Comparative Analysis of Exhaust Emission Using Conventional and Blended Fuels

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ABSTRACT

The emissions of conventional engine have many air pollutants which have numerous negative effects on public health and natural environment. The principal pollutants of emission are Hydro-carbon, carbon monoxide, nitrogen oxide, sulphur oxide. The rapid deletion of petroleum fuels and there over increasing cost have led to an intensive research for alternative fuels which would give a better efficiency but application of this alternative fuel on practical basis would require critical examination of their emission. Analyse emission of conventional engine using various blends of alternative fuels with conventional fuel using emission gas analyser which analyses the percentage of pollutants in emission of engine by constant speed method.

Keywords: ***Hydro-carbon, carbon monoxide, nitrogen oxide, sulphur oxide, Emission gas analyser, constant speed method.***

1. INTRODUCTION

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. The search for alternative fuels, which promise a harmonious 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. Alcohol has been used as a fuel for internal combustion engines since their invention. The properties of methyl, ethyl and butyl alcohol are compared with octane (high quality gasoline) and hexadecane (high quality diesel fuel). Note that octane and hexadecane (petroleum fuels) have higher boiling points, lower latent heats and are insoluble in water. The alcohols become more like petroleum fuels as their chemical weights increase. Methyl alcohol has the low combustion energy. However, it also has the lowest stoichiometric or chemically correct air-fuel ratio. Therefore, an engine burning methyl alcohol would produce the most power. It also is possible to take advantage of the higher octane ratings of methyl (and ethyl) alcohol and increase the engine compression ratio. This would increase the efficiency of converting the potential combustion energy to power. Finally, alcohols burn more completely, thus increasing combustion efficiency. Understanding the effect of using blends of alternative fuel in SI engine on emission require basic knowledge of emission of SI engine running on conventional fuel.

2. EXPERIMENTAL SETUP

The stationary petrol engine is selected for experimentation. The specifications of the engine are given below.

Petrol engine test rig.
8:1 compression ratio
Single cylinder four stroke Air cooled engine.
Electrical loading (Air heater 500W each)
Air flow across Orifice (Orifice diameter = 12.5mm)
Bore = 70mm
Stroke = 66.7mm
Coefficient of discharge = 0.62.

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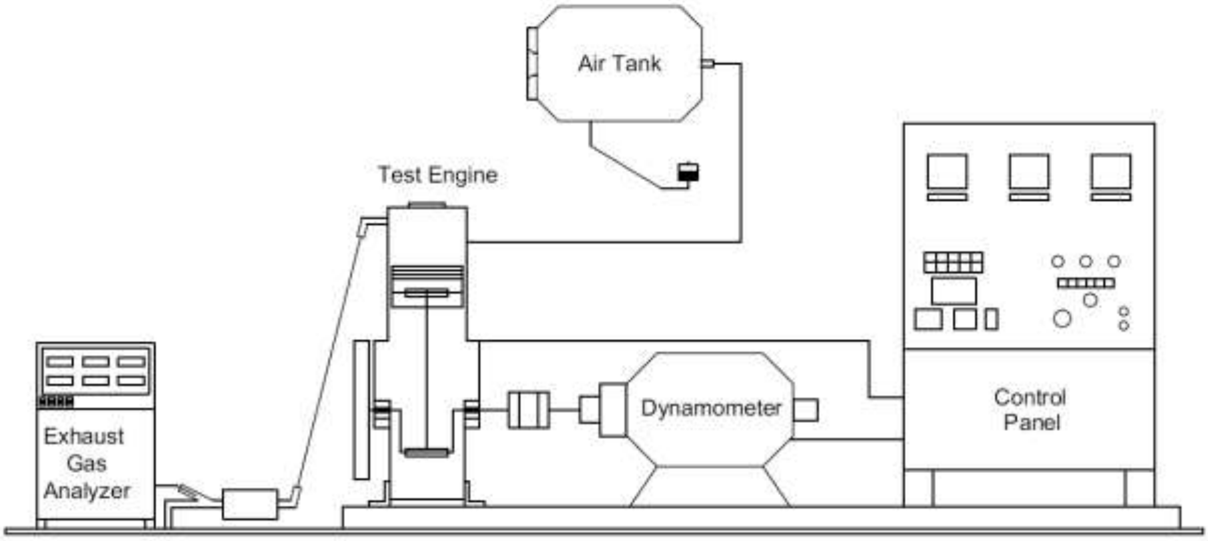

