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Experimental Analysis and Effects of Gasoline as an Additive in Compression Ignition Engine

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***Abstract:** A compression ignition engine is a sort of engine where the fuel utilized is diesel. In this current study, various influences on petrol-diesel mixture have been introduced in a mono cylinder vertical diesel engine and investigated factually for various stages. Denouement of 0%, 4%, 8% and 12 % of gasoline by volume is varied with diesel and the outcomes has been registered with the foundation of test perceptions at 1500(rpm). Out of various trial experimental outcomes, it is found out that, with the addition of gasoline fuel the real brake -power output rises at the rate of 4-9% and also the brake specific fuel consumption reduces by relatively 6%. Also, the study found out that increase in the volume fraction of gasoline decreases the fuel density, surface tension and kinematic viscosity. In addition, the various blending of petrol fuel causes a decrease in the size of the droplet because the surface tension decreases with the inclusion of petrol, thereby generating an extension in the instability of droplet. Meanwhile, petrol blending resulted in the development of the ignition delay period and also the formation of a comparatively higher homogeneous mixture. These peculiarities in the combustion characteristics cause a drastic reduction of NOx. However, the Hydrocarbon and Carbon Monoxide emissions were slightly increased. The boosting of burden in engine curtails the effect of gasoline blending on combustion performance and exhaust fumes discharges.*

***Keywords:** Brake horse power, Compression ignition engine, Gasoline volume, Blending of fuel, Emissions.*

I. INTRODUCTION

One of the main reasons behind this study of Gasoline-Diesel mixture is that, in high terrain areas, also in heavy load carrying trucks, there is a practice of blending certain quantity of petrol with diesel [1]. This was done because of the factual improvement of power of the diesel engine, thereby carrying the intended load. As this condition prevails, there require the need of a solid analysis of the above situation and figure out the results of proficiency as efficiency, emissions, power etc. on diesel-petrol combination at diverse fractions and different load in the unadulterated traditional diesel compression ignition engines [2]. The study find useful for giving an awareness to public, which ultimately attests the advantages and disadvantages of blending diesel-petrol under above extents and conditions.

Under the classification of Internal Combustion Engines, a Diesel engine plays the role of one of the most dynamic liquid fuel combustion prime movers. However, on the other side, a diesel engine experiences various disadvantages. One of the disadvantages is their limited speed range, particularly for high terrain and heavy load vehicle applications. Because of ignition delay, the rotational speed (rpm) of CI engine is not applicable for higher levels [3]. Due to this reason and also the various accoutrements such as low equivalence ratios, tremendous pressure differences, etc., normally a diesel engine is much heavier than gasoline engine of equivalent power [4]. Meanwhile, the Ignition delay period shall be controlled and the engine speed could be expanded by presenting a specific technique for fuel infusion or in the design of burning frameworks in the combustion systems [5]. A design of Pre- combustion chamber and addition of piston bowls can be quoted as examples of these improvements in the systems. In this way, the mixture of air-fuel is accelerated by expanded gas movements, so the period of ignition delay can be reduced and the injection pressure of fuel at 7–14MPa levels are sufficient [6]. Along these lines, nozzles with mono hole and fuel systems which are cheaper can be utilized. By selecting relatively high speed ratio or rates of the engine and comparably higher proportionality equivalence proportion ratio, lighter design of engines structure can be created [7]. Yet, the use of pre combustion burning chamber expands the surface region of burning chamber and this causes an extra heat loss and relatively higher brake-specific fuel consumption (BSFC). On contrast, high infusion pressures at the rate of 100–150 MPa levels are considered by using special injection methods, for example, common-rail direct ignition (CRDI) system [8]. However, for this condition, necessities of trend setting innovations are required and are increasingly costly requirement. A diesel fuel burning-compression engine operating on the basis of self-ignition compression technique has advanced thermal efficiency and comparatively lower fuel utilization attributes than a petrol combustion spark ignition engine; thence the practice of diesel used engine vehicles are as of now across the board [9]. But, there prolongs the challenges of environmental effects in the form of pollution of NOx and soot. Low temperature combustion (LTC) is one method to allow the reduction of NOx and soot emissions simultaneously. Consequently, the LTC strategy is notified on the control of local air-fuel rich mixture regions and the drastic reduction of the temperature in cylinder where combustion takes place [10]. To understand this combustion concept, high exhaust gas recirculation (EGR) rate need to be applied to the conventional diesel engine.

