Journal of Chemical and Pharmaceutical SciencesISSN: 0974-2115

Effects and Advantages of Gasoline Direct Injection System

Vishwanath M*, S. Madhu
Department of Automobile Engineering, Saveetha School of Engineering, Chennai-602 105
***Corresponding author: E-Mail: mathumarine@gmail.com**

ABSTRACT

Gasoline direct injection process is a form of gas give procedure used in current developments of vehicle. The gasoline financial system and the stringent exhaust emission norms has led to the transmission in the gasoline process from carburetor direct injection method. Probably the most predominant international initiative of the automobile industry is to improve an immediate-injection fuel engine. Four technical aspects that make up the groundwork applied sciences in direct injection methods.

a) Air waft into the cylinder is improved.
b) The form of the piston with curved high controls the combustion by way of mixing the air-gasoline combination.
c) The stress of gas injection is accelerated by the excessive strain gas Pump.
d) The vaporization and dispersion of the gas spray is managed by means of the excessive stress swirl injector

Gasoline financial system will also be acquired by using adjusting air fuel ratio situated on the performing load. It presents a right estimation of the nice of gasoline required at right time and supplies manipulate over combustion. Gasoline in this paper advantages and effects of fuel direct injection procedure is reviewed.

KEY WORDS: Gasoline direct injection (GDI), High Pressure Fuel Pump, Carburetor.

1. INTRODUCTION

The fundamental goals of the automotive enterprise is to acquire a excessive energy, low precise fuel consumption, low emissions, low noise and higher drive relief cars. The increase in air pollution as a result of automobiles, the atmosphere protective organizations has drawn down the emission limits annually which results in the controlled emission in autos. To expand engine efficiency there is a ought to enhance gasoline provide methods which might lead to the entire gasoline combustion in engine cylinder producing maximum power. This has led to the transition of gas give method to direct injection. In direct injection approach the fuel to the cylinder is provided through a gasoline injector positioned within the cylinder. Fuel Direct Injection (GDI) engines presents various benefits, It avoids fuel wall film within the manifold, improves accuracy of air/fuel ratio in the course of dynamics, reduces throttling losses of the gas exchange with the aid of stratified and homogeneous lean operation, higher thermal effectivity by means of stratified operation and increases compression ratio, decreases the gasoline consumption and CO_2 emissions, curb warmness losses, accelerated performance and volumetric effectivity because of cooling of air charge, higher cold start efficiency and higher the force alleviation.

2. METHODS & MATERIALS

Figure 1 shows the detailed information of the test nozzles. A single-hole nozzle with a nozzle diameter of 0.110 mm was employed. The nozzles had a length of 0.61 mm. The geometry of single-hole nozzle is representative of the design features of the current gasoline direct injector used in the alpha engine. The single-hole nozzle consisted of three identical parallel orifices of 0.2mm as well as a total cross sectional area consistent with the cross sectional area of the reference single-hole nozzle.

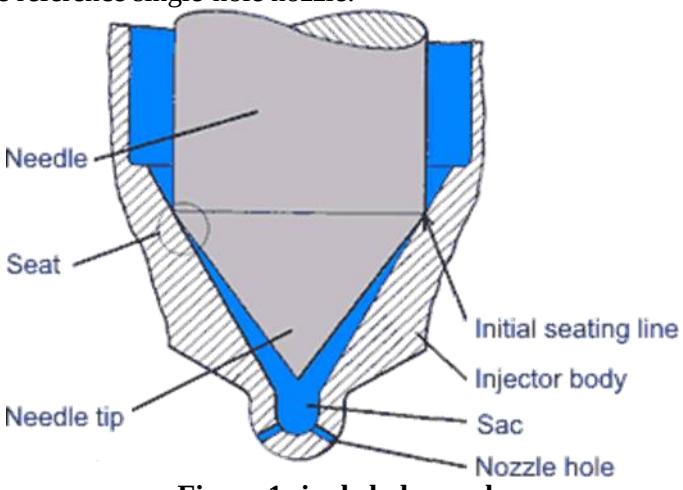

Figure.1 single hole nozzle

Fuel injection nozzle is made of high carbon steel, so it will not burn, but suppose to melt. The material used in it, would be of greater melting point, to avoid melting during its working. It will be designed as it has higher melting point, the expected temperature caused during fuel injection.

