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An Optical Study on Spray Characteristics of Ethanol-Diesel Fuel Blends of High Ethanol Content in a Constant Volume Chamber

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The characteristics of spray are crucial variables that directly influence combustion performance, playing a significant role in the ignition and emission parameters of diesel engines. This study explored the influence of different ethanol concentrations in diesel fuel on the spray development process. Experiments were performed in a constant volume chamber, and MATLAB software was used for post-processing the images. The experimental setup involved changing the ethanol blending ratios (50, 60, 70, 80, 90%), injection pressures (800, 1000, 1200 bar), and ambient pressures (1.5, 3 MPa). Before conducting the spray experiment, a fuel phase separation test was performed according to the ethanol blending ratio at room temperature. The analysis focused on macroscopic characteristics (spray penetration length, spray cone angle, spray area) to assess the effects of ethanol addition. furthermore, microscopic characteristic (Sauter mean diameter) was considered to validate the experimental results. The results showed that adding ethanol substantially decreased the penetration length, moderately increased the spray cone angle, and led to a slight reduction in spray area compared to 100% diesel spray. It was validated that increasing ethanol blending rate affects decreasing Sauter mean diameter, thus it enhances atomization of ethanol-diesel blending fuel.

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