Investigations of Twin-Jet Sprays for DISI Engine Conditions

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Abstract

A well atomized spray enhances the evaporation process in gasoline engines. This work studies a sheet break-up mechanism formed by two impinging jets as a more effective alternative to the commonly used pressure driven break-up in multi-hole nozzles.

Figure 2 shows exemplarily three different shadowgraphy single shot images (view: max. radial expansion) for three different nozzle geometries, for which the bore-hole diameter (I → II) and the impinging angle (II → III) of the jets were changed.

I II III

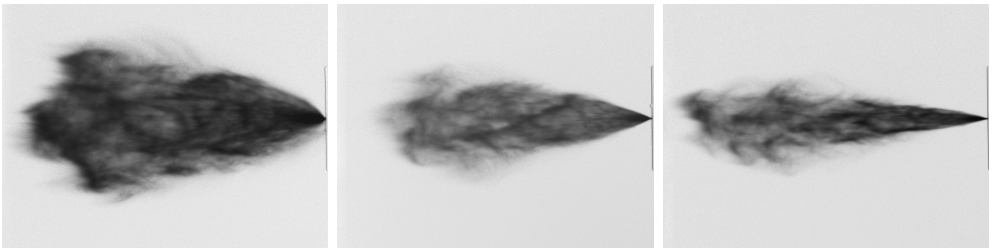

Fig. 2 Single shot shadowgraphy-images for different nozzle design parameter acquired 450µs after visible start of injection;
Parameters: p_{amb}=0.1MPa, p_{fuel}=20MPa, T_{fuel}=350K, T_{amb}=350K, injection time: 1ms

To summarize, the penetration depth and the cone angle can be adjusted in combination with nozzle-hole diameter and impinging angle, which allows the adjustment of both, mass flow and spray shape. A bigger bore-hole diameter increases both, the spray cone angle and the penetration depth; a bigger impinging angle of the two liquid jets results in an increase of spray cone angle, but decreases the penetration depth.

In order to quantify the quality of the atomization process the drop size distribution was determined spatially and temporally with Phase-Doppler-Anemometry. In Table 1 the measured mean drop sizes for both injectors are shown for three different injection pressures for a fully opened injector. Here the small pressure dependency of the mean drop size of the twin-jet injector gets clear. Considering a pressure change from 20MPa to 5MPa, an increase of 16 percent (1.2µm) for the twin-jet injector is accompanied by an increase of 46 percent (4.5µm) for the multi-hole injector.

Tab. 1: Evaluation of the measured mean diameter during full needle lift of the injector in a distance of 30mm to nozzle tip

	Bosch HDEV 5.2 min. mean diameter [µm]	Twin-jet Injector min. mean diameter [µm]	Reduction
5 MPa	14.2	8.8	38.0 %
10 MPa	11.8	8.4	28.8 %
20 MPa	9.7	7.6	21.2 %

At full needle lift the measured mean drop size for the twin-jet injector compared to the multi-hole injector decreases drastically –depending on injection pressure– 21.2...38 percent. Furthermore, the level of 8.8µm mean droplet diameter of the twin-jet injector found for an injection pressure of 5MPa is not reached from the multi-hole injector even for a pressure of 20MPa.

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