

# Ethanol as an Alternative Fuel in Two Stroke SI Engine an Experimental Approach

A.Senthilrajan<sup>1</sup>, C.Ramji<sup>2</sup>

Lecturer senior grade, Department of Mechanical Engineering, Mohamed Sathak Polytechnic College,  
Kilalarai, Tamil Nadu, India<sup>1</sup>

Asso. Professor, Department of Mechanical Engineering, university College Engineering College, Ramanathapuram,  
Tamil Nadu, India<sup>2</sup>

**ABSTRACT:** Keeping in view the dwindling resources of petroleum products, the need to find the suitable alternate fuel for use in transportation. The fuel which is taken for this analysis is ethanol 5% of gasoline was added to act as solubliser and prevent the separation between the ethanol and lubricating oil. For testing a 50cc TVS engine was taken. Several tests such as mileage, temperature of exhaust gases, cooling rates of fins and exhaust gases were analyzed. The emission rate of carbon monoxide was low 0.2% when compared to petrol engine. The maximum mileage of ethanol was 50Kmpl and for petrol it was 40Kmpl. The exhaust gas temperature was lower in ethanol fueled engine than petrol which increases the thermal efficiency of the engine. The emission rates of CO, NO<sub>x</sub>, HC were lower in ethanol based engines.

**KEYWORDS:** Ethanol, petrol, exhaust emissions, exhaust temperature, thermal efficiency, mileage

## I. INTRODUCTION

Gasoline is the major product of the petroleum industry and form most of the SI fuels they contains a mixture of hydrocarbon, paraffin's, olefins, naphthalene and aromatics. Energy consumption has been increasing continually since the urbanization. Energy demand rises worldwide, due to the growth in global population, and the fast development of transportation. Transport is the largest consumer of world oil.

## II. LITERATURE SURVEY

About 20% of CO<sub>2</sub> emissions are from the transport part [1]. Now most cars use petrol for the fuel. But fossil fuel is limited and uneven distribute. Furthermore traditional fuels have more pollution to environment. Nowadays, energy security, climate change and rising of global energy demand are gradually entering the attention of public. In order to reduce oil dependency and develop sustainable transport, many countries plan to replace conventional fuels with alternative fuels in the future [2]. The energy use of the majority of the world is based on fossil fuels. For instance, 96% of the transportation depends on oil or other oil products in Europe. In 2010, Europe import 210 billion euro oil [3]. However oil will experience shortage in future decades, supplies are uncertain and unstable. Furthermore, oil production only occurs in some regions. In 2030 OPEC will account for 70% of liquid oil supply and 45% of total market [4]. Thus the depletion of oil or any policy change of the oil supply could cause huge influence in energy security. Since the energy crises, energy securities start to be coincided worldwide. To become energy independent and develop alternative energies becomes policy of many counties. The internal combustion engines of vehicles emit lots of pollutants like hydrocarbons, nitrogen oxides, carbon monoxide and carbon dioxide which can lead to cancer, acid rain, heart disease and global warming, respectively. In 2009, transport accounted for 25% energy-related carbon dioxide emission [1]. In additional, half of this emission was produced by passenger vehicles. EU has called for international cooperation to limit the global temperature increase to no more than 2 °C. In order to achieve that goal, EU needs to

