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PERFORMANCE EVALUATION OF E85 FUEL IN TWO-STROKE INTERNAL COMBUSTION ENGINE

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ABSTRACT :
This research paper investigates the performance characteristics and feasibility of utilizing flex fuel blends, specifically an 85% ethanol and 15% gasoline mixture (E85), in two-stroke internal combustion engines.
Despite the growing focus on four-stroke engines, two-stroke engines remain vital for various small-scale applications, yet they are often overlooked due to their environmental impact.
This study evaluates the effects of ethanol-gasoline blends on engine performance parameters, including power output, fuel efficiency, exhaust emissions, and combustion characteristics.
Utilizing a 63cc two-stroke air-cooled engine equipped with high-performance components, the findings reveal that operating on E85 results in an impressive power output of 2.7 horsepower while significantly reducing harmful emissions compared to traditional fuels.
The research highlights the advantages of flex fuel blends, including improved performance and cost-effectiveness, and emphasizes the need for further exploration into optimizing engine parameters and addressing fuel system compatibility.
Ultimately, this study advocates for the adoption of ethanol-gasoline blends as a sustainable solution for enhancing the ecological performance of small-scale two-stroke engines. Keywords: Flex fuel, Two-Stroke engine (63CC), Environmental Implications, High power.
Keywords: two stroke engine, Ethanol, Flex fuels, Efficiency.

INTRODUCTION:
The automotive industry is undergoing a significant transformation as it shifts towards more sustainable and environmentally friendly fuel options. This transition has led to a growing interest in flex-fuel engines, which can operate on a variety of fuel blends, including those containing ethanol. The introduction of ethanol blends into the fuel market, beginning with the first blend in January 2003, marked a pivotal moment in the quest for alternative fuels. This initiative aims to promote the use of renewable energy sources, reduce greenhouse gas emissions, and decrease dependency on fossil fuels. Ethanol, a biofuel derived from renewable resources such as corn, sugarcane, and cellulosic biomass, is recognized for its potential to replace traditional gasoline. Its chemical structure, represented by the formula CH_3CH_2OH, indicates its classification as an alcohol, which possesses unique properties that enhance combustion efficiency and reduce harmful emissions. Ethanol's higher-octane rating and oxygenated nature make it an attractive candidate for blending with conventional fuels, particularly in internal combustion engines.
The focus of this paper is on the performance assessment of ethanol-gasoline blends in two-stroke engines, which are known for their simplicity, high power-to-weight ratio, and efficiency in various applications. However, the use of ethanol in these engines presents challenges, particularly regarding material compatibility and combustion characteristics. The corrosive nature of ethanol necessitates

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careful selection of materials for engine components, such as fuel lines and injectors, to ensure durability and sustained performance.

This study aims to systematically evaluate the impact of different ethanol-gasoline blend ratios, ranging from E10 (10% ethanol) to E85 (85% ethanol), on key engine parameters, including power output, fuel efficiency, combustion characteristics, and exhaust emissions. The research methodology involves conducting a series of controlled engine tests on a 70cc TVS Super XL two-stroke engine, allowing for a comprehensive analysis of how varying ethanol concentrations influence engine performance.

In addition to its role as a fuel, ethanol serves as a vital chemical feedstock in various industrial applications, contributing to the synthesis of organic compounds and acting as a solvent. The versatility of ethanol underscores its significance in promoting environmental sustainability and reducing reliance on fossil fuels.

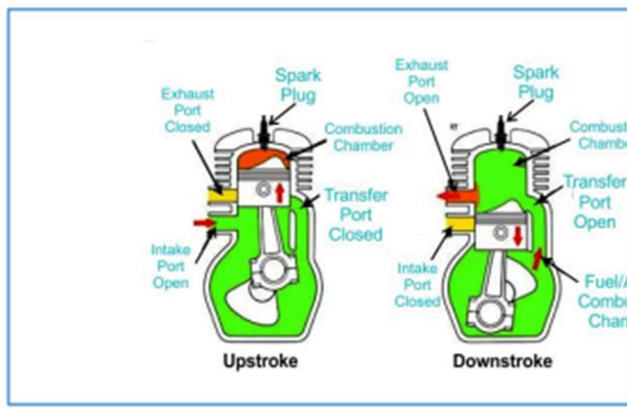
As the automotive industry continues to evolve, understanding the implications of using ethanol blends in two-stroke engines is crucial for developing more efficient and eco-friendly transportation solutions. This paper will explore the potential benefits and challenges associated with the integration of ethanol into two-stroke engine technology, ultimately contributing to the broader discourse on sustainable fuel alternatives in the automotive sector.

LITERATURE:

Two Stroke (63cc) Engine:

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.

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:

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.

