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Study of the sooting propensity of different oxygenated biofuels

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Abstract

Effects induced by the use of different oxygenated biofuels as additive or substitute on the soot formation process have been studied using a laboratory-scale test bench allowing the standardization of liquid fuels turbulent spray flames. Investigations have been carried out by coupling Laser-Induced Incandescence and Fluorescence (LII/LIF) to obtain mappings and concentration profiles of soot and soot precursors (including light soot precursors and high-number ring aromatic species). The influence of the oxygen moieties on the sooting propensity has been analyzed through the study of the correlation existing between the peak soot volume fraction measured in flame conditions and the Threshold Soot Index (TSI) or the recently proposed Oxygen Extended Sooting Index (OESI) of the tested fuels. Such a methodology allowed the identification of the effects involved in the soot reduction observed when adding biofuels to conventional gasoline or Diesel (i.e. the dilution and the oxygenated functional group effects). Finally, different LII models have been developed and confronted to data collected in well characterized flames. Such models are based on spatial and temporal discretization of the mass- and energy-balance equations involved in the excitation process of soot particles by a laser source. Inverse methods have then been used to evaluate some physical properties of soot such as their diameter and their absorption function at different heights in the studied flames; such data being of interest to better understand the evolution of soot properties as a function of their formation stage depending on the nature of the burnt fuel.

Biography

Romain Lemaire has completed his PhD at the age of 25 years from Lille University in France. After working as a Process & Development engineer in the chemical industry, he joined Mines Douai (a French engineering school) where he developed an experimental laboratory dedicated to the study of fuel oxidation and coal combustion under oxygen enriched air. He is now co-director of the Industrial Energetic Department in charge of research activities. He has published several papers focusing on fuels and biofuels combustion in reputed journals.