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Short Comunication

Comparative Study of Exhaust Emission of Commonly Used Fuel in an Internal Combustion Engine

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Abstract: The aim of this work is to find out composition of exhaust gases from I.C engine when CNG, LPG, Petroleum are used. The main consequence of exhaust gases are environmental pollution. The environmental pollution depends upon presence of pollutants like CO, NOx, HC & PM. This paper aspires to find out the fuel that emits minimum pollution when used in the same automobile, thereby finding a cleaner, environment friendlier fuel. The results presented in the project are obtained from an experimental study carried out on a Maruti Alto Car. Experimental investigation indicates that CNG, LPG and petrol have significant effect on exhaust gases. In spark ignition engines, the output parameter is achieved by controlling various input fuels. This paper discusses the effects of various input fuels on exhaust gases.

Keywords - LPG, CNG, Petrol, Exhaust gases.

INTRODUCTION

The increased use of automobiles and the rapid rate of industrial development in the world made petroleum supplies unable to keep up with demands. Moreover, petroleum fuels pollute the environment with their combustion products. Control devices were used to reduce pollution, but resulted in about 15% reduction in the vehicle mileage. It is, therefore, worthwhile to look into the suitability of using "clean" burning fuels for use in spark ignition engines (S.I.E). Using of alternative fuels maybe achieved by converting an existing engine to operate on either the original fuel and the alternative fuel "dual fueling" or, in general, a specially designed engine for the new fuel will offer better performance. Two categories of fuels are investigated: alcoholic fuels and gaseous fuels. Alcohols could be produced from renewable resources and produce less exhaust pollutants. Gaseous fuels offer, cleaner combustion due to improved fuel-air mixture preparation and higher H/C ration than in conventional liquid fuels[1].

Table-1: Comparative properties of gasoline, LPG & CNG [2, 3].

Properties/fuels	Gasoline	LPG	CNG
Chemical structure	C_7H_{17}/C_4 to C_{12}	C_3H_8	CH_4
Energy density	109,000-125,000	84,000	35,000 @ 3000 psi
Octane number	86-94	105+	120+
Lower heating value (MJ/Kg)	43.44	46.60	47.14
High heating value (MJ/Kg)	46.53	50.15	52.20
Stoichiometric air/fuel ratio	14.7	15.5	17.2
Density at 15°C (kg/m3)	737	1.85	0.78
Autoignition temperature °K	531	724	755-905
Specific gravity at 60°F	0.72-0.78	0.85	0.424

LPG AS AN ALTERNATIVE FUEL

LPG is obtained from the process is the process of natural gas and crude oil extraction and as by-product of oil refining. Its primary composition is a mixture of propane and butane. It has higher octane number (105) than petrol (91-97).The use of LPG in internal combustion engines yielded higher thermal efficiency and better fuel economy compared to unleaded gasoline. This is due to mainly the higher octane rating, which permits greater engine compression ratio without the occurrence of knock.LPG also has higher heating value compared to other fuels and can be liquefied in a low-pressure range of 0.7 to 0.8MPa at atmospheric pressure. Gaseous fuels such as liquefied petroleum gas (LPG) and liquefied natural gas (LNG) have been widely used in commercial vehicles, and promising results were obtained in terms of fuel economy and exhaust emissions. LPG gas as a low carbon and high octane number fuel produces lower carbon dioxide (CO_2) emission as compared to gasoline. The use of LPG as an alternate fuel for road vehicles has been studied extensively in recent years i.e., approximately 4 million vehicles are operating on LPG worldwide. Most of these were mainly light, medium and heavy-duty trucks originally operated on gasoline and later converted to LPG using approved and certified conversion kits[4].

ENGINE MODIFICATION REQUIRED

Many propane vehicles are converted gasoline vehicle inexpensive conversion kits include a regulator/vaporizer that change liquid propane to a gaseous form and an air/fuel mixer that meters and mixes the fuel with filtered intake air before the mixture is drawn into engine's combustion chambers. Also included in conversion kits is closed-loop feedback circuitry that continually monitors the oxygen content of the exhaust and adjusts the air/fuel ratio as necessary.LPG vehicles additionally require a special fuel tank that is strong enough to withstand the LPG storage pressure of about 130 pounds per square inch.

CNG AS AN ALTERNATIVE FUEL

Compressed natural gas (CNG) has been used as an alternative fuel. The advantages of CNG compared to petrol are: Unique combustion and suitable mixture formation; Due to high octane number of CNG,

engine operates smoothly with high compression ratios without knocking; CNG with lean burning quality will leads to lowering exhaust emissions and fuel operating cost; CNG has a lower flame speed; Engine durability is very high. The flame speed of Natural gas is lower compared to petrol. The lower flame speed causes the total combustion duration prolonged compared with petrol fuel[5.]

