Gasoline Direct Injection-A Review Paper

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***Abstract*- In this review paper Author defines the benefits of using direct injection in the gasoline engines. The review comes up with the various changes that can be made with the air/fuel ratios. The case studies related to fuel combustion delay, less intake of fuel pressure from fuel cistern to combustion chambers, and emissions of harmful pollutants due to unburnt fuel. The cylinder bore wear was also being discussed for the future space in current area of research work. Injector positioning was discussed in detail to clarify the experimentations done in past years.**

Keywords—GDI Injectors;Cavitations;Knock;Pre Ignition;Turbo Charged Engine

VIII. INTRODUCTION

During the early years of the nineties' the Automobile industry deals with the higher consumption of fuels in the vehicles, specifically in the engine that are driven on gasoline as a fuel. Because in gasoline engine there is the use of Carburetor or MPI to mix the fuel and air in the proper ratio so that it can burnt properly in the engine. By the use of these two fuel supply system there are some of the limitations due to which there is the wastage of fuel and engine performance output is not according to the input. To overcome these disadvantages the GDI system is introduced. The GDI system reduced the fuel consumption in engine and there is increase in the performance of the engine (up to 30%).

IX. DIRECT INJECTION METHODS

There are two methods for the direct Injection
1) Direct injection of liquid fuel
2) Direct Injection of pre mixture of air/fuel.

Direct Injection is the one of the higher pressure injection in which the fuel is directly injected in to the compressed air that is present in the combustion chamber but pressure of the injected fuel should be higher than the pressure inside the cylinder i.e.4Mpa-15Mpa this is sufficient to produce a well atomize spray. Pre mixture injection is one of the low pressure injection in which formation of mixture is occurred outside the cylinder, in this injection the fuel (Pressure range 0.6Mpa) is mixed in the part of air(Pressure range 0.55Mpa).The pre mixture leads to the complete burning of mixture in the combustion chamber and less emissions.

X. ADOPTION OF GDI FROM PFI

There is the difference in the mixture technique in the GDI and PFI. In the PFI injection system the fuel is injected in to the air just before the inlet valve. When the inlet valve is closed the fuel is sprayed into the air due to which the some of the liquid film formation occurred on the inlet valve this will results in the disadvantages such as metering error, fuel delivery delay. Due to the fuel delivery delay there is misfire and improper burning occurred that causes the emission of unburnt hydrocarbons. These are the some of the disadvantages that overcome in the GDI by direct injection of fuel in the cylinder. By using direct injection in to the combustion chamber it avoids the liquid film formation on the walls of the valve, there is also the reduction in the fuel transportation time from fuel tank to combustion chamber. The fuel entered in to the cylinder is well atomized due to the higher fuel injection pressure this will also overcome the problem of cold start. The evaporation of the fuel droplets in to the air allows the air to cool down and allows the better compression ration by not depending upon the fuels octane rating.

MAJOR ADVANTAGES AND DISADVANTAGES OF GDI

A. Advantages

- No manifold film
- Precise air fuel ratio control
- Reduction in cold starting problems
- Fuel economy is improved due to-

- ✓ Increased Volumetric efficiency
- ✓ Higher compression ratio
- ✓ Less pumping loss

B. Disadvantages

- Relatively high No_x emissions
- Increased particulate emissions

XI. OPERATING MODES IN GDI

There are two modes of GDI

A) Stratified mode for low load and low speed operation.

B) Homogeneous stoichiometric mode for higher loads and higher speeds.

A. Startified Mode

During the stratified mode of the fuel is injected in to the combustion chamber during the compression stroke, the rich combustible mixture is kept near the spark plug, in this way the lean mixture also burnt easily in the stratified mode and also gives the better fuel economy.

B. Homogeneous Stoichiometric mode

In Homogeneous mode the fuel is sprayed during the suction stroke, the fuel gets mixed with the air and form a homogeneous mixture. There is much more time before combustion of the mixture, it gives the advantage of charge cooling by taking the heat from the air present in the cylinder. By the advantage of the charge cooling it improves knock limit and hence higher compression ratios can be used in GDI. There are three types of Injector, Spark plug arrangements shown below in fig. 1-

1) Air guided 2) Wall guided 3) Spray guided

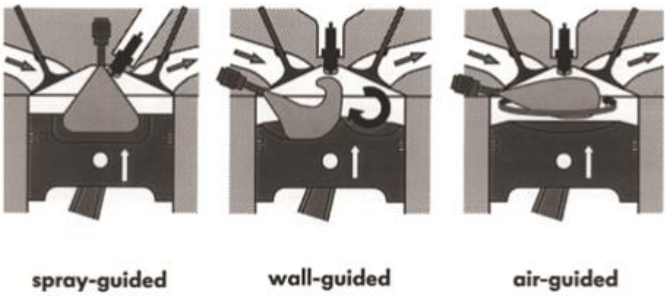

Fig. 1. *Injector Spark plug arrangements*

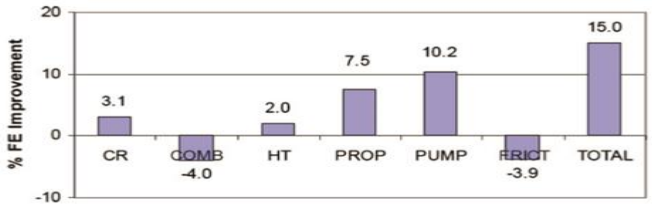

Fig. 2. . *Fuel Economy Improvements*

In Fig.2 the various factors that influence fuel are presented. The pumping is the biggest contributor to fuel economy in GDI system which shows the 10% advantage in fuel economy by using GDI system, followed by the mixture properties that is 7.5% advancement then heat transfer has 2% advancement and then there is 3.1% advancement in the fuel economy improvement.

Conclusions

In nutshell we can reason that, GDI beats the issue related with the PFI innovation in gas motor and advantages with better fuel utilization and diminished discharges. Fuel infusion framework is center of GDI motor and the accomplishment of this motor is because of capacity of fuel infusion framework to shape the required blend for the diverse GDI operational mode. GDI is the demonstrated and possible advances in GDI framework can possibly fulfill future outflow standards however it needs efficient research to receive ever more elevated fuel infusion weight and improvement in ignition handle. The future research work can be further continued on the emission testing with different fuel types and changing compression ratio by varying operating paramaters.The reduction and measuring of pollutants emitted can also be good area of research work to be worked on this engine. Authors had chosen this as research work because very limited studies were found on this area of automotive sector.

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