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A Study on Spray Characteristics of Ethanol-Diesel Fuel Blends of Ethanol Content using a Constant Voulume Chamber

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Spray characteristics are one of the variables that directly affect engine performance and engine design, having a significant impact on ignition and exhaust parameters in diesel engines. In this study, the effect of ethanol-diesel blended fuel with varying ethanol concentrations on the spray development process was investigated using diesel as an ignition agent. A static chamber and MATLAB were combined for the study of spray characteristics. The impact of adding absolute ethanol to the diesel blend fuel was evaluated using a static chamber that reproduces diesel engine conditions. Spray development images captured using a high-speed camera and shadowgraph technique were analyzed with MATLAB image processing techniques. Prior to the spray experiments, fuel phase separation tests were conducted at room temperature to evaluate the phase separation stability according to ethanol blend ratios. In the experimental design, the main variables considered were high ethanol blend ratios (50, 60, 70, 80, 90, 100%), injection pressure (80, 100, 120 MPa), and ambient pressure (1.5, 3 MPa). The results showed that ethanol addition changes the physical and chemical properties of the fuel, reducing density, viscosity, and surface tension. As a result, the spray penetration distance decreased, and the diffusion angle increased. Blended fuels with lower viscosity and surface tension showed larger diffusion angles, while blended fuels with higher density showed increased penetration distances. Furthermore, spray characteristics were influenced by injection parameters, indicating that an optimized injection strategy is a key factor in the spray development process.

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