SPECIFICATION OF ENGINE USED:

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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

Engine Type	Two strokes
Cooling Type	Air cooled
Fuel Used	E85 Blend
Fuel Ratio	25:1
Engine displacement	63CC
Engine power	2.7HP
Engine speed	7500 RPM

MATERIAL USED FOR ENGINE COMPONENTS:

Non corrosive alloy is used in core components such as Piston, Crank case, Crank shaft and Carburettor. 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.

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

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

Fig. 2 Core Engine Components

Fig. 3 Steel Fuel Lines

Fig. 4 Carburetor Pin

FLEX FUEL USED :

E85 fuel, a blend consisting of 85% ethanol and 15% gasoline, is increasingly recognized as a viable alternative fuel for two-stroke flex-fuel engines. Commonly used in flex-fuel vehicles (FFVs), E85 has gained attention for its potential environmental benefits and its impact on the automotive industry. This paper reviews the composition, characteristics, production methods, and environmental implications of E85 fuel, particularly in the context of two-stroke engines.

E85 is primarily composed of ethanol, a renewable biofuel derived from plant materials such as corn, sugarcane, and switch grass. The high ethanol content contributes to lower carbon emissions and reduced greenhouse gases when burned, making E85 a cleaner-burning fuel compared to traditional gasoline. However, the net environmental benefits of E85 can vary based on production methods and land use changes associated with growing feedstock for ethanol.

The characteristics of E85 fuel, including its octane rating, energy content, and combustion properties, are crucial factors influencing its use in two-stroke internal combustion engines. E85 typically has a higher-octane rating than regular gasoline, which can enhance engine performance and reduce knocking. However, it also has a lower energy content per gallon, which may lead to reduced fuel efficiency (lower miles per gallon) in vehicles using this blend. Understanding these characteristics is essential for evaluating the impact of E85 on engine performance and emissions.

E85 finds its primary application in flex-fuel vehicles, which are designed to run on various ethanol-gasoline blends. This paper discusses the development of FFVs, their compatibility with E85, and the challenges and opportunities associated with the widespread adoption of flex-fuel technology in two-stroke engines. While E85 supports domestic renewable fuel production and contributes to energy security by reducing reliance on imported oil, it also presents challenges. For instance, the corrosive nature of ethanol requires careful selection of materials for engine components to ensure durability and sustained performance.

The use of E85 has been promoted for its potential environmental benefits, including reduced greenhouse gas emissions. This paper 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 limitations. The lower energy content of E85 compared to gasoline may result in reduced fuel efficiency, which can deter some consumers.

MODIFICATIONS FOR TWO-STROKE ENGINES TO OPERATE ON E85 FUEL:

When converting conventional two-stroke gasoline engines to run on E85 fuel, several key modifications are necessary to optimize performance and ensure compatibility with the unique properties of ethanol. First, the carburettor must be tuned to achieve the appropriate air-fuel ratio, which is essential due to the higher air content required for E85. Additionally, the fine mesh filter in the carburettor should be removed, as E85 is sufficiently refined and does not contain impurities that necessitate additional filtration.

Ignition timing adjustments are also critical, as the combustion characteristics of E85 differ from those of gasoline. Ensuring that the spark plug heat range is appropriate for the modified fuel mixture is vital to prevent issues such as pre-ignition or overheating. Furthermore, considering E85's higher octane rating, increasing the engine's compression ratio can enhance performance by maximizing the fuel's anti-knock properties, leading to improved power output and efficiency.

One of the most important modifications involves replacing all components susceptible to ethanol corrosion, including the carburettor, fuel lines, and seals. Ethanol can degrade materials commonly used in conventional engines, leading to brittleness and potential failure. Therefore, upgraded fuel system components made from materials resistant to ethanol corrosion, such as stainless steel, certain plastics, or ethanol-compatible rubbers, are essential.

Additionally, adjustments to the fuel delivery system, including larger injectors or modified carburettors, are necessary to accommodate the higher ethanol content and different stoichiometric air-fuel ratios of E85. Upgrading seals and gaskets to ethanol-resistant materials is crucial to prevent leaks and maintain proper sealing within the fuel system.

Parameter	Gasoline (E0)	E85
Air Fuel Ratio	14.7:1	9:1
E. Density	33.7Kwh/Gal	22.6Kwh/Gal
LHV	12.21 Kwh/kg	7.45 Kwh/kg
Total Fuel	1kg	1.63 kg
Total Energy (LHV x Total Fuel)	12.21 kwh	12.17 kwh

