Experimentation And Testing Of Blend Of Pentanol (C5h11oh) And Gasoline On 4-Stroke Single Cylinder Variable Compression S.I. Engine.

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ABSTRACT

Internal combustion engine are the most preferred prime mover across the world. Spark ignition engine is preferred locomotive prime mover due to its smooth operation and low maintenance. The gasoline is fossil fuel which is limited in reservoirs causes varieties of study in search of alternative fuel for SI engine, where alcohol promises best alternative fuel. Increased oil consumption rising fuel prices and along with the lack of sustainability of oil-based fuels have generated an interest in alternative, renewable sources of fuel for internal combustion engines, namely alcohol-based fuels. Comparative testing of pentanol, ethanol and gasoline on the basis of blending percentage is first part, followed by investigation of oxygen role on the basis of oxygen percentage in the blend. An experimental investigation was conduct to determine the emission characteristics of higher alcohols and gasoline (UTG96)) blends. While lower alcohols (ethanol) had been used in blends with gasoline.

Comparisons of emissions and fuel characteristics between higher alcohol/gasoline blends and neat gasoline was made to determine the advantages and disadvantages of blending higher alcohols with gasoline. All tests were conducted on a 4-Stroke single cylinder Variable Compression Engine. An attempt has been made to obtain optimal blend with some percentage of Pentanol, ethanol, butanol and propanol

Keywords: [Brake thermal efficiency, brake specific fuel consumption, emission control]

INTRODUCTION

The demand of energy is ever increasing for the industries as well as automobiles. Internal combustion engines are the major sources of energy for automobiles. These engines consume mainly petroleum products like petrol (gasoline) and diesel as fuels. Increased consumption and unstable rates of end prices of fuel made us in various troubles resulting in more attraction of alternative and low cost biofuel. Also lavish consumption of fossil fuels has led us to reduction in underground-based carbon resources. The search for alternative fuels, which promise a correlation with sustainable development, energy conservation, efficiency and environmental preservation, has become highly pronounced in the present days. The fuels of bio-origin can provide a feasible solution to this worldwide petroleum crisis. Also, gasoline and diesel-driven automobiles are the major sources of greenhouse gases emission. Scientists around the world have explored several alternative energy resources, which have the potential to quench the ever-increasing energy thirst of today's population and to minimize the emission with higher consumption. It has been anticipated that the petroleum reserve will be exhausted soon if some alternative fuels, at least partially do not replace petrol and diesel. The alternative fuel should have reasonably good thermal efficiency, low pollution level and should be available for a long time. There is an essential need of alternate fuels in a way or other. Today intensive search for the alternative fuels for both spark ignition (SI) and compression ignition (CI) engines and it has been found out that the higher alcohol derivatives are suitable for alternative fuels. In spark ignition engines fuels like pentanol, butanol are the suitable substituents for the petrol. They can be blended with petrol over a wide range of percentage according to the requirement. Another reason for the need of alternate fuels for IC engines is the emission problems. Combined with other air polluting factors, the large number of automobiles is a major contributor to the air quality problems of the world. One of the major attractions of Pentanol is its higher calorific value. Each blend prepared of Pentanol like P5, P10, has higher heat value than any other fuel in alcohol group. Petrol is depleting day by day & its use has been limited up till now, so by the year 2098 the availability of Petrol will be less, resulting to use Alternative Fuel to enhance the performance as well as availability.

Literature Review

Mridul Gautam and Daniel W. Martin conducted an experimental investigation to determine the of emission characteristics of higher alcohols and gasoline (UTG96)) blends. While lower alcohols (methanol and ethanol) have been used in blends with gasoline, very little work has been done reported on higher alcohols (propanol, butanol, and pentanol). Comparisons of emissions and fuel characteristics between higher alcohol/gasoline blends and neat gasoline were made to determine the advantages and disadvantages of blending higher alcohols with gasoline. All tests were conducted on a single cylinder Waukesha Cooperative Fuel Research (CFR) engine operating at steady state conditions and stoichiometric A/F ratio. The contribution of alcohols and aldehydes to the overall OMHCE emissions was found to be less than 1% for every blend tested and, thus, made up a minimal amount of the total hydrocarbon emissions cycle fuel consumption (mass per unit time) of higher alcohol/gasoline blends ranged from 3% to 5% higher than neat gasoline due to the lower stoichiometric A/F ratios required by the blends. However, the brake specific fuel consumption (BSFC) (mass per unit time per unit power output) for the blends ranged from 15% - 19% lower than the BSFC of neat gasoline.