Gasoline Direct Injection (GDI): In inside combustion engines, gasoline direct injection (GDI) repeatedly known as gasoline Stratified Injection (FSI) is an increasingly preferred style of gasoline injection method employed in state-of-the-art 4 and two-stroke petrol engines. The petrol/fuel is particularly pressurized and injected by using high voltage driven injectors by way of a common rail gas line straight into the combustion chamber of each and every cylinder as opposed to conventional single or multi-factor gasoline injection that occurs in the intake manifold tract or cylinder port. In some functions gasoline direct injection makes it possible for stratified gasoline cost (ultra lean burn) combustion for increased gas effectivity and diminished emission stages at low load. The most important benefits of a GDI engine are curb emission levels, elevated gas effectivity and bigger engine power output. Additionally the cooling influence of the injected fuel and the more evenly dispersed combustion combos and temperatures enable for multiplied ignition timing settings which are an equally major procedure requirement. Emissions levels can also be extra appropriately managed with the GDI system. The minimize phases are carried out via the targeted control over the quantity of gasoline, air and ignition settings that are varied in keeping with the engine load conditions and ambient air temperature. Additionally there are not any throttling losses in some GDI designed engines as in comparison with a traditional gas injected or carbureted engine which greatly improves effectivity and reduces pumping losses in engines with no throttle plate. Engine speed is controlled through the engine management method which regulates gas injection and ignition timing parameters as an alternative of having a throttle plate which restricts the incoming air give. Adding this operate to the engine management process requires colossal enhancement of its processing and reminiscence as direct injection plus different engine management systems have to have very exact mapping for just right performance and drivability. The engine administration procedure regularly chooses among three combustion cycles: extremely lean burn, stoichiometric, and entire energy output. Each cycle is characterized via the air-gas ratio. The stoichiometric air-fuel ratio for petrol (gas) engines is 14.7:1 by means of weight, however the ultra lean cycle can contain ratios as excessive as 35:1 (and even bigger in some engines for extraordinarily restrained intervals). These mixtures are a lot leaner than in a traditional gasoline injected engine and lower gasoline consumption and designated levels of exhaust emissions considerably. Extremely lean burn cycle is used for gentle-load strolling stipulations, at regular or reducing avenue speeds, the place no acceleration is required. The gas shouldn't be injected on the consumption stroke but as a substitute on the latter stages of the compression stroke so that the small quantity of air-gas combination is optimally positioned near the spark plug. This stratified cost is surrounded in general by way of air which keeps the gas and the flame far from the cylinder walls for low emissions and warmth losses. The combustion of the fuel takes location in a radial (donut-formed) cavity on the piston's surface designed to reinforce air swirl and delivered with the aid of a especially designed injector nozzle. This permits triumphant ignition without misfire even when the air/fuel blend is very lean. Stoichiometric cycle is used for average load conditions. Fuel is injected for the period of the intake stroke making a homogenous gasoline-air mixture in the cylinder. From the stoichiometric ratio an surest burn results in a easy exhaust emission additional cleaned via the catalytic converter. Full power cycle is used for rapid acceleration and heavy loads (as when climbing a hill). The air-fuel combination is homogenous and the ratio is slightly richer than stoichiometric which helps avert knock (pinging). The gas is injected throughout the consumption stroke. Direct injection is supported via different engine administration methods such as variable valve timing (VVT) with variable size intake manifold (VLIM) or acoustic managed intake method (ACIS). A high efficiency exhaust gas recirculation valve (EGR) is absolutely required to reduce the high nitrogen oxides (NOx) emissions that influence from burning extremely lean mixtures. Traditional fuel injection engines could inject fuel for the duration of the four stroke sequence, as the injector injects gasoline onto the again of a closed valve. Previous direct injection engines the place the injector injects gasoline directly into the cylinder have been restrained to the induction stroke of the piston. Because the RPM increases the time on hand to inject gas decreases. More modern GDI programs have enough gas stress to inject greater than once for the period of a single cycle. Gas injection takes location in two phases. In the course of the intake stroke, some quantity of gas is pre-injected into the combustion chamber which cools the incoming air for this reason improving volumetric effectivity and guaranteeing an excellent gas/air mixture inside the combustion chamber. Foremost injection takes location as the piston methods high useless centre on the compression stroke shortly earlier than ignition.

