ANALYSIS OF ETHANOL-DIESEL HIGHER BLENDS

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Abstract: Ethanol has been part of alcoholic beverages for long time, but its application has expanded much beyond that during the20th Century. Much of the recent interest is in the use of ethanol as fuel.

Ethanol produced by fermentation, called bioethanol, accounts for approximately 95% of the ethanol production. It is recently widely used as an additive to gasoline. Corn in the Unites States and sugarcane in Brazil are widely used as raw materials to produce bioethanol. Cellulosic materials are expected to be the ultimate major source of ethanol and also represent a value-adding technology for agricultural coproducts. While bioethanol is considered as a sustainable energy source, it requires further purification for uses other than fuel. The most common purification technique utilized in the ethanol industry is rectification by further distillation.
However, distillation has critical disadvantages including high cost and limited separation capacity. Several alternatives have been proposed to replace distillation such as non-heating fractional distillation by ultrasonic irradiation, oxidation of impurities by ozone, and adsorption of impurities by activated carbon or zeolite. Chemical and sensory analyses are used to determine the quality of alcohol and to optimize various steps in production. have been developed for chemical analyses.

addition of ethanol to gasoline to boost octane is an alternative to more severe refining operations making ethanol one of the most cost-effective octane enhancers available to the refiner and blender to

Introduction

Compression combustion engines are a source of air pollutants such as HC and Co, but are still widely used throughout the world. The use of renewable fuels such as ethanol, which is a low-carbon fuel, can reduce the emission of these harmful gases from the engine. A fundamental analysis is proposed in this research to experimentally examine the emission characteristics of diesel–ethanol fuel blends. Furthermore, a multi-objective genetic algorithm (e-MOGA) was developed based on the experimental data obtained to fine the most effective or Pareto set of engine emission and performance optimization solutions. So, the optimization problem had two inputs and seven objectives[2]. The findings showed that the use of diesel–ethanol fuel blends decreased the concentration of CO and HC emissions by 3.2–30.6% and 7.01–16.25%, respectively, due to the
high oxygen content of ethanol. As opposed to CO and HC emissions, the NOx concentration showed an increase of 7.5–19.6%. This increase was attributed to the high combustion quality in the combustion chamber, which resulted in a higher combustion chamber temperature. The growing world population and fossil fuel consumption result in a steep rise in energy demand. When population grows and living conditions rise, there is increasing fear that there will be energy shortages to power the vehicles Due to environmental considerations and the increase of petrol prices, many investigators are now trying to discover renewable sources that could replace fossil fuels.
The prominent drivability and economic efficiency make diesel engines extensively employed in many applications such as automobile propulsion source, engineering

machinery for technical purposes, and ship power requirement. It has been a major objective in the development of diesel engines to reduce emissions. Alternative energies are sustainable, safer and more efficient than traditional fuels.

Biofuels seem to be a great replacement for fossil fuels, which are always accompanied by environmental, economic, and stability issues. Here, biofuel is referred to as any liquid fuel produced from plant materials and utilized as a replacement for petroleum. Biofuels such as ethanol–diesel, are considered to be optimum alternative fuels for SI and CI engines because these fuels are.

Literature Review

Since 1976 the Brazilian government has made it mandatory to blend ethanol with gasoline, and since 2007 the legal blend is around 25% ethanol and 75% gasoline (E25). By December 2011 Brazil had a fleet of 14.8 million flex-fuel automobiles and light trucks and 1.5 million flex-fuel motorcycles that regularly use neat ethanol fuel

In 2008 an alternative process to produce bio-ethanol from algae was announced by the company Algenol. Rather than grow algae and then harvest and ferment it, the algae grow in sunlight and produce ethanol directly, which is removed without killing the algae. It is claimed the process can produce 6,000 U.S. gallons per acre (5,000 imperial gallons per acre; 56,000 liters per hectare) per year compared with 400 US gallons per acre (330 imp gal/acre; 3,700 L/ha) for corn production. In 2015 the project was abandoned.

In a 2008 study, complex engine controls and increased exhaust gas recirculation allowed a compression ratio of 19.5 with fuels ranging from neat ethanol to E50. Thermal efficiency up to approximately that for a diesel was achieved. This would result in the fuel economy of a neat ethanol vehicle to be about the same as one burning gasoline.

