Issue 1 vol 4 ISSN: 2321-8134

IJFEAT

INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

PERFORMANCE ANALYSIS OF SINGLE CYLINDER DIRECT INJECTION PETROL ENGINE USING VARIOUS BLENDS OF ETHANOL AND PROPANOL WITH GASOLINE

Rohit Thakare[1], Bhushan Jadhav[2], Sarang deshpande[3] , Saurabh kumbharkhane[4]

[1]*Student, Mechanical Dept. ,J.D.I.E.T. Yavatmal ,Maharashtra ,India,rohitthakare1996***@gmail.com**
[2]*Student, Mechanical Dept .,J.D.I.E.T. Yavatmal.,Maharashtra ,India,bhushanj365@***gmail.com**
[3]*Student, Mechanical Dept. ,J.D.I.E.T. Yavatmal ,Maharashtra ,India,sarangdeshpande084@***gmail.com**
[4]*Student, Mechanical Dept., J.D.I.E.T. Yavatmal ,Maharashtra ,India,Kumbharkhanesurbh@***gmail.com**

Abstract

In this project we study about the fuel Additives and its effect on performance of Engine byusing blending of gasoline with Propanol which is an alcohol with three carbon atoms and the molecular formula is C_3H_7OH. An experimental investigation is conducted to evaluate theeffects of using blends of Gasoline with Propanol with 5% & 10%. We are conducted the experiment on MK-25 HSP Engine and checked the performance related to Brake specific fuel consumption (BSFC) & Brake thermal efficiency & Exhaust emissions. The tests are conducted using each of the above fuel blends or with the engine working at a speed of 2800-3000 rpm and at four different loads. In each test, fuel consumption, exhaust smokiness and exhaust regulated gas emissions such as nitrogen oxides, carbon monoxide and total unburned hydrocarbons are measured. The differences in the measured performance and exhaust emission parameters of the three Propanol –gasoline fuel blends from the baseline operation of the S.I engine, i.e., when working with neat gasoline fuel, are determined and compared. It is revealed that this fuel,which can be produced from biomass forms a challenging and promising blend fuel for S.I engines. The differing physical and chemical properties of Propanol against those for the petrol fuel are used to aid the correct interpretation of the observed engine behavior.

Index Terms:

--- *** ---

INTRODUCTION

In this chapter, we have found out & studied various research papers related to gasoline,blend of gasoline with ethanol, blend of gasoline with Propanol of various scientists.Scientists have listed out the various conclusions on the individual research papers of theirs.We compared the facts & figures of the scientists research papers with our experimental data.The research papers were related to Performance & Emission characteristics of above stated Fuels.A challenge that humanity must take seriously is to limit & decrease the exhaust emissions and increase the efficiency. Probably the best candidate fuels to replace gasoline in the short term are alcohols. Alcohols can be blended with gasoline in spark ignition engines. In the medium term ethanol was the most important alternative fuel for replacing gasoline but ethanol was now also being replaced with as an substitute to higher alcohols such as Propanol due to cold starting problems and higher volume-based fuel consumption, so we are looking for a higher alcohol and Propanol is used to test in such conditions mainly to increase the thermal efficiency and reduce the amount of fuel consumption and exhaust emission here.

Sr. No	Property	Gasoline	Ethanol	Propanol
1.	Chemical formula	$mCnH_2n$	C_2H_5OH	C_3H_7OH
2.	Oxygen content Wt%	0.00	34.73	26.62
3.	Specific gravity	0.7430	0.7894	0.8037
4.	Stoichoimetric A/F	14.51	8.91	10.28

5.	RON	96.5	111	112
6.	Calorific value	44000KJ/Kg	29700KJ/Kg	30680MJ/Kg

Literature Review on Research Paper Based:Research Paper Based On Gasoline :

