Evaluation of PDA Applicability in Regard to Heavy Fuel Oil Spray Investigations

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The better understanding of the key in-cylinder processes must be seen as a prerequisite for the further development and optimization of large marine Diesel engine combustion systems. The existing extensive set of reference data with respect to the macroscopic behaviour of fuel sprays at relevant conditions including various fuel qualities, which have been acquired on an experimental facility specifically devised for this purpose (Herrmann et al., 2007), shall now be extended towards microscopic spray characterization.

The particular challenge in this context is related to the opaque nature of the heavy fuel oil (HFO) widely used on those engines, which is associated with limitations with respect to the applicability of optical measurement techniques such as PDA (Wigley et al., 1999). Therefore, a thorough assessment of the practical implications of applying PDA on HFO sprays has been conducted, starting from the theoretical evaluation of the optical properties. The most suitable configuration for the actual experiments has been identified on the basis of extensive pre-studies involving dedicated test setups for validating the PDA droplet size measurements. In this context, in-depth analyses have been made in order to determine the refractive index required for the proper investigation of specific configurations.

Using a scattering angle of 90° in combination with perpendicular polarized light, first measurements have been performed in a HFO spray and the results compared against corresponding data obtained for light fuel oil at a scattering angle of 70° and parallel polarization (see Figure 1). The fuel quality has a clear impact both on the velocity and size distribution. In particular, the average diameter of the HFO droplets is bigger and the distribution covers a larger range, which is in line with the expectations in view of the different composition and physical properties.

Hence, the applicability of PDA for HFO spray investigations could be confirmed and a suitable setup identified for delivering high quality results.

Fig. 1 Droplet size at 90 bar and 900 K chamber condition

References