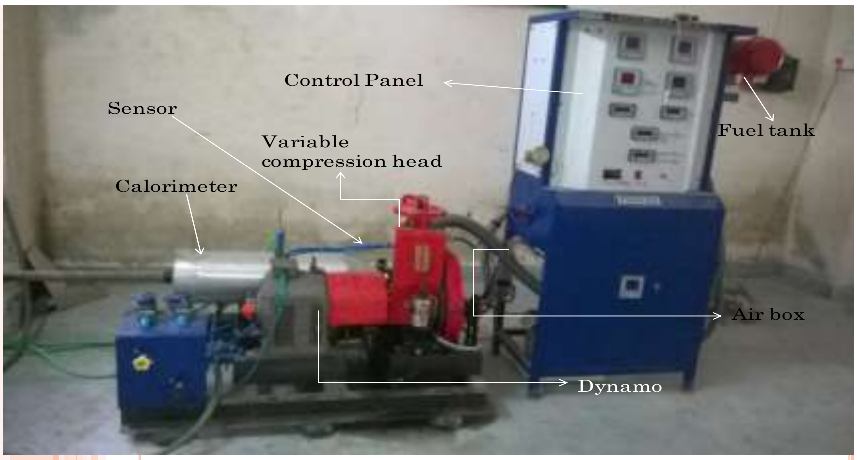
Yasser Yacoub, Reda Bata, MridulGautam, Daniel Martin were individually blended Alcohols with carbon numbers ranging from **C1** to **C5** with unleaded test gasoline (UTG-96) by. All of the alcohol-gasoline blends had the same oxygen mass content. The performance characteristics of the blends were quantified using a single cylinder spark ignition engine. All tested alcohol-gasoline blends have a higher brake thermal efficiency than neat gasoline operating, when compared at the same compression ratio, with the exception of ethanol-gasoline blend with 2.5% oxygen mass content. For an engine optimized for maximum brake thermal efficiency and knock limiting operating conditions, (CI, C~, C~) alcohol-gasoline blends operate at higher efficiency (- **2%** for CJJTG 2.5% 0 2 and -6% C2-UTG ***5.0% 02)*** when compared to neat gasoline, due to its higher optimum compression ratio. Ethanol-gasoline blends show the highest improvement in optimal compression ratio (-2.5% for 2.5% ***02*** and -10.0% for 5.0% ***02).*** For an engine optimized for knock limiting operating conditions and five degree BTDC spark timing, (C1,C2,C3) alcohol-gasoline blends operate at higher efficiency (- 4% for CI-UTG 2.5% O2 and -7.5% CJJTG 5.0%

Jitendra kumar, N.A Ansari, Vikas Verma, Sanjeev Kumar carried out an experimental study on Exhaust Gas Analysis of Ethanol Blended Gasoline Fuel in Spark Ignition Engine They took commercial gasoline as reference which is originally blended with 5%ethanol. Hence 5%, 10%, 15%, 20% ethanol blended with Gasoline initially was tested in SI engines A four cylinder, four stroke, varying rpm, Petrol (MPFI) engine was tested on blends containing 5%,10%,15%,20% ethanol and performance characteristics, and exhaust emissions were evaluated. From the results, they concluded that Ethanol blends are quite successful in replacing pure Gasoline in Spark Ignition Engine. Results clearly show that there is a decrease in exhaust emissions, increase in Brake Thermal Efficiency.

Properties	**Gasoline**	**Ethanol**	**Butanol**	**Pentanol**
Chemical Formula	$mCnH_2n$	C_2H_5OH	C_4H_9OH	$C_5H_{11}OH$
Chemical name	Gasoline	Ethanol	N-Butyl alcohol	N-Amyl alcohol
Molecular Weight	108	46.07	74	88
Density (Kg/cm^3)	0.7-0.8	0.794	0.81	0.815
Flash point (^0C)	-43	16	35	49
Viscosity (cSt)	0.4-0.8	1.52	3.64	4
Oxygen content	0.00	34.7	21.59	18.15
Research Octane No.	91-96	107	96	----
Calorific Value (KJ/Kg)	43500	28865	33075	34727