Prof. YifengWang : In his research paper he studied A semi detailed chemical kinetic mechanism (473 species and 1267 reactions) to describe the oxidation of a gasoline surrogatefuel consisting of *n*-heptane, iso-octane, toluene and disobutylene (DIB) is developed. Themodel shows generally good agreement with the experimental ignition delay times measuredin shock tubes for not only individual components but also their various mixtures over a widerange of temperatures and pressures. Although both simulations and experiments indicatetoluene has a promoting effect on the auto-ignition - 14 -of iso-octane in a specific region, theeffect of toluene addition to isooctane is still not fully resolved. Nonetheless, it is found thatthe reactions of benzyl radical with allene are not important for the kinetic interactions. The measured laminar burning velocities of a research gasoline fuel, CR-87, can be well reproduced by using a TRF + DIB mixture($C_6H_5CH_3$/iC_8H_{18}/nC_7H_{16}/JC_8H_{16},45/25/20/10% by liquid volume) as a surrogate. In a homogeneous charge compression ignition (HCCI) engine, the model can capture the shift in resistance to auto-ignition for suchTRF + DIB fuel when the operating conditions change. A sensitivity analysis shows the chemical origin of such shift cannot be solely explained based on the extent to which NTC(negative temperature coefficient) behaviour is absent. The effect of decreasing the inlet temperature and increasing the inlet pressure is a result of the concerted action of manifoldfactors .

Research Paper Based On Ethanol

Prof. Wei-dong hsieh: In his research paper he studied the purpose of this study is toexperimentally investigate the engine performance and pollutant emission of a commercial SI engine using ethanol–gasoline blended fuels with various blended rates (0%, 5%, 10%, 20%,and 30%). Fuel properties of ethanol–gasoline blended fuels were first examined by the standard ASTM methods. Results showed that with increasing the ethanol content, theheating value of the blended fuels is decreased, while the octane number of the blended fuels increases. It was also found that with increasing the ethanol content, the Reid vapour pressure of the blended fuels initially increases to a maximum at 10% ethanol addition, and then decreases. Results of the engine test indicated that using ethanol–gasoline blended fuels, torque output and fuel consumption of the engine slightly increase; CO and HC emissions decrease dramatically as a result of the leaning effect caused by the ethanol addition; and CO_2 emission increases because of the improved - 16 - combustion. Finally, operating condition rather than the ethanol content.**Prof. Rong- Hong Chen :**In his research paper he studied The effects of ethanol–gasoline blended fuel on cold-start emissions of an SI engine were studied. During cold-start, the ECUcontrols fuel injection rate based on cooling water temperature and intake air temperature,which were carefully controlled during the experiment. More ethanol content in the blendedfuel makes the air–fuel mixture leaner and also affects the RVP value. The engine could bestarted stably with E5, E10, E20, and E30. The HC and CO emissions decreased significantlywith more ethanol than 20% added. However, for E40 the engine idling became unstablebecause the air–fuel mixture was too lean. Therefore, the ethanol content in gasoline for bestcold-start emissions was determined to be at least 20 per cent but no greater than 30 per cent.Page 15

Prof. B.M Masum : In his research paper he studied worldwide emission legislation and growing demands for lower fuel consumption and anthropogenic CO_2 emission require significant efforts to improve combustion efficiency while satisfying the emission quality demands. Ethanol fuel combined with gasoline provides a particularly promising and, at the same time, a challenging approach. Ethanol is widely used as an alternative fuel or an effective additive of gasoline due to the advantage of its high octane number and its self sustaining concept, which can be supplied regardless of the fossil fuel. As a result, vast study has been carried out to study its effects on engine performance and emission. The first part ofthis article discusses prospect of fuel ethanol as a gasoline substitute. Then it discuss comparative physico chemical properties of ethanol and gasoline. The slight differences in properties between ethanol and gasoline fuels are enough to create considerable change to combustion system as well as behaviour of SI engines. These effects lead to several complex and interacting mechanisms, which make it difficult to identify the fundamentals of how ethanol affects NOx emission. After that, general NOx forming mechanisms are discussed tocreate a fundamental basis for further discussion. Finally, the article discusses different fuel composition, engine parameter and engine modification effects on NOx formation as well as mathematical approach for NOx prediction using ethanol.**Prof. BedriYuksel:** In his research paper he studied One of the major problems for the successful application of gasoline–alcohol mixtures as a motor fuel is the realization of astable homogeneous liquid phase. To overcome this problem, a new carburetor was designed .With the use of this new carburetor, not only the phase problem was solved but also the alcohol ratio in the total fuel was increased. By using ethanol–gasoline blend, the availability analysis of a spark-ignition engine was experimentally investigated. Sixty percent ethanol and40% gasoline blend was exploited to test the performance, the fuel consumption, and the exhaust emissions.