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This method will effectively lower NOx emissions by controlling the amount of oxygen intake concentration and thereby increasing the heat capacity of mixture gas in cylinder inside the combustion chamber.

Meanwhile, this method underpins the diffusion burning, and progresses the premixed combustion by elongating the ignition delay. Extension of the ignition-delay or the start postpone period is the most ideal approaches to frame proper homogeneous-uniform mixture because it solely permits appropriate mixing time before combustion [10]. In addition, another conceivable technique for broadening the ignition delay is by presenting fuel with low-cetane number and high-octane number. Many research groups have conducted the studies in this field and is shown in reference which is highlighted as numbers in square bracket. The representations of fuels with low-cetane number are ethanol and gasoline fuel.

II. EXPERIMENT PROCEDURE

The amalgamation of Gasoline Fuel in Diesel Compression Ignition Engines**:** The present scenario comprises a mono cylinder vertical four stroke compression ignition which is naturally aspirated, water cooled experimental engine with make field marshal is used. Some of the characteristic features of the engine are: its rated speed is 1600rpm, rated horse power is 7.35KW, inner diameter of engine 114.3mm and length of stroke is 139.7mm.

III. RESULT AND DISCUSSION

Since the engine is having a persistent speed of 1600 rpm, its rpm is set to 1500 for this trial reason and thereby the torque endures the same under all the circumstances. Underneath chart reproduces the validation of this statement. The TFC, total fuel consumption is reduced in scope of 4-8% with the volume of expansion of gasoline with diesel; however the power is significantly increased. Meanwhile, after this specified ratios, the effective power goes on decreases. The main cause of this phenomenon is due to the deterioration which has happened in the combustion chamber because of prolonged combustion exposures which progressively leads to the increasing tendency of detonation, which may further cause impinging sound in the engine.

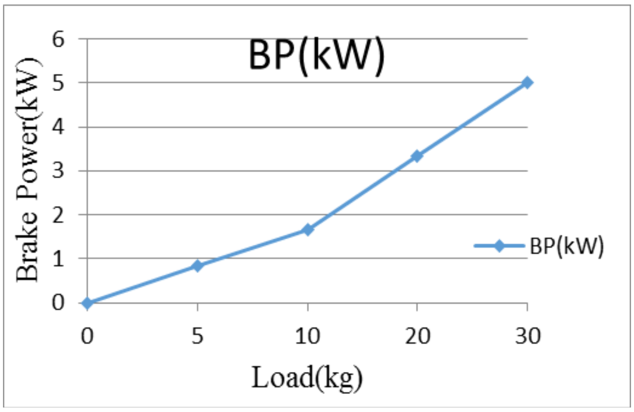

Fig:1 Load Vs Brake Power

Brake Power versus Load in figure 1 clearly demostrates that Brake Power varies linearly with load applied.

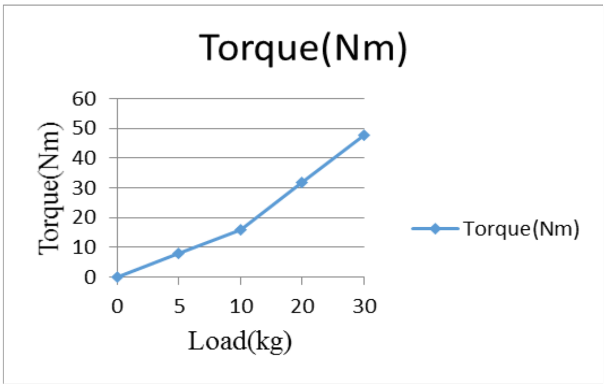

Fig:2 Load Vs Torque

Torque versus Load graphical representation too claims the nature of the Brake Power versus Load graph which is clearly shown in figure 2.

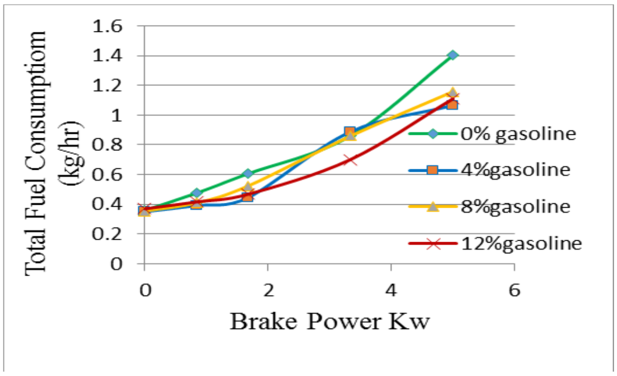

Fig:3 Brake Power Vs Total Fuel Consumption (TFC)

The above shown Figure 3 gives an idea about how amalgamation of gasoline effects the fuel consumption as the Brake Power increases. On an eye view it clearly speaks that increased gasoline amalgamation reduces total fuel comsumption over all experimented loads.

