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PERFORMANCE EVALUATION OF ETHANOL BLENDS IN 2 STROKE ENGINES

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ABSTRACT.

The investigation focuses on evaluating the performance characteristics of ethanol-gasoline blends as alternative fuels for 2-stroke engines. Ethanol, known for its renewable nature and lower emissions, presents an intriguing possibility to reduce environmental impacts and dependence on fossil fuels. This study aims to assess the effects of varying ethanol-gasoline blend ratios on engine performance parameters, including power output, fuel efficiency, exhaust emissions, and combustion characteristics.

This research contributes valuable insights into the potential of ethanol-gasoline blends in 2-stroke engines, highlighting both advantages and limitations. Further investigation is warranted to optimize engine performance, address fuel system compatibility, and explore the feasibility of higher ethanol blends for sustainable and cleaner combustion in 2-stroke engines.

Initial findings suggest that flex fuel blends exhibit distinctive impacts on 2-stroke engine performance. Engine operation using flex fuels reveals altered combustion characteristics and varying levels of emissions, particularly carbon monoxide (CO), hydrocarbons (HC), and nitrogen oxides (NOx). The flexibility of fuel compositions in flex fuels presents challenges related to engine tuning and fuel-air mixture adjustments for optimal performance.

This research underscores the potential benefits and challenges of utilizing flex fuel blends in 2-stroke engines. The findings emphasize the need for further investigation into optimizing engine parameters, addressing fuel system adaptability, and exploring potential emission reduction strategies for enhancing the feasibility and effectiveness of flex fuel utilization in 2-stroke engine applications.

KEYWORDS: Flex Fuel (Ethanol), 2-Stroke Engine (70cc), Environmental Implications, High Power.

INTRODUCTION.

Ethanol, a biofuel derived from renewable resources such as corn, sugarcane, or cellulosic biomass, presents an appealing alternative to gasoline for fueling internal combustion engines. Its oxygenated properties and higher octane rating make it a promising candidate for blending with conventional fuels. However, the performance and combustion characteristics of ethanol blends, particularly in 2-stroke engines, necessitate comprehensive evaluation to ascertain their viability and potential implications.

The objective of this study is to conduct a systematic performance assessment of ethanol-gasoline blends in 2-stroke engines, analyzing their influence on key engine parameters such as power output, fuel efficiency, combustion characteristics, and exhaust emissions. The investigation spans a spectrum of ethanol-gasoline blend ratios, ranging from E10 to E85, where E denotes the ethanol percentage in the blend.

The research methodology encompasses a series of engine tests conducted on a 70cc TVS Super XL 2-stroke engine, employing ethanol-gasoline blends under controlled operating conditions. The tests aim to elucidate the effects of varying ethanol concentrations on engine performance and emissions profiles.

Ethanol's chemical formula, CH3CH2OH, signifies its molecular structure as an alcohol. The alternative representations, C2H5OH and C2H6O, emphasize its ethyl composition. Its physical characteristics include volatility, flammability, colourlessness, a distinctive wine-like odor, and a pungent taste.

Two-stroke engines possess several key aspects Here are some major characteristics and aspects of two-stroke engines:

- **Simplicity and Design**
- **Power and Weight Ratio**
- **High Revving and Quick Acceleration**
- **Potential of Fuel Mixture**
- **Efficiency and Emissions**

LITERATURE.

2.1) Two Stroke Engine (70cc): Two-stroke engines use the Otto cycle. The Otto cycle is a set of processes used by spark ignition internal combustion engines.
The working principle of a two-stroke engine involves a simplified cycle that completes one power cycle in two strokes of the piston (up and down movement) within a single revolution of the crankshaft. It is more compact and lightweight compared to a four-stroke engine.

