

# A Review Approach on Reducing the Exhaust Emission by Blending Fuel Technology

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**ABSTRACT:** In Recent days, the most critical and important issue of Internal Combustion Engines are the Exhaust Emission. In now days, the big concern is about to reduce the exhaust emission, in particular of CO<sub>2</sub> and the replacement of Fossil fuel with renewable sources. The recent technologies are focusing on using the Dual Fuel technology. In engine, for reducing the exhaust emission, blending fuel has been used. Oxygenated fuels such as alcohols are recognized as an effective way to reduce soot emission and to improve the combustion process. Among the alcohols, ethanol has been suggested as one of the most promising blending components for diesel fuel. Developing renewable energy has become an important part of a worldwide energy policy to reduce greenhouse gas emission caused by fossil fuel.

**KEYWORDS:** Exhaust Emission, Blending Fuel, Renewable Energy Sources, Dual Fuel Technology, Greenhouse Emission.

## I. INTRODUCTION

The economic and environmental concern associated with using gasoline as the primary fuel for motorized vehicles have increased the demands for alternative fuel sources. Some alternative fuels can be added to gasoline to reduce its overall cost. Other alternative fuels can be used directly in present day's engines. Most alternative fuels are renewable sources because they can be replaced easily and it will not run out. However, gasoline is made from petroleum, non-renewable resources that can run out. Burning gasoline in engines also generate pollutions [1]. Petroleum-based fuels will not last forever; renewable sources of energy are therefore needed. Already in the phase of combustion motors invention and development, ethanol was in discussion as a fuel option. But it was not until the 1970s, when ethanol as a fuel supplement started to raise attention [2].

Renewable energy standards in the US have positioned ethanol addition to gasoline squarely into the long-term view. Currently, gasoline in the United States contains up to 10% ethanol by volume (E10); however, the United States Environmental Protection Agency (EPA) has already begun allowing E15 to be sold to consumers and this allowance has opened the door for future increases. With stricter particulate matter (PM) regulation in Europe and the US putting more focus on PM emissions from spark ignited (SI) engines, and increasing ethanol content in gasoline, it is important to understand how ethanol blending influences the sooting tendency of gasoline in a comprehensive way [3].

Fuels with high viscosity tend to form larger droplets in the injection which leads to a poor fuel atomization that increases the spray tip penetration and decreases the spray angle, deriving into a poor combustion. This finally increases the exhaust emissions and smoke opacity, and tends to form engine deposits. Moreover, long-term durability problems may be related to the use of high viscosity fuels, and carbon deposits may dilute in the engine lubricant leading to engine damage. Also, high-viscosity fuels require more energy in the fuel pump and increase wear in the injection system [4].

The world faces the crises of energy demand, rising petroleum prices and depletion of fossil fuel resources. Biodiesel has obtained from vegetable oils that have been considered as a promising alternate fuel. The researches regarding blend of diesel and single biodiesel have been done already. Very few works have been done with the combination of two different biodiesel blends with diesel and left a lot of scope in this area. The preservation of energy is decreasing now a days and it alleged that it leads to energy demand. In the last two decades, alternative fuels have obtained and

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identified as essential. A potential biodiesel substitutes diesel oil, consisting of ethyl ester of fatty acids produced by the transesterification reaction of triglycerides of vegetable oils and ethanol with the help of a catalyst.

## II. LITERATURE REVIEW

**H. Sajjad, H.H. Masjukia, M. Varman, Mohammad Mahmudur Rahman Khan, M.I. Arbab, S.Imtenan, A.Sanjid:-** In this study, an unmodified single cylinder 4 –stroke diesel engine was used to investigate diesel, GTL fuel and their blends in terms of engine performance and exhaust emission characteristics. GTL and its blends demonstrated improved engine performance increasing maximum power 9.1%, brake thermal efficiency 20% and lowering BSFC 9.1% than diesel. Exhaust emissions also showed diminutions in CO (22~25%), HC (30~40%) and NO (6~8%). These improvements ensure the potential for the application of GTL diesel blends. Since GTL has superior fuel property than B5, the blends of these two fuels showed improved fuel properties in terms of viscosity and density. GTL can be operated on unmodified diesel engines also as the performance and emission characteristics are satisfactory, even better than B5 diesel. D50G50 and D80G20 both these fuel blends showed improved engine performance and exhaust emission compared to B5 diesel. D50G50 showed improved performances and emissions compared to D80G20 [5].

