

Ethanol-Fueled Engine

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Abstract - Energy inputs are critical in maintaining the growth of a country. The concern over the exhausting of conventional sources of energy prompted the nation to view biodiesel fuels as a potential alternative to conventional liquid fossil fuels. In this regard, ethanol has emerged as an important renewable fuel for transportation purposes. This paper aims to run an SI engine with ethanol with the oxygenated additives so as to reduce the exhaust emissions.

Key Words: Fuel system, IC engine, non conventional automobile

1. INTRODUCTION

Ethanol (C₂H₅OH) is a renewable fuel. It can produce from agricultural feedstocks, such as sugarcane and also from forestry wood wastes and agricultural residue. It can also derive chemically from ethylene or ethane. Ethanol has a simple molecular structure with well defined physical and chemical properties. Ethanol can also be employed as a transportation fuel even in its original form and can also be easily blended with other fuels, such as gasoline and diesel.

Currently, there is a lot of interest in ethanol production from renewable feedstocks, to minimize the emissions of carbon dioxide, which is greenhouse gas that contributes to global warming. The addition of ethanol to gasoline results in the enhancement of the octane number in blended flues and changes the distillation temperature as well as reducing CO₂ emission.

2. ADVANTAGES OF ETHANOL-FUELED ENGINE

- Ethanol has a high heat of vaporization. As the liquid fuel evaporates in the air stream being charged to the engine, a higher heat of vaporization cools the air allowing more mass to be drawn into the cylinder. This increase the power produced from the given engine size.
- Ethanol burns faster than petrol allowing more uniform and efficient torque development.
- Ethanol has lower exhaust emissions than gasoline engines.

- Ethanol has high octane number compared to petrol. This means higher compression ratios can be used, which results in higher engine efficiencies and higher power from the engine.

3. WORKING OF ETHANOL-FUELED ENGINE

Flexible fuel vehicles (FFVs) have an internal combustion engine and are capable of operating on gasoline and any blend of gasoline and ethanol up to 83%. FFVs have one fueling system, and most components are the same as those found in a conventional gasoline car.

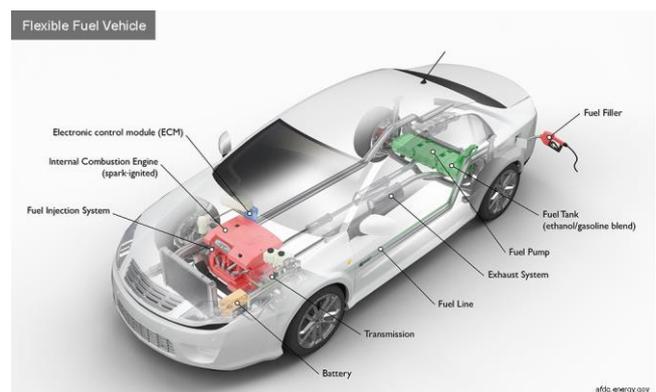


Figure 1- Working of Ethanol fueled IC engine [5]

4. MODIFICATIONS REQUIRED FOR USE OF ETHANOL AS A FUEL

4.1 SPARK PLUG TIMING

The spark plug timing of an engine must be advanced to run on ethanol. This is done to provide ethanol with enough time to complete combustion since ethanol burns slower than gasoline. Different studies recommended advancing the spark timing by 20 degrees.

4.2 VACUUM ADVANCE

Changing the economy of vacuum advance shows the best fuel economy on the engine tested when the vacuum advance is set to give an additional 10 degree of advance over the idle ignition time.

4.3 CARBURETOR MODIFICATIONS

In all of the tests reviewed, the engine requires more volume of fuel when operated on ethanol as compared to operation on gasoline. The correct stoichiometric air-fuel mixture for ethanol is 9:1, while the correct mixture for gasoline is 14.7:1. The reason for the difference in the ratios is that ethanol lower energy contained per volume than gasoline.

By the study recommended, it is found that an increase in the jet size of 10 to 15% is sufficient. Adjusting the carburetor also adjusts the equivalence ratio, i.e., actual air: fuel ratio/stoichiometric air: fuel ratio.

4.4 PREHEATING AIR: FUEL MIXTURE

Heating the air: ethanol fuel mixture requires 2.5 times more heat for vaporization. For this reason, some additional heat may be desired for the air-fuel mixture before it enters the cylinder.