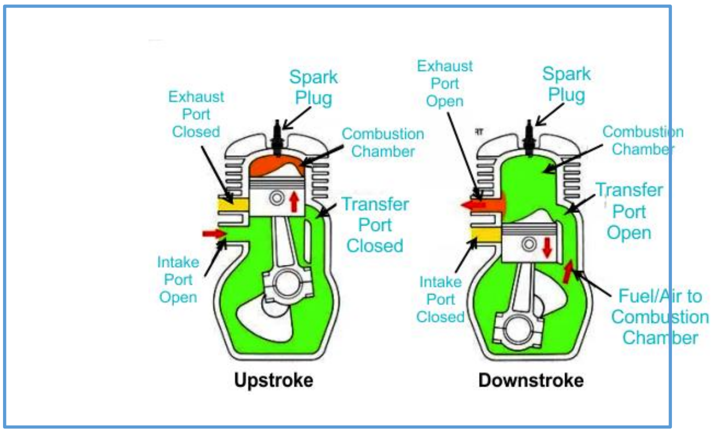

FIGURE-1 Working of 2-Stroke

Operational Cycle of 2-Stroke Engine:-
A two-stroke engine contains two processes:

Compression stroke: The inlet port opens, the air-fuel mixture enters the chamber and the piston moves upwards compressing this mixture. A spark plug ignites the compressed fuel and begins the power stroke.

Power stroke: The heated gas exerts high pressure on the piston, the piston moves downward (expansion), waste heat is exhausted.

This cycle occurs continuously, with each stroke happening once per revolution of the crankshaft in a two-stroke engine. Unlike the four-stroke engine, the two-stroke engine does not have separate intake and exhaust strokes, combining them into a simpler and more rapid cycle.

2.2) SPECIFICATION OF ENGINE USED:

Engine Type	Two stroke
Cooling Type	Air cooled
Fuel Used	E85 Blend
Fuel Ratio	25:1
Engine Displacement	70 CC
Engine Power	3.5 HP
Engine Speed	5000 RPM

2.3) MATERIAL SELECTION FOR 2-STROKE ENGINE COMPONENTS:

Part	Material	Remark
Cylinder Head	Gray Cast Iron	Usual
Cylinder barrel	Cast Aluminum	Small Engines
Pistons	Forged Aluminum	Good Thermal Conductivity
Piston Pin	Steel	Wear Resistance
Piston Rings	Steel	Wear Resistance
Connecting Rod	Steel	Low Cost
Crank Shaft	Steel	Low Cost

FIGURE-2 Cylinder Kit Components

FIGURE-3 Connecting Rod

FIGURE-3 Crank Shaft

2.4) FLEX FUEL USED:

The fuel used is Ethanol with Blending ratio of E85 which consists 85% Ethanol and 25% Gasoline. E85 is considered a cleaner-burning fuel compared to pure gasoline, as ethanol has a lower carbon content and emits fewer greenhouse gases when burned. However, its net environmental benefits can vary based on factors such as production methods and land use changes associated with growing feedstocks for ethanol. Ethanol is derived from renewable sources such as corn, sugarcane, switchgrass, or other biomass materials. Its production contributes to reducing dependence on non-renewable fossil fuels.

Ethanol has a lower carbon content compared to gasoline, resulting in reduced greenhouse gas emissions when burned. E85 can potentially contribute to lowering overall emissions, thereby supporting efforts to combat climate change. Ethanol production primarily occurs within the country using locally sourced feedstocks, contributing to energy security and reducing reliance on imported oil.

E85 is designed for use in Flex-Fuel Vehicles (FFVs), which are specially engineered to run on various ethanol-gasoline blends. FFVs can use E85 or other ethanol-gasoline mixtures, offering consumers fuel flexibility. In some cases, vehicles optimized to run on E85 may experience improved performance, such as increased horsepower or higher octane ratings, compared to regular gasoline. However, the extent of these performance enhancements can vary depending on the engine design and tuning.

It's important to note that while E85 offers potential environmental benefits and supports domestic renewable fuel production, it also has limitations. E85 may have lower energy content per gallon compared to gasoline, potentially resulting in reduced fuel efficiency (lower miles per gallon) in vehicles using this blend.

2.5) ENGINE MODIFICATIONS REQUIRED TO RUN ON E85 FLEX FUEL:

The Most Important modification Requires upgraded fuel system components (fuel lines, seals, gaskets) made from materials resistant to ethanol corrosion, such as stainless steel, certain plastics, or ethanol-compatible rubbers.