Natural gas is produced from gas wells or tied in with crude oil production. Natural gas (NG) is made up primarily of methane (CH_4) but frequently contains trace amounts of ethane, propane, nitrogen, helium, carbon dioxide, hydrogen sulfide, and water vapor Methane is the principal component of natural gas. Normally more than 90% of natural gas is methane, the detail of natural gas compositions as shown in **Table 1**. That in the natural gas composition more than 98% is methane. Natural gas can be compressed, so it can stored and used as compressed natural gas (CNG). CNG requires a much larger volume to store the same mass of natural gas and the use of very high pressure on about 200 bar or 2,900 psi. Natural gas is safer than gasoline in many respects. The ignition temperature for natural gas is higher than gasoline and diesel fuel.Additionally, natural gas is lighter than air and will dissipate upward rapidly if a rupture occurs. Gasoline and diesel will pool on the ground, increasing the danger of fire. Compressed natural gas is non-toxic and will not contaminate groundwater if spilled. Advanced compressed natural gas engines guarantee considerable advantages over conventional gasoline and diesel engines. Compressed natural gas is a largely available form of fossil energy and therefore non-renewable. However, CNG has some advantages compared to gasoline and diesel from an environmental perspective. It is a cleaner fuel than either gasoline or diesel as far as emissions are concerned. Compressed natural gas is considered an environmentally clean alternative to those fuels[6]

MODIFICATION REQUIRED FOR CNG

It doesn't take much besides a new fuel tank to convert a gasoline-burning engine to one that also runs on natural gas. Attached to the fuel tank is the regulator**,** which reduces tank pressure from 3600 psi to 125 psi. Fuel is then fed to a parallel fuel rail and to new, secondary injectors plugged into an adapter. A wiring harness plugs into the factory engine-control unit and intercepts throttle information, sending it to a new fueling computer**,** which slightly alters the data and passes it to the CNG injectors through a parallel wiring harness.

BLENDED GASOLINE

BalaJi et.al[5]. Investigated the effect of using unleaded gasoline and additives blends on spark ignition engine (SI engine) performance and exhaust emission. A four stroke, single cylinder SI engine was used for conducting this study. Performance tests were conducted for fuel consumption, volumetric efficiency, brake thermal efficiency, brake power, engine torque and brake specific fuel consumption, while exhaust emissions were analyzed for carbon monoxide (CO), Hydrocarbon (HC), and Oxides of nitrogen (NOx) using unleaded gasoline and additives blends with different percentages of fuel at varying engine torque condition and constant engine speed. The result showed that blending unleaded gasoline with additives increases the brake power, volumetric and brake thermal efficiencies and fuel consumption. The CO and HC emissions concentrations in the engine exhaust decreases while the NOx concentration increases. The addition of 5% isobutanol and 10% ethanol to gasoline gave the best results for all measured parameters at all engine torque values[7]

RESULT AND DISCUSSION

In this work, composition of exhaust gases is found out with the help of experimental analysis performed on Alto Car engine. Experimental investigation with the help of Maruti Alto Car on exhaust gas emission

is systemically investigated by using combination of different fuels. It was found that the effect of CNG, LPG, Petrol significantly affect the composition of exhaust emission

Table -2: Comparison of emission on alto car running on different fuels

FUEL	CO (g/km)	HC (g/km)	NOX (g/km)
Petrol	0.256	0.065	0.09
CNG	0.12	0.042	0.07
LPG	0.234	0.039	0.11

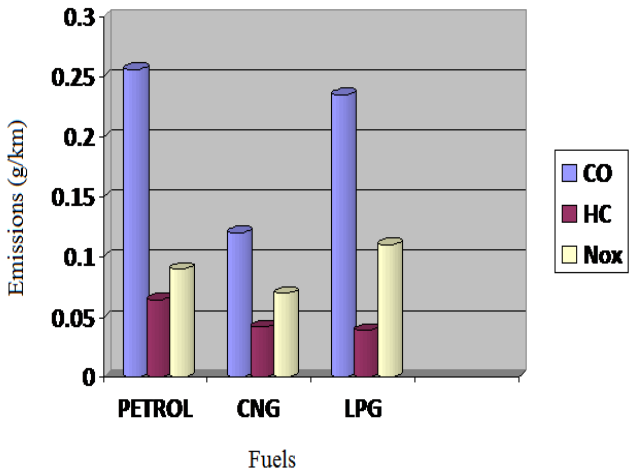

Figure 1: emissions from different fuels

.CONCLUSION

With the help of above result, it is evident that CNG is the better fuel for cleaner environment. The air pollution can be controlled by selecting CNG. This shows the flexibility of using the alternate fuel for control of air pollution.

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