Fig-1: Schematic of Experimental Setup

2.1. PROPERTIES OF ETHANOL AND GASOLINE

The physical and chemical properties of Gasoline and Ethanol as follows Automated Modelling.

No.	Property	Ethanol	Gasoline
1.	Density (kg/m^3) @298^{o}k	790	720-780
2.	Stoichiometric A/F ratio	9.02	14.6
3.	Higher heating value (KJ/Kg)	26780	418000 - 44000
4.	Lower heating value (KJ/Kg)	21156	313500 - 33000
5.	Octane number	98	88
6.	Boiling point (K)	351.6	300- 498
7.	Flash Point (K)	285	<233
8.	Ignition point (K)	697	553 - 702

3. RESULTS AND DISCUSSIONS

Experiments were conducted on use of conventional gasoline and gasoline alcohol blends on single cylinder four stroke engine. The engine was tested at original compression ratio 8:1, 2100 rpm with gasoline, E10, E20, E30, E40 and E50. Various emissions such as HC, CO, NO_X and CO_2 were measured and the characteristic curves are drawn.

3.1 CONSTANT SPEED METHOD RESULT TABLES (N=2100 RPM).

FOR PETROL					
LOAD (KN)	0	0.5	1	1.5	2
CO (%)	3.264	2.979	2.287	1.785	1.401
HC (ppm)	1773	1396	1028	1163	1258
CO_2 (%)	1.6	2.22	2.09	2.63	2.66
NOx (ppm)	25	77	78	106	173

Table-1: For Result Constant Speed Petrol

FOR E10					
LOAD (KN)	0	0.5	1	1.5	2
CO (%)	1.884	1.729	1.216	0.917	0.917
HC (ppm)	952	641	551	798	798
CO_2 (%)	1.94	2.30	2.55	2.64	2.64
NOx (ppm)	111	116	159	256	327

Table 2: For Result Constant Speed E10

FOR E20					
LOAD (KN)	0	0.5	1	1.5	2
CO (%)	2.739	2.152	1.368	1.136	2.503
HC (ppm)	1101	880	790	960	632
CO_2 (%)	8.51	8.81	9.29	9.09	9.22
NOx (ppm)	85	91	217	450	630

Table-3: For Result Constant Speed E20

FOR E30					
LOAD (KN)	0	0.5	1	1.5	2
CO (%)	11.141	8.187	7.642	4.693	2.783
HC (ppm)	1021	702	608	284	445
CO_2 (%)	4.84	6.31	6.47	5.82	9.56
NOx (ppm)	25	53	15	219	460

Table-4: For Result Constant Speed E30

FOR E40					
LOAD (KN)	0	0.5	1	1.5	2
CO (%)	1.867	6.381	4.493	3.045	6.42
HC (ppm)	1363	845	694	671	562
CO_2 (%)	4.63	5.03	7.19	8.05	9.51
NOx (ppm)	27	0	83	212	372

Table-5: For Result Constant Speed E40

FOR E50					
LOAD (KN)	0	0.5	1	1.5	2
CO (%)	7.823	7.334	4.154	3.026	0.228
HC (ppm)	1151	754	686	781	526
CO_2 (%)	5.08	5.74	7.58	7.62	8.87
NOx (ppm)	18	0	54	187	190

Table-6: For Result Constant Speed E50

3.2 EMISSION ANALYSIS

The emissions are measured with respect to load and blending percentage of ethanol in gasoline. So following are the effects and their curves for individual emissions products.

