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EXPERIMENTAL INVESTIGATION OF EMISSIONS IN MPFI SI ENGINE BY USING IAA & IBA BLENDS WITH GASOLINE

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Abstract

The global supply of fossil fuels is finite and is predicted to run out in the next 65 years. The focus has been on clean, renewable, and sustainable nonpetroleum fuels due to the quick depletion of the global crude oil supplies and environmental concerns. Development of conventional fuel for IC engines is necessary due to the energy crisis and environmental damage caused by fossil fuels. There have been several studies done on utilizing Isoamyl Alcohol and Isobutanol as a fuel in SI engines. Current study, effect of Isoamyl alcohol (Isopentanol or 3-methyl 1-butanol) and Isobutanol/gasohol fuel proportions on SIE emission parameters were investigated. The multi-point fuel injection system is more environmentally friendly because it reduces the amount of dangerous chemicals that are released when fuel is burned. Fewer harmful byproducts are produced when fuel burns inside the engine because fuel is delivered to it more precisely. The tools used by the engine to clean the exhaust have been improved through a multi-point system of fine tuning. Therefore, multi-point systems result in cleaner air and an engine. For the purpose of defining emissions, tests were carried out on CRs (11.0:1) at three different engine rpm's ranging from 2000, 3000, 4000 and 5000 using four different fuel blends (B0, 100% petrol, B10, 90% petrol, 10% Isoamyl alcohol and 10% isobutanol), and B20, 80% petrol, 20% Isoamyl alcohol and 30% isobutanol). According to experiment results, using Isoamyl alcohol reduced exhaust emissions values when compared to using petrol. From the experimental work it is observed that when speed increases all emissions (CO,CO_2,O_2,HC & NO_X) are also increased against maximum speed of 4500 rpm.

Keywords: Emissions, IAA,IBA, MPFI , IC Engine.

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Introduction

Fossil fuel consumption is increasing greenhouse gas emissions into the atmosphere, which has adverse consequences on both humans and the ecosystem [1]. Due to their resemblance to gasoline, alcohol fuels make excellent choices for alternative fuels for engines [2]. Spark ignition engines may utilize it as fuel because of the large octane number amount of alcoholic fuels and content of oxygen in the atomic nature. Use of Isoamyl alcohol as a fuel is therefore crucial for evaluating waste [3]. Researchers have been considering large alcohols with as high as multiple atoms in recent years due to their decreased hygroscopicity, greater fuel volume, improved ignition quality, and ease of proportions with traditional working substances. [4-5]. For isopentanol, Sarathy et al. have presented fresh experimental findings. For isopentanol/air mixes, the shock pipe ignition delay time was studied at various equivalence ratios, between 819 and 1252 K in temperature, and between 40 and 60 bar in atmospheric pressure. The results of the investigation reveal that the generated model is sufficiently comparable, as evidenced by the data collected from a wide variety of experimental settings [6]. In order to thoroughly investigate the combustion chemistry of isopentanol, Lucassen et al. used a spectrometer in premixed small flames. On the basis of previous research results will help to improve the model that has been explored. [7]. About 64% of the waste product, called fusel oil, Isoamyl alcohol, 15% isobutyl alcohol, 10% water, 9% ethanol, 1% n-butyl alcohol, and 1% n-propyl alcohol are also present[8]. The ideal substitute for ageing fossil fuels is an alternative fuel since it can be generated responsibly, reduces pollution, and requires less oil imports. RCCI engines were used in this study for a number of trials, which were controlled via wire throttle settings [9]. One of the most practical and economical options for reducing smoke and NOx emissions is a new type of IC engine called RCCI[10]. In truth, resources are utilized efficiently, however, both light-duty and heavy-duty engines use more fuel. Isoamyl alcohol is widely present in unwanted sugar mill waste. It compares different alcoholic fuel qualities for spark-ignition engines with multi-point fuel injection. [11]. Because of the interaction of a small cetane number, a larger latent heat of vaporisation, and a small kinematic viscosity of conventional fuels when analyzed with the base fuels, unburned hydrocarbon and carbon monoxide emissions increased despite the presence of in-fuel oxygen. This was caused by the ternary blend's lower levels of smoke opacity and brake-specific nitrogen oxides, which were seen during engine operation with a ternary blend because higher played a dominant role[12]. A simpler (cheaper) sensor set may be employed if the controller performance criteria are relaxed, according to the framework. Here, for the first time, we apply the sensor selection and controller co-design method to turbocharged engines that use exhaust gas circulation. To verify the method, high quality GT-Power simulations are performed[13]. The world's fossil fuel supplies are finite and are anticipated to run out in the next 65 years. Clean, renewable, and sustainable nonpetroleum fuels have received a lot of attention recently due to the quick depletion of the world's crude oil supplies and environmental concerns. The need for alternative fuels is driven by the energy crisis and the environmental damage caused by fossil fuels. Some studies have been done with SI engines running on ethanol as fuel. Use of ethanol blends with gasoline is required in several nations. The quantity of published works on carburetor type SI engines running on gasoline-ethanol mixtures[14].