Ideal for Downsizing Concepts with Turbo charging: Fuel direct injection is a process whereby gas is injected straight into the combustion chamber at excessive stress. This is an amazing approach of decreasing gasoline consumption and emissions on the one hand and widely boosting using dynamics on the opposite. Combined with revolutionary downsizing principles and turbo charging, savings in gas consumption and CO_2 emissions will also be delivered within the region of 15 percent. The high strain injection procedure is in particular suitable for engines with a energy to-weight ratio between around 60 and one hundred kW/liter together with downsizing premiums of as much as forty five percentage in future. In case of "severe downsizing" with mark downs in engine displacement of up to 50 percentage, it makes sense to mix the method with additional measures such as changes to the gears or electrification of the power train with a view to make certain an ultimate riding expertise.

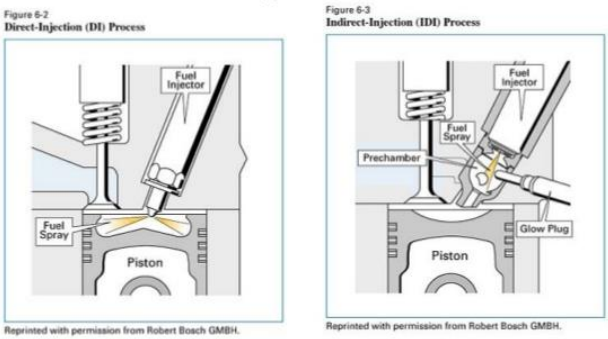

Figure.2. Direct injection vs Indirect Injection

No turbo lag, improved dynamics: Scavenging Turbochargers are competent to arrive their set increase strain simplest beyond a exact engine velocity. At low engine speeds, the exhaust gasoline flow within the turbine is too susceptible, with the outcomes that the air cannot be compressed well adequate. This produces a rapid lag. Bosch's "scavenging" approach procedure solves this quandary by way of in brief opening the consumption and exhaust valves simultaneously, creating a dynamic head between the consumption and exhaust facets of the engine and increasing the supply of contemporary air within the combustion chamber. This generates up to 50 percent better torque at low engine speeds. Scavenging leverages the synergies from gasoline direct injection, variable camshaft adjustment and turbo charging and provides increased responsiveness on a par with that of excessive potential engines.

From optimized injection to centralized: Control In gas direct injection the air-fuel combo is shaped immediately within the combustion chamber. Whilst the excessive stress pump brings the fuel stress in the fuel rail as much as the specified stage of round 200 bar, recent air flows by way of the open intake valve into the consumption port and finally into the combustion chamber. Excessive stress injectors, which can be outfitted instantly to the fuel rail, meter and vaporize the gas at satisfactory speed, making sure ideal fuel-air mixing. Innovative laser-drilled injection holes have the funds for highest spray design flexibility and scale down wetting of the combustion chamber walls. Motronic is an digital manipulate unit developed via Bosch. It agencies collectively, prioritizes, and techniques all demands product of the engine and converts them into control instructions. The key standards for this conversion is torque. In an effort to make certain that torque is delivered in a smooth and comparatively cheap trend, Motronic regulates the air/gas ratio consequently.

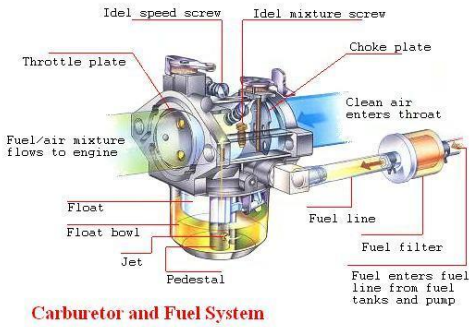

Figure.3. Carburetor and Fuel system

Advantages of GDI:

- **Power Output:** apart from some excessive finish modified cars, gas injection mostly presents a lot better power output and efficiency than a common place carburetor founded automobile.
- **Fuel effectivity:** considering fuel injection is on the whole managed by way of a auto's electronic control unit or automobile laptop, gas consumption is usually managed much better than with a carburetor. It commonly outcome in higher fuel efficiency.
- **Emissions efficiency:** With better gasoline effectivity comes higher emissions efficiency. Gasoline injected autos produce a long way fewer carbon based emissions than cars with carburetors.
- **Capability to Accommodate substitute Fuels:** cars that use direct gasoline injection are better equipped to handle replacement fuels, and fuels with additives which might be designed to support maintain your auto engine clean.
- **Drivability and gentle Operation:** autos that use gasoline injection rather than a carburetor most commonly drive much smoother, considering gasoline flow is better managed and extra constant.
- **Diagnostic capability:** considering that direct injection is regulated through your auto's pc, problems with gasoline injection can effectively be diagnosed with a simple pc diagnostic experiment.

3. RESULTS

Benefits of fuel injection include smoother and more consistent transient throttle response, such as during quick throttle transitions, easier cold starting, more accurate adjustment to account for extremes of ambient temperatures and changes in air pressure, more stable idling, decreased maintenance needs, and better fuel efficiency. Fuel injection also dispenses with the need for a separate mechanical choke, which on carburetor-equipped vehicles must be adjusted as the engine warms up to normal temperature. Furthermore, on spark ignition engines, (direct) fuel injection has the advantage of being able to facilitate stratified combustion which has not been possible with carburetors.

It is only with the advent of multi-point fuel injection certain engine configurations such as inline five cylinder gasoline engines have become more feasible for mass production, as traditional carburetor arrangement with single or twin carburetors could not provide even fuel distribution between cylinders, unless a more complicated individual carburetor per cylinder is used. Fuel injection systems are also able to operate normally regardless of orientation, whereas carburetors with floats are not able to operate upside down or in zero gravity, such as encountered on airplanes.

4. CONCLUSION

It's clear that GDI gasoline supply programs has superiority due to their versatility. These methods have grown to be popular due to their skills to cut back poisonous, CO_2 emission and fuel consumption to comply with environmental security norms. The quantity of fuel injection may also be exactly metered and monitored. In order that preferred air-fuel ratio is acquired for distinct cylinders. The GDI engine has a high compression ratio and a tremendously effective air intake system which outcome in extended volumetric efficiency. This indicates that the GDI procedure has better cost stratification.

REFERENCES

Bella G, Rotondi R, Corcione FE, Valentino G, Experimental and computational analysis of a diesel spray, in: 4th International Conference ICE99, Internal Combustion Engines: Experiments and Modeling, Capri, 1999.

Borman G.L, Combustion Engineering, McGraw-Hill, New York, 1998.

Brower G, Chang S.K, Corradini M.L, El-Beshbeeshy M, Martin J.K, Krueger J, Physical mechanism for atomization of a jet spray: A comparison of models and experiments, 881318 SAE Paper, 1988.

Devita A, Alaggio M, Rotondi R, Experimental and numerical studies of diesel fuel and biodiesel spray, ASME Technical Paper, 2000.

Ibrahim EA, Yang HQ, Przekwas AJ, Modeling of spray droplets deformation and breakup, AIAA J. Propulsion Power, 9, 1993, 651– 654.

Iwamoto Y, Noma K, Nakayama O, Yamauchi T, Development of Gasoline Direct Injection Engine, SAE Technical Paper 970541, 1997.

O'Rourke P.J, Amsden A.A, The tab method for numerical calculation of spray droplet breakup, 872089 SAE Paper, 1987.

Paoletti S, Engage a multi-block environment for grid generation, in: ICIAM 95, Third International Congress on Industrial and Applied Mathematics, Hamburg, Germany, 1995.

Reitz R.D, Computer modeling of sprays, in: Spray Technology Short Course, Pittsburgh, PA, May 1996.

Rossella Rotondi, Gino Bella, Gasoline direct injection spray simulation, International Journal of Thermal Sciences, 45 (2), 2006, 168-179.

Zhao F, Lai MC, Harrington DL, Automotive spark-ignited direct-injection gasoline engines, Progress in Energy and Combustion Science, 25 (5), 1999, 437–562.