Research Paper Based On Propanol :

Prof. Jing Gong ,Shuang Zhang: In their research paper they studied the laminar flamespeeds of C3 oxygenated fuels (*n*-propanol, propanal and acetone) and hydrocarbon(propane) were measured in a combustion bomb to compare combustion characteristics of C3alcohol, aldehyde, ketone, and alkane. Propanal shows the highest flame speeds whileacetone gives the lowest one. The experimental observations are further interpreted withchemical kinetic models. The effects of distinctive molecular structures on the fuelconsumption pathways are clarified. Propanal generates a large H atom pool that enhancesthe oxidation, leading to the highest flame speeds. However, acetone forms methyl radical(CH_3) and has lower flame speeds as a consequence. The calculated maximumconcentrations of H, OH, and CH_3 confirm this analysis. It is found that propanal yields the highest H and OH concentrations while acetone produces the lowest H and OH concentrations among all tested fuels. Moreover, acetone presents higher CH_3 concentration, especially for fuel rich condition. *n*-Propanol and propane show comparable flame speeds andsimilar radical concentrations, especially H and OH. The different kinetics amonghydrocarbon species with the same carbon numbers can provide a horizontal.**Prof. Saltun :**In his research paper he studied the effect of blends of iso-propanol &unleaded gasoline on exhaust emission of S.I. Engine were experimentally investigated .Exhaust Emission test were conducted on a 4-stroke 4-cylinder & direct Injection S.I. Engine.The engine test were performed at 3 throttle opening position at 4 various speed in the rangeof 1000-4000 rpm with 1000 rpm period. The experimental results compared with unleaded gasoline showed that emission of CO & HC decreased with iso-propanol unleaded gasoline blend while CO_2 emisson increased.

EXPERIMENTATION

The internal combustion engine performance is generally indicated by the term efficiency, thermal efficiency and fuel consumption of the engine. The important parameters of an engine apart from exhaust gas analysis have been aimed at in this study.Experimentation is carried out on Greaves MK-25 engine which is modified by Tech-ED limited Bangalore. Further detail of engine and setup is described below.

Blend Preparation

Various blends are prepared using Ethanol, Propanol & pure gasoline at various proportions shown in table & figure below.

Fig. 3.2.1 Blend samples

Blend sample

Blends	Gasoline (%)	Ethanol(%)	Propanol (%)
E0	100	-------	------
E10	90	10	------
Pr5	95	------	5
Pr10	90	------	10
EPr1.5	88.5	10	1.5

3.3 Experimental Setup:

Fig. No. 3.3 MK -25 HSP Engine

Engine used are four stroke single cylinder variable compression engine. Having Bore of 70 mm. Stroke 66.7 mm, Displacement of engine are 256 cc Having compression ratio 4.6to 9.0 .Cooling system are forced water cooling system have been used and the Ignitionsystem are Electronic ignition system.

Sr. no	Constraints	Value/ Characteristics
1	Type	4 stroke, Side Valve ,Single cylinder, Air cooled &Water cooled Horizontal shaft
2	Bore , mm	70
3	Stroke, mm	66.7
4	Displacement, cc	256
5	Fuel	Petrol
6	Fuel tank capacity, lit.	4.5
7	Continuous output- a)KW b)HP	 2.5 3.5
8	Continuous output rpm	3000
9	Cooling system	Natural air cooling
10	Compression ratio	4.67
11	Starting method	Rope & pulley(Recoil Starter Optional)
12	Oil sump capacity(lit.)	1.12
13	Lubrication system	Splash Type
14	Spark plug	MICO W 160 Z2
15	Governor system	All Speed Mechanical Governor
16	Cylinder	Cast Iron BS:1452/17
17	Cylinder head	Special Grade Aluminum Alloy
18	Connecting rod	Aluminum Alloy
19	Ignition system	Electronic

3.| Exhaust Gas Calorimeter :

It is an object used for calorimeter, or the process of measuring the heat of chemicalreaction or physical changes as well as heat capacity. It is a counter flow type heat exchangerwith thermocouples located at its outlets and inlets to measure the temperatures.

4. Electric Dynamometer:

3.4.4 Electric Dynamometer

An Electric Dynamometer also Known as Eddy Current Dynamometer. It is a devicethat is designed to measure the torque of Electric motors. It is used in bench test of motors todetermine mechanical or electromechanical characteristics of the motors. It is used to testhigh power traction machines.

