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Research Paper

EXPERIMENTAL INVESTIGATION OF DIESEL ENGINE USING GASOLINE AS AN ADDITIVE

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In the present study the effects of gasoline has been investigated empirical in a single cylinder vertical diesel engine for gasoline-diesel mixture. The effects of 0% 4%, 8% and 12% (by volume) gasoline mixed directly to diesel and the effect has been looked upon experimental at speed of 1000 (rpm). From experimental results it is determined that by application of gasoline addition effective power output increases at the level of 4-9% and fuel consumption decreases by approximately 6%. In this study we found that increasing the gasoline volume fraction decreased the fuel density, kinematic viscosity, and surface tension. The blending of gasoline caused a decrease in droplet size by increasing the small droplets and decreasing the large droplets because the surface tension decreased with the addition of gasoline fuel, thereby inducing an increase in droplet instability. On the other hand, gasoline blending resulted in an extension of the ignition delay and the formation of a more homogeneous mixture. These combustion characteristics caused the simultaneous reduction of NOx and soot. However, the HC and CO emissions were slightly increased. The difference in HC and CO emissions between pure diesel and gasoline blended diesel fuels decreased as the engine load increased. An increase in engine load diminished the effects of gasoline blending on combustion performance and exhaust emissions.

Keywords: Internal combustion engine, Gasoline, Diesel, Emission, Ignition, Detonation

INTRODUCTION

The main inspiration for this study is that in hill areas, heavy vehicles laden with heavy loads in hill areas, they mix certain amount of petrol along with diesel, by investigating the fact behind it was known to improve power of the engine thereby carrying more load. The intension of the study is that to analysis the above situation in detail and understands the effects of emission, power, efficiency, etc., on petrol-diesel mixture at different ratios and loading conditions in the case of compression ignition engines. This study is more into public awareness, which

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proves the merits and demerits of mixing under above conditions.

DIESEL ENGINES

Diesel engines are the most efficient liquid fuel burning prime movers. But they suffer from various disadvantages. Their limited speed range is the main disadvantages, particularly for vehicle applications. The rotational speed (rpm) of diesel engine cannot be chosen at high levels because of ignition delay. For this reason and as a result of various effects such as high pressure levels and low equivalence ratios, etc., a diesel engine is heavier than an equivalent gasoline engine. Ignition delay can be reduced and the engine speed can be increased by using particular injection or combustion systems. Pre combustion chamber and piston bowls are examples of these systems. Thus, the formation of fuel-air mixture is enhanced by additional gas motions, so ignition delay would be decreased and fuel injection pressures at 7-14 MPa levels would be sufficient. Also, single hole nozzles and cheaper fuel systems could be used. By choosing high engine speeds and higher equivalence ratios, lighter engines for vehicles can be obtained. But the pre combustion chamber increases the combustion chamber surface area and causes additional heat losses and higher brake-specific fuel consumption. On the other hand, high injection pressures at 100-150 MPa levels are selected by using special injection techniques, for example, common-rail system, in recent years. But for this solution advanced technology is necessary and more expensive.

A diesel combustion engine operating via a compression ignition method has higher thermal efficiency and lower fuel consumption characteristics than a gasoline combustion engine operating via a spark ignition method; hence diesel engine vehicles are currently popular and widespread. However, there still exist environmental challenges to be addressed, such as the reduction of nitrogen oxides (NOx) and soot emissions.

Low Temperature Combustion (LTC) allows the simultaneous reduction of NOx and soot emissions. The LTC strategy is based on the prevention of local fuel-rich mixture regions and the reduction of the in-cylinder combustion temperature. To realize this combustion concept, a high Exhaust Gas Recirculation (EGR) rate was applied to the conventional diesel engine. This method effectively reduces NOx emissions by reducing the intake oxygen concentration and increasing the heat capacity of in-cylinder mixture gas in the combustion chamber. In addition, this method retains the portion of diffusion combustion, and improves the premixed combustion by extending the ignition delay. Premixed Charged Compression Ignition (PCCI) combustion is the represent LTC strategy.

Extending the ignition delay is the best way to form a homogeneous mixture because it allows sufficient time for mixing. In addition, extension of the ignition delay is possible by reducing the cetane number by adding fuel with low-cetane and high-octane numbers, and relevant studies are being conducted by many research groups. Representative low-cetane number fuels are ethanol and gasoline fuel.

