in the 15% TBA is reduced 2% HC and mtbe is 1% reduced compare the diesel.

Effect of Load vs Co_2

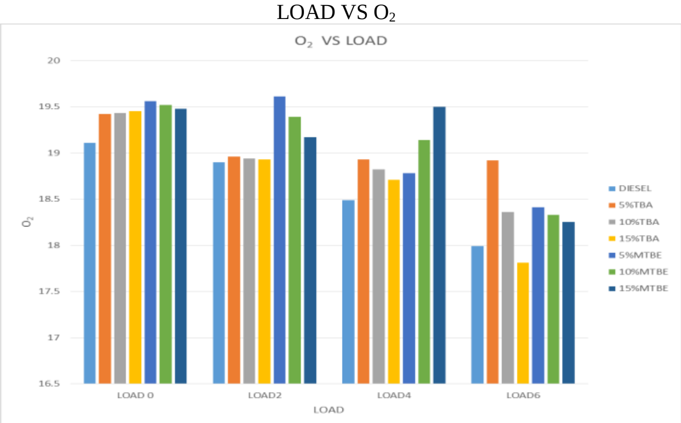
LOAD VS CO_2



In the CO_2 reduced 6% in 5% mtbe and 4% reduced in TBA the 60% load the blend is effective to reduced the CO_2. In o load condion the efficitive of additive is reduced the CO_2 in load is increased in load increased.

Effect of Load vs O_2

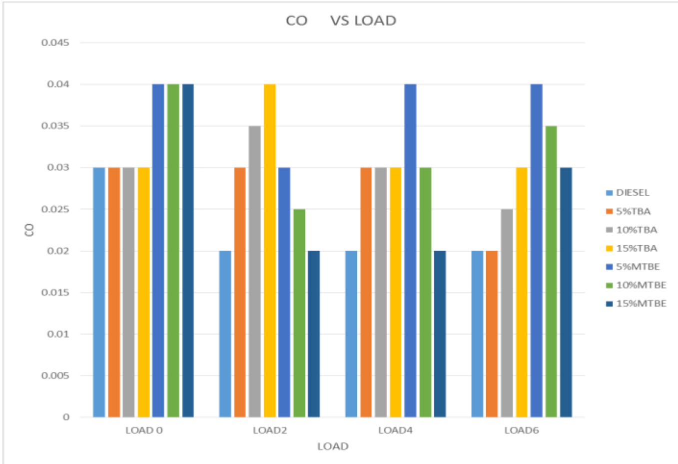
LOAD VS O_2



In the O_2 is emited in the higher percentage due to the excess gas of the atmospheric air the gas is not affect the environment so it is no problem in the O_2

Effect of Load vs CO

LOAD VS CO



In the CO is same and less amoun of emitted in 5% TBA and 15% MTBE the O load conditions I emit more co increase co is reduced it means the complete combustion is occur the co is reduced.

VI. Conclusion

In the analysis the tert butyl alcohol and methyl tert butyl ether is can be used as a resource to obtained oxygenated fuel.the blend of oxganate methyl tert butyl ether and tert butyl alcohol can be highly advantageous in raising octane with out modified to engine and fuel system.lower exhaust emission are obtained with more oxygen in the fuel and improved power output are additionl benefits

The result is taken from the graph

Performance Wise

Break thermal efficiency

In the break thermal efficiency is increased in tert butyl alcohol and methyl tert butyl ether compared the base line diesel .bth is 2% increased in the 15% TBA and 3% increased in the 15% MTBE

Mechanical efficiency

In the mechanical efficiency is increased in tert butyl alcohl and methyl tert butyl ether compared the base line diesel. Mechanical efficiency is 2% increased in the 15% TBA and 3% increased in the 15% MTBE

Emission wise

In the emission is reduced 6%using the TBA and 8% reduced in MTBE compare diesel.

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