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PERFORMANCE AND FEASIBILITY OF FLEX FUEL TWO STROKE ENGINE

Mr. Suraj Gautam, Student, B.Tech. Mechanical and Automobile Engineering (Evening), School of Mechanical Engineering, Lingayas Vidyapeeth, Faridabad, Haryana.

Abstract
In the contemporary landscape of automotive technology, the focus has predominantly been on the evolution of four-stroke engines, often overshadowing the potential of two-stroke engines in small-scale applications. Despite their efficiency and power density, two-stroke engines have faced a notable lack of attention and consideration on a global scale. This oversight is particularly relevant in the context of their pivotal role in powering various small-scale operations, ranging from scooters and dirt bikes to jet skis, motor boats, cutting equipment, agricultural machinery, smaller outboard motors, and essential lawn maintenance tools like mowers and chainsaws. Despite their significance, the environmental impact of two-stroke engines aligns with concerns associated with other internal combustion engines.

This research paper delineates a comprehensive pathway for the operation of two-stroke internal combustion engines utilizing environmentally friendly flex fuels. Specifically, we explore the integration of an ethanol and gasoline blend, consisting of 85% ethanol and 15% gasoline—a composition that not only delivers superior power but also boasts a high octane value when juxtaposed with conventional fuels, all while maintaining cost-effectiveness.

The adoption of E85, renowned for its potential environmental advantages, particularly in reducing greenhouse gas emissions, forms a pivotal aspect of our investigation. Our study utilizes a two-stroke air-cooled engine module with a displacement of 63cc, meticulously equipped with high-performance components engineered to withstand ethanol exposure, ensuring the non-corrosive integrity of both the fuel system and core engine components.

Operating on E85 fuel, our engine exhibits an impressive power output of 2.7 horsepower (HP), opening avenues for versatile applications in relevant fields. Traditional two-stroke engines, known for their elevated emissions, especially in small-scale applications, are markedly improved when transitioning to flex fuels. This not only enhances overall engine performance but also presents an economically viable solution, contributing significantly to the reduction of harmful emissions.

The strategic incorporation of E85 in our research underscores a pivotal step towards mitigating environmental concerns linked to small-scale two-stroke engines. By capitalizing on the benefits of ethanol and gasoline blends, this study advocates for a sustainable approach to power generation, concurrently addressing performance requirements and ecological considerations in the realm of internal combustion engines.

Keywords: Flex fuel, Two Stoke engine (63CC), Environmental Implications, High power

I. Introduction

Inclination of modern automobile engineering toward the green fuel turned the spotlight form traditional gasoline engines to flex fuel engines marking a drastic change in automotive history, first ethanol blend was introduced in January, 2003. The program contribute to promote the use of alternative and environment friendly fuels and to reduce import dependency for energy requirements. Which leads today’s era to replace traditional fuels.

Operation of two stroke flex fuel engines will significantly contribute our goal on a linear platform by replacing this engine form relevant areas. Overtaking the key challenges while designing ethanol friendly engines. Which includes the proper selection of material used in engine components like fuel transporting lines and others. These engines comparatively demand an anti-corrosive material to support the sustained performance for high power and low operational cost which endorse the significant quality for the environment.

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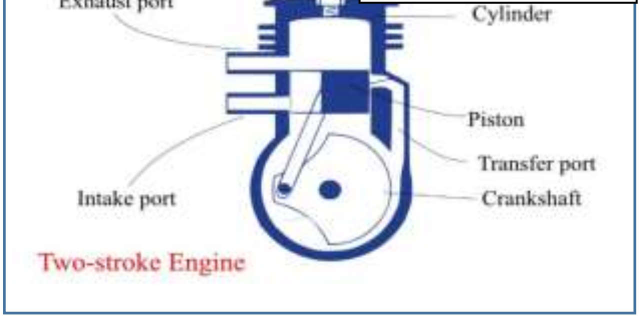
Ethanol is a versatile organic compound known by various names, such as ethyl alcohol, grain alcohol, drinking alcohol, or alcohol. Ethanol, which is represented by the chemical formula CH3CH2OH and is also written as C2H5OH or C2H6O (with ET representing ethyl), is a volatile and flammable colorless liquid with a wine-like odor and pungent taste. This paper explores its chemical properties, production methods, historical uses, and modern applications across diverse industries.
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, colorlessness, a distinctive wine-like odor, and a pungent taste.
Ethanol is naturally produced through the fermentation process of sugars by yeasts. Additionally, petrochemical processes, such as ethylene hydration, contribute to its production. This section delves into the two primary methods, highlighting their significance in meeting global ethanol demand.
Ethanol serves as a chemical solvent and plays a crucial role in the synthesis of organic compounds. Its versatility extends to being a fuel source, contributing to environmental sustainability. Additionally, the dehydration of ethanol results in ethylene, a vital chemical feedstock. This section elaborates on the industrial significance of ethanol.
Two-stroke engine technology, emphasizing its noteworthy contributions to performance and environmental sustainability. The discussion encompasses key aspects such as:

- Power-to-weight ratio
- Simplicity of design
- Advancements in emissions reduction strategies.
- Efficiency in High-Performance Applications
- Reduced Mechanical Losses
- Potential for Alternative Fuels

II. Literature

2.1 Two stroke (63CC) engine: The two-stroke engine operates on the principle of a two-step combustion and power cycle, making it more compact and lightweight compared to a four-stroke engine. The key components of a two-stroke engine include the piston, crankshaft, cylinder, and a system for intake and exhaust of air and fuel.
Basic Operating Cycle:

Fig. 1 Two Stroke Engine



1. Intake and Compression Stroke: As the piston moves upward, it compresses a mixture of air and fuel in the combustion chamber. Simultaneously, the crankshaft completes one full revolution.
2. Combustion and Power Stroke: When the compressed mixture is ignited by a spark plug, it rapidly combusts, generating high-pressure gases that force the piston downward. This downward movement is what produces the engine's power.
3. Exhaust Stroke: As the piston reaches the bottom of its travel, it uncovers an exhaust port, allowing the burned gases to be expelled from the cylinder. The movement of the piston also creates a vacuum, drawing in a fresh mixture of air and fuel for the next cycle.
4. Transfer Port: A critical feature of two-stroke engines is the use of transfer ports, which connect the crankcase (where air and fuel are mixed) to the combustion chamber. These ports facilitate the transfer of the air-fuel mixture into the cylinder and the expulsion of exhaust gases.

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2.2 Specification of engine used:

Table. 1 Engine Specs.

Engine Type	Two stroke
Cooling Type	Air cooled
Fuel Used	E85 Blend
Fuel Ratio	25:1
Engine Displacement	63 CC
Engine Power	2.7 HP
Engine Speed	7500 RPM

2.3 Material used for engine components:

Non corrosive alloy is used in core components such as Piston, Crank case, Crank shaft and Carburetor. Non corrosive high quality rubber fuel lines are used for the outer for delivery and steel lines are used internally because all the rubber components become hard and brittle due to ethanol and tends to facture while operation.

Table. 2 Material used

Component	Dimension	Material Used
Cylinder kit	120 x 90 x 80 MM	Forged Steel
Piston	40 x 49.7 MM	Forged Aluminum
Piston rings	50 MM	Forged Aluminum

Fig. 2 Core Engine Components

Fig. 3 Steel Fuel Lines

Fig. 4 Carburetor Pin

2.4 Fuel used:

E85 fuel, a blend of ethanol and gasoline consisting of 85% ethanol and 15% gasoline. Commonly used as an alternative fuel in flex-fuel vehicles, E85 has gained attention for its potential environmental benefits and impact on the automotive industry. This paper reviews the composition, characteristics, production methods, and environmental implications of E85 fuel.

Table. 3 Fuel Compassion

E85 fuel, comprising 85% ethanol and 15% gasoline, has emerged as a promising alternative to

