

CONTROL OF EXHAUST EMISSIONS BY USING BIMETALLIC (BRASS+Al) PISTON ON TWO STROKE SPARK IGNITION ENGINE

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Abstract: As day by day there is technological development seen all around world, the research work is progressing, but the resources involved in them are depleting rapidly. The demand of resources and fuels for technological development is increasing day by day. In order to keep the pace of development high there is a need to think about some alternate fuel with better efficiency which would help overcome the demand keeping in mind the resources for the future generation. An alternative fuel needs to be developed and researched upon which could help us get greener and better tomorrow. Two stroke engine is one which completes all cycles of operations in one revolution of the crankshaft. Experiment has to be conducted on two-stroke spark ignition engine by using bimetallic piston runs with methanol blended gasoline and ethanol blended gasoline (20% of methanol blended and 20% of ethanol blended with 80% of gasoline by volume respectively) to control un-burnt hydrocarbons (UBHC) emissions, carbon mono oxide (CO) emissions. These pollutants are the roots for health problems to human beings and cause hazardous in nature but also encounter the environment. Hence control of these pollutants call for immediate attention. Aluminum and brass plates (1mm and 0.5mm) fixed on piston crown with help of rivet arrangement. A microprocessor-based analyzer was used for the measurement of un-burnt hydro carbon (UBHC) and carbon monoxide (CO) in the exhaust of the engine at various magnitudes of load. Brake thermal efficiency increased with ethanol blended gasoline with both variants of the engine. Bimetallic piston engine showed improved performance when compared to base piston engine with both different test fuels. In comparison with ethanol blended gasoline reduced pollutants less effectively than the methanol blended gasoline

Keywords: Two stroke engine, un-burnt hydro carbon (UBHC), Carbon Monoxide (CO), Engine performance.

I. INTRODUCTION

Alcohol blended gasoline enhanced engine performance and declined pollution levels when compared to pure gasoline on basic engine. Carbon monoxide (CO) and un-burnt hydrocarbons (UHC), major exhaust pollutants founded due to incomplete combustion of fuel, cause a bound human health disorders. Such pollutants are motive for detrimental effects on animal and plant life, also harmful to environment producing some negative causes. The changes in the machine basic structure, with brass and aluminum plates attached on

piston crown and improve engine performance as copper and its alloys are good conductor of heat and combustion is improved with bimetallic strip. The present paper evaluated the performance of bimetallic piston engine (BPE) with ethanol, methanol blended gasoline and compared with basic engine (BE) with pure gasoline operation.

II. LITERATURE REVIEW

S. NarasimhaKumar [1] Engine Used: Single-Cylinder, two-stroke, SI engine, and watercooled, having properties such as brake power 2.2 kW, fixed speed of 3000 rpm. Rope brake dynamometer is used to measure brake power. The experiment is carried out with 9:1 engine compression ratio. Piston crown of the engine is modified with copper coating in the inner side. As copper is a very good conductor it helps in improving engine performance and the combustion. Definite quantity of air is allowed inside catalytic converter which is fitted with the engine's exhaust pipe, in which the air is allowed at a constant rate to avoid backpressure. Presence plus absence of catalytic converter and air injection 3 sets (a. without catalytic converter and air injection, b. presence of catalytic converter plus absence of air injection, c. with catalytic converter and air injection) of experiments were carried out for various fuels in copper coated and in conventional engines. As equated with methanol mended gasoline process performance increased with gasohol in copper coated and conventional engine. However, in comparison with gasohol operation pollution levels decreased with methanol blended gasoline operation. In set-b operation CO and UHC emissions decreased by 40%, while in set-c process reduced these emissions by 60% with investigated fuels while equated to set-1 operation.

M.V.S. Murali Krishna [2] Engine used is SI engine with single cylinder, two stroke, alcohol blended gasoline (20% ethanol and remaining gasoline). Piston crown is copper coated for a thickness of 300 μ . Catalytic converter is provided with different catalysts (manganese ore and sponge iron and equated with criterion engine (CE) with pure petrol). Engine properties are 2.2 kW brake power and a speed about 3000 rpm brake power is measured using rope brake dynamometer. Here the main aim is to control the exhaust emissions.