**GeorgiosFontaras, Nikiforos-Georgios Zacharof and BiagioCiuffo:-** This paper reviews the influence of different factors that affect fuel consumption and CO<sub>2</sub> emission on the road and in the laboratory. Factors such as driving behaviour, vehicle configuration and traffic condition are reconfirmed as highly influential. Neglected factors (side winds, rain, and road grade) which may have significant contributions in fuel consumption in real world driving are identified. Finally, the effect of the traffic conditions should be taken into account. Increase and decrease in fuel consumption and CO<sub>2</sub> emission can occur, depending on the mix of traffic conditions, when comparing against conditions similar to those experienced over a cycle [6].

**Magin Lapuerta , Juan Jose Hernandez , David Fernandez-Rodriguez , Alexis Cova-Bonillo:-** Recently, there is increasing interest in using butanol as a renewable component not only for gasoline but also for diesel fuels. This work investigates the effect of its concentration on diesel and biodiesel blends on the auto ignition time, comparatively to equivalent blends with ethanol, in a constant-volume combustion chamber. The increase of alcohol content in diesel or biodiesel, led to an increase in auto ignition times. Such increase was not linear but sharper for high alcohol contents, and was higher with ethanol than with butanol. The increase in the delay time with the ethanol content is more prominent than for butanol, consistently with its lower cetane number. However, the differences in auto ignition time become more visible when these alcohols are blended with diesel fuel whereas they become less significant when they are blended with biodiesel fuel. For butanol blends, the increase in auto ignition delay time is very similar when diesel or biodiesel (with similar cetane numbers) were used in the blends. However, some differences appear when ethanol is blended with diesel or biodiesel fuels, with larger delay times in the former case. The maximum pressure in the combustion chamber was observed to decrease as the alcohol content was increased, especially in the case of ethanol, as a consequence of the reduced heating value, of the reduced equivalence ratio and of the over-dilution caused by their large delay times [7].

**K. Nantha Gopal, Arindam Pal, Sumit Sharma, Charan Samanchi ,K. Sathyanarayanan and T. Elango:-** In the present study, in-depth research and comparative study of blends of biodiesel made from WCO and diesel is carried out to bring out the benefits of its extensive usage in CI engines. The experimental results of the study reveal that the WCO biodiesel has similar characteristics to that of diesel. The brake thermal efficiency, carbon monoxide, unburned hydrocarbon and smoke opacity are observed to be lower in the case of WCO biodiesel blends than diesel. On the other hand specific energy consumption and oxides of nitrogen of WCO biodiesel blends are found to be higher than diesel. In addition combustion characteristics of all biodiesel blends showed similar trends when compared to that of conventional diesel. The diesel engine can perform satisfactorily on biodiesel and its blends with the diesel fuel without any engine modifications. The SEC increases with change in percentage of biodiesel in the blends due to the lower heating value of biodiesel. It is also observed that there is significant reduction in CO, UBHC and smoke emissions for

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biodiesel and its blends compared to diesel fuel. However, NO<sub>x</sub> emission of WCME biodiesel is marginally higher than petroleum diesel. It can be concluded that WCO biodiesel could replace the diesel in order to help in controlling air pollution, encouraging the collection and recycling of waste cooking oil to produce biodiesel and reduce the dependency on fossil fuel resources to some extent without sacrificing engine performance [8].

**C. Syed Alam, C.G. Saravanan and M. Kannan:-** In this paper Experiments were conducted to determine engine performance, exhaust emissions and combustion characteristics of a single cylinder, common rail direct injection (CRDI) system assisted diesel engine using diesel with 25 percentage of zizipus jujube methyl ester blended fuel (ZJME25). Along with this ZJME25 aluminum oxide nano particles were added as additive in mass fractions of 25 ppm (AONP 25) and 50 ppm (AONP 50) with the help of a mechanical Homogenizer and an ultrasonicator. It was observed that aluminum oxide nano particles blended fuel exhibits a significant reduction in specific fuel consumption and exhaust emissions at all operating loads. At the full load, the magnitude of HC and smoke emission for the ZJME25 before the addition of aluminum oxide nano particles was 13.459 g/kW h and 79 HSU, whereas it was 8.599 g/kW h and 49 HSU for the AONP 50 blended ZJME25 fuel respectively. The results also showed a considerable enhancement in brake thermal efficiency and heat release rate due to the influence of aluminum oxide nano particles addition in biodiesel–diesel blend. The specific fuel consumption is higher for the ZJME25 than neat diesel at the entire load and it has reduced with a raise in the dosing level of AONP. The brake thermal efficiency of neat diesel is higher than ZJME25 blend at all the loads and a small improvement is observed with the AONP with ZJME25. The CO emission decreases with the use of AONP in ZJME25. The addition of AONP decreases the HC emissions when comparing with neat diesel and ZJME25 blend. The NO<sub>x</sub> emission is lower for the neat diesel than the ZJME25. The NO<sub>x</sub> emission was found to be slightly increased with the addition of AONP with biodiesel blends. The amount of smoke emission is lower for ZJME25 than the neat diesel. The addition of AONP in ZJME25 the smoke emission was further decreased [9].

