A Review Paper on Performance and Emission Test of 4 Stroke Diesel Engine using Ethanol Diesel Blend at Different Pressure

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Abstract— In day today's relevance, it is mandatory to device the usage of diesel in an economic way. In present scenario, the very low combustion efficiency of CI engine leads to poor performance of engine and produces emission due to incomplete combustion. Study of research papers is focused on the improvement in efficiency of the engine and reduction in emissions by adding ethanol in a diesel with different blends like 5%, 10%, 15%, 20%, 25% and 30% by volume. The performance and emission characteristics of the engine are tested observed using blended fuels and comparative assessment is done with the performance and emission characteristics of engine using pure diesel.

Key words: Stroke Diesel, Ethanol, Brake thermal efficiency

I. INTRODUCTION

A. History

The world in the 21st century presents many critical challenges. One of the most important challenges is the environment. As population increases and the standard of living improve, there is a growing concern that there will be a shortage of energy to heat our homes and power the vehicles on which we so heavily depend. We must also remember the need for clean air, clean water, cleaner burning fuels, and biodegradable, renewable materials. Advances in technology have allowed development of alternative energy sources. Alternative energy sources are renewable, cleaner, and more dependable than traditional fuels.

Ethanol is an alternative energy source. It is an alcohol made by fermenting corn or other similar biomass material. When mixed with unleaded gasoline or diesel, ethanol increases octane levels, decreases exhaust emissions, and extends the supply of gasoline. Ethanol in its liquid form, called ethyl alcohol, can be used as a fuel when blended with gasoline or diesel or in its original state. It can also be used as a raw material in various industrial processes.

Ethanol is made by fermenting almost any material that contains starch or sugar. Grains such as corn and sorghum are good sources; but potatoes, sugar cane, Jerusalem artichokes, and other farm plants and plant wastes are also suitable. In ancient times ethanol was known as an in toxic ting drink. In the United States, ethanol is produced mainly by the fermentation of corn. It is the same alcohol used in beverage alcohol but meets fuel-grade standards. Ethanol that is to be used as a fuel is "denatured" by adding a small amount of gasoline to it. This makes it unfit for drinking. During the late 1800s, ethanol was used in the United States for lamp fuel and sales exceeded 25 million gallons per year.

At the request of large oil companies, the government placed a tax on ethanol during the Civil War. This tax almost destroyed the ethanol industry. In 1906 the tax was lifted and alcohol fuel did well until competition from oil companies greatly reduced its use. The first large scale use of ethanol was as a fuel occurred during the early 1900s when petroleum supplies in Europe were short. In America, Henry Ford's Model T and other early 1920s automobiles were originally designed to run on alcohol fuels.

Germany and the U.S .both relied on ethanol to power vehicles for their armies during World War II. After World War II, oil prices decreased which caused the use of ethanol to decrease as well. The limited use of ethanol continued until the oil crisis in the early 1970s.

B. Ethanol

Ethanol is also known as ethyl alcohol. It is clear colourless liquid with mild and pleasant odour. Fossil fuel are limited, so requirement of alternative fuel. Ethanol is one of the best option for alternative fuel because it is a by-product of sugarcane and corn which is agricultural product and easily available in the market. Ethanol is also produced by using municipal waste.

In the last two decades of the 20th century, major advances in engine technology have occurred, leading to greater fuel economy in vehicles. The reduction of emissions from engines has become a major factor in the development of new engines and manufacturers are trying to meet the requirements specified by Environmental Protection Agency. As a result the use of non-conventional fuels as a means of meeting these requirements has generated much attention. When considering an alternative fuel for use in diesel engines, a number of issues are important. These issues include supply and distribution, integrity of the fuel being delivered to the engine, emissions and engine durability. An additional factor that makes ethanol attractive as a fuel extender or substitute is that it is a renewable resource. The dwindling fossil fuel sources and the increasing dependency of the USA on imported crude oil have led to a major interest in expanding the use of bio energy.

A national bio based products and bio energy initiative was formally proposed in 1999 and steps have been taken to identify areas of research presently underway and those that need to be expanded. Research into the use of ethanol in diesel engines fits well into this initiative. The objectives of this paper are to review the studies that were completed on ethanol-diesel blends in the 1980's when the emphasis was on providing a diesel fuel extender or substitute, and to review research undertaken recently where emissions reductions and technical feasibility in the new generation of diesel engines have been the main focus.