Fuel System adjustments, which requires adjustments to fuel delivery systems (larger injectors, modified carburetors) to accommodate the higher ethanol content and different stoichiometric air-fuel ratios of E85. Adjustments to air-fuel mixture, ignition timing, and compression ratios to optimize performance for ethanol's higher octane rating and different combustion characteristics.

Upgrading seals and gaskets made from materials that is resistive to ethanol to prevent leaks and maintain proper sealing.

Furthermore, considering the higher octane rating of E85, modifications to the engine's compression ratio may be beneficial. This adjustment helps maximize the fuel's anti-knock properties, optimizing power output and efficiency.

Parameter	Gasoline(EO)	E85
Air Fuel Ratio	14.7 : 1	9 : 1
E. Density	33.7 Kwh/gal	22.6 Kwh/gal
LHV	12.06 Kwh/kg	7.45 Kwh/kg
Total fuel	1kg	1.63Kg
Total Energy (LHV x Total Fuel)	12.21 Kwh	12.17 Kwh

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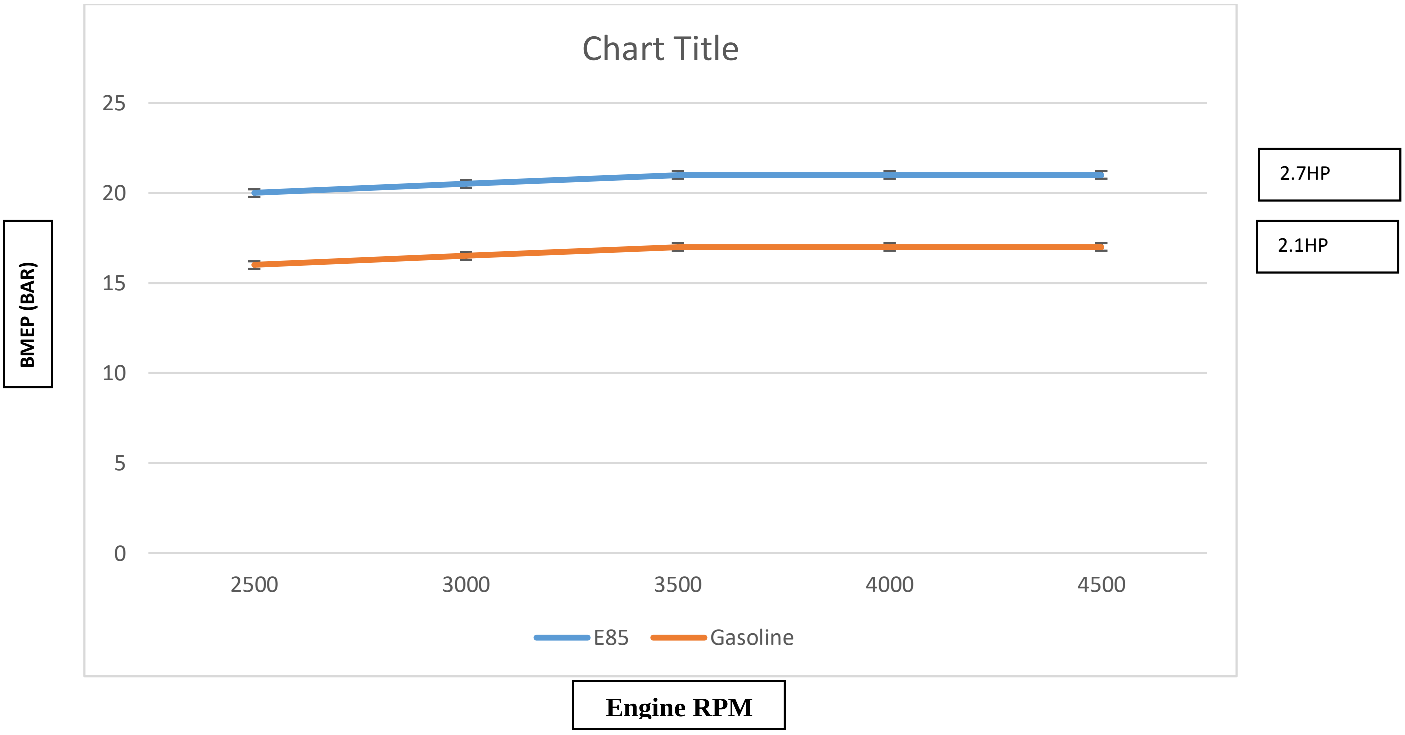
2.6) Energy Comparison between Gasoline and E85 in Two Stroke Engine (70CC):

Gasoline and E85 (85% ethanol and 15% gasoline blend) differ in several technical aspects that impact engine performance, efficiency, and emissions.