4.5 COLD START MODIFICATION

One of the main problems in using ethanol in an engine is low temperature. Ethanol requires more heat of vaporization than gasoline. This can be overcome by use of additives and 350-watt resistance heater in the intake manifold.

4.6 CHANGE IN COMPRESSION RATIO

The increase of engine's compression ratio to 10 to 15.1 will take advantage of high octane rating of ethanol to produce more power.

4.7 USING TURBOCHARGER

A turbocharger uses exhaust gases to drive a turbine connected to another turbine that forces outside air through the carburetor. This air causes an increase in the combustion pressure.

5. DIFFERENT EFFECTS OF ETHANOL FUEL

The proof of alcohol by the internal combustion engine is one of the most important factors that must be considered in the use of ethanol. Ethanol is concentrated during the distillation of a mixture of ethanol and water. Each time the mixture is distilled, its proof (two time the percentage content of the alcohol in the alcohol-water solution) increases. Therefore, the lower proof (higher the water content) ethanol is cheaper to produce and economically more attractive as a petroleum substitute.

5.1 SAFETY IN HANDLING ETHANOL

Ethanol is not highly toxic but some discomforts have been known to occur if the fumes are inhaled for a long period of time in a poorly ventilated area.

The storage of ethanol must be handled differently from that of gasoline. For maximum safety, ethanol must be stored in a white tank in a shaded area.

5.2 DETERIORATION OF MATERIALS IN CONTACT WITH ETHANOL

Ethanol was found to be corrosive to several materials that are exposed within the engine or fuel system of the vehicle.

In the fuel system, ethanol has been found to be corrosive to polyamide filter housing (Polyurethane and polyester bonded fiberglass). For this reason, it is recommended that all hoses and the fuel pump diaphragm be made of neoprene rubber, a material compatible with ethanol.

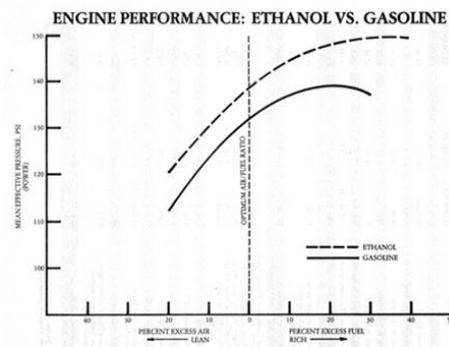


Figure 2- Engine performance: Ethanol vs. Gasoline [6]

6. CONCLUSIONS

Most automobiles on the road today run on high ethanol blends if legally certified conversion kits were available. Ethanol is renewable, clean, domestically produced motor fuel and as such, can solve many of the nation's economic, political and environmental problems. As an alternative fuel, ethanol (and other alcohols) is superior to all other alternatives because it is easy and inexpensive to manufacture flexible-fuel vehicle (FFV) and to convert non-FFV to FFV. The national fuel distribution system is geared towards the production, storage, and distribution of liquid fuel. The production cost of a new FFV is essentially identical to a non-FFV of the same model. FFV requires no additional fuel tanks or other space and weight hogging equipment, and do not present the driver with any compromises vis-à-vis the gasoline powered engine. The vehicle performs the same on ethanol and on gasoline and can always be fueled on gasoline if ethanol is not available.

REFERENCES

- [1] Yash Menon et al.; Investigation of Effect of Ethanol Blends on Performance Parameters of I.C. Engine; International Journal of Engineering Research & Technology (IJERT); ISSN: 2278-0181; April 2014.

- [2] V.Gnanamoorthia, G. Devaradjaneb; Effect of diesel-ethanol blends on performance, combustion and exhaust emission of a diesel engine; International Journal of Current Engineering and Technology; ISSN 2277 – 4106; March 2013
- [3] M.Srinivasnaik et al.; Bio-fuels as Alternative fuels for Internal Combustion Engines; International Journal of Scientific and Research Publications; ISSN 2250-3153; Volume 5, Issue 12, December 2015
- [4] Benjamin G Moxey; A study of flame development with isooctane alcohol blended fuels in an optical spark ignition engine; Brunel University, London; September 2014
- [5] <https://www.afdc.energy.gov/vehicles/how-do-flexible-fuel-cars-work>
- [6] http://journeytoforever.org/biofuel_library/ethanol_motherearth/me1.html

BIOGRAPHIES



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