Sr. No	Fuel Property	Diesel	Ethanol
1	Chemical Formula	$C_{12}H_{23}$	C_2H_6O
2	Density (Kg/m^3)	837.8	799.4
3	Viscosity (mm/s^2)	2.649	1.1
4	calorific value	44893	29180
5	Cetane Number	54	9
6	Flash point	50	12

7	pour point	0	—
8	O_2 Content (%)	0	34.73
9	Carbon Content (%)	86.16	52.14
10	H_2 Content (%)	13.86	13.13
11	Stoichiometric A/F Ratio	14.75	9.06

Table 1.1: Ethanol Properties Compare With Diesel [12]

II. LITERATURE REVIEW

R senthilkumar, R Manimaran and V Gopalkrishanan[1] have worked on that the performance and emission behavior of the diesel engine using ethanol diesel blend. Ethanol is a bio-based renewable and oxygenated fuel, thereby providing potential to reduce the PM emission in diesel engine and to provide reduction in life cycle of carbon die-oxide. The main objective of this project has to studied the performance, and to control the emissions of the diesel engine using blended fuel by preheating the inlet air. The present work has been carried out using single cylinder, four strokes, water cooled diesel engine. In this phase, experiment investigations are conducted using five sets of blended fuels i.e 10%, 15%, 20%, 25%, 30% Ethanol – Diesel blend have been prepared and preheating the inlet air to 40ºC, 50ºC and 60ºC. The performance and emission characteristics are studied and compared with the base fuel. [1]

The Brake thermal efficiency of ethanol diesel blend is lower without pre heating condition, but at 40ºCand 50ºC inlet air condition, for 10% ethanol diesel blends gives the much better BTE compare to the neat diesel fuel On emission characteristics CO and HC emission is increasing. Addition of ethanol will lead to complete combustion so that HC and CO emission should reduce, but here the introduction of ethanol in diesel fuel, HC emission increased at various load condition. CO and HC emission is higher for the pre heated condition compare to without pre heating condition. The NOx emissions were reduces because it absorbs heat during combustion due to its higher latent heat of vaporizations. So it reduces the peak combustion temperature. When using ethanol diesel blends. Generally, smoke opacity is increased as load increases. Without pre heating condition produces less smoke compare with the preheating conditions for ethanol diesel blends. [1]

RakhiMaheta, MousamiChakrabourty, Parimal A. Parikh[2] have experimentally investigated that the alcohol like ethanol and butanol properties compare with diesel and experimental analysis of ethanol-diesel blend or butanol-diesel bland use as fuel. This paper is show the different characteristics of both ethanol and butanol compare with diesel as per ASTM standards. [2]

The ethanol show properties like calorific value, density, flash point, cetane number with pure diesel. There is only flash point reduce due to alcohol blend. [2]

Eknath R. Deore, Ramchandra S. Jahagirdar, MilindSuryajiPatil, Purushottam S. Desale[3] have experimentally investigated to compression ratio for ethanol diesel blend. Kirloskar make tested for blends of diesel with ethanol. Tests were conducted for three different compression ratios. Engine test setup was developed with moving cylinder head for variation of compression ratio to perform investigations using these blends. The engine performance studies were conducted with rope break dynamometer setup. Parameters like speed of engine, fuel consumption and torque were measured at different loads for pure diesel and for blends of diesel with ethanol at different compression ratio. Break Power, BSFC, BTE and heat balance were evaluated. Paper represents the test results for blends 5% to 20% and three different compression ratios. [3]

20 % mixture of ethanol blend with diesel has a very good efficiency compared with pure diesel and blend of kerosene. Also it is observed that the 20 % ethanol blend is having higher volumetric efficiency compare with diesel and kerosene blend. Exhaust gas temperature for ethanol blend has not shown any substantial increase compare with pure diesel. Hence blending of ethanol at about 20 % can lead to a better performance of engine compare with pure diesel. [3]

DattatrayBapuHulwan, Satishchandra V. Joshi [4]have worked about injection timing on which ethanol blend run the engine. The blends tested are D70/E20/B10 (blend A), D50/E30/

B20 (blend B) D50/E40/B10 (blend C), and Diesel (D100). The blends are prepared to get maximum percentage of oxygen content but keeping important properties such as density, viscosity and Cetane index within acceptable limits. [4]

