Optimization of Orifices Arrangement for the Maximized Spray Tip Penetration of Wall-Impinging Sprays Injected by Group-Hole Nozzles

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Abstract

In this study, the factors related to the optimization of wall-impinging sprays injected by closely spaced micro-orifices (group hole nozzle) were investigated to improve the in-cylinder air utilization by enhancing the spray tip penetration after wall-impingement. To maximize the spray tip penetration of group hole nozzle sprays, the different types of group hole nozzles, which have different intervals and angles between orifices, were applied in this study. The spray tip penetration of evaporating sprays were measured based on the optical thickness images captured using a laser absorption scattering (LAS) technique.

The results showed that the distance between the arbitrary centers of two impinging jets at the impingement wall (χ) has the significant effect on the spray tip penetration of group hole nozzles. The elliptical shape of spray was observed for all test nozzles although the ratio between major axis and minor axis of ellipse was different for each nozzle. The elliptical shape of wall-impinging spray was changed with time and the crossing timing when the minor axis starts to be major axis appeared earlier as the χ distance decreased and the injection pressure increased. The spray tip penetration of group hole nozzle spray was maximized around the χ distance of 5.4mm where the strong momentum region of each jet starts to interact just after the wall-impingement. The related mechanism on this phenomenon was discussed in terms of (1) the momentum separation of each jet to the penetrating direction and the spray axis direction and (2) the momentum interaction of two jets after wall-impingement.

Key words: group-hole nozzle, orifice arrangement, spray tip penetration

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