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Performance Evaluation of Ambassador Car Spark Ignition Engine Using Aniline-Petrol Blends

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ABSTRACT

Alternative fuels are gaining more and more importance due to increasing oil prices, and environmental concerns. Producing and using renewable transportation fuels is one approach for sustainable energy future for the world. A renewable fuel not only contributes lesser global climate change but also they have potential to preserve the agricultural activities. Alcohols are very promising alternative fuels for Spark Ignition engines. This paper presents performance analysis of Ambassador Car engine carried out using different aniline-petrol blends. The experimentations have been carried out with an aim of obtaining comparative measures of fuel consumption rate, brake thermal efficiency and exhaust gas temperature. The attained results show that that blend containing up to 20% aniline can perform successfully in engine without any design modification.

Keywords: Alternative fuels, aniline, Blending, S.I. engine performance.

INTRODUCTION

The awareness of the effect emissions on the environment has risen in the last two decades. This has caused strict regulations of emissions. Most of the fuels commercially available today are fossil fuels. There are two major disadvantages of using fossil fuels; the source will eventually depleted and the usage results in an environmental pollution. The study of alternative fuels has become increasingly important due to these problems. The use of renewable fuels is the key to overcome these problems. Fuels that are created from a renewable feedstock are often known as alternative fuels and generally are eco-friendly. Among different alternatives for petrol in S.I. engine, alcohols are considered to be most promising alternate. The properties of alcohols are quite close to petrol. [1-2]

Aniline (also called aminobenzene) is an oily, flammable liquid. It occurs naturally in some foods. It is produced in very large amounts (1 billion pounds in 1992) by seven companies in the United States. U.S. demand is likely to increase 3% to 4% per year for the next several years. The largest users of aniline are companies that make isocyanates, especially methyl diphenyl diisocyanate. Other companies use aniline to make pesticides, dyes, and rubber. Companies also use smaller amounts of aniline to make drugs, photographic chemicals, varnishes, and explosives. Exposure to aniline can occur in the workplace or in the environment following releases to air, water, land, or groundwater. It enters the body when people breathe air or consume food or water contaminated with aniline. It can also be absorbed through skin contact. It does not remain in the body due to its breakdown and removal. [3-4]

OBJECTIVE

The purpose of this experimental investigation is to study the effect of using various blends of aniline and petrol on performance of Ambassador Car engine. Pure petrol was used as a reference fuel. The main objectives of this work are:

i. To compare important properties of aniline with petrol.
ii. To analysis short-term performance of Ambassador car engine when operated on three different blends of aniline and petrol.
iii. To compare the obtained results with those of pure petrol.

The blends of aniline and petrol were prepared on volume basis. The following nomenclature is used in this work A20: 20% vol. of aniline and 80% vol. of petrol and PP: Pure petrol.

FUEL CHARACTERIZATION

The important properties of aniline are compared with petrol in Table 1.

Table 1: Important properties of aniline in comparison with petrol [5-7]

PROPERTIES	Aniline ($C_6H_5NH_2$)	Methanol (CH_3OH)	Ethanol (C_2H_5OH)	Butanol (C_4H_9OH)	Petrol (CH_8H_{18})
Molecular weight (kg/ kmol)	93.13	32.0	46.01	74.1	114.0
Density (kg/cm^3)	0.102	0.793	0.785	0.810	0.765
Air-fuel ratio	11.6	6.5	9.0	11.2	14.6
Calorific value (MJ/kg)	31.4	22.7	26.9	29.2	44.0
Heat of vaporization (MJ/kg)	3.394	1.2	0.92	0.43	0.36
Research Octane Number	98	136	129	96	91–99
Motor Octane number	79	104	102	78	81-89

It can be seen from the Table 1, alcohols have lower calorific value than petrol and aniline. Also air-fuel ratio is less than petrol. Thus, need to run richer than gasoline. The fuel in an engine has to be vaporized before it will burn. Insufficient vaporization is a known problem with alcohol fuels during cold starts in cold weather. As the latent heat of vaporization of aniline is nearly half of that of ethanol, an engine running on aniline should be easier to start in cold weather than one running on ethanol or methanol. [3, 7]

Alcohol fuels have less energy per unit weight and unit volume than gasoline. To make it possible to compare the net energy released per cycle a measure called the fuels specific energy is sometimes used. It is defined as the energy released per air fuel ratio. The net energy released per cycle is higher for aniline than ethanol or methanol and about 10% higher than for gasoline. The octane number of aniline is closAlcohol fuels have less energy per unit weight and unit volume than gasoline. A fuel with a higher octane rating is less prone to knocking and the control system of any modern car engine can take advantage of this by adjusting the ignition timing. This will improve energy efficiency, leading to a better fuel economy than the comparisons of energy content different fuels indicate. By increasing the compression ratio, further gains in fuel economy, power and torque can be achieved. [9-12]

EXPERIMENTATION

The experimental setup consists of four cylinders, four stroke, water-cooled stationary Ambassador car engine mounted on rigid base frame. The specifications of the test engine are given in Table 2.