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 7, Issue 6, June 2018

reduce % of GHGs by 60% by 2050, with compare to 1990 level [5]. The most promising way is making use of alternative fuel vehicle. A change for alternative energy for future cars can be a vital option for achieving sustainable development goals. Cars which use alternative energy are called alternative fuel vehicles. Alternative fuel vehicle refers to not using traditional fossil fuels like gasoline and diesel. The conventional fuels are able to substitute by other types of energy resource, such as electric, hydrogen, bio-fuel, natural gas and etc. Convectional fuels for vehicles include gasoline and diesel. 80% of cars in the cities have an energy efficiency of 15%, which means that of a 60 L fuel tank only 9 L is useful while 51 L transfers into heat and pollutants. The emissions of conventional fuels consist e.g. of NO<sub>x</sub>, CO<sub>x</sub>, SO<sub>x</sub>, hydrocarbon, VOC (Volatile Organic Compound) and PM (Particulate Matter). The CO<sub>2</sub> emission of conventional car is varying with type of technology and power level. In 2012 the average CO<sub>2</sub> emissions of conventional car is 120 g/km. Diesel and gasoline have volumetric energy densities of 35 MJ/L and 32 MJ/L respectively [6]. S. Jaichandar and K. Annamalai [7], have discussed the effect of use of biodiesel fuel on engine power, fuel consumption and thermal efficiency are collected and analyzed with that of conventional diesel fuel. N.H.S.Ray, M.K.Mohanty and R.C.Mohanty [8] have worked on Biogas as Alternate Fuel in Diesel Engines". They reviewed the current status and perspectives of biogas production, including the purification & storage methods and its engine applications. Lower hydrocarbon (HC), smoke and particulates emission has been reported in diesel engines operating on biogas diesel dual fuel mode. Er. Milind S Patil, Dr. R. S. Jahagirdar, and Er. Eknath R Deore [9] have worked on Performance Test of IC Engine Using Blends of Ethanol and Kerosene with Diesel. They used 3.75 kW diesel engine AV1 Single Cylinder water cooled, Kirloskar Make to test blends of diesel with kerosene and Ethanol. This paper presents a study report on the performance of IC engine using blends of kerosene and ethanol with diesel with various blending ratio. Parameters like speed of engine, fuel consumption and torque were measured at different loads for pure diesel and various combination of dual fuel. Break Power, BSFC, BTE and heat balance were calculated. Paper represents the test results for blends 5% to 20%. D. Ramesh and A. Sampathrajan [10] in their work entitled Investigations on Performance and Emission Characteristics of Diesel Engine with Jatropa Biodiesel and its Blends used a 5.2 kW diesel engine with alternator was used to test jatropa biodiesel and its blends. A pilot plant was developed for biodiesel production from different vegetable oils and used for this study. In the case of jatropa biodiesel alone, the fuel consumption in the diesel engine was about 14 per cent higher than that of diesel. The percent increase in specific fuel consumption ranged from 3 to 14 for B20 to B100 fuels. The brake thermal efficiency for biodiesel and its blends was found to be slightly higher than that of diesel fuel at tested load conditions and there was no difference between the biodiesel and its blended fuels efficiencies. The CO<sub>2</sub> emission from the biodiesel- fuelled engine was slightly higher than diesel fuel as compared with diesel. The carbon monoxide reduction by biodiesel was 16, 14 and 14 per cent at 2, 2.5 and 3.5 kW load conditions. The NO<sub>x</sub> emissions from biodiesel was increased by 15, 18 and 19 per cent higher than that of the diesel at 2, 2.5 and 3.5 kW load conditions respectively. In this work ethanol as alternate fuel was tested in two stroke engine and compared with petrol engine.

### III. EXPERIMENTATION& WORKING

In two stroke engine the cycle was completed in two strokes or one revolution of the crank shaft. Charge is sucked through the inlet valve and compressed by the piston after compression ignition and expansion takes place A **two-stroke** (or **two-cycle**) engine is a type of [internal combustion engine](#) which completes a power cycle with two strokes (up and down movements) of the [piston](#) during only one crankshaft revolution. In a two-stroke engine, the end of the combustion stroke and the beginning of the compression stroke happen simultaneously, with the intake and exhaust functions occurring at the same time. Two-stroke engines often have a high [power-to-weight ratio](#), power being available in a narrow range of rotational speeds called the "power band". Compared to four-stroke engines, two-stroke engines have a greatly reduced number of moving parts, and so can be more compact and significantly lighter. The Fig 1. Shows the experimental setup

