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Experimental Investigation on Gasoline Fuel Blended with Composite Additives and its Effect on Emission

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Abstract

Low performance and pollution caused by incomplete combustion are one of the major drawbacks of IC Engine. Additives are blended with petrol to reduce the emission. All these additives, when used individually, give one or two positive effects. There is a need, therefore, for composite additives made from different additives that can give all the positive effects they give individually. This project aims to prepare a mixture of oxygenates and antiknock additive (ethanol) that can reduce carbon emissions, knock, and increase efficiencies without revealing any harmful effects on your engine, including one oxygen (ethanol) and one antiknock (Toluene).

Keywords: *Gasoline, Composite Additives, Emission.*

1. Introduction

Oil based fuel has been in use for over 100 years, and the needs of such fuels have grown to satisfy the growing demands of customers. Other goods can be theoretically readily used, such as methanol, gasoline, other alcoholic beverages, coal, diesel, gas oil, dimethyl ether, natural gas, liquefied petroleum gas, natural compressed gas, liquid wood fuels, biofuels, hydrogen, etc. Fuel can be used to boost the characteristics of a commodity or to introduce new characteristics. It is typically formulated synthetically and used at low concentrations in the finished product (1-500 mg / kg).For conventional car oils a combination of several chemical additives is used to ensure the gasoline reaches the optimal level of performance. Fuel additives are chemical compounds that help to improve engine performance and to regulate pollution products. To protect the environment, fuel additives are largely associated with gasoline additives and oil-based fuels.

1.1 Additive Types

The forms of additive include oxygenates, ethers, anti-oxidants, anti-knocks, gasoline dyes, metal defects, corrosion inhibitors.

1.1.1 Oxygenates:

1.1.1.1 Di-methyl carbonate (DMC):

Oxygenated chemical compounds form a part of their chemical structure, containing oxygen. The term generally refers to the addition of oxygenated chemical compounds tofuels. Oxygenates are commonly used as additives to gasoline to reduce the carbon monoxide and soot created during fuel burning.

1.1.1.2 ETBE (ethyl tert-butyl ether):

ETBE— C2H5OC(CH3)3 can be synthesized by reacting to bioethanol (47%v / v) and isobutene (53 percent v / v) with heat through the catalyst, and ETBE helps reduce emissions of carbon dioxide (greenhouse gas) into the atmosphere through vehicles. As an additive to fuel, ETBE has been thoroughly studied in terms of its effect on exhaust emissions, post-treatment exhaust systems, evaporative emissions, cold storage, materials used in charging systems and others in engine-powered vehicles with spark ignition.

1.1.1.3 Methyl tert-butyl (MTBE) ether:-

Methyl tertbutyl ether (also known as MTBE, tert-butyl methyl ether, tertiary butyl ether, and TBME) is an organic

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chemical compound (CH3) 3COCOCH3. The MTBE is a flame retardant, sparingly water-soluble sticky substance, colorless. It has a strongly minty taste similar to diethyl ether and contributes to the poor taste and aroma of tea. MTBE is a filler for petrol used to improve the octane level as a source of oxygen. Its use in the US is disputed and decreases largely due to its prevailing agricultural and ethanol-friendly rules.

1.1.1.4 Ethanol or Ethyl Alcohol (C_2H_5OH): -

Ethanol is generally referred to as wine and liquor, as well as ethyl alcohol and drinking beers. It is the most common source of alcohol in alcoholic beverages, made from sugar-fermenting yeasts. It is a psychoactive medication and one of humanity's first recreational drugs. When taken in sufficient quantities, this may contribute to alcohol intoxication. It is used as a solutive, as a heat, as an antiseptical and as an active fluid in conventional (post-mercury) thermometers. It is a solid, flammable and colourless liquid, sometimes referenced as C2H5OH or C2H6O, with the simple formulation CH3CH2OH.