Experiments are conducted on a multi cylinder, DI diesel engine, whose original injection timing was 13° BTDC. The engine did not run on blends B and C at this injection timing and it was required to advance timing to 18° and 21° BTDC to enable the use of blends B and C respectively However advancing injection timing almost doubled the NO emissions and increased peak firing pressure. Smoke reduced remarkably for blends especially at medium and high loads of both speeds and all injection timings. Maximum reduction is about 60% to 70% at higher loads for respective high ethanol content blend at all injection timing and speeds. Advancing injection timing reduced the smoke for all blends and diesel fuel at both speeds. Significant reduction in smoke is observed for high ethanol content blends; however reduction in smoke does not indicate the reduction in particulate matter in same proportion. [4]

De-gang Li, Huang Zhen, Luˇ Xingcai, Zhang Wu-gao, Yang Jian-guang[5] have been performed on the effect of different blends used in DI engine its performance and emission checked. The effects of different ethanol–diesel blended fuels on the performance and emissions of diesel engines have been evaluated experimentally and compared in this paper. The purpose of this project is to find the optimum percentage of ethanol that gives simultaneously better performance and lower emissions. The experiments were conducted on a water-cooled single-cylinder Direct Injection (DI) diesel engine using 0% (neat diesel fuel), 5% (E5–D), 10% (E10–D), 15% (E15–D), and 20% (E20– D) ethanol–diesel blended fuels. With the same rated power for different blended fuels and pure diesel fuel, the engine performance parameters (including power, torque, fuel consumption, and exhaust temperature) and exhaust emissions [Bosch smoke number, CO, NOx, total hydrocarbon were measured. Thermal efficiency increased with an increase of ethanol contents in the blended fuel at overall. [5]

The BSFC of ethanol–diesel blended fuels increased for the reason that the low heat value of ethanol is about 2/3 of that of the diesel. The increase was especially remarkably at low load conditions. However, the BTE of the engine fuelled with ethanol–diesel blend fuel improved with an increase of ethanol content in blend fuels. For example, the BTE increased by up to 1–2% when the engine used the E15–D blend at overall engine operating conditions. [5]

Alan C. Hansen, Qin Zhang, Peter W.L. Lyne[6] have reviewed that safety and storage of ethanol blend and performance and emission test on diesel engine. Ethanol is an attractive alternative fuel because it is a renewable bio-based resource and it is oxygenated, thereby providing the potential to reduce particulate emissions in compression–ignition engines. In this review the properties and specifications of ethanol blended with diesel fuel are discussed. Special emphasis is placed on the factors critical to the potential commercial use of these blends. These factors include blend properties such as stability, viscosity and lubricity, safety and materials compatibility. The effect of the fuel on engine performance, durability and emissions is also considered. The formulation of additives to correct certain key properties and maintain blend stability is suggested as a critical factor in ensuring fuel compatibility with engines. However, maintaining vehicle safety with these blends may entail fuel tank modifications. [6]

It is accepted that the addition of ethanol to diesel fuel will have a beneficial effect in reducing the PM emissions at least. The amount of improvement varies from engine to engine and also within the working range of the engine itself. While there is considerable value in being able to use the fuel directly in an unmodified engine, small adjustments to fuel injection characteristics may result in further gains in reducing emissions. [6]

Dr. E. A. Ajav and Mr. O. A. Akingbehin[7] have experimentally investigated the property which compare with pure diesel and blends. Six blends (5, 10, 15, 20, 25, and 30%) of ethanol by volume with diesel were used. The properties determined were; relative density, viscosity, cloud and pour point, flash point and calorific value. The results show that both the relative density and viscosity of the blends decreased as the ethanol content in the blends were increased. The cloud point was found to be 50C for all the blends and diesel while the pour point of –5,-7,-10,-13 and-36oC were obtained for diesel and blends with 5, 10, 15 and 20% ethanol content respectively. The pour point for two blends (25 and 30%) was not reached. Flash point of 74oC was obtained for diesel while 24, 25, 27, 25, 25 and 26oC were obtained for blends with 5, 10, 15, 20 25 and 30% ethanol respectively. Calorific values of 44515, 43632, 43632, 43192, 42745, 41874, 41004, and 40577kJ/kg were obtained for diesel and the ethanol-diesel blends respectively. Based on the findings of this study, blends with 5, 10, 15 and 20 percent ethanol content were found to have acceptable fuel properties for use as supplementary fuel in farm engines. [7]

Relative density was found to be lower than that of diesel fuel alone. Lower pour points were recorded for all the blends compared to 5°C pour point obtained for diesel fuel alone. The cloud point was same for all the fuels tested. All the blends were highly flammable with flash point temperature that was below the ambient temperature. [7]