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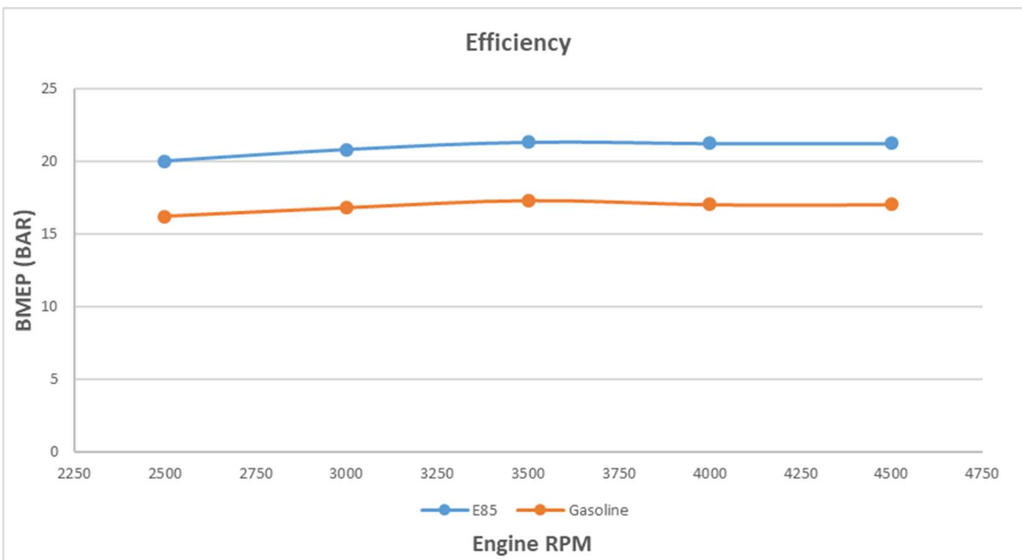
ENERGY COMPARISON BETWEEN GASOLINE AND E85 IN TWO STROKE ENGINE:
Gasoline and E85 (85% ethanol and 15% gasoline blend) differ in several technical aspects that impact engine performance, efficiency, and emissions.

- 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.

EFFICIENCY COMPARISON :

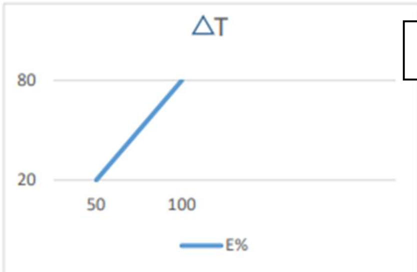
- Maximum BMEP at the rate of Ideal Fuel /Air ratio
- E85-108ON @ 13:1 CR vs E10-91.8ON @ 10:1 CR
- E85 can reach much more boost at high compression ratio which leads to higher power.

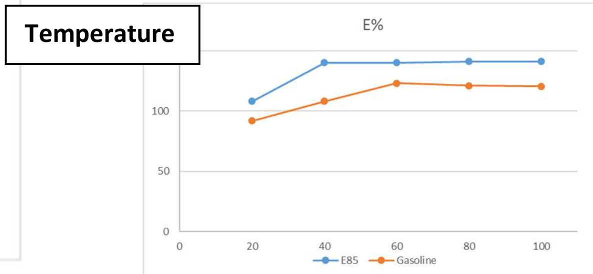


COOLING ADVANTAGE:

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

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, focusing on power output, emissions, and overall efficiency. The experiments conducted on a standardized two-stroke engine revealed that E85 exhibited comparable power output to gasoline, alleviating concerns about performance reduction when using ethanol blends. However, the E85-fueled engine demonstrated slightly higher fuel consumption, indicating a potential trade-off in efficiency. Environmental assessments showed that E85 produced lower levels of carbon monoxide (CO) and hydrocarbons (HC), highlighting its potential as a cleaner-burning fuel, although nitrogen oxides (NOx) emissions were slightly elevated. The combustion characteristics of E85 were found to be more stable, contributing to smoother engine operation, likely due to ethanol's higher-octane rating. Additionally, E85-fueled engines operated at lower temperatures, which may enhance engine durability and longevity. Overall, while E85 offers advantages such as reduced CO and HC emissions and improved combustion stability, the increased fuel consumption and NOx emissions warrant careful consideration. This study provides valuable insights for the adoption of E85 in two-stroke engines, emphasizing the need for a nuanced understanding of its performance characteristics and environmental implications.

CONCLUSION:

This research provides a comprehensive examination of a two-stroke engine fueled by traditional gasoline and E85, highlighting a technical comparison that assesses engine performance, environmental impact, and economic viability. The study found that E85 demonstrated power output comparable to gasoline, dispelling initial concerns about performance loss. However, the slightly higher fuel consumption of E85 indicates a need for further optimization to enhance fuel efficiency in two-stroke engines.Notably, the engine operated smoothly on E85, attributed to its higher-octane rating and improved combustion characteristics, which are crucial for applications requiring precision and reliability. Environmentally, E85 showed lower emissions of carbon monoxide (CO) and hydrocarbons (HC), reinforcing its potential as a cleaner-burning fuel, although increased nitrogen oxides (NOx) emissions highlight the need for a balanced evaluation of environmental impacts.