Research Methodology

Choosing a Research Engine test configuration with 3 cylinders, 4 strokes, MPFI engine. The concept is to investigate Emission characteristics of Petrol with blends of IAA & IBA by selecting the MPFI SI research engine with wire throttle technique in the manner described below.

- By varying the blend ratio from B 0 to B 20 in relation to the speed from (2500,3000,3500, 4000 & 4500).

Experimental setup and procedure

Now a days, Fuels play an important role in the lives of future generations. Several alternative fuels are employed to keep the world running. Alternative fuels with a high octane rating, such as alcohol, emit less pollutants. Although resources are efficiently utilized in general, fuel consumption is higher in light and heavy-duty engines. The foundation fuel in this experiment is Petrol, with the remaining fuels being primary alcohols like Isoamyl alcohol and Isobutyl alcohol. We may vary speed and load in the MPFI research engine by employing the wire throttling approach.

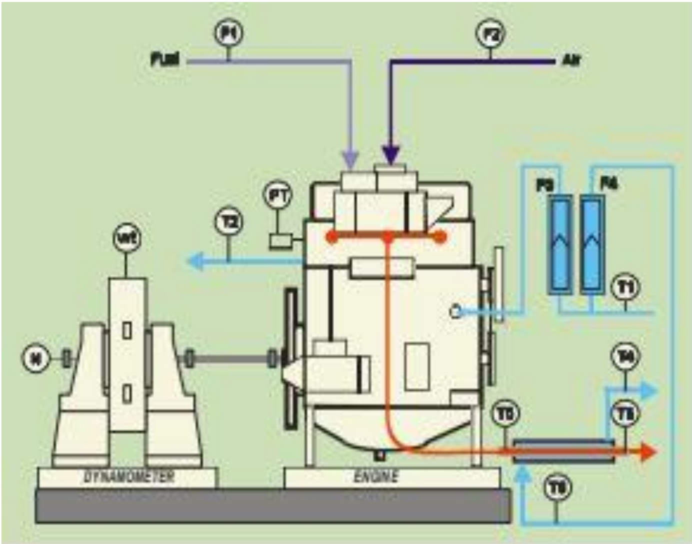


Fig. 1 Engine Front View

This research engine uses different mixes of B0, B5, B10, B15, and B20 at varied speeds. MPFI is a method of injecting fuel into an internal combustion engine through multiple ports on each cylinder's intake valve. It delivers the exact quantity of fuel to each cylinder at precisely the right time.

EngineSoft is a Lab view-based software suite for tracking engine performance, and it was built by Apex Innovations Pvt. Ltd. The bulk of engine testing application requirements, including monitoring, reporting, data entry, and data logging, can be satisfied by EngineSoft. The programme assesses power, efficiency, fuel use, and heat emission. The experiment was conducted at Apex Laboratories in Shangli, Maharashtra, and the details were reported.

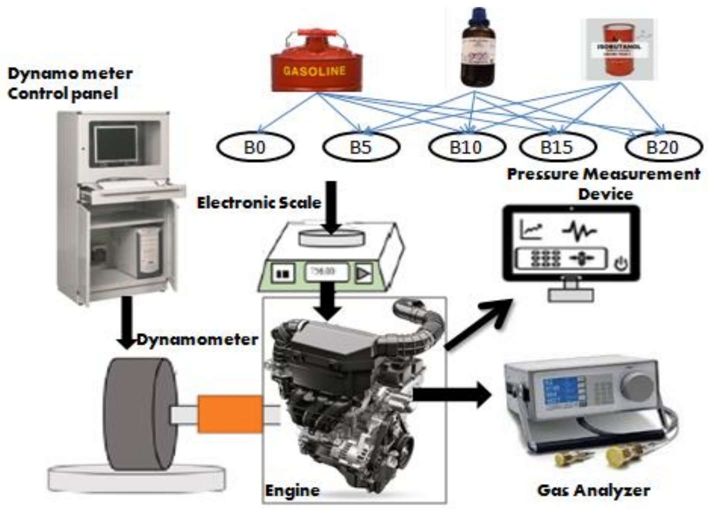


Fig. 2 Engine Flow Diagram

The experimental setup is outlined in Table 1. It may be set up dependent on the engine's settings. Varied graphs are produced under various operating situations. During on-line testing of the engine in RUN mode, the vital signals are scanned, recorded, and plotted on a graph. To show the data in graphical and tabular forms, the saved data file is accessed.