Irshad Ahmed[8] has reviewed on characteristics of ethanol blends with diesel. There are air polluting exhaust gasses such as Particulate Matter, Carbon monoxide, Oxides of Nitrogen, Sulphur, and other harmful compounds. It has been shown that formation of these air pollutants can be significantly reduced by blending oxygenates into the base diesel. Ethanol blended diesel is a cleaner burning alternative to regular diesel for both heavy-duty and light-duty compression ignition engines used in buses, trucks, off-road equipment, and passenger cars.[8]

Pure Energy's E-Diesel fuel blend has shown significant improvements over previous attempts by other entities in Europe and Brazil. E-Diesel is a crystal clear, stable fuel that can easily substitute diesel on a one-to-one basis with only a slight penalty in fuel economy. The emissions profile for both particulate matter and NOx emissions promises to significantly improve air quality and meet the regulatory requirements for fleets operating on both new and older diesel engines in small-duty, medium-duty, and high-duty configurations. In full commercial use, E-Diesel promises to bridge the gap between the air quality emission standards and engine technology. E-Diesel will help expand ethanol markets and hence increase the use of corn by over 300 million bushels a year. E-Diesel is a commercially viable alternative to regular diesel and it is currently available for commercial use. [8]

Effect of Fuel Injection Pressure on Performance of Single Cylinder Diesel Engine at Different Intake Manifold Inclinations[9] M.L.S Deva Kumar, S.Drakshayani, K.Vijaya Kumar Reddy have performed on different fuel injection pressure and its effect on performance and emission characteristics. Fuel injection pressure play an important role in better atomization of injection fuel allows for a more complete burn and help to reduce pollution. [9]

The main objective is to studied the effect of fuel injection pressure on performance and pollution of the single cylinder diesel engine at different intake manifold inclinations. From this research paper it was found that engine at 60° manifold inclination at 180 bars has given efficient performance and less pollution. [9]

III. RESULT

Best mechanical efficiency	60°, 180 bar
Best volumetric efficiency	60°, 200bar
Best thermal efficiency	90°, 180bar
Less HC emission	30°, 200bar
Less NO_x emission	60°, 180bar
Less CO_2 emission	60°, 160 bar

Table: 2.1 [9]

B. K. Venkanna, Swati B. Wadawadagi and C. Venakatarama Reddy[10] have experimentally investigated on the pressure effect is more important while we would work with biodiesel and diesel blend use as fuel in Kirlosker single cylinder diesel engine. Use of row honge oil blend with diesel fuel in diesel engine with enhanced injection opening pressure appears to be scare. This research work presented some findings of use of row honge oil blend with diesel fuel in direct injection diesel engine with increased injection opening pressure. [10]

No problem faced at the time of starting the direct injection diesel engine run smoothly. Brake specific fuel consumption of H20 is slightly increasing then diesel. There is performance; emission and combustion parameter of H20 are almost nearer to diesel. For getting best result work with H30, increase pressure from 200 to 225 bars. [10]

Rosli Abu Bakar, Semin and Abdul Rahim Ismail[11] have performed on fuel injection pressure play an important role in Kirlosker single cylinder diesel engine. Fuel injection in diesel engine is presented diesel engine such as fuel direct injection, the pressure can be increased about 100-220 bar in fuel pump injection system. Engine performance values such as indicated pressure, HP, BMEP and fuel consumption have been investigated at different pressure.

Higher injection pressure gives increase higher engine performance and power at injection pressure 220 bar. [11]

IV. CONCLUSION

From the review of literature, it can be analyzed of different ethanol blend and also studied different bio diesel. Ethanol is used because it is by product of sugar cane and corn; the agricultural sector has long back ground of India's economy. Ethanol blends are in diesel engine at different blend 20% of ethanol use in diesel engine so reduced use of fossil fuel. By using ethanol blend expected life of fossil fuel will be increase because ethanol is renewable sources available. Emission is reducing mainly NO_x and HC when Ethanol diesel blend used as a fuel. From literature survey, different findings are concluded.

- Thermal efficiency, volumetric efficiency and mechanical efficiency increase at full load by using ethanol diesel blends.
- Intake pressures are more effective on performance of CI engine.
- The percentage of ethanol is affect on CI engine and 20% ethanol diesel blend has better result than the other blends.
- NO_x emission mainly decreased.

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