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 7, Issue 6, June 2018

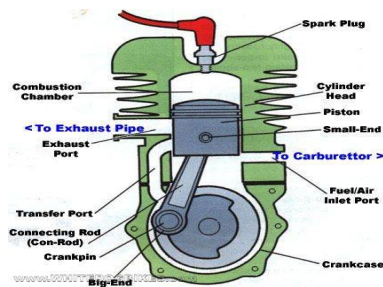


Fig.1 Experimental setup

### III. MODIFICATIONS

The safe conversion of petrol engine to ethanol fuel engine should not lead to any complication while running. The calorific value of ethanol is lower than petrol the jet size have to be increased keeping ethanol and petrol in mind. The following calculation is done to find the jet size of ethanol by assuming the efficiency as constant.

$$Q_{\text{petrol}} = Q_{\text{Ethanol}}$$

$$(\text{Density} \times \text{area} \times \text{LCV})_p = (\text{Density} \times \text{area} \times \text{LCV})_e$$

$$A_e = 1.6875 A_p$$

$$D_e = 1.299 d_p$$

The dia of jet must be increased 1.299 times to use ethanol as fuel. The original dia of jet is 0.5mm to increase it to a calculated amount a drill of 0.6495mm is used. The octane number of ethanol is higher than that of petrol the compression ratio can be increased by slightly machining the base of the engine head or by reducing the thickness of the gasket. this leads to increase in thermal efficiency.

Air fuel ratio

The air required for combustion of alcohols is lower than petrol

#### Properties of ethanol and petrol

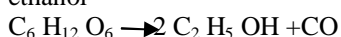
	C <sub>2</sub> H <sub>5</sub> OH	m C <sub>n</sub> H <sub>2n</sub>
Chemical formula	C <sub>2</sub> H <sub>5</sub> OH	m C <sub>n</sub> H <sub>2n</sub>
Molecular weight	46	112
Specific gravity	0.79	0.9
Boiling point	78	30
A/F ratio	3.57	6

To analyze the performance of ethanol, extensive vehicle filled with ethanol mixed with 5% petrol the standard route of 10Km is taken the tests were conducted with following factors

1. Drivability
2. Engine condition
3. Temperature of different parts
4. Fuel economy

#### Production of ethanol

Ethanol can be manufactured from any feed stock containing carbohydrates such as corn, wheat, sugar beets, potatoes, sugarcane. The ethanol production from sugarcane requires simple, well established process. Sugar cane juice is obtained from cane and it was clarified by filtration and concentration ,evaporation the juice is fermented to get raw ethanol



# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 7, Issue 6, June 2018

## Properties of Ethanol

- High calorific value
- High latent heat of evaporation
- Volatile
- Low vapor pressure
- High octane number
- Good solvent

## IV. RESULTS AND DISCUSSIONS

### Drivability

After completing the tests on standard route it was found that ethanol was better than petrol. Cold starting is good with ethanol than petrol engine at slow speeds ethanol was not suitable than petrol. But at full load and moderate load ethanol performance was good.

### Engine condition

After completing the test trails the engine was dismantled and studied the carbon deposit is satisfactory in ethanol than petrol because of high carbon content in petrol

### . Maximum speed

The engine was operated at full load with both the fuels. The maximum speed attained with petrol was 45Km/h and for ethanol it was 50Km/h. This shows that the power of ethanol was good

### Fuel economy

The vehicle taken for test gives a mileage of 45Km/l of petrol but ethanol gives a mileage of 41-43Km/l due to increased jet size. The Fig 3 explains the effect.

S.NO	FUEL	DISTANCE	SPEED	CONSUMPTION
1	Etanol	3Km	30Km/h	70ml
		5 Km	30Km/h	125 ml
2	petrol	3Km	30Km/h	65ml
		5 Km	30Km/h	120ml