In June 2016, Nissan announced plans to develop fuel cell vehicles powered by ethanol rather than hydrogen, the fuel of choice by the other car manufacturers that have developed and commercialized fuel cell vehicles, such as the Hyundai Tuscon, Toyota Mirai and Honda FCX Clarity. The main advantage of this technical approach is that it would be cheaper and easier to deploy the fueling infrastructure than setting up the one required to deliver hydrogen at high pressures, as each hydrogen fueling station cost US$1 million to US$2 million to build.

in a 2007 report by National Geographic point to modest results for corn ethanol produced in the US: one unit of fossil-fuel energy is required to create 1.3 energy units from the resulting ethanol. The energy balance for sugarcane ethanol produced in Brazil is more favorable, with one unit of fossil-fuel energy required to create 8 from the ethanol.

A 2006 University of California Berkeley study, after analysing six separate studies, concluded that producing ethanol from corn uses much less petroleum than producing gasoline.

The January 2006 Science article from UC Berkeley's ERG, estimated reduction from corn ethanol in GHG to be 13% after reviewing a large number of studies. In a correction to that article released shortly after publication, they reduce the estimated value to 7.4%. A National Geographic overview article (2007) puts the figures at 22% less CO2 emissions in production and use for corn ethanol compared to gasoline and a 56% reduction for cane ethanol. Carmaker Ford reports a 70% reduction in CO2 emissions with bioethanol compared to petrol for one of their flexible-fuel vehicles.

PROBLEM STATEMENT

The adoption of higher ethanol blends in diesel engines necessitates a comprehensive understanding of their impact on engine performance, emissions, and durability, addressing critical challenges and paving the way for sustainable and efficient transportation solutions.

For this, we went forward with the usage and analysis of ethanol as a sustainable fuel to make ethanol diesel higher blends in diesel engine.

OBJECTIVE

The objectives of studying ethanol-diesel blends in the context of higher blends in diesel engines can be multifaceted and may include:

1. Performance Evaluation: Assess the impact of higher ethanol blends on diesel engine performance parameters, including power output, thermal efficiency, and torque characteristics.

2. Combustion Analysis: Investigate the combustion behavior, ignition

characteristics, and stability of higher ethanol-diesel blends to understand their suitability for use in diesel engines.

3. Emission Analysis: Evaluate the emissions profile of diesel engines running on higher ethanol blends, focusing on pollutants such as nitrogen oxides (NOx), carbon monoxide (CO), hydrocarbons (HC), and particulate matter. Compare these emissions with those from conventional diesel engines.

4. Fuel Properties: Characterize the physical and chemical properties of ethanol-diesel blends, including viscosity, density, calorific value, cetane number, and lubricity. Understand how these properties influence engine performance and combustion.

5. Environmental Impact: Assess the environmental benefits of using higher ethanol blends, including their potential to reduce greenhouse gas emissions and mitigate climate change. Compare the life cycle analysis of ethanol-diesel blends with traditional diesel fuel.

6. Engine Durability and Wear Analysis: Investigate the effects of higher ethanol blends on engine components, focusing on wear and tear, corrosion, and other durability aspects. Identify any potential challenges related to engine maintenance and longevity.

7. Cold Start Performance: Evaluate the cold start characteristics of diesel engines running on higher ethanol blends, as cold weather operability is crucial for vehicles in regions with low temperatures.

8. Material Compatibility: Examine the compatibility of higher ethanol blends with engine materials, gaskets, seals, and fuel system components. Identify any issues related to material degradation and develop solutions to enhance compatibility.

9. Economic Viability: Analyse the economic feasibility of adopting higher ethanol blends in diesel engines, considering factors such as production costs, infrastructure requirements, and government incentives.

10. Policy and Regulation: Investigate the existing policies and regulations related to the use of ethanol-diesel blends, identifying barriers and suggesting policy recommendations to promote their adoption in the transportation sector.

11. Public Awareness and Acceptance: Assess public perception and awareness of ethanol-diesel blends. Identify strategies to increase awareness and acceptance among consumers, vehicle manufacturers, and fuel suppliers.

By addressing these objectives, research on ethanol-diesel blends can provide valuable insights into their feasibility, benefits, challenges, and potential applications in diesel engines, contributing to the development of sustainable and environmentally friendly trans

LIST OF THEORIES AND PRACTICES

1 Substrates

Ethanol is produced from various kinds of substrates. The substrate used for ethanol production is chosen based on the regional availability and economical efficiency.

1. Sugarcane
2. Sugar beet
3. Sugar sorghum
4. Starchy materials
5. Corn

2 Production process

Starchy materials are converted to ethanol by two major processes, dry milling and wet milling.