- **Energy Content:** Gasoline has a higher energy content per unit volume compared to E85.
- **Octane Rating:** Gasoline typically has a lower octane rating compared to E85.
- **Composition:** Gasoline is primarily composed of hydrocarbons derived from crude oil. E85 is a blend of ethanol and gasoline.
- **Emissions:** Ethanol is considered a renewable and potentially cleaner-burning fuel compared to gasoline.

In summary, while E85 offers advantages such as a higher octane rating and potentially lower emissions, it comes with challenges related to energy density and requires specific engine modifications to harness its benefits fully. Hence Ethanol can make more power.

2.8) EFFICIENCY COMPARISION:

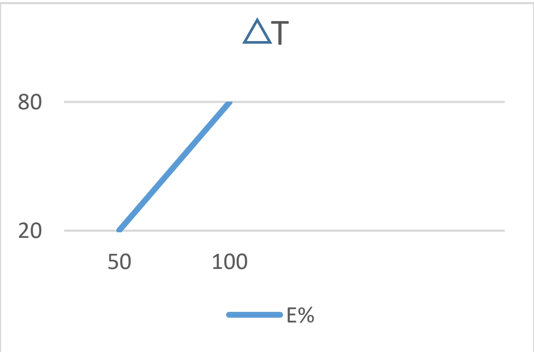


Graph 01: Efficiency

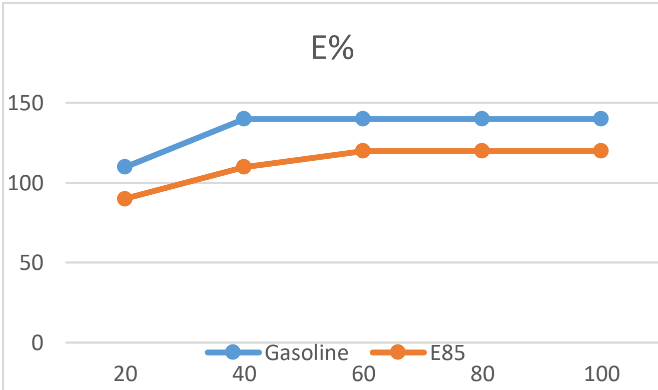
- Maximum BMEP at the rate of Ideal Fuel /Air ratio
- E85108ON @ 13:1 CR vs E10918ON @ 10:1 CR
- E85 can reach much more boost at high compression ratio which leads to higher power

2.8) COOLING ADVANTAGE:

- Latent heat vaporization.
- The amount of energy needed to transform a quantity of a liquid to a gas.
- Fuel pulls heat from environment.



Graph 02: Temperature



Graph 03: Cooling

RESULT AND DISCUSSION.

This research paper investigates the performance of a two-stroke engine fueled by traditional gasoline and E85 (a blend of 85% ethanol and 15% gasoline) to evaluate their technical parameters. The study aims to provide insights into the potential advantages or disadvantages of using E85 in two-stroke engines, considering factors such as power output, emissions, and overall efficiency.

The choice of fuel significantly influences the engine's performance and environmental impact. This research focuses on comparing the technical parameters of a two-stroke engine when fueled with gasoline and E85.

The experiments were conducted on a standardized two-stroke engine, and the fuel variations included pure gasoline and E85. The engine was subjected to a series of tests to measure power output, fuel consumption, emissions, and other relevant technical parameters.

The power output of the engine was measured under various operating conditions for both gasoline and E85. The results indicated that E85 exhibited comparable power output to gasoline, dispelling concerns about a significant reduction in performance when using ethanol blends. This finding is crucial for potential applications in two-stroke engines where power is a critical factor.