The economic viability of E85 for small-scale engines was also explored, revealing potential cost savings due to the availability and affordability of ethanol. This makes E85 an attractive option for applications in agriculture, power tools, and recreational vehicles, despite the trade-off of slightly higher fuel consumptionThe study acknowledges limitations and suggests areas for future research, including long-term engine durability and the effects of varying ethanol content in E85 blends. Overall, the findings indicate that E85 is a viable alternative to traditional gasoline in two-stroke engines, warranting serious consideration in the pursuit of sustainable and efficient fuel options. Continued exploration of innovative solutions is essential to balance performance, environmental sustainability, and economic feasibility in internal combustion engines.

REFERENCES:

[1] C. R. Birkebak, J. H. Johnsen, "Effect of Fuel and Engine Variables on Two-Stroke Cycle Engine Performance and Exhaust Emissions," SAE Technical Paper 2010-01-0354.
[2] J. W. Van Dam, "Recent Advances in Two-Stroke Engine Technology," SAE Technical Paper 2010-32-0004.
[3] M. Stefanowski, K. Woodburn, "Future Potential and Development Methods for Future Two-Stroke Engines," SAE Technical Paper 2010-32-0003.
[4] T. R. Bhat, R. Ganesan, "Development of a High Performance 125cc 2-stroke Scooter Engine," SAE Technical Paper 2010-32-0010.
[5] D. L. Harrington, C. L. Fiveland, "Effect of Injection Timing and Piston Bowl Geometry on PCCI Combustion in a 2-stroke HSDI Diesel Engine," SAE Technical Paper 2010-01-0162.
[6] J. V. Duoba, "Development of a Small, Two-Stroke Engine for U.S. Army APU Applications," SAE Technical Paper 2010-01-1121.
[7] S. I. Ahmed, S. Murari, "Performance and Emission Characteristics of a Two-Stroke SI Engine Using Blends of Gasoline with Ethanol-Water Mixture as Fuels," SAE Technical Paper 2010-01-2130.
[8] C. S. Martorano, R. S. Deyoung, "Development of a Two-Stroke, Port Injected, Single Cylinder Research Engine for Use as a Laboratory Teaching Tool," SAE Technical Paper 2010-32-0021.
[9] R. Van Basshuysen, F. Schafer, "Internal Combustion Engine Handbook: Basics, Components, Systems, and Perspectives," 2nd Edition, Springer, 2010.
[10] D. R. Rogers, "Two-Stroke Engine with Low Pressure Direct Fuel Injection," U.S. Patent 7,680,511 B2, March 16, 2010.
[11] Wang, M., & Wu, M. (2014). Fuel-cycle assessment of selected bioethanol production pathways in the United States. Environmental Research Letters, 9(2), 024001.
[12] Agarwal, A. K., & Rajamanoharan, K. (2017). Ethanol blend level effects on emissions from spark ignition engines. Renewable and Sustainable Energy Reviews, 75, 988-1001
[13] Lapuerta, M., Armas, O., Rodríguez-Fernández, J., & García-Contreras, R. (2010). Effect of ethanol– biodiesel–diesel blends on the engine performance and exhaust emissions of heavy-duty transport diesel engine. Fuel, 89(10), 2813-2820.
[14] De Almeida, C. M. V. B., Carvalho, L. B., & Aquino Neto, S. (2012). Ethanol–gasoline– Basshuysen RV and Schafer F. Internal combustion engine handbook. Warrendale, PA: SAE International, 2002. 22. Heywood JB. Internal combustion engine fundamentals. 1st ed. New York: McGraw-Hill, 1988.
[15] Amorim RJ. [Analysis of an increase in the volumetric compression ratio of a flexible multifuel engine aiming an improvement in performance]. Ana´lise do aumento da raza˜o volume´trica de compressa˜o de um motor flexı´vel multicombustı´vel visando melhoria de desempenho [D.Sc. Dissertation Thesis]. Federal University of Minas Gerais, Belo Horizonte, Brazil, 2005
[16] Caton PA, Hamilton LJ and Cowart JS. An experimental and modeling investigation into the comparative knock and performance characteristics of E85, gasohol [E10] and regular unleaded gasoline [87 (R+ M)/2]. SAE technical paper 2007-01-0473, 2007.
[17] Zvirin Y, Gutman M and Tartakovsky L. Fuel effects on emissions. In: Sher E (ed). Handbook of air pollution from internal combustion engine: pollutant formation and control. San Diego, CA: Academic Press, 1998, p.604
[18] Wyszynski L, Stone C and Kalghatgi G. The volumetric efficiency of direct and port injection gasoline engines with different fuels. SAE technical paper 2002-01-0839, 2002