

## **Spray Development for Low Temperature Combustion in an HSDI Optical Diesel Engine using Multiple Injection Strategies**

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### **Abstract**

In this paper, the spray development in an HSDI optical diesel engine was studied for low temperature combustion conditions by employing an advanced injection strategy with an early pre-TDC pilot injection followed by an after-TDC main injection. Heat release rates were calculated based on in-cylinder pressure. The spray development process for the entire cycle was visualized by using a high speed digital video camera synchronized with a high repetition rate copper vapor laser. Combustion process was also visualized by imaging the natural flame luminosity. From the experimental results, it is found that spray structure for the pilot injection is quite different from the main injection. Due to lower ambient pressure and temperature for early Pre-TDC injection timings, liquid spray shows highly dispersed structure with longer penetration. Depending on the pilot injection timing, fuel can penetrate into the squish region for earlier injection timings. Due to small fuel quantity, fuel impingement is rarely seen from the spray images. But for the main injection, much shorter liquid penetration is observed, which is resulted from the high pressure and high temperature ambience with the piston close to the TDC. Due to the interaction of the spray jet with the piston bowl geometry, it is seen that fuel impingement occurs at the bowl lip, and this impingement splits the fuel spray into two parts with one going up into the squish region and the other going down into the piston bowl. This interesting observation was further confirmed by the combustion images with dual point ignition.

Key words: Low temperature combustion, HSDI diesel engine, Mie-scattering, Natural flame luminosity, Multiple injection strategy

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