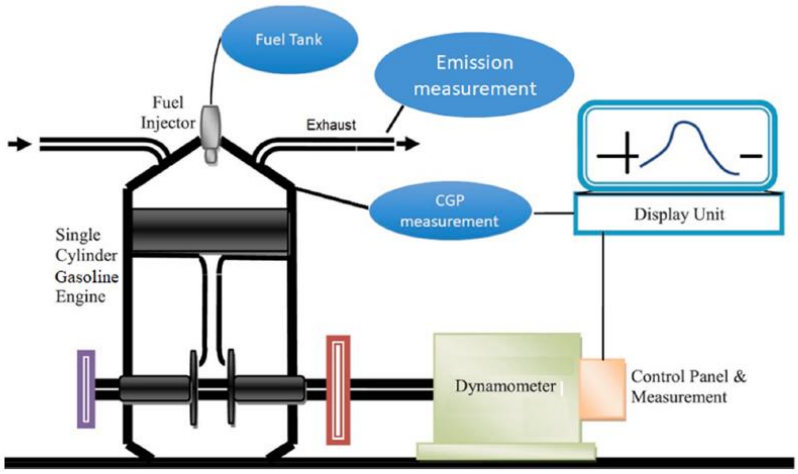


Fig. 3 Measurement Components

Evaluation of waste products has become more significant in recent years. The waste product from sugar factories known as fusel oil contains a significant amount of Isoamyl alcohol. When used as fuel, alcohols with high octane numbers produce fewer emissions. In this study, a spark ignition (SI) engine's outcomes and ejections were improved by using Isoamyl alcohol at high compression ratios (CR).

Fig. 4 Experimental Setup

The experiments were conducted with various fuels, including At maximum load, different CRs (8.0:1, 8.5:1, and 9.0:1), and different speeds (2600, 2800, 3000, and 3200 rpm), the following fuels were tested: A0 (%100 petrol), A10 (%10 Isoamyl alcohol-%90 petrol), A20 (%20 Isoamyl alcohol-%80 petrol), and A30 (%30 Isoamyl alcohol-%70 petrol). The data show that compared to using petrol, using Isoamyl alcohol at all CRs reduced exhaust emissions. The use of A30 resulted in approximately 12.2%, 35.6%, and 6.45% lower than CO, NOx, and HC outs when compared to petrol. Using the energy conservation equation and a known recorded cylinder pressure trace, the combustion heat release rate can be computed.

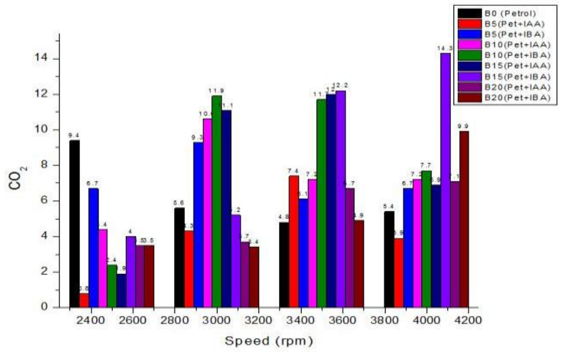
$$\frac{dQfuel}{d\phi}=\frac{dU}{d\phi}-\frac{dW}{d\phi}-\frac{dQwall}{d\phi}$$

Test Engine Specifications

Item	Specifications
Model	Maruti S-presso
Manufacturer	Maruti Udyog Ltd.
Type	Petrol -Three Cylinder inline
Cooling	Water Cooled
Displacement	998cc
Compression ratio	11.0:1
Maximum Power	43.20 kW@ 3500 rpm
Cylinder Bore and Stroke Length	73.00(mm) and 79.50(mm)

Results and Discussion

The Emissions values from the experiment are recorded and it was generated and simulated by using origin software. The Blend B0 (100%Petrol) , B5 (95% Petrol and 5% IAA), B5 (95% Petrol and 5% IBA), B10 (90% Petrol and 10% IAA) , B10 (90% Petrol and 10% IBA), B15 (85% Petrol and 15% IAA) , B15 (85% Petrol and 15% IBA) , B20 (80% Petrol and 20% IAA) and B20 (80% Petrol and 20% IBA) are considered and speeds from 2500 to 4500 rpm are recorded. Here X Axis is considered as Speed (rpm) and all the Y axis are consider with emissions (CO, CO_2, O_2,HC & NO_X).