**Ashraf Elfakhany and Abdel-Fattah Mahrous:-** This research presents an experimental investigation into a new blended fuel; the effects of n-butanol–methanol–gasoline fuel blends on the performance and pollutant emissions of an SI (spark ignition) engine were examined. Four test fuels (namely 0, 3, 7 and 10 volumetric percent of n-butanol–methanol blends at equal rates, e.g., 0%, 1.5%, 3.5% and 5% for n-butanol and methanol, in gasoline) were investigated in an engine speed range of 2600–3400 r/min. In addition, the dual alcohol (methanol and n-butanol)–gasoline blends were compared with single alcohol(n-butanol)–gasoline blends (for the first time) as well as with the neat gasoline fuel in terms of performance and emissions. The experimental results showed that the addition of low content rates of n-butanol–methanol to neat gasoline adversely affects the engine performance and exhaust gas emissions as compared to the results of neat gasoline and single alcohol–gasoline blends; in particular, a reduction in engine volumetric efficiency, brake power, torque, in-cylinder pressure, exhaust gas temperature and CO<sub>2</sub> emissions and an increase in concentrations of CO and UHC (unburned hydrocarbons) emissions were observed for the dual alcohols [10].

**Hariram V and Bharathwaaj R.:-** This study analyses the experimental and theoretical effects on the blends of Bee Wax biodiesel with straight diesel on combustion parameters. A zero-dimensional mathematical model is developed to analyse the rise in in-cylinder pressure along with Wiebie's heat release correlations, ignition delay, gas dynamics model, heat transfer model and frictional model. The combustion parameters include in-cylinder pressure rise, net heat release and rate of pressure rise are investigated and found to be higher for straight diesel and deteriorated with the increase in blends of BWB. The theoretical simulation also supports the experimental data with constant injection timing, speed and compression ratio. The rate of heat release for straight diesel, BWB10 and BWB20 at 0%, 50% and 100% load shows an increasing trend between 20.38 J/CA and 57.96 J/CA which may be due to enhanced pre-mixed combustion phase which is also supported by the simulated results with a deviation of 7.2%. The rate of pressure rise for simulated straight diesel, BWB10 and BWB20 was found to be 8.3% higher than the experimental data across all loading conditions [11].

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**B. Prabakaran and Anurag Udhoji:-** This study is to investigate the effect of zinc oxide nano particle addition to diesel biodiesel-ethanol blends. Solubility tests were done for the fuels at three different temperatures. Out of eighteen blends, six blends were stable at 5 C, 15 C and above 25 C. Out of the six blends, two blends were checked for properties as per ASTM standards. One of them was chosen for testing the performance, combustion and emission characteristics in a diesel engine. In the same blend, zinc oxide was added in the amount of 250 ppm. Property testing of the blended fuel indicated that there was an increase in calorific value due to addition of nano particle. The performance tests were conducted on a single cylinder four stroke direct injection diesel engine at a constant speed of 1500 rpm. For the blend containing zinc oxide, there was an increase in BSFC, HRR and cylinder pressure. Also, there was a decrease in BTE, NO<sub>x</sub> and smoke, as compared to diesel. The addition of zinc oxide nano particles increased the BTE and decreased the BSFC as compared with the biodiesel diesel ethanol blend at full load. BTE reduced by 21% and 9%.

- BSFC increased by 39% and 14%.
- Maximum pressure increased by 8% and 13%.
- HRR increased by 118% and 129%.
- CO decreased by 62% and 92%.
- HC increased by 21% and reduced by 9%.
- NO<sub>x</sub> reduced by 35% and 16%.
- Smoke decreased by 54% and 82% [12].