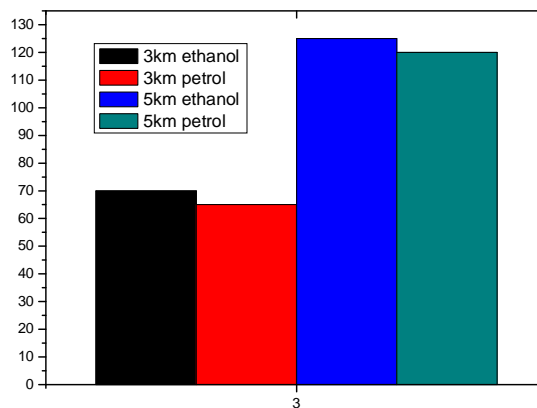


Fig 3 fuel consumption for petrol and ethanol

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 7, Issue 6, June 2018

## V. EXHAUST GAS ANALYSIS

This test was conducted with the full throttle condition and the temperature was noted for every 60seconds .The tests were conducted with both petrol and ethanol. The table gives the results. The results showed that the exhaust gas temperature at each stage was lower than that of petrol the lower exhaust temperature increases the thermal efficiency of the engine. The Fig.4 shows the exhaust temperature for both the fuels.

S.NO	TIME	PETROL	ETHANOL
AT FULL THROTTLE	ROOM TEM	34	34
	AFTER 1 MIN	76	70
	AFTER 2 MIN	128	120
	AFTER 3 MIN	170	162
	AFTER 4 MIN	180	170

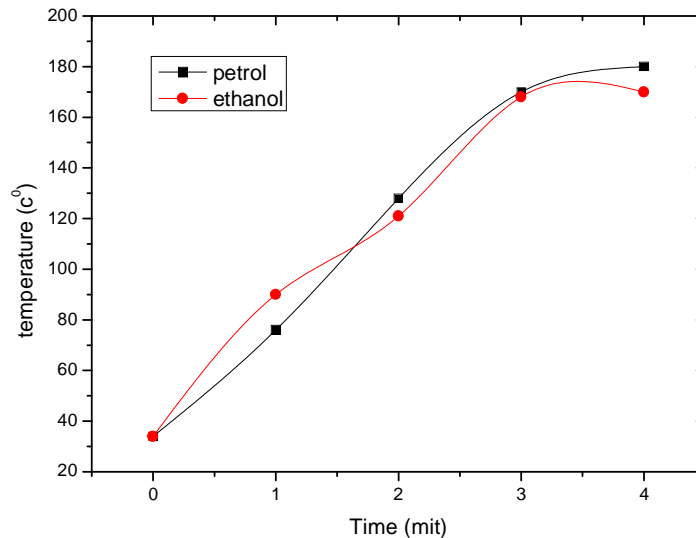


Fig.4 Effect of exhaust gas temperature

## VI. COOLING RATE OF FINS

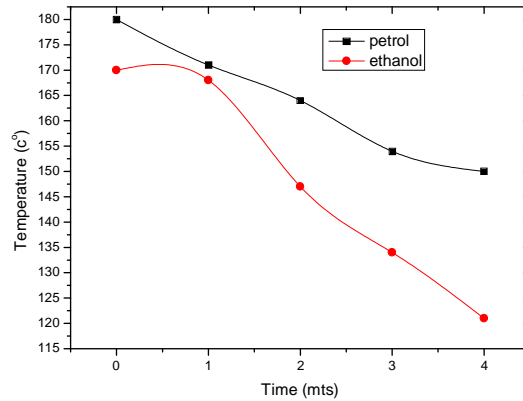
The engine was operated at maximum speed and temperature after that it was allowed to cool the temperature at each interval of time was noted using thermocouple. From this observation it was found that the cooling rate of ethanol fuel was good than petrol engine this was explained in Fig.5

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 7, Issue 6, June 2018



S.NO	TIME	PETROL	ETHANOL
AT FULL THROTTLE	ROOM TEM	180	170
	AFTER 1 MIN	171	162
	AFTER 2 MIN	164	147
	AFTER 3 MIN	158	135
	AFTER 4 MIN	150	121

Fig.5 Effect of cooling

## VII. EXHAUST GAS ANALYSIS

The exhaust gas was analyzed using computerized exhaust analyzer. First ethanol with 5% petrol acts as lubrication was tested in idle, high, hot ideal modes and the readings obtained were analyzed. The CO ,HC level of ethanol engine was good when compared to petrol engines.