Flow Control Arrangement:

Fig. 3.4.5 Flow Control Arrangement

Flow controls are used to regulate the water flow for the cooling of engine. Flow control Stainless steel ball valves are connected to control water flow for engine jacket,exhaust gas calorimeter and also to the pressure sensor cooling adopter.

Sensors:

There are various type of sensors :-

I. **Flow sensors for water flow measurement: A** turbine type water flow sensor isconnected to measure the flow rate of water to the engine water jacket and also to theexhaust gas calorimeter.

II. **Pressure sensor with water cooling arrangement (Combustion Pressure):** A Piezotronic pressure sensor is mounted on the engine head at a suitable position tomeasure the combustion chamber pressure at different loads. A water cooling adopteris provided to cool the sensor; the sensor is mounted at the centre of the coolingadopter. A low noise cable is connected to the sensor and the signal conditionerwhich makes communication with them

III. **Speed measurement sensor:** The proximity sensors are mounted below the couplingwith a reference for measuring the speed and crank angle. Speed sensor is connectedto the speed indicator and the crank angle sensor is a connected to the signalconditioner.

Five Gas Analyser:

It is designed and manufactured for testing the emissions from automotive engines,which run on petrol as well as CNG and LPG. The instrument can measure carbon monoxide(CO), carbon dioxide (CO2) and oxygen in percentage and hydrocarbons (Hexane equivalentPage 24(HC)) and nitric oxide (NOx) in ppm. It is generally supplied as a four gas analyzer without he NOx sensor. When NOx sensor is added PEA205 becomes a five gas analyzer.

Control Panel ;

Control Panel is also known as Display Panel in which Digital Indicators are mounted for indicating Air- rate, fuel- rate, torque, temperature, water flow, speed and signal conditioner for PV-Pθ- D Pθ. (interface unit). A load controller is mounted on the same panel for varying different loads

Software:-

"Engine Analysis Software" such as VCR software used. The software evaluates performance band combustion analysis. Various graphs and reports are obtained at different operating condition. During test run start mode, necessary signals are scanned, stored and presented in graph. The results and graphs can be printed. The data can be exported for further analysis.

Procedure;

Operating Procedure:-

1. First of all we have to prepare the blends of Ethanol with gasoline and second Blendof Propanol such as EPr1.5 with Gasoline on the basis of Volumetric Composition.

2. Individually taken Propanol blends respectively on flask and mixed it with theGasoline.

3. Poured the blend in the fuel tank.

4. Plug the mains cord and switch on the control panel so that all the indicators willdisplay their respective readings.

5. Start the water flow to the engine.

6. Make sure that the temperature sensors are in their respective pockets.

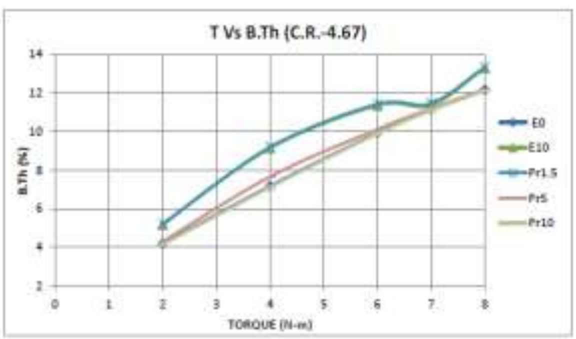
7. Start the engine by cranking with the use of handle.

8. Allow it to stabilize the rated speed i.e.2800 rpm.
9. We have taken different readings based on different blends of Propanol.
10. Run the software so that its starts displaying the respective data and also thecalculated results in the display panel.
11. Then log the data by clicking "log data" for zero load, then one complete Zero loadcycle data will be acquired.
12. Repeat the same for different load like and full loads.(max. load is 8 N meter)
13. After logging the full load data, click " stop " and view or print the Reports and graphs and exit.
14. Now bring back the load to zero and stop the engine by pulling the stop lever.
15. Shut- off the water supply after about 15 minute (*so that the pressure sensor should not get heated)
16. Then shut down the computer and switch off the mains.