GASOLINE ADDITION

In the presented study, a single cylinder naturally aspirated vertical four stroke compression ignition, water cooled experimental engine manufactured by field marshal is used. The main characteristics of the engine are: rated speed is 1000 rpm, rated power is 7.35 kW, bore diameter 114.3 mm and stroke length is 139.7 mm.

As the engine is a constant speed engine rpm is set to 1500 and hence the torque remains same under all the conditions above figure shows the representation of this statement. Total fuel consumption reduces in range of 4-8% by volume of gasoline addition on diesel and power increased. After this ratios, effective power decreases because of deterioration happened in the combustion and increasing of detonation tendency.

Figure 1: Brake Power vs Load

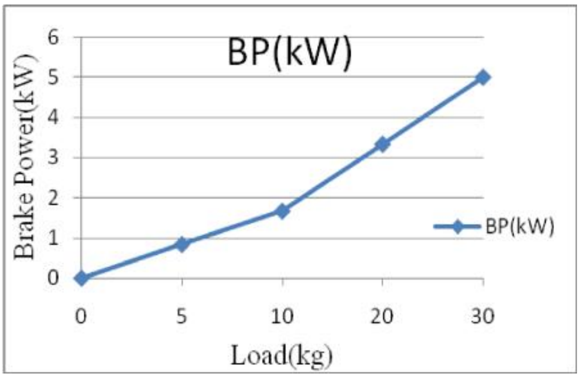


Figure 2: Torque vs Load

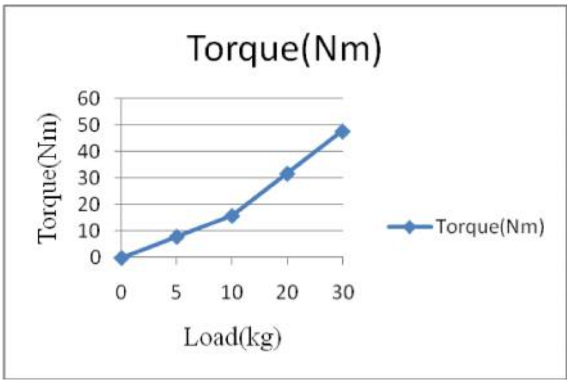
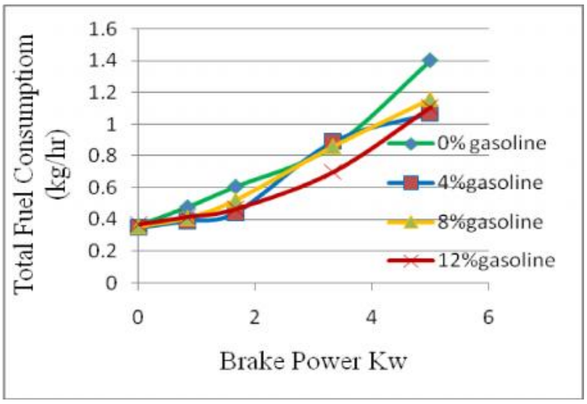


Figure 3: Total Fuel Consumption vs Brake Power



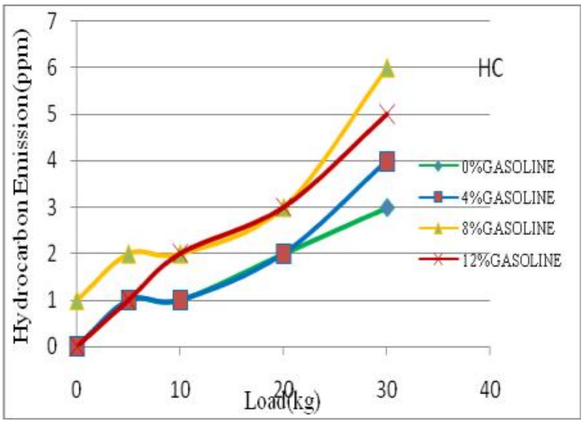
The increase of gasoline volume fraction decreased the fuel density, kinematic viscosity, and surface tension. These properties are directly influenced by the improved atomization performance.