Experiment is conducted with copper coated engine having a compression ratio about 7.5:1 with alcohol blended gasoline which reduced considerable emissions when compared with conventional engine (pure gasoline operation). Examine fuels on both constellation of the engine gave reduced pollutants when catalytic converter including air injection is used. Sponge iron catalyst reduced the pollutants effectively in comparison with manganese ore for both examine fuels in both conventional and copper caked engine. When equated with ethanol blended gasoline methanol melled gasoline efficaciously brought down the pollutants. In sponge iron CO emissions is decreased by 40%, and in manganese ore criterion engine with pure petrol process they decreased by 20%. In copper coated engine these pollutants reduced by 20% when compared to both test fuels in conventional engine. As equated with manganese ore catalyst sponge iron reduces the pollutants more effectively which was proven by this experiment. When compared with gasohol operation in copper coated and conventional engine methanol blended gasoline reduced pollutants effectively.

P.V.K Murthy[3] Here the main aim is to assess the performance of the engine with four stroke, one cylinder spark ignition system engine. With 2.2kW brake power and speed varying from 2400 to 3000rpm. Eddy current dynamometer was used for assessing brake power. Compression ratio was varied from 3 - 9 with change of clearance volume by accommodation of cylinder head, threaded to cylinder. The performance was evaluated at various speeds. The fuel used was alcohol blended. Gasoline, ethanol and methanol are mixed in the ratio 80:10:10 respectively. The engine was copper coated in combustion chamber with thickness, 300 μ upon piston crown, including inner surface of cylinder head. At several values of brake mean effective pressure the performance parameters such as brake thermal and volumetric efficiency, temperature of exhaust gas were determined in the engine, at fully loaded process of the engine with alcohol melled gasoline the combustion characteristics such as peak pressure and its time of occurrence, maximum range of pressure rise, including heat release were found out. The results found out were, in gasoline operation thermal efficiency increased by 9% and in alcohol blended gasoline operation the thermal efficiency increased by 8%. In gasoline operation exhaust gas temperature decreased by 19% and in alcohol blended gasoline operation the exhaust gas temperature decreased by 5%. In gasoline operation and in alcohol blended gasoline operation volumetric efficiencies were compatible.

H S Farkade1[4] Here in first part the objective is to make a comparative study in the blending percentage of methanol,

ethanol and butanol and in the second part the objective is to investigate the oxygen role on the basis of oxygen percentage in the blend. To do this the experiment was done with greaves MK-25 engine. Basically MK-25 has f-shape combustion chamber which was replaced by over head piston. The change in clearance volume of the engine was caused by the up and down movement of the piston which results in change in compression ratio. The change in compression ratio allowed by over head piston was 2.5 to 8. The outputs determined were as follows. The performance with the highest replacement of gasoline by butanol at 5 % of oxygen content and the same oxygen percentage for other two alcohols are better. Low emission of CO, HC and higher emission of CO₂ was given out due to the presence of oxygen which is a desirable combustion and that results in complete combustion. Also higher temperature favors NO emission.

III. EXPERIMENTAL WORK

In order to analyze the performance and emission characteristics of internal combustion engine, an experimental set-up was developed. In the present work, bimetallic strip on piston crown and ethanol and methanol blended gasoline was used as fuels on volume basis. The experiment was carried out on a single cylinder air cooled two-stroke spark ignition engine. Eddy current dynamometer is used for loading i.e. electrical loading. The engine specifications are given in Table-1

TABLE 1
TEST ENGINE SPECIFICATIONS

Particulars	Specifications
Make	SUZUKI
Arrangement of cylinders	Vertical
No of cylinders	1
Bore	50mm
Stroke length	50mm
Rated speed	5000 rpm
Rated power	7.8HP
Starting	Kick start
Type of cooling	Air cooled

IV. RESULTS AND DISCUSSIONS

Table.2 Data of performance parameters at a compression ratio of 6:2 and speed of 5000 rpm with different test fuels with different configuration of the engine.