The relation between Brake Power and Total fuel consumption

When the volume of gasoline mixture is increased as per the above mentioned proportions; many properties like; the fuel density, kinematic viscosity, and surface tension consequently gets decreases. However, these thermodynamic properties which are directly linked are extremely dominated by the improved atomization work.

Table: 1 Flash point and Auto-ignition of various fuel

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

The auto start temperature of any fuel is the minimum temperature at which will immediately aggravate in a standard atmospheric condition without the wellspring of outside start.

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The streak flash point of any fuel is the most minimal temperature at which can be vaporized to custom a flare-up blend noticeable all around in the air or atmosphere. Diesel fuels self-begin temperature is apparently less in assessment with that of the gasoline fuel. However the flash point of gasoline is lower than that of diesel due to the reason that the property of volatility of petrol fuel is high. Since the auto-start temperature of petrol fuel is higher than diesel, it can exploit a marvel called sequential or successive burning, which implies the diesel fuel consumes first due to compression-pressure process and after that gasoline burns, noticeably giving a completely productive procedure of ignition. Different parameters of available fuels are mentioned in Table 1.

The mixing of various proportions of gasoline shows a decrement in the bead measure of droplet by expanding eventually the quantity of small droplets and diminishing the quantity of enormous drops. The major reason is due to the tension of the surface film of a liquid caused by the attraction of the particles in the surface layer by the bulk of the liquid, which tends to minimize surface area.

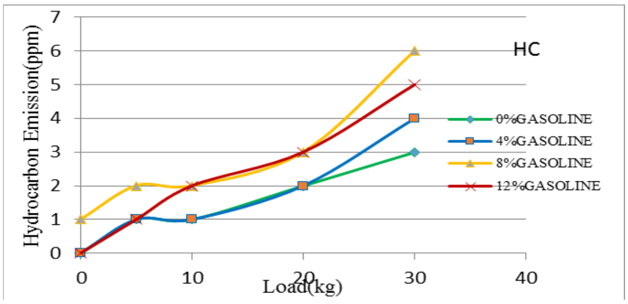

Fig:4 Load Vs HC Emissions

This graphical relation doesnot speak clearly about gasoline amalgamation and HydroCarbon emmision. Eventhough it gives an idea that increase in gasoline amalgamation increase Hydro Carbon emmision.The experimental result shows that the period of ignition delay was considerably extended and comparatively a more stable homogeneous mixture was developed as a result of the blending of gasoline fuel.

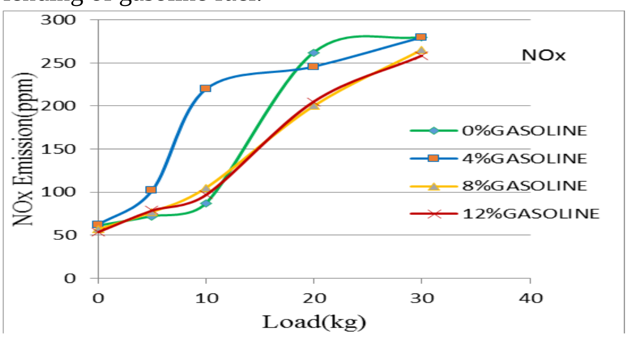

Fig:5 Load Vs NOx Emissions

This graphical relation in figure 5 too doesnot speak clearly about gasoline amalgamation and NOx emmision. Eventhough it says percentage amalgamation of gasoline is inversely proportional to NOx emmision.

The experimental result shows that the period of ignition delay was considerably elongated and comparatively a more stable homogeneous uniform mixture was developed because of the blending of gasoline fuel. This enhanced combustion features of the newly mixed fuel in different proportions have instantaneously reduced the emissions of Nitrous oxides and soots. However, the Carbon Monoxide and Hydrocarbon emissions were slightly increased due to the unburned fraction of mixed fuel. The difference in HC and CO emissions among uncontaminated diesel and the blended gasoline-diesel fuels at various proportions decreases, as there is a significant increase in the engine load. All the results with various parameters are shown in the graphs.

