

Gaseous Emission in Electronic Fuel Injection system- A Review

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Abstract— This review paper includes introduction to Electronic fuel injection and working principles of it. Now a days all automobile manufacturer are very much concern in making less emission vehicles in order to meet the emission norms. By using carburettor version, automobile manufacturer cant able to achieve the emission norms. Hence there is new technology implemented where carburettor version vehicle are replaced by Electronic Fuel injection vehicle. Where the fuel injection is totally controlled by Electronic Control Unit (ECU).

Keywords— Fuel Injection, Emission Control, SI Engine.

I. INTRODUCTION

In order to control the emission from automobiles and also there is a compulsion to meet the emission norms by the government. There is a need to develop a new technology to reduce the NoX emission. In most of the countries the emission control is getting strict in order to save environment. Automobile engine produces a considerable amount of pollutants when gasoline is used as a fuel due to short-circuiting. These pollutants include un-burnt hydrocarbons and carbon monoxide, which are harmful to every lives.

Hence, carburettor version two wheeler and four wheelers are replaced by Electronic Fuel Injection (EFI) System.

II. WORKING PRINCIPLE

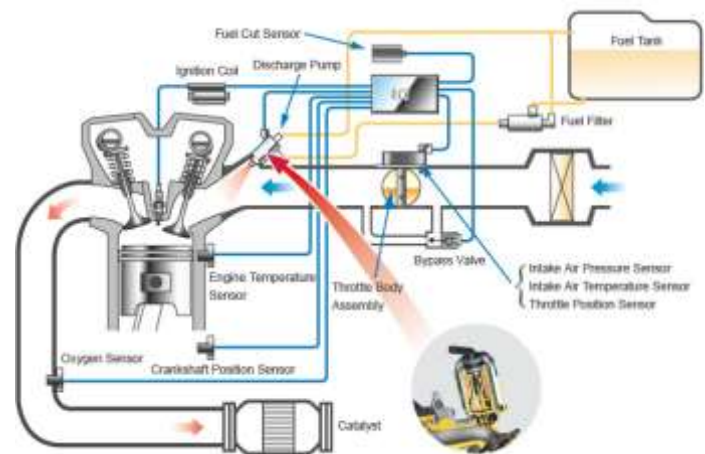
In order to achieve the emission norms in our country, EFI is one of the technologies. There are many types of fuel injections used in automobile sectors. Some of them are

- Single Point or Throttle body injection,
- Continuous injection
- Port or Multi point fuel injection,
- Central port injection
- Sequential fuel injection,
- Direct fuel injection,
- Swirl injection.

Electronic fuel injection can be implemented in any of the above methods.

In an EFI system the intake air alone took from air filter then it is send it via intake throttle body to combustion chamber. The fuel is injected in between the way of intake pipe. The amount of fuel to be injected is determined by the Electronic Control Unit (ECU). ECU decide the amount of

fuel by many parameters. Some of them are Engine Cylinder temperature, Exhaust oxygen value etc,. These values are took from separate sensors which is fixed in those positions such as Engine cylinder temperature took from temperature sensor which is fixed close to the Engine cylinder. Same way in Exhaust muffler there will be an oxygen sensor which will give the percentage of oxygen content in Exhaust gas. These sensors send the values to the ECU. By using this input values ECU will determine the amount of fuel which is to be injected in the cylinder. The following figure clearly explains the working of Electronic Fuel Injection System



The below table clearly shows the emission level of Carbon Monoxide, Hydro carbon, Nox emission for various levels of emission stage.

Emission Norm	CO	HC	NO _x	HC+NO _x	PM
BS-III	2.30	0.20	0.15	---	---
BS-IV	1.00	0.10	0.08	---	---
Euro 6	1.00	0.10	0.06	---	0.005

III. FUEL INJECTION

Ajay Kumar Singh [1] reviewed about the Direct fuel injection in 2 stroke petrol engine. Hence Direct injection allows proper mixture of fuel and air, giving complete of controls and emissions. As a result of using direct injection

the power output and efficiency increased. By using direct injection its also economical too and it gives correct estimation of required fuel at proper time.

Avinash Kumar Agarwal [2] has successfully developed a 4 stroke, 16 cylinder V configuration, medium speed, large bore locomotive engine. The engine which they had developed employs Pipe-line-Nozzle system for fuel injection into the cylinder. They had also calibrated Electronic Control Unit (ECU) and various maps were developed for engine. They had obtained a 4% of fuel consumption over the duty cycle.