1. Dry milling

Dry milling the dominant and more efficient ethanol production process than wet milling. It produces about 2.8 gallons of ethanol per bushel of corn

2. Wet milling

The components of grain are separated in wet milling before saccharification. Produces various high value products such as corn gluten meal (CGM) and corn gluten feed (CGF) are produced though wet milling. It produces about 2.7 gallons of ethanol per bushel of corn

Ethanol analysis

Gas chromatography

A sample is vaporized at an injection port by heat. The sample vapor is sent to column packed with adsorbent or absorbent. Inside column, each component in sample is separated depending on its physical and chemical property. The end of column the concentration of each compounds are measured by a detector. There are many kinds of coatings for column. A coating should be chosen depending on the target compounds. Also, there are many kinds of detectors. Each detector has advantages and disadvantages. Thus, a detector should also be chosen carefully to detect target compounds.

Specifications – Denatured Fuel Ethanol (DFE)

Ethanol, % by volume, min 92.1 D5501

Methanol, % by volume, max 0.5 D5501

Solvent washed gum, mg/100mL, max 5.0 D381

Water content, % by volume, (% by mass), max 1.0 (1.26) D7923, E1064 or E203

Inorganic Chloride, mg/kg (mg/L), max 6.7 (5) D7319 or D7328

Copper, mg/kg, max 0.1 D1688

Acidity, as acetic acid, mg/kg, (% by mass) [mg/L], max 70 (0.0070) [56] D7795

pHe 6.5 – 9.0 D6423

Sulfur, mg/kg, max 30. ** D5453

Existent Sulfate, mg/kg, max 4 D7318, D7319 or D7328

WORKING

In this, a sample of 25litres of ethanol was required. since ethanol lacks easy availability in the market, we bought Ethanol for Rs.100/lt.

This ethanol has a purity level upto 99 percent as per the claims of the source. This ethanol would be further blended with diesel between 10C to 40C. The blend characteristics are further analysed in the RK Diesel software. After the final output, the blend will be used In the vehicle for energy purpose.

three samples each containing 2 Litres of mixture, the mixture consists ratio of ethanol and diesel as follows:-

1) ETHANOL 1L : DIESEL 1L
2) ETHANOL 1.4L : DIESEL 0.6L
3) ETHANOL 1.8L : DIESEL 0.2L

All the samples stated above are to be undergone for 'Exergy Analysis' for the exact amount of content of Carbon, Hydrogen, Oxygen and Sulphur in the sample/Mixture. After this analysis and its positive results, mixture is good to go for testing in diesel engine