ETANOL			PETROL		
CO LEVEL	HC LEVEL	SPEED	CO LEVEL	HC LEVEL	SPEED
0.30%	4100PPM	IDLE	0.40%	4500PPM	IDLE
0.20%	3100PPM	HIGH	2.40%	3700PPM	HIGH
0.12%	2700PPM	HOT IDEL	0.60%	3000PPM	HOT IDEL

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 7, Issue 6, June 2018

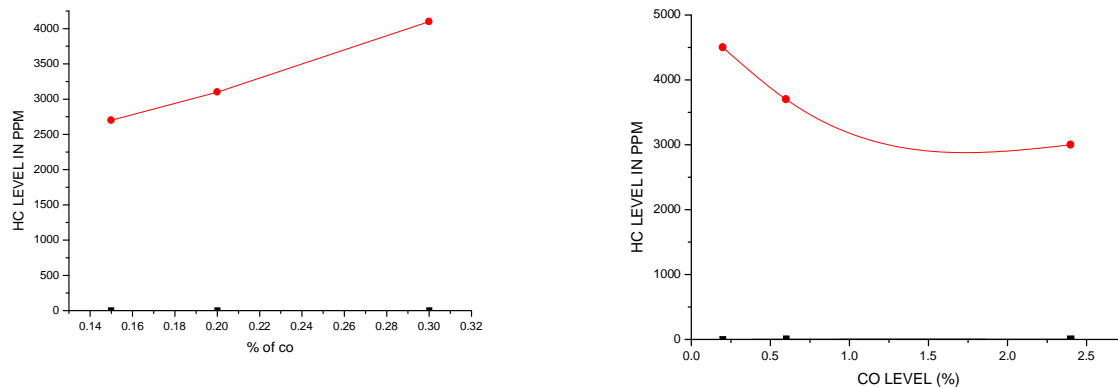


Fig.6 Effect of CO and HC levels

## VIII. CONCLUSION

After the tests conducted with TVS SI engine the following points are arrived

- For slow speeds 0-10Km/h ethanol performance was poor when compared to petrol
- Low carbon deposits were found in ethanol fuels
- Ethanol engines develops more power than petrol engines
- The exhaust gas temperature was very low in ethanol engines which increases thermal efficiency
- The exhaust emissions such as CO,HC were low in ethanol fuels
- Separate lubrication or 5% petrol mixes with ethanol can be used as fuel
- The cost of ethanol was comparatively higher than petrol

## REFERENCES

- [1] Energy Data Centre of the IEA, "Key World Energy Statistics," International Energy Agency, Paris, France, 2014.
- [2] Achtnicht, M., et al., "The impact of fuel availability on demand for alternative-fuel vehicles," Transportation Research Part D: Transport and Environment, Volume 17, Issue 3, Pages 262-269, 2012.
- [3] Pierpaolo Cazzola, et al., "Energy Technology Perspectives," International Energy Agency, Paris, France, 2014.
- [4] BP. "BP Energy Outlook Booklet," British Petroleum, London, 2012
- [5] European Commission "Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system." European commission white paper, Brussels, 2011.
- [6]. J. Van Mierlo, et al., "Which energy source for road transport in the future? A comparison of battery hybrid and fuel cell vehicles," Energy Conversion and Management, Volume 47, Issue 17, Pages 2748–2760, 2006.
- [7] S. Jaichandar and K. Annamalai, „The Status of Biodiesel as an Alternative Fuel for Diesel Engine” Journal of Sustainable Energy & Environment 2 (2011) 71-75
- [8] N.H.S.Ray, M.K.Mohanty and R.C.Mohanty, „Biogas as Alternate Fuel in Diesel Engines” IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 9, Issue 1 (Sep. - Oct. 2013), PP 23-28 [www.iosrjournals.org](http://www.iosrjournals.org)
- [9] Er. Milind S Patil, Dr. R. S. Jahagirdar, and Er. Eknath R Deore, „Performance Test of IC Engine Using Blends of Ethanol and Kerosene with Diesel” International Journal of Engineering Science and Technology Vol. 2(8), 2010, 3503-3509
- [10] D. Ramesh and A. Sampathrajan, „Investigations on Performance and Emission Characteristics of Diesel Engine with Jatropa Biodiesel and Its Blends” Vol. X. March, 2008