Table 1: Properties of Ethanol

PROPERTIES	ETHYL ALCOHOL
Physical Condition	Clear Liquid
Outlook	Colourless
Odour	Mild, pleasant, like Wine
Vapour Pressure	59.3 mm Hg at 20 ^oC
Viscosity	1.200 cP at 20 ^oC
Boiling Point	78 ^oC
Freezing/Melting Point	-114.1 ^oC
Solubility	Miscible
Specific Gravity	0.790 at 20 ^oC
Molecular Weight	46.0414
Molecular Formula	C_2H_5OH

1.1.2 Antioxidants:

Antioxidants are oxidant-inhibiting compounds. Oxidation is a chemical reaction capable of producing free radicals, resulting in chain reactions.

1.1.2.1 Butylated hydroxytoluene (BHT):-

Butylated hydroxytoluene (BHT) is a lipophilic biopsy compound, chemical related to phenols that is beneficial to their antioxidant properties, and is also called dibutyl hydroxytoluene, with a C_{15} $H_{24}O$ chemical formula.

1.1.2.2 2,4-Dimethyl-6-tert-butylphenol:-

2,4-Dimethyl-6-tert-butylphenol–$C_{12}H_{18}0$ is an alkylated phenol used industrially to avoid rubbing in oil and as a stabilizer ultraviolet to a clear liquid with a 21-23 degree Celsius melting point and a boiling point of 248-249 degrees Celsius. It is soluble and is not readily understood to be biodegradable in acidic, neutral, and alkaline liquids.

1.1.2.3 Ethylenediamine:-

The organic compound with formula C2H4(NH2)2 is ethylenediamine. This colorless liquid with a smell-like ammonia is a very simple amine.it which is highly alkaline and miscible with water and alcohol. It is hygroscopic and immune to sunlight, and absorbs carbon dioxide from the sun.

1.1.3 Antiknock Agent:

The antiknock agent is a fuel additive used to reduce engine knocking and improve the octane gasoline level by increasing the temperature and power of auto-ignition.

1.1.3.1 Ferrocene:-

This is the prototypical metallocene, a group of organometallic chemicals formed by two cyclopentadienyl chains which are bound on the opposite sides of the central metal atom.Ferrocene is an organometalline compound that has a composition $Fe(C_5H_5)_2$ Antiknock agents are ferrocene and its metabolites which are used with the S.I gas. Engines; stronger than tetraethyl pipe traditionally used. The ferrocene depot iron will generate a conducting film on the spark plug surfaces.

1.1.3.2 Toluene:-

Toluene - C7H8 is a water-insoluble and translucent solvent with the normal thinner paint smell. It is a mono-replaced benzene analog. Toluene can be used as an octane booster in diesel fuel used in internal combustion motors. Toluene is another part of a group of fuels used recently for jet fuel substitutes. The aromatic compound material of Toluene is used as a synthetic jet fuel. It's more heavy than air toluene vapour. It is less dense than water and floats even on water.

Table 2: Properties of Toluene

PROPERTIES	TOLUENE
Chemical Formula	C7H8
Molar Weight	92.140
Density	0.866 g/cm^3
Melting Point	-95 ^oC
Boiling Point	110.6 ^oC
Solubility	Slightly soluble
Physical State	Clear liquid
Vapour Density	3.1

1.1.3.3 Iron pentacarbonyl:-

The compound containing the formula Fe(CO)5 is ferrous pentacarbonyl, also known as iron carbonyl. Fe(CO)5 is a straw-colored, free-flowing fluid of the usual pungent

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aroma. This material is a reference to various iron products, many of which are important in organic synthesis. Fe(CO)5 is formed by fine iron particles carbon monoxide reaction.

1.1.3.4 Iso-octane or Trimethylpentane:-

2,2,2,4-Trimethylpentane is an organic compound containing either the formula (CH3)3CCH2CH(CH3)2 or isooctane. It is an isomer of several octans (C8H18). The unique isomer is the standard 100 level on the octane scale of the classification (the zero point is n-heptane). It is an essential part of the fuel that is often used in relatively large amounts to increase the knock strength of the oil.