Table 1: Flash Point and Auto-Ignition Temperature of Fuels

Fuel	Flash Point c	Auto-Ignition Temperature c
Diesel	62	210
Gasoline	43	280
Kerosene	65	220

Auto ignition temperature of a substance is the lowest temperature at which it will spontaneously ignite in a normal atmosphere without external source of ignition. Flash point of a substance is the lowest temperature at which it can vaporize to form an ignitable mixture in air. Diesel's auto ignition temperature is visibly low in compare with that of gasoline. The flash point of gasoline is lower than diesel due to volatility of gasoline is more. Auto-ignition temperature of gasoline is more than diesel. Hence this phenomenon can lead to something called sequentional burning, which means the diesel burns first on

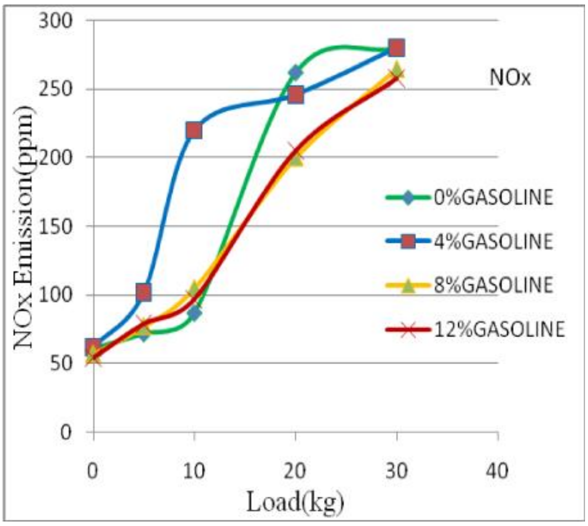
Figure 4: Hydrocarbon Emissions vs Load



compression and after which gasoline or kerosene burns, thereby giving a fully efficient burning.

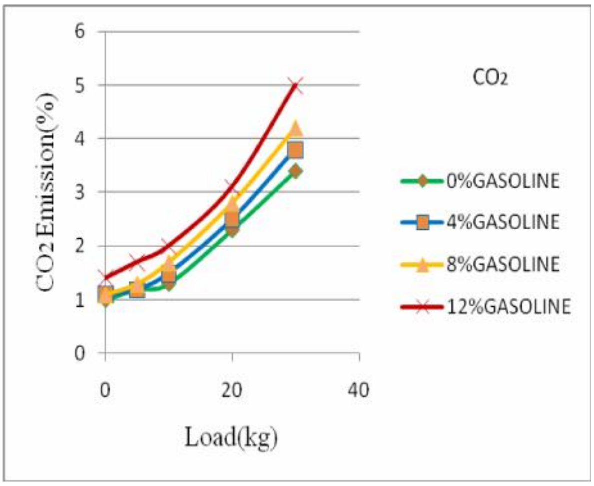
The blending of gasoline caused a decrease in droplet size by increasing the number of small droplets and decreasing the number of large droplets. The decrease in droplet size was due to the decrease in surface tension as the gasoline fuel fraction increased, which induced an increase in droplet instability.

Figure 5: NOx Emissions vs Load



The ignition delay was extended and a more homogeneous mixture was formed as a result of gasoline blending. These improved combustion characteristics simultaneously reduced NOx and soot emissions. However, the ISHC and CO emissions were slightly increased. The difference in HC and CO emissions between pure diesel and gasoline blended diesel fuels decreased as the engine load increased.

Figure 6: CO_2 Emissions vs Load



As the engine load increased, the effects of gasoline blending on combustion performance and exhaust emissions diminished due to following which increase in the amount of diesel; the combustion process was then governed by diesel fuel.

CONCLUSION

The increase of gasoline volume fraction decreased the fuel density, kinematic viscosity, and surface tension. These properties are directly influenced by the improved atomization performance. The blending of gasoline caused a decrease in droplet size by increasing the number of small droplets and decreasing the number of large droplets. The decrease in droplet size was due to the decrease in surface tension as the gasoline fuel fraction increased, which induced an increase in droplet instability. The ignition delay was extended and a more homogeneous mixture formed as a result of gasoline blending. These improved combustion characteristics simultaneously reduced NOx and soot emissions.

Addition of 4% (by volume) of gasoline on diesel produce good result and it is applicable in diesel engine. However, the HC and CO emissions were slightly increased. In the addition of gasoline in diesel will make to increase CO_2 that is a positive advantage in the emission point of view. The difference in HC and CO emissions between pure diesel and gasoline blended diesel fuels decreased as the engine load increased. From experimental results it is determined that by application of gasoline addition effective power output increases at the level of 4-9% and fuel consumption decreases by approximately 6%.

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