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

traditional gasoline. This paper aims to examine the key aspects of E85, shedding light on its composition, properties, and the broader implications of its use in the automotive sector.
E85 fuel is primarily composed of ethanol, a renewable biofuel derived from plant materials, and a smaller fraction of gasoline. This section details the specific composition of E85, emphasizing the ethanol content and its implications for engine performance.
The characteristics of E85 fuel, including its octane rating, energy content, and combustion properties, are crucial factors influencing its use in internal combustion engines. This section explores these characteristics and their impact on vehicle efficiency and emissions.
E85 finds its primary application in flex-fuel vehicles (FFVs), which are designed to run on various ethanol-gasoline blends. This section discusses the development of FFVs, their compatibility with E85, and the challenges and opportunities associated with the widespread adoption of flex-fuel technology.
The use of E85 has been promoted for its potential environmental benefits, including reduced greenhouse gas emissions. This section critically assesses the environmental implications of E85, considering factors such as life-cycle emissions and the sustainability of ethanol production.
While E85 presents opportunities for a more sustainable automotive future, it is not without challenges. This section outlines the current obstacles and discusses potential advancements in E85 technology, offering a glimpse into the future of alternative fuels in the transportation sector, E85 fuel represents a significant development in the quest for sustainable and environmentally friendly transportation options. Understanding its composition, characteristics, and implications is crucial for assessing its role in the automotive industry and addressing the challenges associated with its widespread adoption.

2.5 Modifications compared to conventional two stroke Gasoline Engine:

As compared to conventional gasoline two stroke engines while working on E85 fuel the engine requires some key adjustment. To optimize the performance without adhering the conventional design as barrier.
For the high air content the carburetor should tuned to obtain the required air fuel ratio and hence the fine nest present in the carburetor should be removed because E85 fuel is fine enough and does not content any kind of impurities during transportation of the fuel.
The modifications in the ignition timings are also very crucial in this process because ignition timing of E85 fuel is different essential to ensure that the spark plug heat range is appropriate for the modified fuel mixture to prevent issues such as pre-ignition or overheating.
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.
The most important modification required to operate on E85 is to replace all the ethanol corrosive components including carburetor, fuel lines etc. because ethanol may be corrosive to the existing material which is used in the engine. Ethanol can dry the component and make brittle which can lead to accidents or engine failure.

2.6 Energy Comparison between Gasoline and E85 in Two Stroke Engine (63CC)

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

- Octane Rating

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- Energy Content
- Combustion Characteristics
- Emissions
- Engine Modification

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.