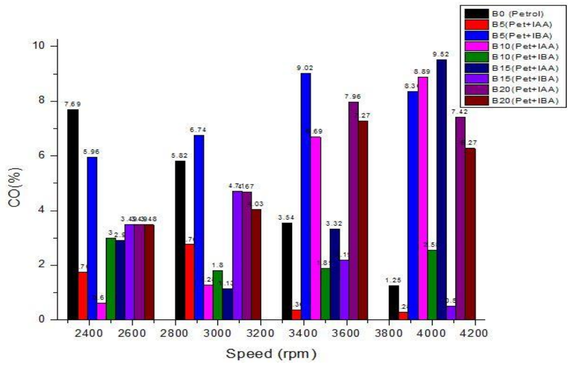
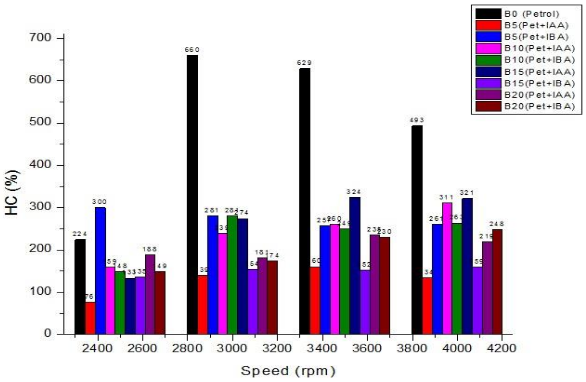


Figure No 1. Speed Vs CO Emissions

Figure No 2. Speed Vs CO_2 Emissions



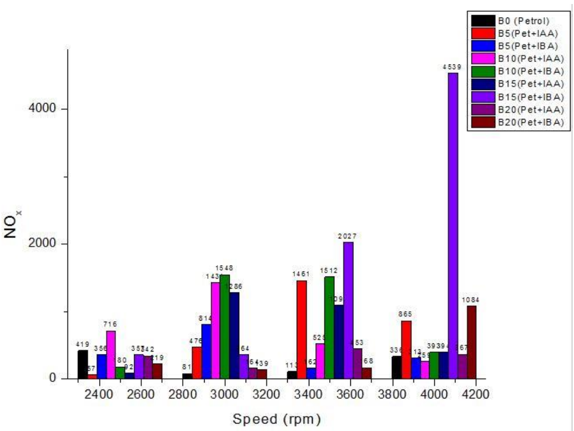


Figure No 3. Speed Vs CO Emissions

Figure No 4. Speed Vs CO Emissions

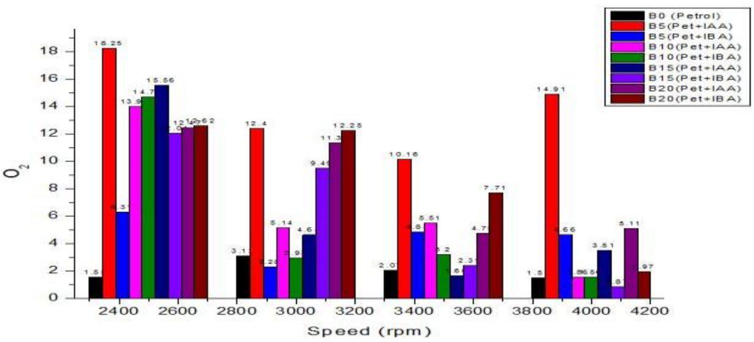


Figure No 4. Speed Vs CO Emissions

Conclusions

- Referring to the figure No 1. As speed increases CO emissions are increased. At maximum speed of 4500 rpm for B0 CO value is noticed as 1.25 % , for Pet+ IBA(B20) it was noticed as 6.27%. The CO emissions for Petrol + IAA are also less than Pet+ IBA at the same speed.
- Referring to the figure No 2. As speed increases CO_2 emissions are

increased. At maximum speed of 4500 rpm for B0 CO_2 value is noticed as 5.5 % , for Pet+ IBA(B20) it was noticed as 9.9 %. The CO emissions for Petrol + IAA are higher than Pet+ IBA at the same speed.

- Referring to the figure No 3. As speed increases HC emissions are increased. At maximum speed of 4500 rpm for B0 HC value is noticed as 149 % , for Pet+ IBA(B20) it was noticed as 248 %. The CO emissions for Petrol + IAA are lower than Pet+ IBA at the same speed.
- Referring to the figure No 4. As speed increases NOX emissions are increased. At maximum speed of 4500 rpm for B0 NO_X value is noticed as 419 % , for Pet+ IBA(B20) it was noticed as 1084 %. The CO emissions for Petrol + IAA are lower than Pet+ IBA at the same speed.
- Referring to the figure No 5. As speed increases O2 emissions are increased. At maximum speed of 4500 rpm for B0 O_2 value is noticed as 6.2 % , for Pet+ IBA(B20) it was noticed as 4.97 %. The O_2 emissions for Petrol + IAA are higher than Pet+ IBA at the same speed.

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