Macroscopic Analysis of Fuels Sprays Using Constant Volume Spray Chamber

1. Facility / Equipment name

For the macroscopic analysis of the fuel sprays coming out of the injector constant volume spray chamber is used with optical access provided for the image analysis, For capturing spray images High speed camera is used with higher frame rate provided with two white light sources in the chamber.

The mechanical injector is operated with the help of mechanical fuel pump and pneumatic high pressure pump is used for solenoid injector, NI Direct Injection module is used for operation of solenoid injector.

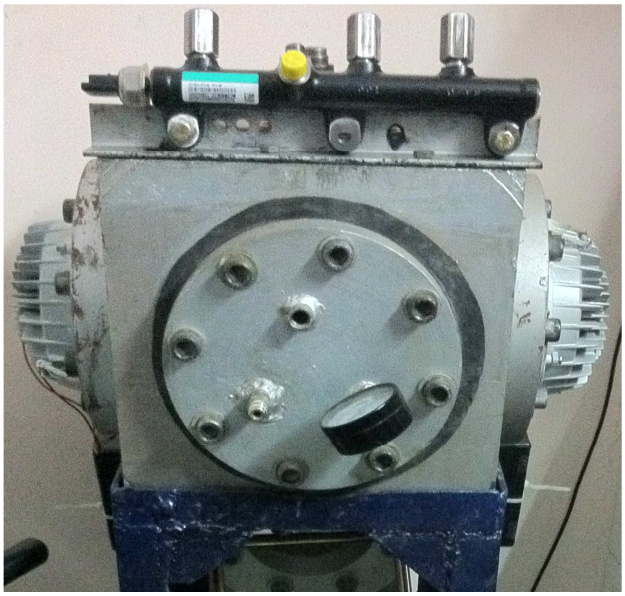
2. Brief description

- For the macroscopic analysis of spray, a square shaped constant volume chamber was designed using SOLIDWORKS. After designing the chamber, casting and machining of the chamber was carried out.

Manufacturing Stressing of Square chamber

- The constant volume spray chamber can be pressurized at maximum of 60 bar using inert gas, so that the injection can be done in the chamber as per to match the actual engine chamber characteristics.

- The chamber has four flanges with optical windows (two for illuminating the chamber with white light sources and two for capturing the images using high speed camera), one flange (for mounting mechanical/solenoid injector) and one solid flange (for N_2 inlet supply, N_2 outlet supply and for mounting pressure gauge).



Complete Square Chamber Set-up

- With the help of high speed camera, The images are grabbed by image grabbing software installed in the computer and are analysed by MATLAB.

- Reliable prediction of spray penetration length, spray cone angle, spray breakup and spray area is required for achievement of increase in fuel efficiency, reduction in exhaust gas emissions.

- In the work, diesel and biodiesel fuel spray development can be studied using High speed imaging of a high pressure diesel common rail injector mounted on a constant volume square spray chamber.

- For image analysis of the spray coming from the mechanical injector a DM10 engine mechanical injector is used having three holes in the nozzle and which can be pressurized to maximum of 250 bar of pressure.

- For injecting the fuel by solenoid injector, pneumatic high pressure pump was used. The high pressure pump can deliver pressure up to 2100 bar continuously through the high pressure line which is connected to the common rail mounted on the chamber. The common rail reduces the pressure fluctuations and supplies the fuel to the solenoid injector.

- For driving the solenoid injector, NI DI injector driver system was used. This module is used for driving peak and hold injectors. The pulse width, pulse duration and injection delay was set with the help of software.

3. List of testing, research and consulting areas where it can be useful

Macroscopic analysis of sprays is the important parameter which may be useful for recent technological growth. Analysis of sprays in the combustion chamber is the broad area of research which has great effect on the exhaust emission and efficiency of engine. Spray area, penetration length, cone angle etc are some of the parameters which are concerned with spray study. As there is the scarcity of petroleum fuel researches are to be focussed on alternative fuels for which macroscopic analysis is the broad area of study.

4. List of keywords for which it should be findable

Spray chamber, Macroscopic analysis, Spray Visualisation, Constant Volume chamber, Spray characteristics, Spray atomisation.