Abstract

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A Reduced Kinetic Model Approach to Quantifying Injector Spray Angle Influence on NG-Diesel Combustion

Author: Sudipta Nath, Ranjan Kumar, Shahanwaz Khan and Somnath Das

Category: Automobile Engineering

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Abstract:

This study examines the influence of injector spray angle on combustion characteristics and emissions in an NG-diesel dualfuel engine using computational fluid dynamics (CFD) with a reduced chemical kinetic model. The model, calibrated with experimental data, revealed that increasing the spray angle from 60° to 140° raised peak cylinder pressure and in-cylinder temperature, while changes beyond 140° were minimal. The optimal spray angle for combustion efficiency differed from that for maximum indicated work, underscoring the need for combined optimization of spray angle and combustion chamber design. Key findings include reductions in combustion duration, NOx, unburned methane, and carbon monoxide emissions upto a spray angle of 120°, with emissions stabilizing between 120° and 160°. The study identifies 120°–160° as the optimal spray angle range for balancing emissions and performance, offering valuable insights for developing more efficient and environmentally friendly dual-fuel engines.

Keywords: Hydrogen substitution, Dual-fuel diesel engine, Combustion characteristics, NOx emissions, Engine optimization

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