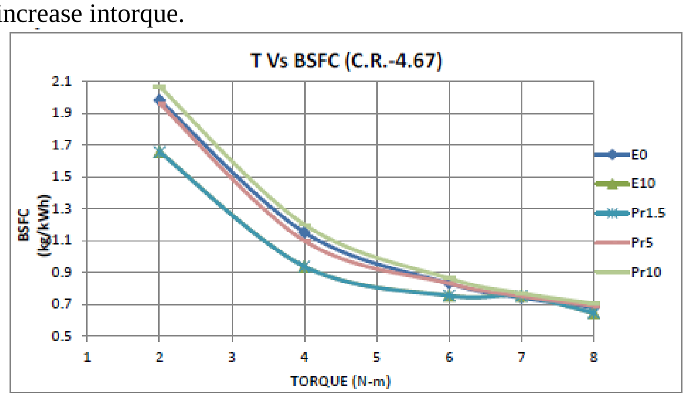
RESULT AND DISCUSSION

In this chapter brief discussion about the result is carried out. Various graphs betweentorque versus brake specific fuel consumption, brake thermal efficiency, %CO, %CO2,HC, NOx temperature are plotted as well as in between compression ratios and brake specific fuel consumption, brake thermal efficiency, %CO, %CO2,HC, NOx are plotted and the brief discussion is also carried out on the same.

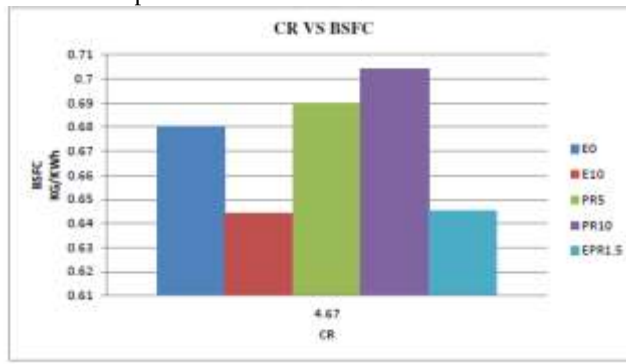
Brake Thermal Efficiency At Various Torque:
The effect of Brake Thermal Efficiency on increasing a torque is shown below. From the figure it is seen that as the torque increases, Brake thermal efficiency also increase.



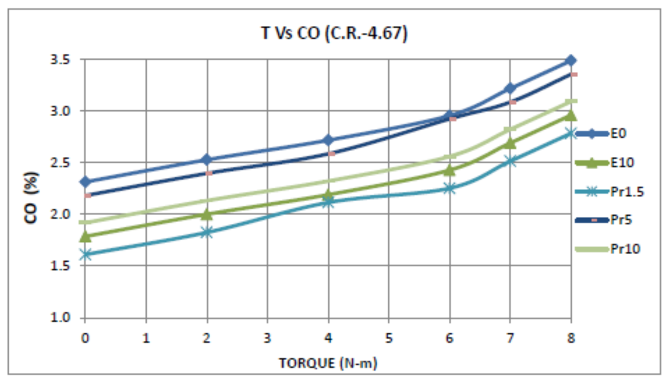
Brake Specific Fuel Consumption Various Torque:
The effect of brake specific fuel consumption on increasing a torque is shown below. It was seen that, BSFC decreases with increase intorque.



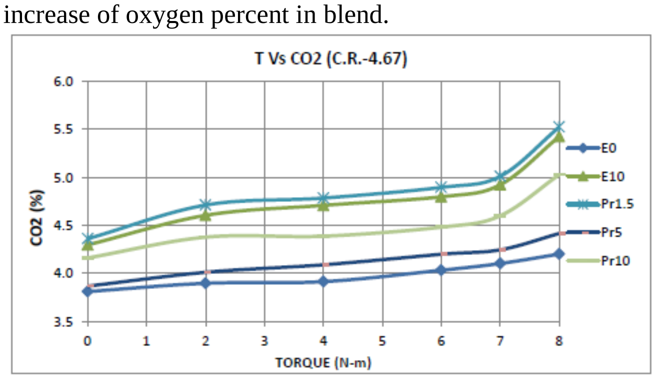
Brake Specific Fuel Consumption At 4.67 Compression Ratios:
Graph has drawn for optimal reading of all blend (E10,E0,Pr5,Pr10 EPr1.5) & it is seenthat brake specific fuel consumption of pure petrol decreases up to compression ratio4.67. Also it was analyzed that EPr1.5 have least value of BSFC as compared with all blends.