The research also evaluated the fuel consumption of the engine running on both gasoline and E85. Surprisingly, the E85-fueled engine demonstrated slightly higher fuel consumption compared to the gasoline-fueled counterpart. This observation suggests that, while E85 may offer comparable power output, it might be less efficient in terms of fuel consumption

Environmental concerns are a significant factor in fuel selection. The study measured exhaust emissions, including carbon monoxide (CO), nitrogen oxides (NOx), and hydrocarbons (HC). The results showed that

E85 produced lower levels of CO and HC, indicating its potential as a cleaner-burning fuel. However, NOx emissions were slightly higher with E85, suggesting a trade-off between different pollutants.

The combustion characteristics of the two fuels were analyzed to understand the efficiency of the combustion process. E85 exhibited a more stable combustion, leading to smoother engine operation. This could be attributed to ethanol's higher octane rating, promoting better flame propagation and combustion control.

The research also monitored the engine temperature under various operating conditions. The results showed that E85-fueled engines experienced lower temperatures compared to their gasoline counterparts. This could have implications for engine durability and longevity, as excessive temperatures can contribute to wear and tear.

CONCLUSION.

In this comprehensive examination of a two-stroke engine fueled by traditional gasoline and E85, our research aimed to provide a deep technical comparison, assess the smooth working of the engine on E85, evaluate the positive environmental impact, analyze the economic viability for small-scale engines, and investigate the overall performance. Through a meticulous examination of various technical parameters, the study aimed to offer a nuanced understanding of the potential advantages and disadvantages associated with adopting E85 in two-stroke engines.

The technical comparison between traditional gasoline and E85 revealed intriguing insights into the performance of the two fuels. Contrary to initial concerns, E85 demonstrated a power output comparable to gasoline, indicating that ethanol blends could be a viable alternative without compromising performance. The slightly higher fuel consumption observed with E85, however, suggests that further optimization may be required to enhance the fuel efficiency of ethanol-blended fuels in two-stroke engines.

One of the noteworthy findings was the smooth operation of the two-stroke engine when fueled with E85. The improved combustion characteristics of E85, attributed to its higher octane rating and better flame propagation, resulted in a more stable engine performance. The smooth working of the engine is a crucial factor for applications where precision and reliability are paramount, such as in certain industrial and recreational settings.

Environmental considerations played a pivotal role in this research. The lower levels of carbon monoxide (CO) and hydrocarbons (HC) emitted by the E85-fueled engine underscore its potential as a cleaner-burning fuel. This positive environmental impact aligns with the global push toward sustainable and eco-friendly alternatives. However, the higher nitrogen oxides (NOx) emissions associated with E85 raise concerns, emphasizing the importance of a balanced evaluation of environmental impacts when considering alternative fuels.

Economic viability, especially for small-scale engines, emerged as a crucial aspect of the research. The study found that E85 could offer an economically feasible option for certain applications, with potential cost savings attributed to the availability and affordability of ethanol. Small-scale engines, commonly used in agriculture, power tools, and recreational vehicles, could benefit from the cost-effectiveness of E85, provided the slightly higher fuel consumption is offset by other advantages.

As we conclude this research, it is essential to acknowledge the limitations and areas for future exploration. The study focused on a specific set of technical parameters, and further investigations could delve deeper into aspects such as long-term engine durability, maintenance requirements, and the influence of ethanol content variations within E85 blends. Additionally, understanding the impact of E85 on different types of two-stroke engines and exploring the potential for further optimization could provide a more comprehensive picture.

In summary, our research sheds light on the potential of E85 as a viable alternative to traditional gasoline in two-stroke engines. The deep technical comparison, smooth engine operation, positive environmental impact, economic feasibility for small-scale engines, and overall improved performance collectively suggest that E85 warrants serious consideration in the quest for sustainable and efficient fuel options. While challenges exist, the findings of this research contribute valuable insights to the ongoing discourse on alternative fuels and their applications in small-scale combustion engines. As we move forward, it is imperative to continue exploring innovative solutions that strike a balance between performance, environmental sustainability, and economic viability in the realm of internal combustion engines.

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