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Numerical study of soot formation using phenomenological soot modelling approach in a biodiesel-fueled compression ignition engine

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Biodiesel is seen as a promising alternative to conventional diesel due to its desirable attributes such as biodegradable, renewable and sustainable. Great effort has been done in investigating renewable biodiesel, an environmental-friendly fuel as fossil fuel alternatives, and its application on diesel engines. In the present study, four different typical biodiesels (cottonseed, rapeseed, sunflower and soybean) were numerically studied on a compression ignition engine, particularly targeting on soot formation in terms of mass and particle size distribution. The corresponding computational fluid dynamic modeling was performed by KIVA4 coupled with CHEMKIN II code, and a special chemical kinetics mechanism consisting of 106 species and 263 reactions was employed to simulate the combustion process, since it contained methyl linoleate, a majority component in most biodiesel, thereby improving the accuracy of simulation. The soot mass and particle number density were solved by rate equations using sub-models of various chemical and physical phenomena, including precursor formation, soot particle inception and coagulation, soot surface growth and oxidation. The role of the chemical reaction mechanism in soot growth and oxidation is derived from the concentration of four species, namely H, O_2, C_2H_2 and the nucleating PAH. It was proposed that lower kinetic viscosity methyl esters was favorable for better fuel–air mixing, thus producing small-sized soot particles that lead to less soot mass loaded. Therefore, combustion temperature should never be the unique factor relating to soot chemistry, and the scenario of soot particle forming was quite sensitivity to the kinetic viscosity of biodiesel.

Biography

Zhao Feiyang obtained PhD degree in 2013 from State Key Lab of Engine of Tianjin University in China, majored in numerical study of diesel engine combustion and emission. Currently, she is a Research Fellow working on optimization of engine combustion in the National University of Singapore (NUS).

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