3.2.1: CARBON MONOXIDE (CO)

CO is a product of incomplete combustion due to insufficient amount of air in the air–fuel mixture or insufficient time in the cycle for completion of combustion. The concentration of CO emissions greatly depends on the operating condition of engine and air–fuel ratio. CO emissions were considered to be greatly affected by negligible variations in air–fuel ratio during experiment. Fig 2 represents the influence of increasing load at constant speed on CO emissions using various blends. CO emissions are seen to decrease with load. This can be due to increase in cylinder temperature resulting in proper combustion.

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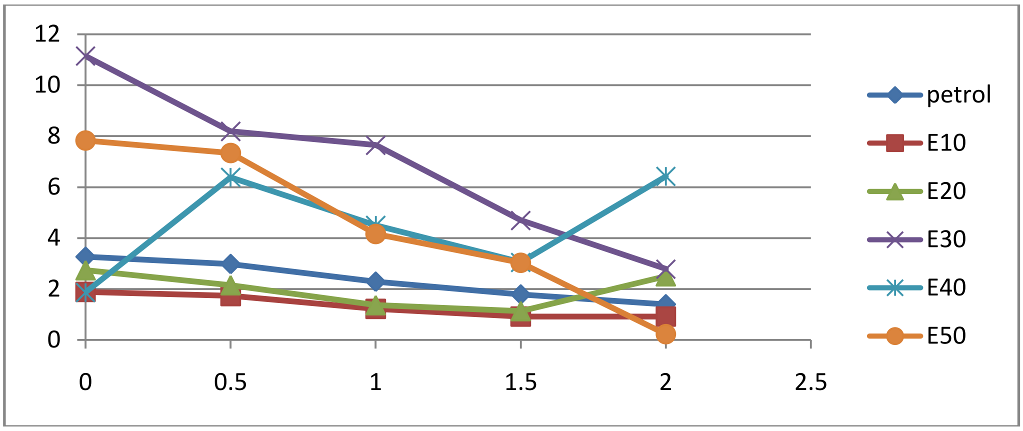

Fig 2 - Variation of CO (%) emission V/S Load (KN) at constant speed (N=2100rpm.)

3.2.2: HYDRO-CARBON (HC)

The concentration of HC emissions is closely related to many design and operating variables. Combustion chamber and induction system design are two important design variables while air–fuel ratio, speed and load are main operating variables. Displacement, combustion chamber shape, bore diameter, stroke and compression ratio affect the surface to volume ratio and HC emission. The lower cylinder temperature resulted in incomplete combustion of the remaining fuel. Fig 3 represents the influence of increasing load at constant speed on CO emissions. The HC emission first decreases then increases. This is because at no load throttle is partially open causing rich mixture to flow through auxiliary jet of carburettor then it reduces as throttle open, again at high load rich mixture is supplied.

