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Modeling and Simulation of Multiphase Evaporation in High Torque Low Speed Diesel Engine

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Abstract : Diesel engines are most efficient and reliable in terms of efficiency, reliability, and adaptability. Most of the research and development up till now have been directed towards High Speed Diesel Engine, for Commercial use. In these engines, objective is to optimize maximum acceleration by reducing exhaust emission to meet international standards. In high torque low speed engines, the requirement is altogether different. These types of engines are mostly used in Maritime Industry, Agriculture Industry, Static Engines Compressors Engines, etc. On the contrary, high torque low speed engines are neglected quite often and are eminent for low efficiency and high soot emissions. One of the most effective ways to overcome these issues is by efficient combustion in an engine cylinder. Fuel spray dynamics play a vital role in defining mixture formation, fuel consumption, combustion efficiency and soot emissions. Therefore, a comprehensive understanding of the fuel spray characteristics and atomization process in high torque low speed diesel engine is of great importance. Evaporation in the combustion chamber has a rigorous effect on the efficiency of the engine. In this paper, multiphase evaporation of fuel is modeled for high torque low speed engine using the CFD (computational fluid dynamics) codes. Two distinct phases of evaporation are modeled using modeling soft wares. The basic model equations are derived from the energy conservation equation and Naiver-Stokes equation. O'Rourke model is used to model the evaporation phases. The results obtained showed a generous effect on the efficiency of the engine. Evaporation rate of fuel droplet is increased with the increase in vapor pressure. An appreciable reduction in size of droplet is achieved by adding the convective heat effects in the combustion chamber. By and large, an overall increase in efficiency is observed by modeling distinct evaporation phases. This increase in efficiency is due to the fact that droplet size is reduced and vapor pressure is increased in the engine cylinder.

Keywords : diesel fuel, CFD, evaporation, multiphase
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