Test Engine and Blends

Tests were performed at the Thermal Engineering laboratory of SSPACE, Wardha. The laboratory consists of engine test rig coupled with electrical dynamometer, exhaust emission analyzer, control panel. The dynamometer and supporting electrical equipment. The engine coupled with dynamometer directly at ratio of 1:1, so the rational speed measured at the dynamometer is exactly the same as an engine speed. Beside the engine itself exhaust assembly, control panel device are mounted to the required parts and place. Exhaust temperature was measured with the help of sensors and emission values were obtained with the help of exhaust gas analyzer.



Sr. No.	Particulars	Data
1	Manufacturer	Crown ton Wheel
2	Model	MK-25/ MK-40
3	No. of Cylinder	Single cylinder
4	Cubic capacity	256 cc
5	Bore	70 mm
6	Stroke	66.7mm
7	Compression Ratio	4.67
8	Cooling System	Forced Air Cooling
9	Ignition System	Electronic
10	Starting Method	Rope and Pulley

Experimental Setup and Procedure

Experimental setup consists of;

1. Single cylinder variable compression engine,
2. Dynamo for starting purpose,
3. Air box,
4. Calorimeter,
5. Control panel,
6. Monitor.
7. Five Gas Analyzer
8. Computer

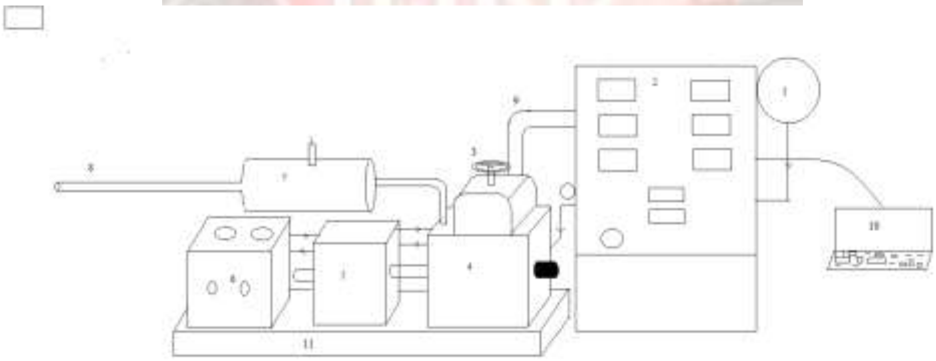


Fig: Schematic View of 4-stroke single cylinder variable compression engine

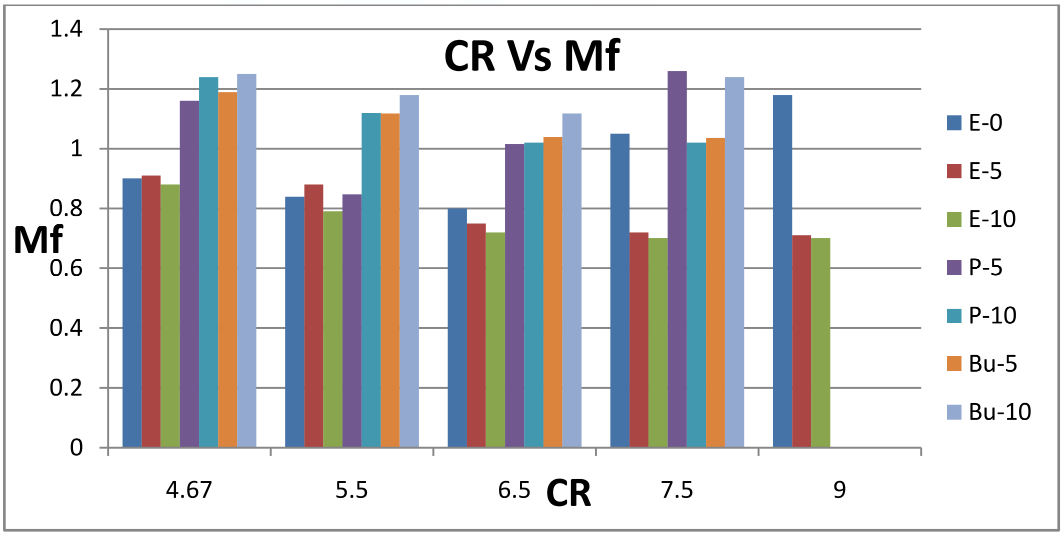
1- Fuel tank
2-Control unit
3-Adjustable compression ratio
4-Engine
5-Dynamometer
6-Flow control valve
7-Calorimeter
8-Exhaust
9-Connection to control unit
10-Monitor
11- Base