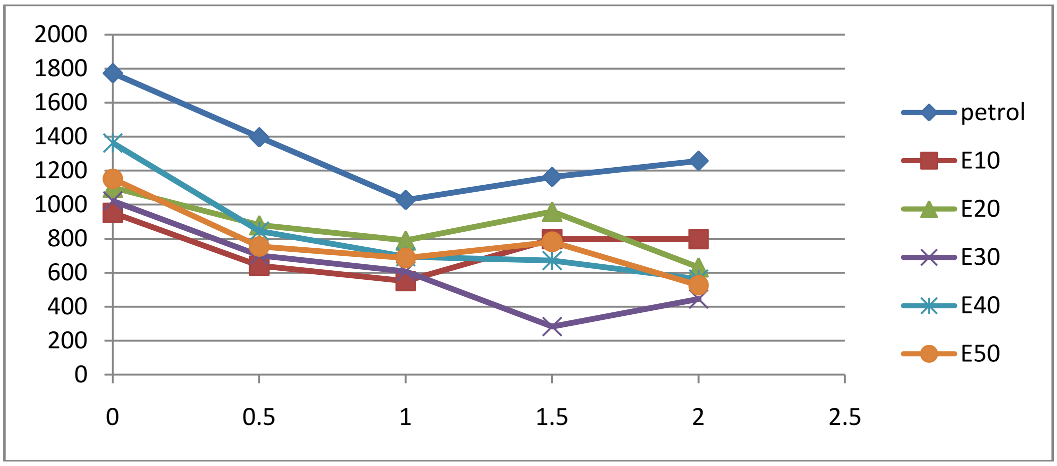

Fig 3- Variation of HC (ppm) emission v/s Load (KN) at constant speed (N=2100rpm.)

3.2.2: NITROGEN OXIDE (NO_X)

Nitric oxide levels mainly depend on the peak temperatures achieved during combustion. Especially NOx emissions are formed above temperature of 1500˚C. Secondly, oxygen concentration is important. NO_x emissions peak at slightly lean mixtures. Fig 4 represents the influence of increasing load at constant speed on NOx emissions. It has same effect as above, NOx increase with increase in load.

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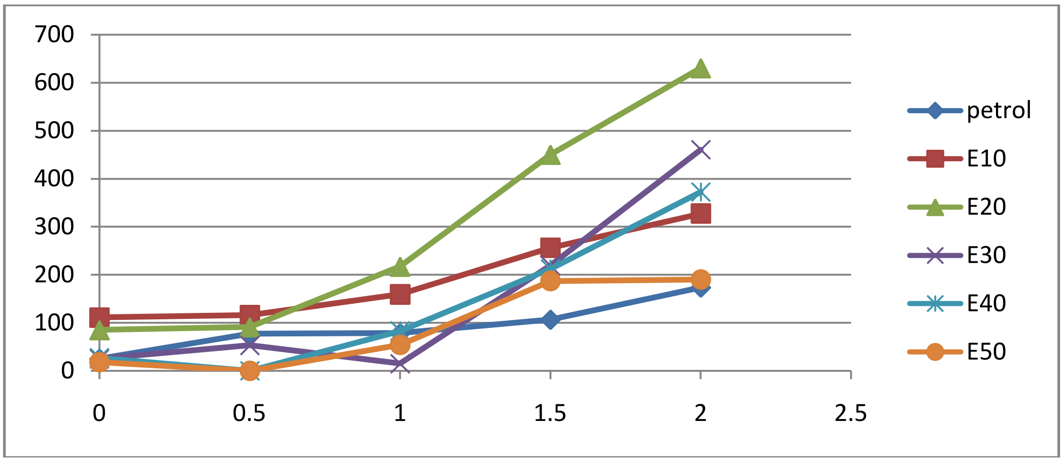

Fig 4- Variation of NO_X (ppm) emission v/s Load (KN) at constant speed (N=2100rpm.)

4. CONCLUSION

The main motivation for the present work the comparative study of engine emission of alcohol blends with gasoline, and to test the suitability of sample as a fuel for S.I.Engine. The addition of ethanol to gasoline fuel enhances octane number of the blended fuels and at operating conditions, ethanol blended fuels slightly decrease engine-out CO and NOx emissions, but they can significantly reduce engine-out THC emissions. At idle, E10 has little effect on the decrease of engine-out CO, HC and NOx emissions, but E30 can drastically reduce engine-out CO, HC and NOx emissions.

A significant reduction in HC emissions was observed as a result of the leaning effect and additional fuel oxygen caused by the ethanol addition. Reduction in NOx emissions was obtained with ethanol addition due to the high latent heat of vaporization of ethanol. The fuels containing high ratios of ethanol E40 and E50 had important effects on the reduction exhaust emissions. The better decrease was obtained with HC compared with CO. The maximum decrease in HC emission was obtained using E30.

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