2. Experimental Setup

A single-cylinder, air-cooled 4-Stroke S.I engine setup shall be considered at the rated power for experimental purposes. In a petrol engine at constant speeds, the effects of additives on fuel combustion and emissions will be analyzed separately at different charges. Composite fuel additives will be added to different proportions in petrol, and their impact on engine performance and emission will be measured. For testing purposes, a 4 Gas Analyzer measuring Carbon Monoxide (CO), Carbon Dioxide (CO2), Fuel Dependent Hydro Carbons (HC), Oxygen (O2), and Nitric Oxide (NOx) is used.

Table 3: 4 Gas Analyzer Specifications

O_2 Cell Type	Electro - Chemical
Power Supply	230 +/- 10%, 50Hz, 60V, 60W Max
Flow Rate	5 Litres / Min Nominal
Measuring	Maximum Range
CO	0 – 10 %
HC	0 – 10000 PPM
CO_2	0 - 20 %
O_2	0 – 25 %

Figure 1:4 Gas Analyzer

3. Experimental Procedure

The motor tests were performed at a fixed engine speed on most articles. Since experimentally reaching safe operating conditions, the motor was exposed to identical charging conditions. The engine was calibrated before all experiments were carried out. An attempt was made to conduct both trials without major changes in the temperature of the inlet air and to lubricate the oil temperature as a means to avoid possible differences in engine operation during the testing and, in particular, to avoid inconsistencies in the engine test. Originally, the engine tests were conducted with 100% fuel and the working characteristics of the engine and the pollutant emissions that define the operation of the engine baseline were determined. Similar procedure was carried out under the same operating conditions, with different additives being fuelled consecutively by the pump. Experimental results have been collected and a study of the influence of the composite additive on pollution. After the gas analyzer switch was switched on, the hose and the probe were connected. The Analyzer Probe is placed at the exhaust and the emission levels have been measured.

4. Results

The impact of the percentage of ethanol and toluene on CO, HC and NOx in the gasoline blend is shown in Fig 1-3. Compared with the gas gasoline, CO emissions reduce with specific mixtures. Such pollutants are reduced due to better combustion. At 5 per cent toluene volume mix, the lowest CO emission is comparable to other pollutants shown in Fig 1. Figure 2 indicates that the production of NOx decreases with different blends when opposed to gasoline petrol. Figure 3 indicates that HC emissions are rising for different blends as opposed to gas gasoline. It can be seen that for all engine torque values 5 percent of toluene blends, the production of CO and HC increases.

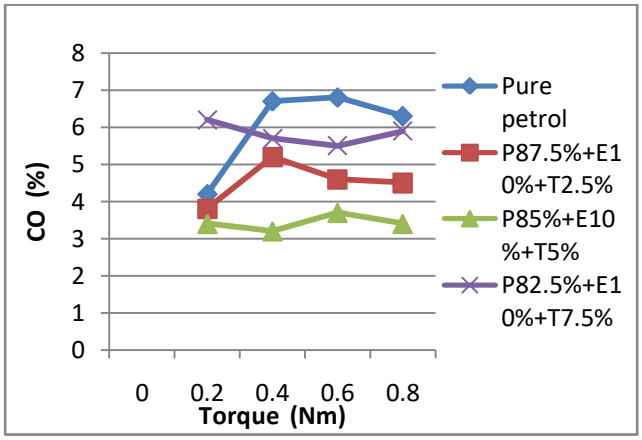

Figure 2: Engine torque vs CO emission

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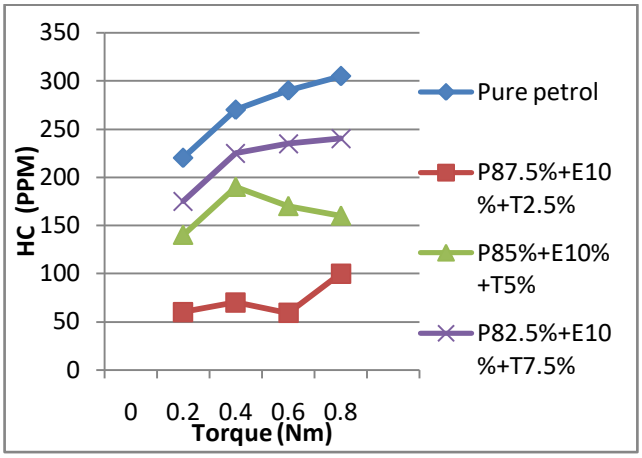