C. Dhanasekaran[3] explained that hydrogen is going to be the one of the most important fuels to solve the issues like greenhouse gases, protecting environment and conventional fuels. In their study they had used a dual engine which hydrogen is injected at intake port and diesel is injected at the cylinder. They had used a single cylinder KIRLOSKAR, D1 Diesel Engine and hydrogen has been injected at various crank angles. They found that the Exhaust HC, Co and Nox has been reduced by adding hydrogen gas into the fuel.

Gollapudi Arun Manohar [4] used a ECU (Electronic Control Unit) hardware device for fuel injection with 2 stroke and 4 stroke engines. They used PWM (Pulse Width Modulation) signal as a input for EFI(Electronic Fuel Injection) , hence the EFI is having solenoid control valve which will work on PWM signal to inject to the fuel. They had used LabVIEW software for testing the PWM signals.

Hardik A Dave [5] developed a new method of device to control the injection timing of fuel. This device is so simple and economical. Hence this device eliminates the sophisticated ECU design. In order to verify the method experimental tests are also investigated in it.

H. M. Patel[6] analyzed and reviewed about fuel injection system. He said that injector is a very complicated part, and massive research has been done to improve Also he said that fuel injection system reduce the chocking which happens in bio diesel engine. He explained that if bio diesel is used in diesel engine there will be chocking problem in fuel injector.

Malleboyna Mastanaiah [7] had studied about the usage of air compressor instead of fuel pump where the petrol is pressurized which is sent to the fuel tank and it comes out through regulating valve which is directed towards the fuel injector. Here the fuel injector is controlled by micro-controller and TPS (Throttle Position Sensor) which is mounted on throttle body. Compressor works until the pressure reaches the maximum range in the fuel tank and once it reached it stops automatically, then starts automatically when the pressure decreases to the minimum range. By using this methodology they had eliminated the

fuel pump completely and also save the power of engine which is used for fuel pump.

Md. Nizam Uddin[8] has modeled, programmed and constructed a computer controlled direct gasoline fuel injection system for four stroke SI engine. A program has made to control the fuel injection in the cylinder once in every two revolutions. A opto- isolator sensor is used in it to maintain the fuel injection period. They said that the model which they had designed works properly at a constant speed of 3000rpm.

Ram Kumar Kunjam [9] had described about advanced electronic fuel injection system which they had developed. The advanced EFI system uses both electrical and electronic devices to monitor and control the engine operation. They had used an Electronic Control Unit (ECU) System which receives the electrical signals in the form of current or voltage from various sensors. They had also given a short overview on the performance and cost implication of system relative to alternative emission control methods.

Renuraman.J [10] did an experimental evaluation of EFI system in a four stroke 125cc engine. In that system the fuel injector injects the fuel according to the engine requirement which is measured by various sensors like speed sensor, crank angle, Lambda sensor, etc. Experimental evaluations are made in order to investigate the performance parameters and emission parameters of the engine.

Saurabh Murlidhar Chaudhari [11] says that due to frequent price hike of fuel we are in compulsion to use an alternate fuel and also to control emission norms like greenhouse effect, global warming. So they had suggested a new device such as electronic mileage booster with magnetic fuel vaporizer combustion would be an alternative source for conventional carburettor engine. The new concept of magnetic fuel vaporizer helps to dissolve the carbon deposits in carburettor, fuel injector, combustion chamber and there by keeping the engine clear.

S.Suryakanth [12] developed a prototype kit which is used in retrofitting existing carbureted two stroke engine to direct injection. Also they had added a external compressor to supply compressed air to the system. They had used a position indicator and encoder in-order to provide the speed and position feedback to the Electronic Control Unit (ECU). Once the design and development of the kit was over. They installed it in Yamaha RX135 vehicle and used in real world road test for drivability. They took the emission and fuel consumptions in the system.

T K S Sai Krishna [13] created a geometry of Diesel fuel injection nozzle, where the fuel flow characteristics in the nozzle significantly affects the process of fuel atomization, combustion and formation of pollutants emission in diesel engine. They had created a three dimensional Solidworks

model in order to describe the injector fuel flow. They had found the results for fuel flow characteristics for steady state condition at various angular conical holes.

Y. Robinson [14] conducted an experimental work on a two Stroke spark ignited engine to reduce the emissions and to enhance the performance of the engine by electronic fuel injection. They had used LAB view software to control the fuel injection system and they mounted the injector at the inlet manifold in order to get good Air Fuel mixture. Their results says that the virtual instrumentation techniques results in improved engine performance, reduced emission and cycle to cycle variations.

CONCLUSION

Electronic fuel Injection (EFI) System is one of the method to achieve the current emission norms. Hence to achieve BS-4 norms EFI system helped a lot. But for BS-6 the emission norms are more complicated to achieve. Therefore we should go for some extra technology in EFI system to achieve it or else we should choose any another alternate fuels inorder to achieve the emission norms and also to save the environment by global warming.

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