Experimental study of the impact of oxygenated fuels on pollutant emissions in flame conditions

In order to reduce the fossil fuel dependency and the net CO_2 emissions of spark-ignition (SI) engines, bio-fuels, which contain oxygenated molecules, are being considered as a promising lever. This is why the percentage of ethanol in gasoline, up to 10% today, will be still increased in the coming years. Although oxygenated fuels tend to reduce soot emissions, the chemical interactions between Polycyclic Aromatic Hydrocarbons (PAHs) with oxygenated compounds is not yet well understood. Moreover, the use of such alternative fuels gives rise to new pollutant issues. For example, they produce much larger formaldehyde and aldehyde emissions compared to standard fuels. As these molecules are highly toxic, they will be regulated in the future Euro 7 norm.

A better understanding of the chemical processes related to the use of these new bio-fuels requires experimental measurements to establish a detailed database including aldehydes, PAHs and soot during the combustion of oxygenated fuels. In this way, a set of laminar flame experiments will be carried out. As a surrogate of gasoline we will consider a reference fuel made of iso-octane, n-heptane and toluene (INT), mixed with ethanol (INT-E), the most plausible oxygenated gasoline for the coming decade, or with butanol (INT-B), as a representative of long-term bio-resourced oxygenated fuels. Comparison between INT-E and INT-B will also allow us to assess the influence of the structure of the oxygenated fuels, which is also not well known.

Hence, the objective of this PhD will be to establish an experimental detailed database to characterize the oxidation of the INT reference fuel, the combustion chemistry of the oxygenated compounds and their influence on key chemical species involved in pollutant emissions. This project will also aim to contribute to a larger research program devoted to the impact of oxygenated fuels on SI engine emissions (ANR OFELIE). Different research laboratories and automobile constructor companies (IFPEN, LRGP, PC2A, PSA, and Renault) will be involved in this ANR OFELIE program.

Applicants must have a master's degree in chemistry-physics or equivalent. Experience in the field of combustion, experimental measurements, and chemical kinetics will be appreciated. The work will take place at PC2A laboratory, Lille University (http://pc2a.univ-lille.fr/).

Keywords: Combustion, Oxygenated Fuels, Laminar Flames, HAPs, Soot

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Funding: ANR French research funding – OFELIE project