Table 2: Specifications of test engine

Engine Make	Ambassador Car Engine
Type	Four-stroke, water-cooled SI engine
Number of Cylinder	4
Length of Stroke	0.091 m
Cylinder Diameter	0.073
Compression Ratio	8.3:1
Dynamometer	Hydraulic

Constant speed performance tests were carried out on the above engine using petrol and three different fuel blends of aniline and petrol. First the engine was run with petrol and different parameters were recorded. The tests were performed at a constant speed of 1200 r.p.m. The experiments were repeated using various blends of aniline-petrol. The following quantities were recorded during the experiments:

i. Speed of the engine
ii. Load on the engine
iii. Specified mass of the fuel consumed
iv. Time for this mass of fuel consumed
v. Temperature of exhaust gas

RESULTS AND DISCUSSIONS

Experimental results in the form of fuel consumption rate, brake thermal efficiency and exhaust gas temperature variations with brake power for petrol and blends of aniline -petrol are expressed in the form of graphs.

The comparison of fuel consumption rate with brake power for petrol and blends of aniline - petrol are shown in Figure 1. Fuel consumption rate increases with increase in brake power for all fuel blends and reference fuel. This increase is proportional to the thermal efficiency of the engine. For blend containing 20% aniline, values of fuel consumption rate at lower loads are slightly lower in comparison with petrol.

The variations of brake thermal efficiency with brake power for petrol and blends of aniline-petrol are shown in Figure 2. It can be seen that the brake thermal efficiency of an Ambassador Car engine with all fuel blends follow a similar trend as that of petrol. That is, brake thermal efficiency increases with increase in brake power. For blend containing 20% aniline, at lower loads, higher brake thermal efficiency was observed in comparison to petrol.

The variation of exhaust gas temperature using aniline blends and reference fuel is shown in Figure 3. The exhaust gas temperature increases with engine load, due to increase in the quantity of fuel used. The exhaust gas temperature with aniline blends was found to be lower as compared to reference fuel operation. Further, exhaust gas temperature decreases with increase in concentration of aniline in fuel blend and was found to be minimum with blend containing 20% aniline. At maximum brake power, exhaust gas temperature with A20 was 410°C as against 450°C with PP.

