Summary of Deliverable D1.5: Supercritical atomisation visualisation for pilot injection events

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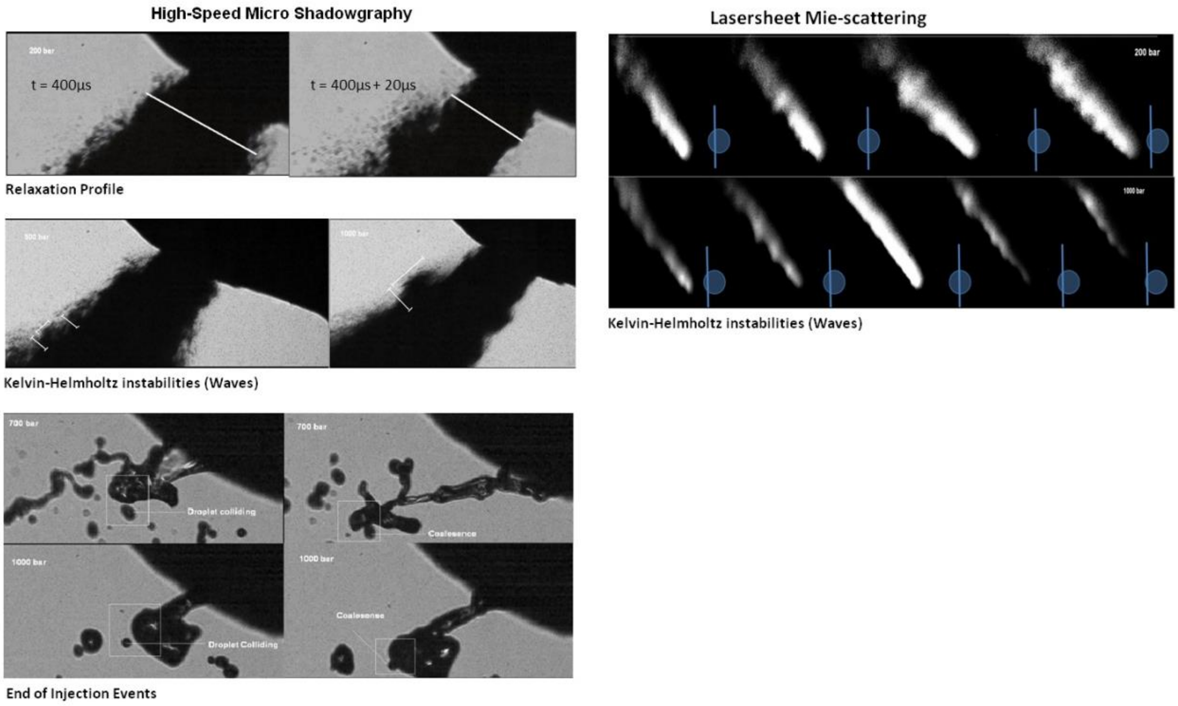

Due the current EU regulations, there is a demand for in-depth investigation of diesel sprays, considering the research during the past five decades has led to a point where it is necessary to dig deep to microscopic levels of research which would further help understand the macroscopic behaviour of the spray. This type of investigation would help find new possibilities required to meet the demands of emission reduction and fuel consumption in diesel combustion engines. One of the major research question addressed in this paper would be to understand the phenomenon that allow the mixing of the ambient gas at the primary atomization region as close as 1mm to the nozzle exit. The phenomenon responsible for mixing process at such early stages as close as 1mm from the nozzle exit were observed experimentally using Micro-shadowgraphy and Mie-scattering techniques. This paper describes an attempt to explain the possible reasons for the presence of high concentration of ambient gas in a diesel spray volume. This led to experimentally investigate the spray structure in the first millimetre of the spray to observe the phenomenon responsible that allows mixing to take place. The combination of high resolution images of the spray shadow and Mie-scattering allows the observation of dynamic phenomenon responsible for ambient

gas mixing process 1mm from nozzle exit. The frequency of fluctuations in the spray structure due to Kelvin Helmholtz Instabilities and relaxation factor are the major driving forces observed at a range of 1.5 to 1mm from the nozzle exit. The results obtained give some new insights that show the clear presence of Kelvin Helmholtz Waves (KHW) and simultaneously, fluctuations of expansion and contraction along the circumference of the spray structure known as the relaxation factor. The dimensional size of KHW and width of the relaxation factor along the spray observed at 1mm from the nozzle exit increase with injection pressure for up-to a width (60 µm) and height (25µm) for KHW and width (250 µm) and frequency (5300 hertz) for the relaxation factor. The number of KHW are inversely proportional to injection pressure. The combined effects of fuel properties and momentum at the end of injection are also explained.