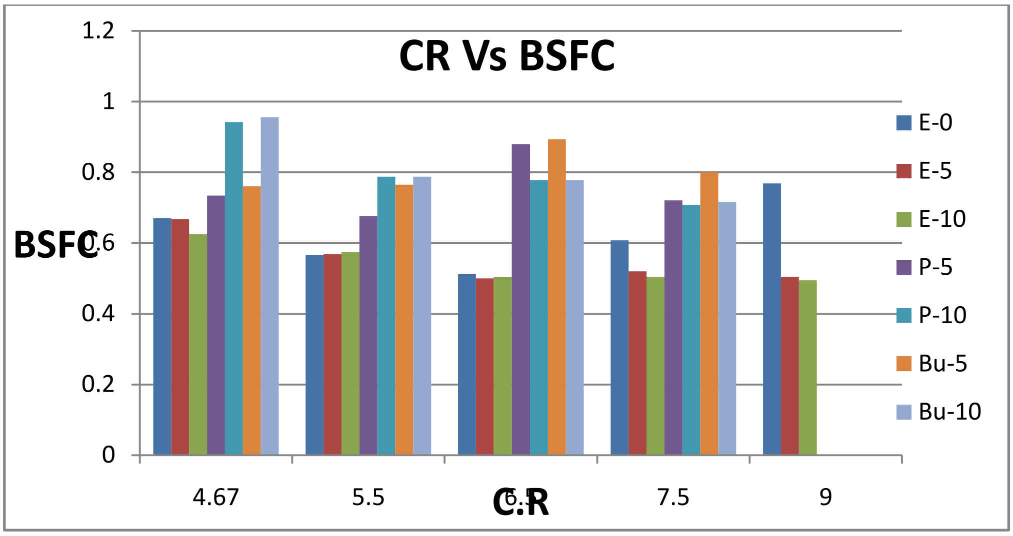
First prepared a blend of ethanol with petrol, likewise pentanol with petrol, butanol with petrol and propanol with petrol in various proportions (5%, 10%) on volume basis. Stirred the blend properly to form homogeneous mixture and inserted it in the fuel tank one by one. Before starting the experimentation all the setup is checked properly. The setup is arranged in the order, first engine coupled with dynamometer in 1:1 ratio and exhaust pipe with exhaust gas calorimeter. After that the control panel is attached to engine on which various readings are took place, like mass of fuel, mass of air, temperature of exhaust gas, ambient temperature, revolutions per minute of engine. The load is varied with the help of torque knob placed on control panel which connection is attached to the eddy current dynamometer. After checking the total setup experimentation started. At very first pure gasoline is inserted in fuel tank and the readings are taken at different torques (0, 2, 4, 6, 8) and at different compression ratios (4.67, 5.5, 6.5, 7.5, 9.0) for the reference point of view. The readings are took place after specific interval of time for the correct measurement purpose. After that blend of pentanol and gasoline are prepared at 5% and 10% on volumetric basis. Torque is varied from 0, 2, 4, 6, and 8 and readings of mass flow rate and rpm are noted down for various compression ratios. Similar process is done for butanol also.