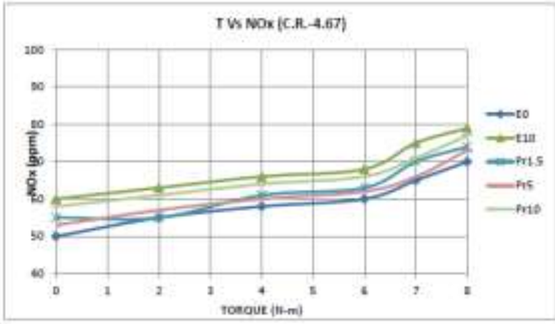
Percentage Of Carbon Monoxide At Various Torque:
The effect of Carbon Monoxide on increasing a torque is shown below. From the figure it is seen that as the torque increases, the percentage of carbon monoxide gets increases & as the percentage of oxygen increased in blend with the addition of ethanol & propanol, percentage of carbon monoxide also gets decrease.



Percentage Of Carbon Dioxide At Various Torques:
The effect of Carbon Dioxide on increasing a torque is shown below. From the figure it is seen that as the torque increases, the percentage ofcarbon Dioxide gets increases. Also it was seen that the percentage of carbon dioxide increases with increase of oxygen percent in blend.

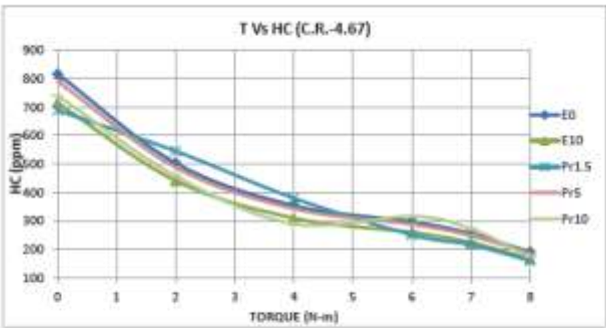


Oxides Of Nitrogen (in ppm) At Various Torque:
The effect of Nitrogen Oxide on increasing a torque is shown below. From the figure it is seen that as the torque increases, the percentage of Nitrogen oxide gets increase.



Uburned Hydrocarbon (in ppm) At Various Torque:

The effect of Hydrocarbon on increasing a torque is shown below. From the figure it is seen that as the torque increases, the percentage of Hydrocarbon gets decreases.



Conclusion:

Performance test was conducted on single cylinder four stroke S.I engine with EPr 1.5%, Pr 5% and Pr 10% blend with the gasoline and compared with E10%and E0% and with pure gasoline. Based on experimental results, the following conclusions are follows:

Effect on Brake Thermal efficiency

Increasing the torque at constant speed increases Brake thermal efficiency..For remaining blends (E0, E10, EPr1.5, Pr5, Pr10). It was found that EPr1.5 have highest Brake thermal efficiency among all blends.

Effect on Brake Specific Fuel Consumption

With increasing the torque at constant speed, Brake thermal efficiency decreases for pure petrol. For remaining blends (E0, E10, EPr1.5, Pr5, Pr10) Brake thermal efficiency decreases then increasing brake specific fuel consumption.

Effect on Carbon Monoxide

Carbon Monoxide percentage increases with increasing the torque at constant speed.As the Oxygen percentage in blends increases, Carbon Monoxide gets decrease due tocomplete combustion. For remaining blends (E0, E10, EPr1.5, Pr5, Pr10).

Effect on Carbon Dioxide

Carbon Dioxide percentage increases as increasing the torque at constant speed. Asthe Oxygen percentage in blends increases, Carbon Dioxide gets also increase. For remaining blends (E0, E10, EPr1.5, Pr5, Pr10).

Effect on Nitrogen Oxide

Nitrogen Oxide percentage increases as increasing the torque at constant speed. Asthe Brake thermal efficiency in blends increases, Nitrogen Oxide percentage gets decrease .For remaining blends (E0, E10, EPr1.5, Pr5, Pr10).Page 40

Effect on Unburned Hydrocarbon

Unburned Hydrocarbon percentage decreases as increasing the torque at constantspeed. Unburned Hydrocarbon percentage decreases for pure petrol.

RON: research octane number.

References:

[1] Yifeng Wang, " A semi detailed chemical kinetic model of a Gasoline surrogate fuel for I.C Engine Application",Vol. 113, Pages 341-356 ,Nov 2014

[2] Jing Gong, " Thermal Science", Vol. 18, Page No. 269-277, 2014

[3] Saltun "Technology", Page No. 183-188 Vol, 13 (3), 2010