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Experimental analysis of the sooting tendency of different oxygenated molecules used as additives in a diesel surrogate

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Soot particles issued from combustion processes are likely to induce harmful effects on health while contributing to climate change. Diesel engines that are widely used across Europe are particularly suitable to the development of soot particles and are therefore subjected to strict regulations. In recent years, many studies presented insightful observations to improve our knowledge of the soot formation mechanism. In parallel, a growing attention has been paid to oxygenated biofuels that appear as an interesting option to reduce the energetic dependence on petroleum as a fuel source. It has thus been observed that the use of oxygenated biofuels reduces soot emissions. Other researches subsequently showed that this reduction was strongly related to the structure of the oxygenate used.

The objective of the present work is to quantify and analyze the potential of soot reduction of several oxygenates used as additives in diesel fuel. More precisely, the impact of the position, the number of oxygen atoms and the type of C-O link (single or double bound) on the production of soot have been studied by mixing up to 75% of an oxygenate (1-butanol, 2-butanol, butanal, butanone or methyl propanoate) in a Diesel surrogate (the "IDEA" mixture composed of 70% n-decane and 30% α-méthylnaphtalene). Measurements have been carried out using a laboratory-scale test bench allowing the standardization of liquid fuels turbulent spray flames. Mappings of soot volume fractions in the investigated flames have been performed using Laser-Induced Incandescence (LII). Maximum soot volume fractions have then been converted into equivalent Yield Sooting Index to be compared with sooting indicators such as the Threshold Soot Index (TSI) and the Oxygen Extended Sooting Index (OESI). Comparing such experimental measurements with index values tabulated in the literature is likely to help a better understanding of the impact of the structure of oxygenated molecules on their soot suppressing effect.

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 by laser diagnostics and coal combustion under oxygen enriched environment. 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.

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