Parameters	Basic Engine(BE)		
	Gasoline	Ethanol	Methanol
Peak BTE (%)	18	21	20
Parameters	Bimetallic Piston Engine(BPE)		
	Gasoline	Ethanol	Methanol
Peak BTE (%)	20	25	23

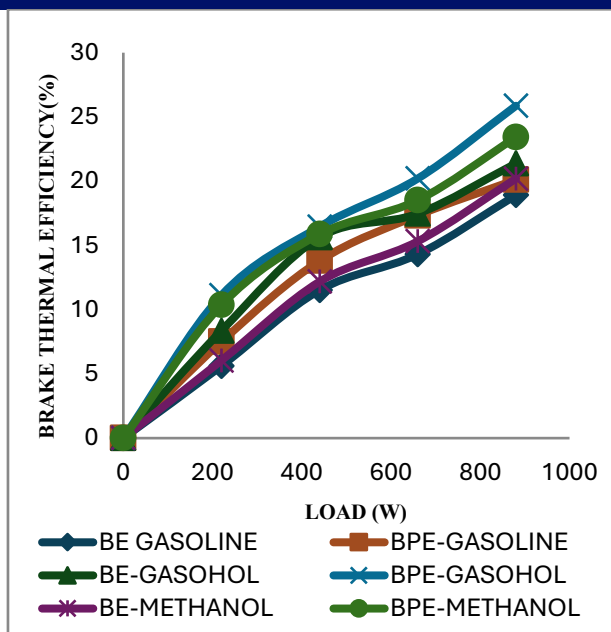


Fig 3: Load Vs Brake thermal efficiency with different test fuels with different configuration of the engine

Higher peak BTE is observed with ethanol blended gasoline operation over natural gasoline due to lower stoichiometric air requirement of ethanol blended gasoline over natural gasoline operation. Though theoretical air demand of the constituent parameter methanol is very less, the range of its calorific value is also less which leads to produce lower peak BTE. BPE showed higher thermal efficiency when compared to BE with various varieties of fuels, Ethanol blended gasoline operation on BPE produced higher peak BTE in comparison with methanol blended gasoline as methanol absorbs more amount of heat from ambience due to its high latent heat, catalytic activity decreases with methanol operation leading to produce less peak BTE in comparison with gasohol operation [9].

TABLE3
DATA OF PERFORMANCE PARAMETERS AT A COMPRESSION RATIO OF 6:2 AND SPEED OF 5000 RPM WITH DIFFERENT TEST FUELS WITH DIFFERENT CONFIGURATION OF ENGINE

Parameters	Basic Engine(BE)		
	Gasoline	Ethanol	Methanol
BSFC (Kg/KW-hr)	0.429	0.406	0.445
Parameters	Bimetallic Piston Engine (BPE)		
	Gasoline	Ethanol	Methanol
BSFC (Kg/KW-hr)	0.403	0.336	0.384

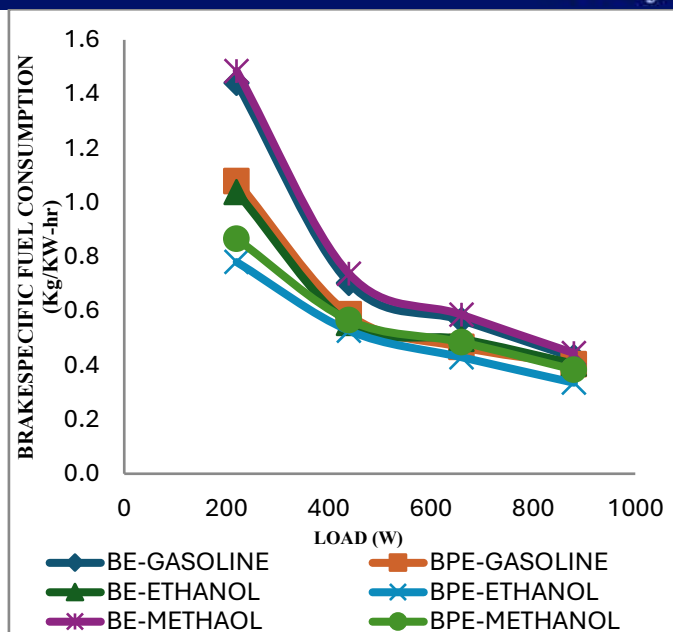


Fig 4: Load Vs Brake specific fuel consumption with different test fuels with different configuration of the engine

For bimetallic piston engine specific fuel consumption reduced for both gasoline and gasoline blended ethanol and methanol [10]. Slightly lower values of gasoline blended ethanol and methanol were due to lower calorific values and higher viscosity, density [11].