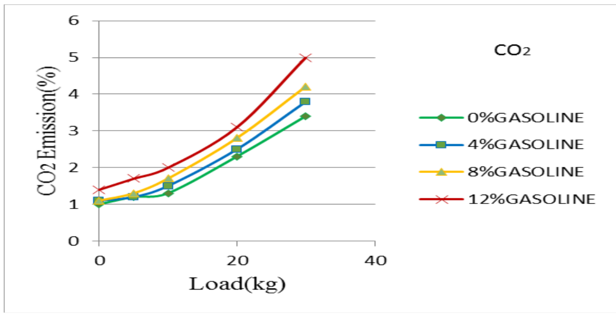

Fig:6 Load Vs Carbondioxide Emissions

This experimental result shows a prominent finding apart from other emmisions as a result of amalgamation as shown in figure 6. In this, as the amalgamation of gasoline increases Carbondioxide emmision also increase. At any stage of loading this result seems to similar nature. Whenever there is an increase in the engine load, the expected outcome of gasoline amalgam with diesel fuel at various proportions, i.e. the combustion performance (efficiency) and exhaust polluting emissions will naturally moves in a diminished manner which consequently increase in the consumption of diesel fuel in the mixture; the advancement of combustion is then progressively accelerated by diesel fuel alone.

IV. CONCLUSION

It is observed from the experiment that the increase of gasoline volume with diesel fuel fraction eventually decreases the properties like density of fuel, kinematic viscosity, and surface tension. Meanwhile, afore mentioned thermodynamic properties are precisely dominated by the enhanced performance of the droplets being atomized. The unification of gasoline diesel mixture in various proportions shows a gradual decline in the fuel droplet size. The phenomenon of ignition delay is eventually extended and comparatively more homogeneous mixture is created as a result of the blending of gasoline or petrol fuel. In addition, bettered combustion characteristics concurrently reduces NOx and soot pollutant emissions.

The appropriate proportion is the addition of 4% (by volume) of gasoline or petrol fuel in the conventional diesel fuel engine which prospectively will yield good results. However, there is a significant increase in the emanations of HC and CO pollutants. From test perceptions and results, it is determined that by applying gasoline-petrol fuel to the diesel fuel, the viable power yield increments outstandingly at the rate of 4-9% and fuel utilization falls by apparently 6%.

REFERENCES

1. Y.J. Kim, K.B. Kim, K.H. Lee, Effect of a 2-stage injection strategy on the combustion and flame characteristics in a PCCI engine, International Journal of Automotive Technology 12 (2011) 639–644.
2. S. Jung, H. Ishida, S. Yammoto, H. Ueki, D. Sakaguchi, Enhancement of NOx-PM trade-off in a diesel engine adopting bio-ethanol and EGR, International Journal of Automotive Technology 211 (2010) 611–616.
3. Sahiin Z. Experimental and theoretical investigation of the effects of gasoline blends on single-cylinder diesel engine performance and exhaust emissions. Energy Fuels 2009; 23:1707– 17
4. P.B. Donbeck, R.D. Reitz, An experimental study of dual fuelling with gasoline port injection in a single-cylinder, air-cooled HSDI diesel generator, in: SAE Tech Paper, SAE, 2010, (2010-01-0869).
5. Durgun O. Experimental methods in internal combustion engines. Karadeniz Technical University, Mechanical Engineering Department, Lecturer notes; 1990.
6. Piaapagiannakis RG, Hountalas DT. Combustion and exhaust emission characteristics of a dual fuel compression ignition engine operated with pilot diesel fuel and natural gas. Energy Convers Manage 2004; 45:2971–87.
7. Krishnan SR, Srinivasan KK, Midkiff KC. Phenomenological modelling of low temperature advanced low pilot-ignited natural gas combustion. SAE techpaper 2007; SAE 2007-01:0942.
8. Arcoumanis C, Bae C, Crookes R, Kinoshita E. The potential of dimethyl ether (DME) as an alternative fuel for compression-ignition engines. Fuel 2008;87:1014–30.
9. Ying W, Longbao Z, Hewu W. Diesel emission improvements by the use of oxygenated DME/diesel blend fuels. Atmos Environ 2006; 40:2313–20.
10. Canakci M. Combustion characteristics of a turbocharged DI compression ignition engine fueled with petroleum diesel fuels and biodiesel. Bioresour Technology 2007; 98:1167–75.

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