ME PhD Thesis Defense

Experimental Studies on Methanol Sprays for IC Engine Applications

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ABSTRACT

In this work, studies have been conducted on sprays of methanol and its emulsions with diesel towards assessing the potential of methanol as an alternative fuel for IC engines. Evaporating spray characteristics of diesel-methanol emulsions and pure methanol are studied in a high-pressure chamber with optical access. The first part of the study involved assessing the stability of methanol-in-diesel emulsions with conventional surfactants such as Span-80 and Tween-80. The hydrophilic-lipophilic balance (HLB) values of the surfactant were varied from 7 to 15 to investigate the role of the surfactant on the macroemulsion stability. It was observed that macroemulsions with up to 10 wt.% of methanol were stable. In the second part of the study, the emulsion sprays were characterized in a constant volume chamber at injection pressures of 500 bar, 1000 bar, and 1500 bar in an inert atmosphere of nitrogen at 50 bar and 900 K. Next, methanol-in-diesel microemulsions were produced by using various surfactants such as 1-dodecanol, pentanol, and butanol. Among these, 1-dodecanol was chosen as the most suitable surfactant for the microemulsion owing to its ability to create microemulsions with up to 25 wt.% of methanol, and its high cetane number. The third part of the study focused on studying the phenomenon of micro-explosion in emulsion fuel droplets under engine-relevant conditions of pressure and temperature. In the fourth part of the study, pure methanol sprays were characterized at injection pressures of 200 bar, 300 bar, 400 bar, and 480 bar in an inert atmosphere of nitrogen at three engine-relevant conditions. Data generated on liquid and vapour penetration at these conditions highlight the effect of the surrounding gas temperature and density on the spray physics. In the last part, an evaporative spray model is developed to understand the spray characteristics of methanol spray. Overall, the data generated in the present work is expected to aid engine designers in adapting both compression ignition and spark-ignition engines for methanol fuel.

ABOUT THE SPEAKER

Anupam Ghosh is a PhD scholar in the department of Mechanical Engineering at IISc Bangalore, working with Prof. R. V. Ravikrishna in the field of atomization & spray science. He obtained a BTech in Mechanical Engineering from Jadavpur University, Kolkata, before joining IISc. His research focuses on experimental thermal-fluid science with applications in transportation and fuel research.

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