TABLE 4

DATA OF CO(%) EMISSIONS AT A COMPRESSION RATIO OF 6:2 AND A SPEED OF 5000 RPM WITH DIFFERENT TEST FUELS WITH DIFFERENT CONFIGURATIONS OF THE ENGINE

Parameters	Basic Engine (BE)		
	Gasoline	Ethanol	Methanol
CO (%)	3.6	2	1.81
Parameters	Bimetallic Piston Engine(BPE)		
	Gasoline	Ethanol	Methanol
CO (%)	2.6	1.1	0.99

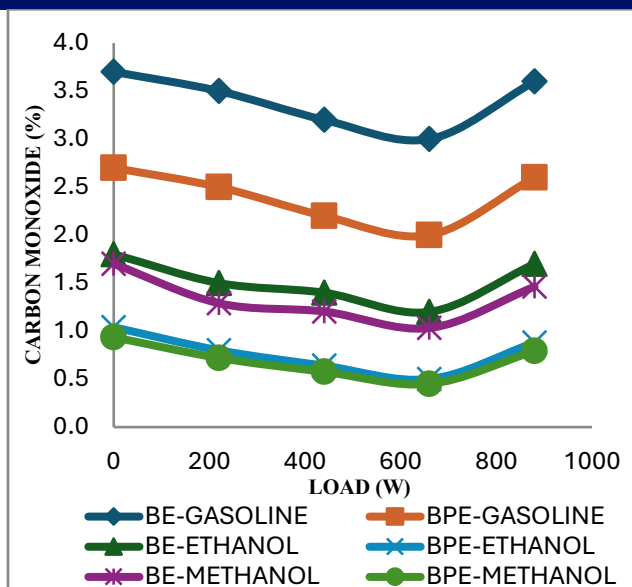


Fig 4: Load Vs CO emission with different test fuels with different configuration of the engine

Show the variation of pollution levels of CO and UBHC at a compression ratio of 6:2 and speed of 5000 rpm with different test fuels with different configurations of the engine. Ethanol, methanol blended gasoline decreased CO emissions at peak load operation when compared to pure gasoline operation on different configurations of the machine, are broken into smaller molecules as well it gets rejected with alcohol.

The process of burning certain components gives water vapour as output. So the blends in it have low air filled requirements when it is compared with gasoline. So oxygen content is more. Thereby the component alcohol has its own structure [12].

Therefore more oxygen that is available for combustion with the blends of alcohol and gasoline, leads to reduction of CO emissions. Ethanol, methanol dissociates in the combustion chamber of the engine and forms hydrogen, which helps the fuel-air mixture to burn quickly and thus increases combustion velocity, which brings about complete combustion of carbon present in the fuel to CO₂ and also CO to CO₂ thus makes leaner mixture more combustible, causing reduction of CO emissions. BPE reduces CO emissions in comparison with BE. Brass acts as catalyst in combustion chamber, whereby facilitates effective combustion of fuel leading to formation of CO₂ instead of CO. UBHC emissions replace the same trend as CO emissions in BPE and BE.

TABLE 5

DATA UHC (PPM) EMISSIONS AT A COMPRESSION RATIO OF 6:2 AND A SPEED OF 5000 RPM WITH DIFFERENT TEST FUELS WITH DIFFERENT CONFIGURATIONS OF THE ENGINE

Parameters	Basic Engine (BE)		
	Gasoline	Ethanol	Methanol
UBHC (ppm)	1950	1804	1760

Parameters	Bimetallic Piston Engine (BPE)		
	Gasoline	Ethanol	Methanol
UBHC (ppm)	1298	1443	1232

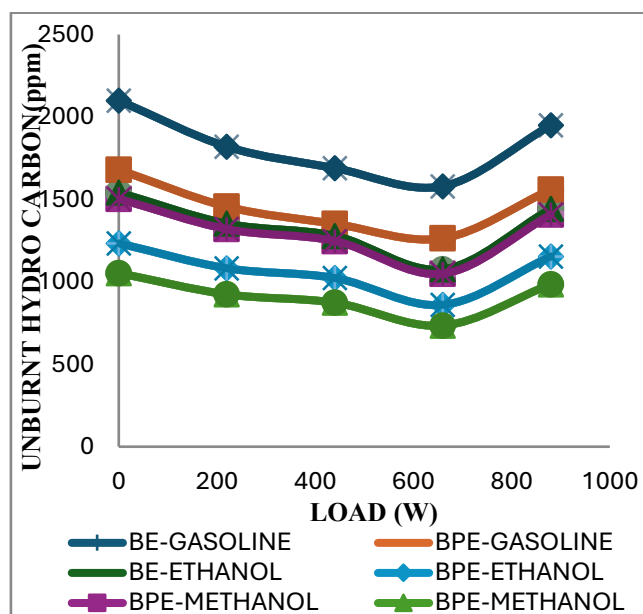


Fig 4: Load Vs UBHC emission with different test fuels with different configuration of the engine