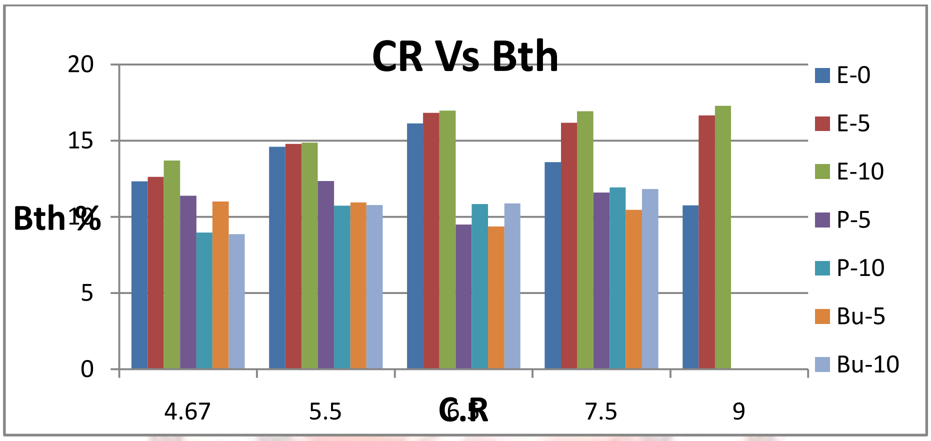
Result and Discussion

Various graphs between compression ratios and fuel consumption, brake specific fuel consumption, brake thermal efficiency, %CO, %CO_2, NOx, are plotted and the brief discussion is also carried out. As shown from the graph as increasing the compression ratio of an engine the mass flow rate of the engine is decreases up to compression ratio 6.5. Above compression ratio 6.5 fuel consumption increases. Likewise as the compression ratio increases brake specific fuel consumption decreases for E0, E5, E10, Bu5, Bu10 blend. But this sequence is not followed by P5 and P10 blend. Up to compression ratio 6.5 as the compression ratio increases brake thermal efficiency increases for pure petrol. But above compression ratio 6.5 brake thermal efficiency it decreases. As we move to lower alcohol blends (E5, E10), brake thermal efficiency increases at increased compression ratio. But in case of pentanol blends (P5, P10) proper sequence is not followed.

Moving to the exhaust gas emissions percentage of carbon monoxide produced in pure petrol is much more than it is in various alcohol blends (E0, E5, E10, Bu5, Bu10,P5, P10). Pure petrol content zero percentage of oxygen content. As we move to pentanol, butanol and ethanol oxygen percentage are increased which results in complete combustion of fuel. As the combustion is complete there is reduction in carbon monoxide emission in alcohol blends. Percentage of carbon di-oxide produced in pure petrol is less than that it is in various alcohol blends (E0, E5, E10, Bu5, Bu10, P5, and P10). Pure petrol contents zero percentage of oxygen content. As we move to pentanol, butanol and ethanol oxygen percentage are increased which results in complete combustion of fuel. As the combustion is complete there is increment in carbon di-oxide emission in alcohol blends.