Figure 3: Engine torque vs HC emission

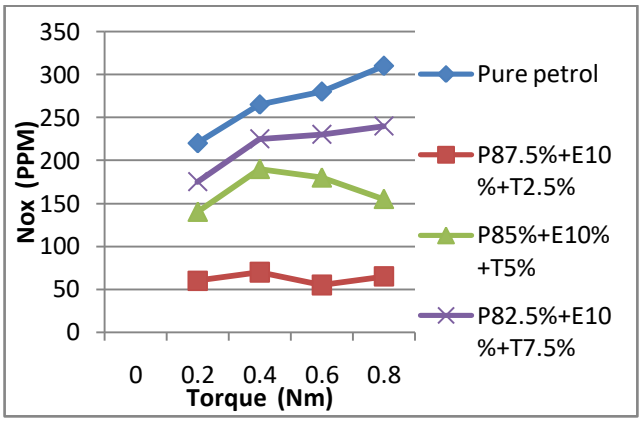

Figure 4: Engine torque vsNOx emission

5. Conclusion

1. The use of ethanol and toluene in the unleaded gasoline blend resulted in a significant reduction in exhaust emissions by about 36.58 per cent and 34.35 per cent of the mean CO and HC emissions for all engine torque, while NOx emissions increase for all engine torque levels.
2. Nonetheless, for all automotive torque levels, ethanol and toluene fuel blends ethanol and diesel fuel blends provide the least improvement in HC and CO output and a significant increase in NOx emissions.
3. Of all fuel mixtures, 5 per cent for toluene and 10 per cent of ethanol added to gasoline produced the highest level of pollution control.

REFERENCES

[1] Lothar Franz, Juergen Mohr, Peter Schreyer, "Oil additives including the ingredients, their processing and diesel engine oils." United States Patent 5.567.845, 1996.

[2] AM Danilov, "Evolution and use of fuel additives in 1996-2000." Fuels and Oils Science and Engineering, 444–455, 2001. Springer springer.

[3] John D Bartleson,. US patent 2,935,390, 1960, "fuel additives."

[4] B.D. Sivakumar, M. Arulmozhi, T. Senthil Kumar, "S.I. success & publication. Oxygenated diesel system. IEEE-The Convention Group.

[5] Wei dong Hsieh, Rong–hongchen, "An S.I engine's engine's engine output and pollutant pollution use ethanol–gasoline blended fuels." Ambient Ambient 36 (2002).

[6] D. Balaji, Dr. P. Govindarajan, "Influence of isobutanol mix in gasoline and ethanol-operated spark ignition engine performance and pollution." Science and technology in the International Journal of Technology.

[7] C. Anish Raman, Dr. K. Varatharajan, "MTBE Study as an Oxygenate Additive to Gasoline."International Journal of Science and Development of Technology.

[8] S. Babazadehshayan, F. ommi, S.M. Seyedpour, "the effect on fuel properties of oxygenates combining with gasoline." Magazine of Power & Technology Global.

[9] Mr. Satish S Ragit, MrAmit R Patil, "Chemical Analysis Study of Gasoline Fuel Mixed with Composite Additive." The International Journal of Latest Engineering and Technology Trends.

[10] M.V. Mallikarjun, Venkata Ramesh Mamilla, "Experimental review of exhaust emissions & multi-cylinder S.I engine performance measurement when used as an additive for methanol." European Ingeniery and Research Magazine.

[11] Sahib shihahahmed, "Methanol impact-gasoline combines efficiency and emissions on S.I generators." World Journal of Mechanical Engineering & Mechatronics.

[12] H.S. Farkade, A.P Pathre, "Methanol, Ethanol and Butanol experimental investigation mixes with S.I engine gasoline." Global Emerging Technology News, and Advanced Engineering.