V. CONCLUSIONS

- ❖ Brake thermal efficiency is 6.96% higher for E20 of bimetallic piston engine at all loads than pure gasoline in basic engine while at 880 W loads.
- ❖ Brake specific fuel consumption is 0.093Kg/KW-hr lower for E20 of bimetallic piston engine at all loads than pure gasoline in basic engine while at 880 W loads.
- ❖ Hydro carbon emission is 718 ppm lower for M20 of bimetallic piston engine when compared to pure gasoline of basic engine at load 880W.
- ❖ Carbon monoxide emissions are 2.61% lower at M20 of bimetallic piston engine when compared to pure gasoline of basic engine at full load.

Performance parameters enhanced with ethanol blended gasoline operation when compared with methanol blended gasoline operation with both BE and BPE. However, pollution levels decreased with methanol blended gasoline operation in comparison with gasohol operation.

VII. SCOPE OF FUTURE WORK

The present work can be extended by varying the bimetallic plate with copper alloys plate on piston crown. The engine can be tested for better performance with various alternative fuels also.

REFERENCES

- [1]. Murali Krishna M V S, Vara Prasad C M & Venkata Ramana Reddy Ch, Studies on control of carbon monoxide emissions in spark ignition engine using catalytic converter, *Ecol Env & Conser*, 6 (2000) 377-380.
- [2]. H S Farkade, Experimental investigation of methanol, ethanol and butanol blends with gasoline on SI engine, *International Journal of Emerging Technology and Advanced Engineering*, ISSN 2250-2459, Volume 2, Issue 4, April 2012.
- [3]. S. Narasimha Kumar, Performance Evaluation of a Two Stroke Copper Coated Spark Ignition Engine with Gasohol with Catalytic Converter with Different Catalysts, *International Journal of Emerging Technology and Advanced Engineering* ISSN 2250-2459, Volume 2, Issue 3, March 2012.
- [4]. Gupta, R.K. and Ahluwalia J.S., ethanol employment in Indian cars, scooters, motorcycles and tractors, *Proc. IV International Symp. On Alcohol Fuel Technology, Brazil*, 5-8, October, 1980, Volume-II, 543-550.
- [5]. Murali Krishna, M.V.S. and Kishor, K. Investigations on catalytic coated spark ignition engine with methanol blended gasoline with catalytic converter, *Indian Journal (CSIR) of Scientific and Industrial Research*, Volume- 67, July, pp: 543-548, 2008.
- [6]. John B. Heywood, "Internal Combustion Engine Fundamentals", *McGraw-Hill Series in Mechanical Engineering*.
- [7]. V. Ganesan, "Internal Combustion Engines", *Tata McGraw-Hill Publishing Company Limited*.
- [8]. P.V.K. Murthy, Performance of Copper Coated Two Stroke Spark Ignition Engine with Alternate Fuels with Catalytic Converter, *Int J Engg Techsci Vol 2(2) 2011*, 145-149.
- [9]. Kotla, P. (2024). Bridging Legacy Systems with Modern Automation: UiPath RPA in Financial Institutions. Available at SSRN 5346246.
- [10]. Chawla, N., Kotla, P., Venna, S. R., & Patel, M. B. (2025, August). Comprehensive Analysis of Robotic Process Automation for Software Project Management. In 2025 2nd International Conference on Intelligent Algorithms for Computational Intelligence Systems (IACIS) (pp. 1-4). IEEE.
- [11]. Hameed, R., Palanivel, R., Kotla, P., Padma, L., & Jeyanthi, S. (2025, August). Blockchain-Integrated Reputation Evaluation Framework for Peer Review. In 2025 Third International Conference on Networks, Multimedia and Information Technology (NMITCON) (pp. 1-5). IEEE.
- [12]. Kotla, P. (2022). Accelerating Shared Services with UiPath: Lessons from Early Automation Centres of Excellence (CoEs). Available at SSRN 5379367.