Abstract

Combustion of water-containing diesel fuels results in a simultaneous reduction of soot and NO_x-emissions, i.e. they partially avoid the so-called *soot-NO_x trade-off*. Already in 2003 *Nawrath et al.* advertised in a patent application [DE 10334897A13] the advantageous application of microemulsified fuels. In the frame of the present work new temperature invariant, highly efficient fuel microemulsions of the type water/antifreeze - diesel fuel - oleic acid/monoethanolamine/oleic acid diethanolamide containing up to 24 wt.% water with appropriate physical characteristics for commercial applications were formulated. The structure of these water-in-fuel microemulsions was studied using small angle neutron scattering (SANS) and dynamic light scattering (DLS). Aiming for microemulsification right before injection, the formation kinetics of microemulsified fuels varying the water content and the temperature was recorded via transmitted light in a stopped-flow system. It turned out that microemulsions form even faster approaching combustion conditions, because of high temperature and pressure conditions. As unexpected reward of the investigations on formulation of microemulsion fuels, novel water-in-fuel nanoemulsions (< 200 nm) were obtained featuring substantial reduction of surfactant content, an interesting economical aspect. Both investigated fuel classes are suitable for load point dependent “on injector”-blending of water (including anti-corrosion agent and lubricant) and diesel (including surfactant-blend) which are mixed within milliseconds in the mixing chamber from the upstream main injector. This procedure in addition avoids contamination of the injection system with water, as only those amounts of water are added that are immediately injected. Exhaust gas emissions, soot-structure and size distribution of water containing fuels compared to pure diesel fuel were analysed. The results show that using load-dependent water containing fuels yield a drastic reduction of soot up to 98 % (FSN) as well as nitrogen oxide emissions up to 62 %.