**B. Ashok, K. Nanthagopal and D. Sakthi Vignesh:-** The present research work examines the suitability of Calophyllum inophyllum as promising feedstock for biodiesel production and its employability in diesel engine operation. The Calophyllum trees are found in abundance in India and can reduce the dependency of petroleum imports to a certain extent. The biodiesel Calophyllum inophyllum Methyl Ester (CIME100) and its blends CIME30 and CIME60 are used in engine testing. The experimental parameters such as brake thermal efficiency, brake specific energy consumption, unburned hydrocarbon, carbon monoxide, and NO<sub>x</sub> emissions are evaluated with CIME100 biodiesel and the results are compared with conventional fuel. It is observed that the CIME biodiesel resulted in slight decrease in brake thermal efficiency. The hydrocarbon and carbon monoxide emissions are reduced with the use of biodiesel with significant penalty in oxides of nitrogen emissions. As the property of CIME and diesel fuel is similar, it can be concluded that the blends of CIME can be used without any modifications in the diesel engine. The BTE is higher for diesel compared to CIME biodiesel and it decreases with increase in percentage of biodiesel in the blends. BSFC and BSEC increase with increase in percentage of CIME biodiesel in the blends [13].

**Prem Kumar, Mahendra Pal Sharma and Gaurav Dwivedi:-** The aim of the present work is to evaluate the fuel properties and investigate the impact on engine performance using Pongamia and waste cooking biodiesel and their ternary blend with diesel. The investigation of the fuel properties shows that Pongamia biodiesel and waste cooking biodiesel have poor cold flow property. This will lead to starting problem in the engine operation. To overcome this problem the ternary blends of diesel, waste cooking biodiesel and Pongamia biodiesel are prepared. The cloud and pour point for ternary blend, (WCB20:PB20:D60) were found to be 7° C and 6.5° C which are comparable to cloud and pour point of diesel 6° C and 5° C, respectively. The result of the test showed that brake specific fuel consumption for Pongamia biodiesel and waste cooking biodiesel is higher than ternary blend, (WCB20:PB20:D60) due to their lower energy content. The brake thermal efficiency of ternary blend and diesel is comparable while the Pongamia and waste cooking biodiesel have low efficiency. The BTE of ternary blend is nearly same as that of diesel at 25% loading with 12% and 12.63%, respectively. The HC and CO emissions are also lower in case of biodiesel and its blends while NO<sub>x</sub> emission is lower for diesel [14].

**Jayashri N. Nair, Ajay Kumar Kaviti and Arun Kumar Daram:-** This project deals with study of emission and performance characteristics on diesel engine with blends of Neem oil as biodiesel. Biodiesel is prepared from Neem oil by transesterification process followed by adding 1% v/v H<sub>2</sub>SO<sub>4</sub>. The tests were performed with B10, B20, B30 blends

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on a single cylinder, 4-stroke, diesel engine. The result shows lower emissions and higher performance for B10 than the other blends and diesel. The brake thermal efficiency is higher than the diesel and CO, HC and NOX emissions were 23%, 8.5%, and 22% lesser than that of diesel. Neem biodiesel blends are showing higher brake thermal efficiency than diesel. In terms of brake power, neem biodiesel can replace diesel in the form of blends as there is no significant drop in engine performance. CO, HC, CO<sub>2</sub>, and NOX emissions of neem biodiesel are decreasing than diesel. O<sub>2</sub> emissions of neem biodiesel are increasing than diesel. Without any modifications, neem biodiesel can be directly used in the diesel engine or it can also be used as blends. B10 shows higher performance and lower emissions than other blends and diesel [15].

**Arun Shankar, Prudhvi Raj Pentapati and R. Krishna Prasad:-** The transesterification of cottonseed oil using strong alkali catalyst and using multi walled carbon nano tubes as catalyst to produce biodiesel was studied. The interaction effects of various factors such as temperature, amount of alkali used, alcohol to oil ratio and reaction time on yield of biodiesel were studied. The maximum yield of 95% biodiesel was obtained. The biodiesel produced was characterized using FT-IR spectral analysis and GC-MS analysis to ascertain the various functional groups and compounds available in it. The properties of biodiesel using homogeneous alkali catalyst and heterogeneous multi walled carbon nano tubes such as calorific value (36.18 MJ/kg, 33.78 MJ/kg), flash point (160 C, 156 C) and other properties such as viscosity, cloud point, pour point and density were found to determine the quality of biodiesel produced [16].