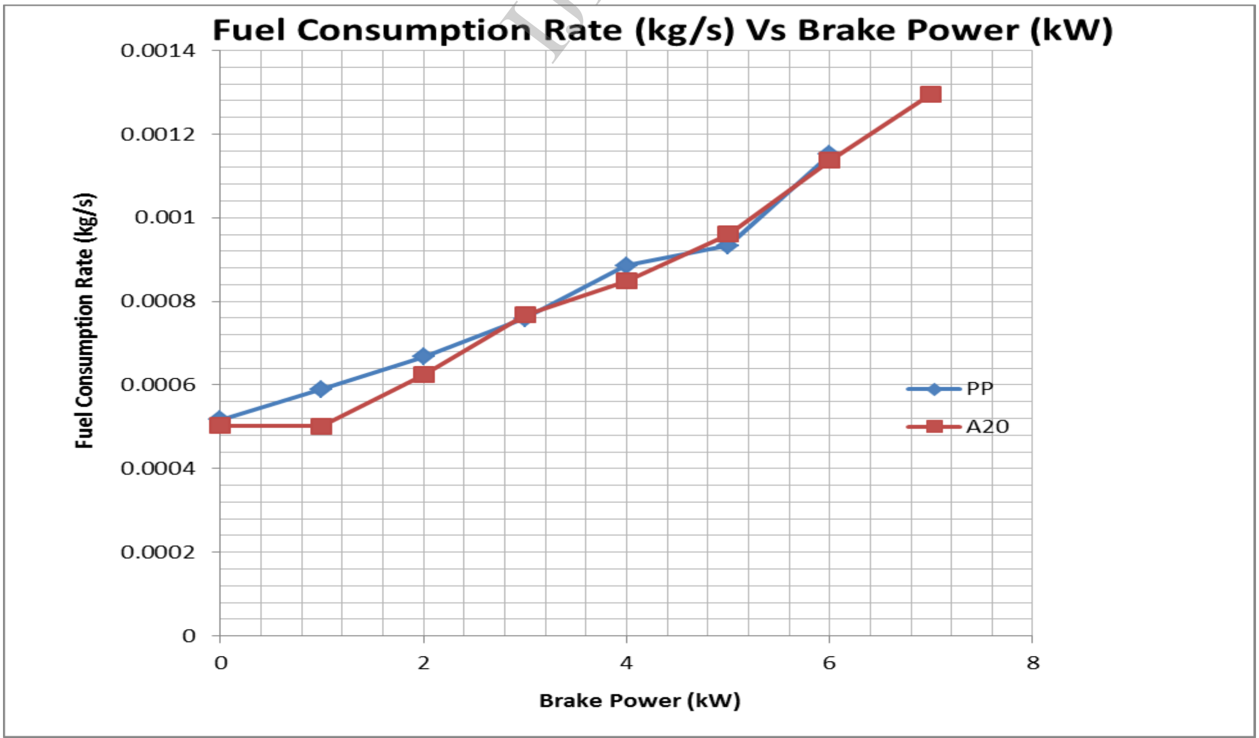

Figure 1 Fuel Consumption Rate vs. Brake Power

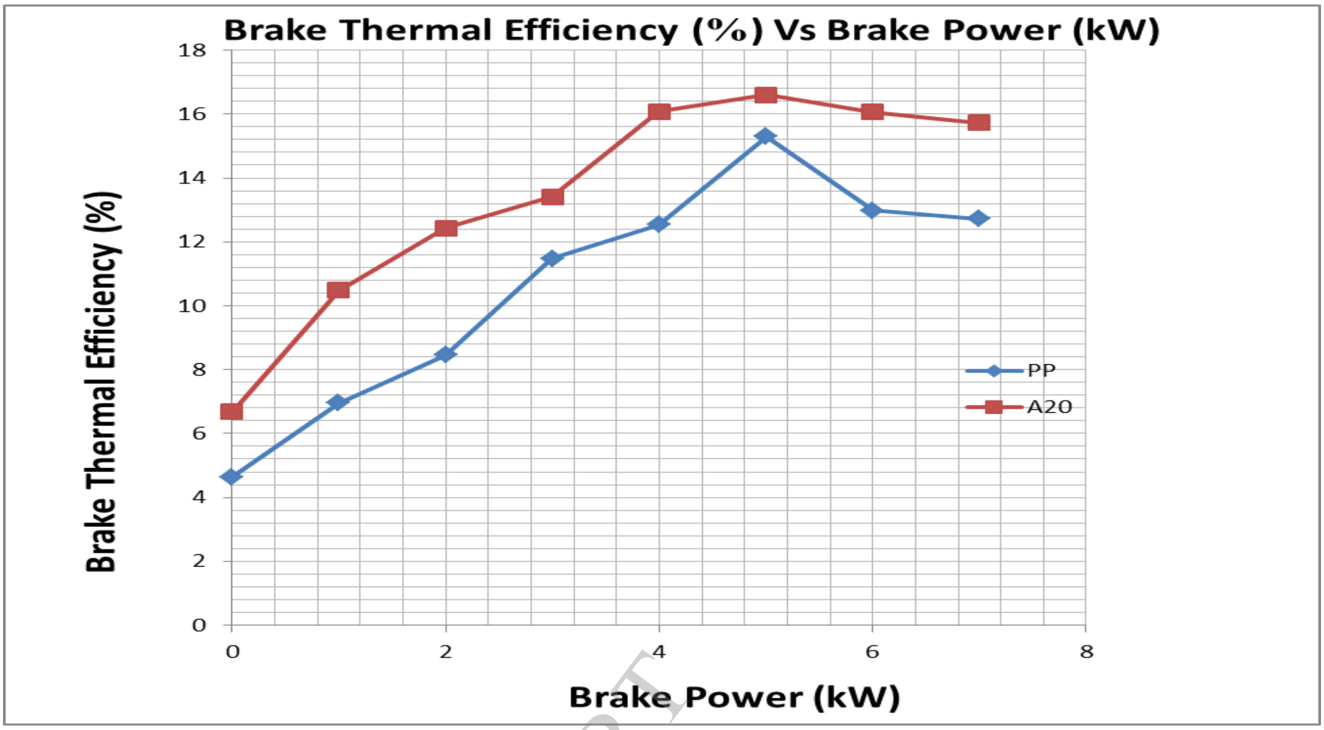

Figure 2 Brake Thermal Efficiency vs. Brake Power

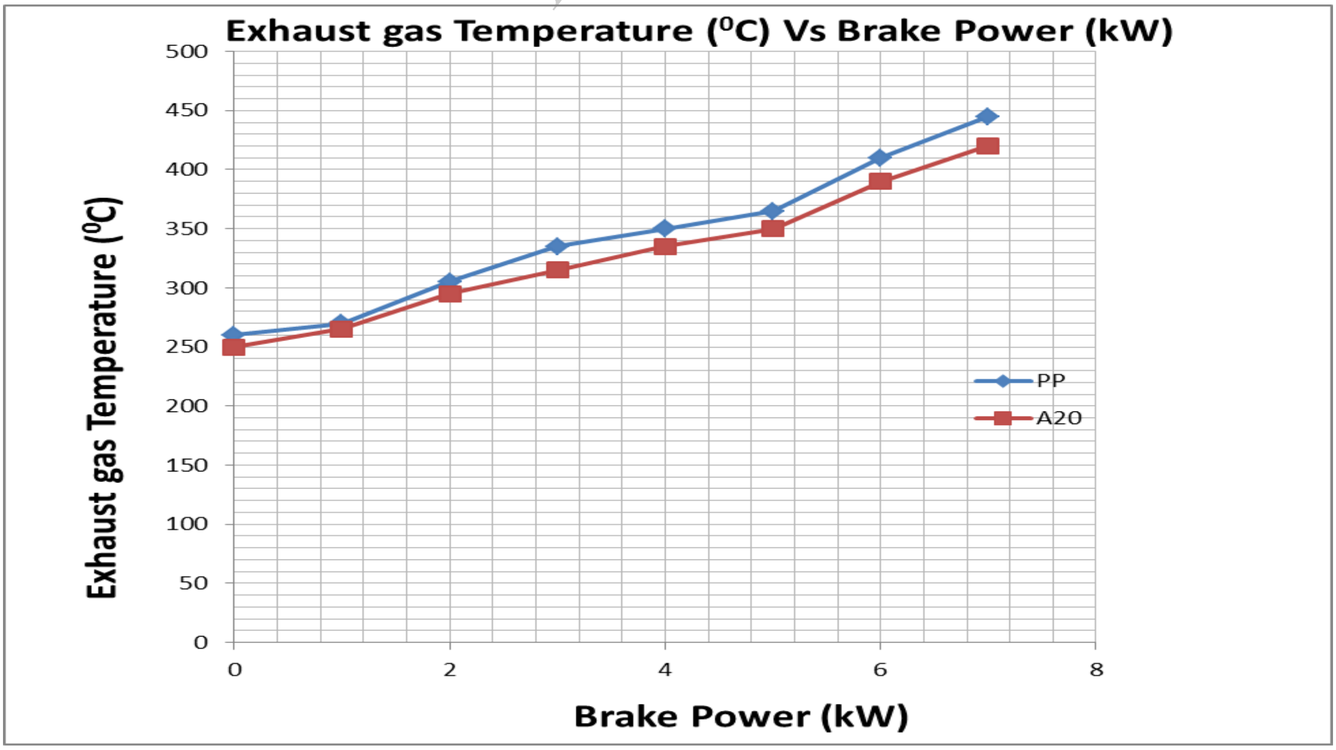

Figure 3 Exhaust Gas Temperatures vs. Brake Power

CONCLUSIONS

Aniline can be used as alternative fuel due to favorable physical properties and safety. Fuel consumption rate and brake thermal efficiency increases with increase in brake power for all fuel blends. Plots for fuel blends follow a similar trend as that of petrol. For blend containing 20% aniline, at lower loads, higher brake thermal efficiency and lower fuel consumption was observed in comparison to petrol. Lower exhaust temperature was observed with aniline blends as compared to reference fuel. It can be concluded that Ambassador Car engine can be successfully operated with blends of aniline-petrol up to 20% without any engine modification and operational difficulty.

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