2.7 Chemical advantage of E85 in Two Stroke Engine (63CC)

Graph.1 Ethanol %

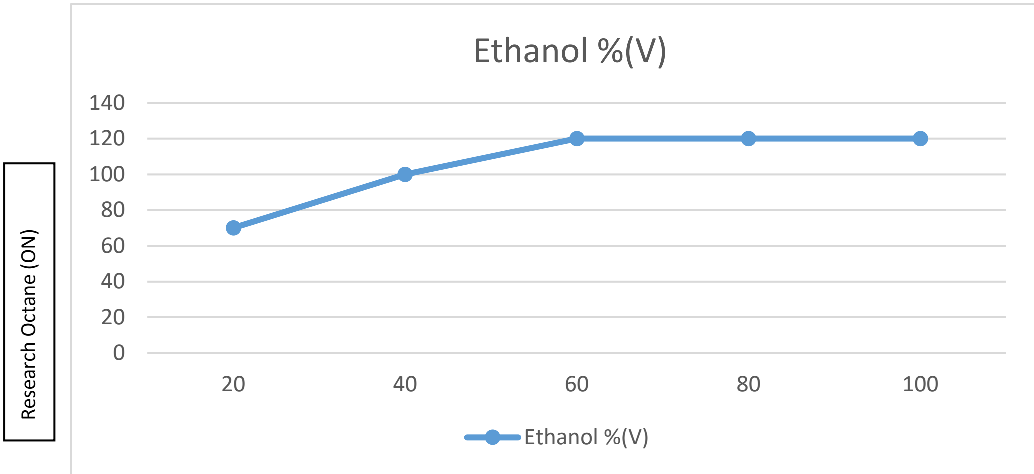


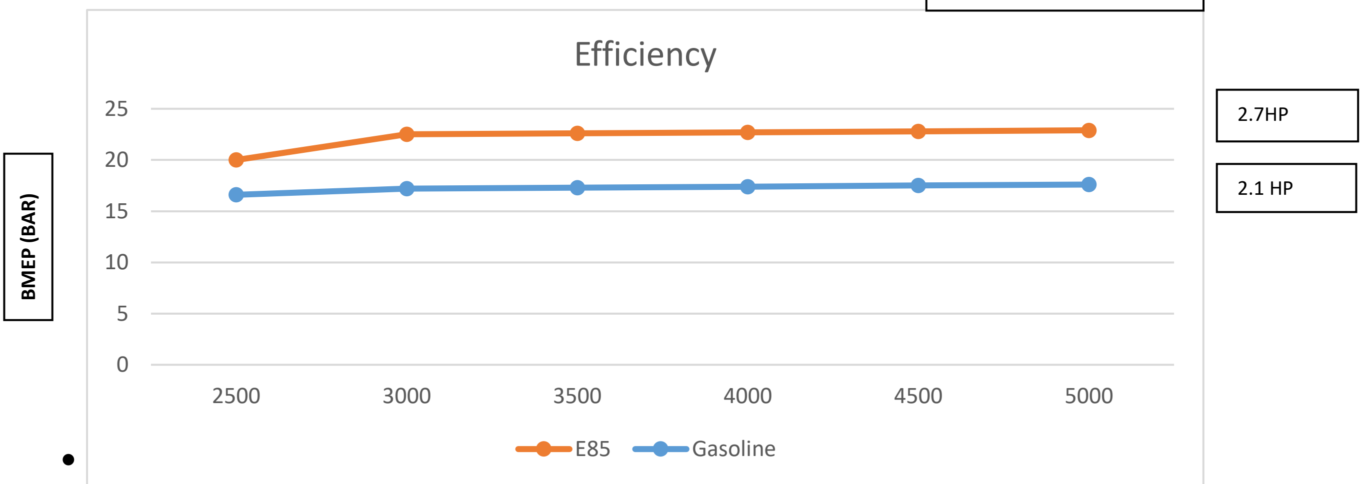
Table 4

Outcomes	
Gasoline	**E85**
97 (ON)	109 (ON)

Outcome: As compared to Gasoline octane number (ON) increases quickly

2.8 Efficiency

Graph.2 Efficiency



- E85108ON @ 13:1 CR vs E10918ON @ 10:1 CR
- E85 can reach much more boost at high compression ratio which leads to higher power

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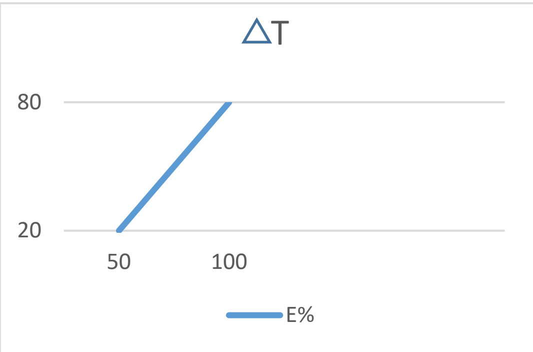
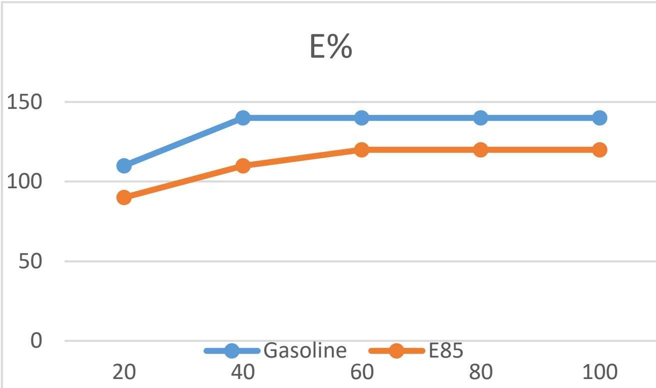
2.9 Cooling advantage

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

Graph. 3 Temperature



Graph. 4 **Cooling**



III. Results and Discussions

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.

In conclusion, the research paper provides a comprehensive comparison of the technical parameters of a two-stroke engine fueled by gasoline and E85. The findings indicate that E85 offers comparable power output with some advantages, such as lower CO and HC emissions and improved combustion characteristics. However, the slightly higher fuel consumption and increased NOx emissions should be considered in the overall assessment. This study contributes valuable insights for those considering the adoption of E85 in two-stroke engines, offering a nuanced understanding of its performance characteristics.

IV. 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.

The improved performance of the two-stroke engine fueled by E85 was a key highlight of the research. The stable combustion, lower engine temperatures, and comparable power output contribute to a more efficient and reliable engine operation. The better overall performance could make E85 an attractive choice for a variety of applications where the advantages outweigh the potential drawbacks.

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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