**K. Sivaramakrishnan:-** In this work The performance and emission of a single cylinder four stroke variable compression multi fuel engines when fueled with 20%, 25% and 30% of Karanja blended with diesel are investigated and compared with standard diesel. Experiment has been conducted at compression ratios of 15:1, 16:1, 17:1, and 18:1. The impact of compression ratio on fuel consumption, brake thermal efficiency and exhaust gas emissions has been investigated and presented. Experimental analysis on the performance of biodiesel over diesel was evaluated by response surface methodology to find out the optimized working condition. The overall optimum is found to be 25% biodiesel-diesel blended with a compression ratio of 18. Brake thermal efficiency of the blends increases as compression ratio increases. The maximum brake thermal efficiency is 30.46% for B25 at full load at compression ratio 18, which is 5% higher than that of diesel The Hydrocarbon Emissions of various blends have been reduced compared to diesel. The minimum emission is 16 ppm at B20 whereas it is 96 ppm for diesel at CR 16. The CO emission of the blend B25 is lesser than that of the standard diesel. The specific fuel consumption decreased with increase in compression ratio. B25 at CR 18 gave brake specific fuel consumption of 0.28 kg/k Wh as against 0.29 kg/k Wh of diesel [17].

**Yanuandri Putrasari, Arifin Nur and Aam Muharama:-** An experiment on the application of diesel and ethanol blends as fuel in diesel engine was carried out at various engine loads and ethanol percentages. The experiments were performed using solar, E2.5%, E5%, E7.5%, and E10% ethanol-diesel blends and 0, 10, 20, 30, 40, 50 and 60 Nm engine loads. Several engine parameters i.e. power, brake specific fuel consumption, brake thermal efficiency, the exhaust gas temperature, and lubricating oil temperature were investigated. As a complement of the experiment, the exhaust emission characteristic of CO, HC and smoke were also investigated. The results indicate that the engine power and the indicated mean effective pressure increase with increasing of ethanol percentage. The brake specific fuel consumption and exhaust gas temperature decrease, meanwhile the lubricating oil temperature increase with increasing the ethanol content. From the experiments, as the increase of ethanol percentage content, the emission of CO, HC and smoke decrease [18].

**Paolo Iodice and Adolfo Senatore:-** The object of this study is to investigate the effect of ethanol-gasoline blends on CO and HC cold start emissions from a four stroke motorcycle. An experimental-analytical investigation was performed on the exhaust cold extra emissions of one motorcycle belonging to the Euro-3 legislative category. The study explains a calculation procedure to model the cold start transient behavior of motorcycles in order to evaluate the impact of ethanol addition (10, 20 and 30 vol %) on cold start emissions compared with a reference commercial

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gasoline. Results of the tests indicate that CO and HC cold start extra emissions by using ethanol–gasoline blended fuels decrease compared to the use of unleaded gasoline. The G20 blend fuel (20% v/v ethanol content) reveals a significant reduction of cold emissions compared to the use of gasoline without any oxygenated additive. The high-ethanol content blend G30 results in higher emissions than those of low content blends; this may be attributed both to incomplete combustion that occurs in the combustion chamber during the transient time when the engine operates over a definite lean limit [19].

**Byungchul Choi, Young Kwon Kim, Gilsung Jung, Chunhwan Lee, Xiaolong Jiang and Inchul Choi:-** The objectives of this study are to investigate the effect of diesel fuel blend with biobutanol on the emission of turbocharged CRDI(common rail direct injection) diesel engine. The blends considered here were blends of diesel fuels with 10 and 20% (by vol.) n-butanol. Engine performance and emission characteristics were measured by the ESC(European Stationary Cycle) test. Emissions of HCs, CO, NO<sub>x</sub>, HCHO, HCOOH and NH<sub>3</sub> were measured by the FTIR. Size and number distribution of particulate matter were measured by the SMPS. From the results, for the n butanol blend, NO<sub>x</sub> emission increased compared with the neat diesel fuel case. At the case of 20% butanol, both THC and CO emissions increased significantly, and both HCHO and HCOOH increased modestly in the low loading of ESC 7, 9, 11 and 13 modes comparing with the neat diesel fuel case. While n-butanol blending with diesel fuel reduced the mass of PM by 50~73% [20].

### III.CONCLUSION

Crude oil price hikes, energy security concerns and environmental drivers have turned the focus on alternative fuels. The gradual advancement of civilization associated with the growth of transport sector has influenced the excessive usage of fossil fuels, initiating a confrontation of dual exigency between abrupt depletion of fossil fuel as well as environmental degradation. From above analysis we conclude that Alternative fuel Technology has been play a vital role in reducing the exhaust emission. Blending fuel technology is one of the best way to implement and reducing the exhaust emission from vehicles. Blending of various fuels like ethanol, methanol, biodiesel etc has a great influence on reducing the exhaust emission.

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