Near Nozzle High-Speed Measurements of the Intact Core for Diesel Spray

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The optical connectivity method is applied for the first time for near nozzle measurements of the intact core length of stock high pressure diesel injectors up to 220 MPa (2200 bar) with high speed imaging. The method is based on an approach by Roosen (1991) and the so called optical connectivity method of Charalampous et al. (2009) for the measurement of the intact core length of sprays. To achieve this, the light is guided through an optical access into the nozzle tip to illuminate the liquid jet along its intact core length from inside. So far, this approach has been applied to rather low pressure injectors or specially designed nozzles.

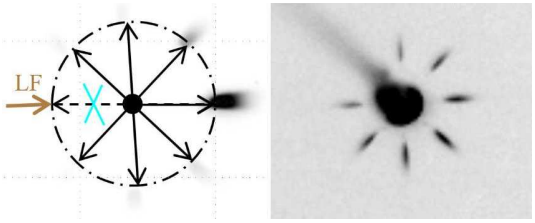

Figure 1. Exemplary, inverted raw pictures: inserted light fiber (LF) through 9 o'clock nozzle hole (additionally visualized pitch circle of nozzle holes respectively direction of the remaining holes) (l.) and centrally coupled light fiber through nozzle tip (r.) (spray core at the 11 o'clock position is hidden by the slightly off focus fiber in the foreground)

For the application on modern common-rail diesel injectors with injection pressures above 200 MPa (2000 bar), two approaches are being evaluated now. In the first approach, an optical fiber is coupled into one of the nozzle holes of a standard heavy duty diesel injector (Fig. 1, l.). Doing so, it was possible to determine the intact core length for the hole on the opposed side. First high speed measurements of the unsteady spray behaviour with up to 25 kHz resolution were feasible. In the second approach the light is guided into the sac hole volume through an additionally drilled access on the center of the nozzle tip (Fig. 1, r.). Here, the lengths of all spray cores could be measured simultaneously. A stable operation was possible up to injection pressures of 220 MPa (2200 bar). Results with transient high speed imaging measurements are then shown. Additionally, a simultaneous application with high speed Mie scattering imaging of the spray shape is presented within this work.

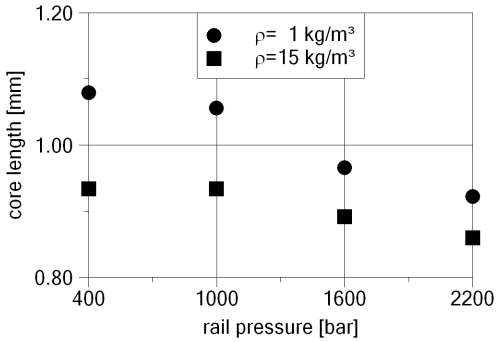

Figure 2. Mean values between $t = 1500\ \mu s$ and $t = 2500\ \mu s$ for variations of the rail pressure and density

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