Spray resulting from High Pressure Atomization with low L over D Multihole Injectors and the role of the Cavitation

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Abstract

Two different low L/D nozzle designs are tested: one version with a sharp entrance (normal injector) and a second version submitted to hydro-grinding to smooth out the nozzle entrance rounding radius in order to counteract the cavitation trend. The resulting spray is analyzed in a close view by direct imaging shadowgraphy and by PDA (Phase Doppler Anemometry).

The comparisons presented, due to the reduction in cavitation on one side of the nozzle in the hydro-ground injector, show that the overall spray morphology is different in comparison to the normal injector. Asymmetric cavitation causes the spray, especially its dense region, to tend towards the injector axis. As the cavitation at nozzle exit is reduced, the angle of the dense spray region is increased and the spray width is reduced.

Having cavitation on one side of the nozzle changes the velocity field of the flow, hence the jet experiences a transverse motion. Further analysis shows that at high pressures the mixing of hydro-ground injector's spray takes place further downstream than for the normal injector. PDA results also do agree with these findings, showing increased droplet axial velocity for the hydro-ground injector, and also a reduction in the range of droplet flow angles, which results from the reduced levels of cavitation. Therefore, cavitation inside the nozzle improves the dispersion of the spray because as soon as the bubbles emerge from the nozzle they break the liquid structures and increase the injection angle. Droplet sizing were applied and surprisingly both sprays lead to close droplet diameters; which means that the result of the overall atomization process is not dramatically influenced by cavitation. These features behaviours are discussed in the paper by analyzing the resulting sprays from the two injectors.

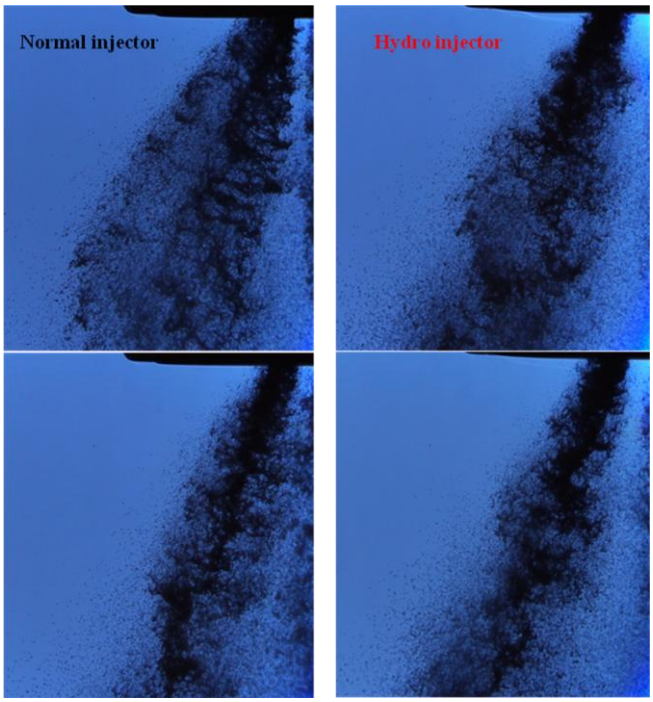

Figure 1: Samples of jet images at 60bar.

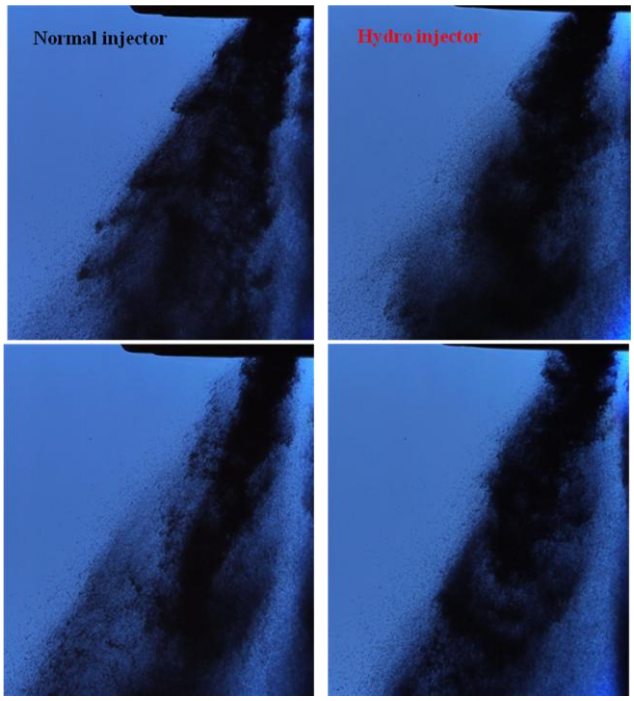

Figure 2: Samples of jet images at 130bar.

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