Observation

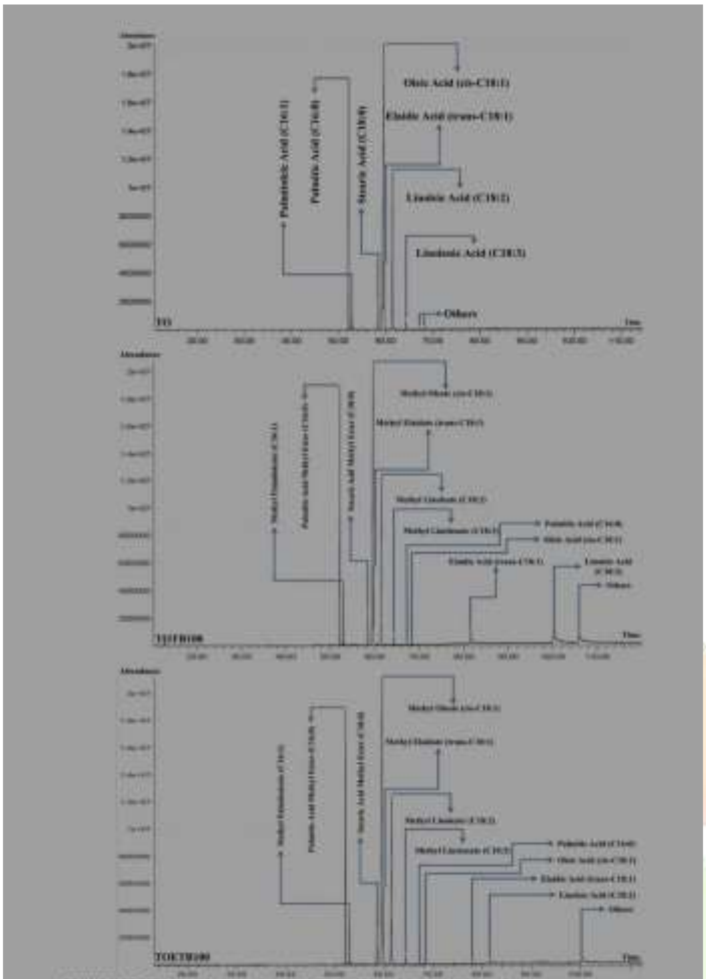


FIGURE S2 GC-MS analysis graphs of TO, TOTB100, and TOETB100 samples

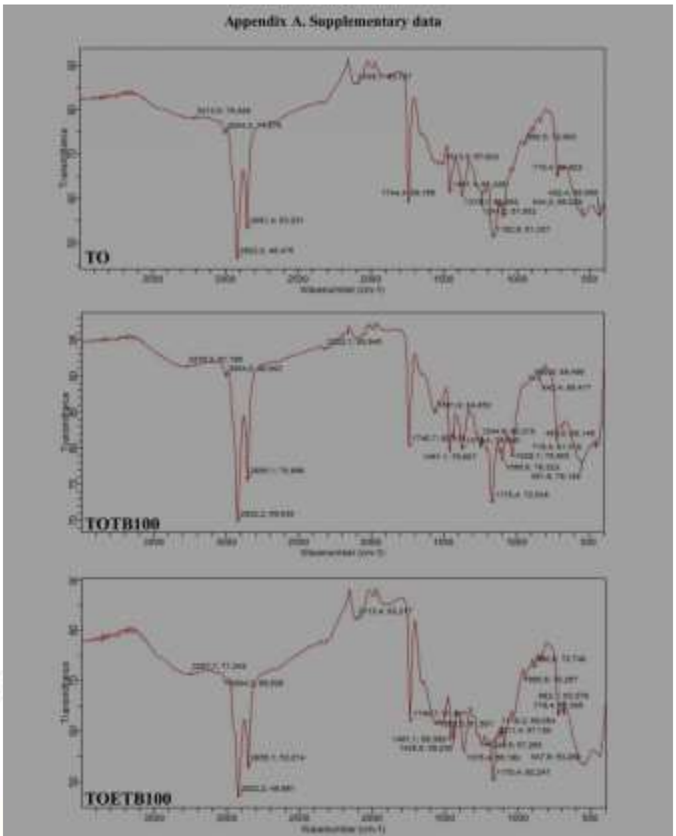
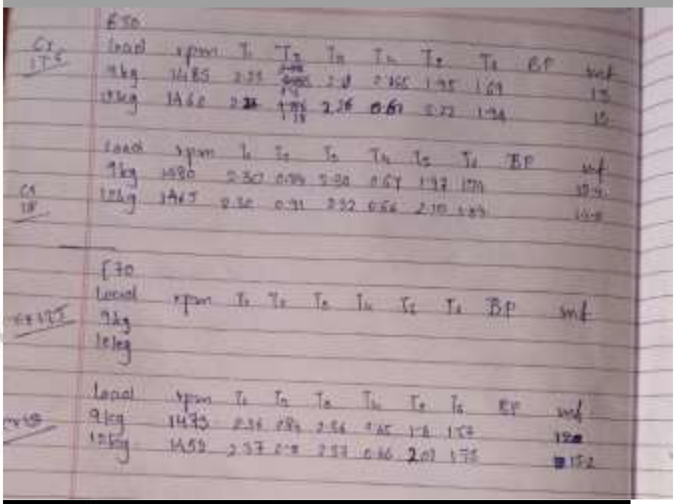
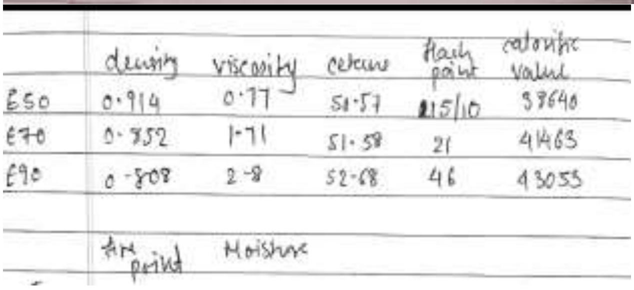


FIGURE S1 FT-IR spectrum of TO, TOTB100 and TOETB100





	density	viscosity	cetane	flash point	calorific value
E50	0·914	0·77	51·57	15/10	38640
E70	0·852	1·71	51·58	21	41463
E90	0·808	2·8	52·68	46	43055

	fire point	Moisture

Conclusion

From all the observations and analysis done under thorough guidance and with precision, we thereby conclude that the blend of ethanol diesel with ethanol having more contents than diesel emit less carbon emissions by upto 60-65 percent and also give a high power output i.e high efficiency than conventional fuels used today

Viscosity of the blend decreases hugely as there is a large amount of ethanol content available in the blend like E70 and E90

Ignition delay of the fuel blend reduces after testing in the engine

Relative densities are also lower than that of diesel fuel

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