Lecture 24

3rd Semester M Tech. Mechanical Systems Design

Mechanical Engineering Department

Subject: Advanced Engine Design

I/C Prof M Marouf Wani

Lecture 24 – Electronic Fuel Injection System For I C Engines
Topic - Advantages of Electronic Fuel Injection System – 17-11-2020

Advantages Of Electronic Fuel Injection System

Better mixture preparation characteristics with **electronic fuel injection system** as **compared** to the **earlier carburetor type of fuel supply system** for the following reasons:

(i) **Better spray characteristics** under **higher pressure differential across** the two sides of the **injector**.

(ii) **Better atomization** of fuel in air.

(iii) **Better mixing** of fuel with air.

(iv) **Lesser time needed for mixing** of fuel with air due to **injector** based **wider and deeper spray**.

The main advantages are of EFI are:

1. **Increased Power output.**
   Due to **better combustion efficiency**. Due to **better control over the air and fuel supply** system over full range of speed and load.

2. **Lower brake specific fuel consumption.**
   Due to **better combustion efficiency**, **improved power** and **lesser loss of hydrocarbons** of the fuel.

3. **Higher Torque**
   Due to **better combustion efficiency** and **reduced loss of hydrocarbons** from the fuel.

4. **Lower Emissions or lesser pollutants.**

   Due to **better combustion efficiency** and **better control** on the operating value of **air-fuel ratio** at each speed and load.

   Nowadays it is possible to design the engine with lower emissions as the objective function using the electronic fuel injection system. The flexibility in design has improved.

   Earlier the engines were designed for maximum power and maximum torque. Subsequently to attract more customers the engines were designed for lower fuel consumption or maximum mileage from vehicle point of view.

5. **Improved cold start, warm-up and acceleration.**

   This is due to **better control over the supply of fuel during these transient engine operations.**

   We can maintain the required air to fuel ratio for such transient engine operations using embedded system microcontroller based electronic fuel injection system.

   This involves the use of signals based on engine sensors and transducers, hardware based signal processing followed by the software based computational signal processing needed to control the pulse width of the solenoid injectors.

6. **Increased volumetric efficiency and therefore increased power and torque.**

   Electronic DC pump is used to spray the fuel in the air at the ports or in-cylinder under a large pressure differential.

   Earlier the controlled supply of fuel was ensured by creating a small **pressure drop** across the two sides of the jets of the **carburetor** using the concept of **Bernoulli's equation** and involving the use of a **venturi**.

   The use of the **venturi** in the design of the **carburetor** however created a **restriction to the flow of air** in the intake manifold thereby reducing the volumetric efficiency of the engine.

With **electronic fuel injection system** a **larger pressure differential** exists during the intake process to facilitate **more flow of air**. This in turn **increased** the **volumetric efficiency** of the engine.

. 7. **Better thermal efficiency.**

Due to **better combustion efficiency** and better control to operate the engine at a **required air to fuel ratio** under the variable load and speed of the engine

A **leaner air to fuel ratio** increases the **thermal efficiency** and decreases the brake specific fuel consumption of the engine. .

. 8.**More fuel tolerant.**

Due to **forced atomization of fuel under pressure** in EFI system there is **flexibility** to use other **alternative fuels** with slightly different physical and chemical properties.

9.**Faster acceleration and deceleration.**

This is possible due to **better control of the quantity of fuel** being injected by the **ECU** which changes the **pulse width** of the solenoid injector after **sensing** the engine speed with **speed sensors** and the **throttle position sensor** fitted with accelerator pedal or throttle plate.

10.**Easy starting and faster warm up.**

This is possible because the **ECU regulates the pulse width** and therefore **fuel flow** after receiving **input signals** from the following **sensors**:

Thermocouples sensing the **temperatures** of the following components of the engine:

(i) Cylinder head

(ii) Engine body or cylinder block

(iii) Engine coolant

(iv) Atmosphere

The **inductive pick up** type of **speed sensor** sensing the following:

(v) Engine crankshaft rotational speed

This **eliminates the use of Choke system** needed during start up of the engine **under cold conditions** for creating a richer mixture conditions with EFI system.

11. **Charge stratification.**

It is possible to create charge stratification **along the length of each cylinder** with EFI system.

This is possible **by retarding the start of fuel injection with same valve timings.**

This creates **rich mixtures near spark plugs** and comparatively **leaner mixtures near piston top away from the spark plug.**

Rich mixture near the spark plug is needed for **better start of combustion.**

The **leaner mixture** towards the opposite piston side helps **to decrease pollutants** because of leaner operation.

12. **Carburetor icing problem is virtually eliminated in case of aircraft engine applications**.

Forced atomization lowers the energy known as **enthalpy of vaporization needed for evaporation of fuel** which causes icing problems.

13. Better control for maintaining a required air to fuel ratio.

The design of a multi-purpose fuel supply system is possible with the use of EFI.

A **Rich mixture** is needed for **maximizing power**

A **lean mixture** is required for **economy or maximum thermal efficiency** and **lower pollution**

A **stoichiometric air to fuel ratio** is needed for maintaining a **balance between above two conditions.**

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Prof M Marouf Wani

I/C Advanced Engine Design
Mechanical engineering Department
National Institute of Technology
Srinagar, J&K
India – PIN 190006

Reference:

Bosch Automotive Handbook
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