CR Vs BSFC
BSFC
1.2
1
0.8
0.6
0.4
0.2
0
4.67
5.5
6.5
7.5
9
C.R
E-0
E-5
E-10
P-5
P-10
Bu-5
Bu-10


CR Vs Bth
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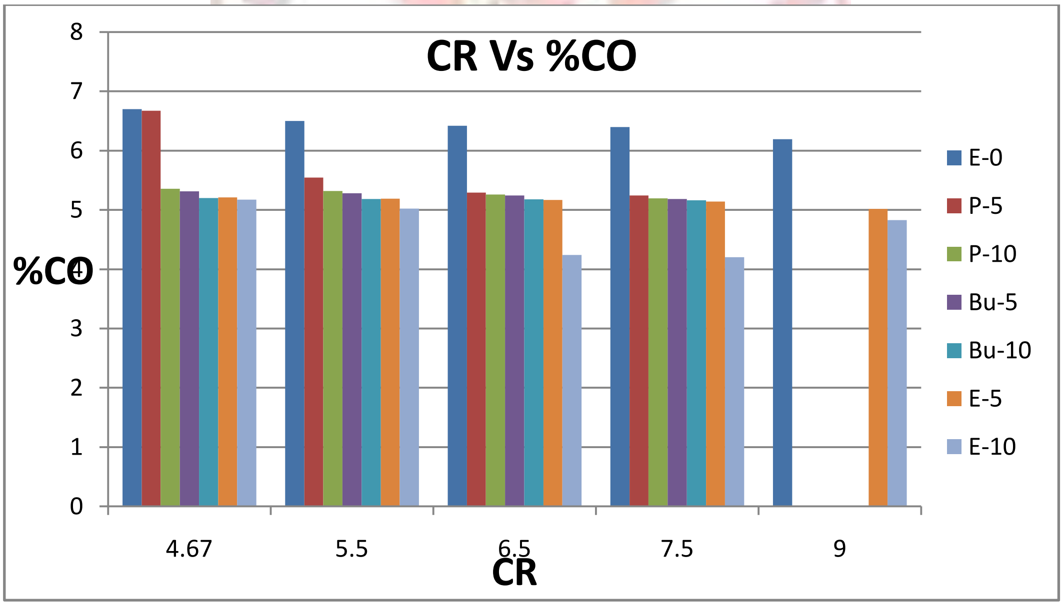
CR Vs %CO
%CO
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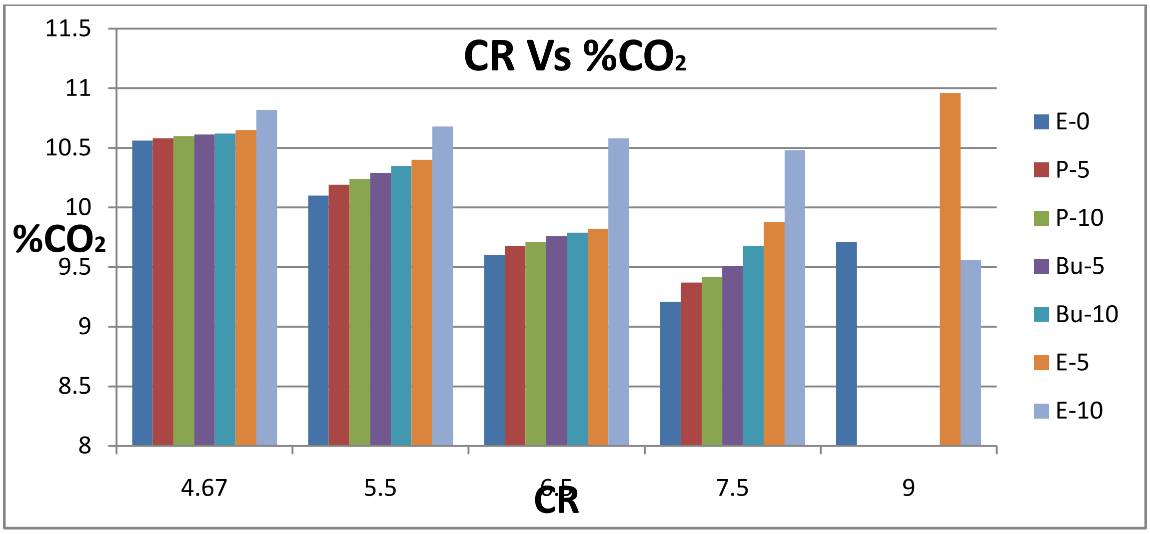

CONCLUSION :

Increasing compression ratio results in decreasing the mass flow rate up to 6.5 compression ratio. Above 6.5 compression ratio, mass flow rate for pure petrol increases. Increasing compression ratio from 4.67 to 9.0, mass flow rate decreases for various blends (P5, P10, E5, E10, Bu5, and Bu10). Increasing the blend percentage (5%, 10%) decreases the mass flow rate for E5 and E10 blends, but increases mass flow rate for pentanol and butanol blends.Increasing compression ratio results in decreasing the brake specific fuel consumption up to 6.5 compression ratio. Above 6.5 compression ratio, brake specific fuel consumption for pure petrol increases. Increasing compression ratio from 4.67 to 9.0, brake specific fuel consumption decreases for various blends (P5, P10, E5, E10, Bu5, and Bu10). Increasing the blend percentage (5%, 10%) decreases the brake specific fuel consumption for E5 and E10 blends, but increases brake specific fuel consumption for pentanol and butanol blends. Increasing compression ratio results in increasing the brake thermal efficiency up to 6.5 compression ratio. Above 6.5 compression ratio, brake thermal efficiency for pure petrol decreases. Increasing compression ratio from 4.67 to 9.0, brake thermal efficiency increases for various blends (P5, P10, E5, E10, Bu5, and Bu10).

Increasing the blend percentage (5% to 10%) increases the brake thermal efficiency for E5 and E10 blends, but decreases brake thermal efficiency for pentanol and butanol blends. Increasing the compression ratio from 4.67 to 9.0 decreases the percentage of carbon monoxide and increases the percentage of carbon di oxide. Increasing the blend percentage from 5% to 10% for ethanol, butanol and pentanol decreases the percentage of carbon monoxide and increases the percentage of carbon di oxide.

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