Influence of Quaternary Combinations of Biodiesel/Methanol/n-Octanol/Diethyl Ether from Waste Cooking Oil on Combustion, Emission, and Stability Aspects of a Diesel Engine

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## **Abstract**

Methanol is considered a favorable renewable fuel for use in diesel engines owing to its advantageous features including sustainability, accessibility, and reasonable price. However, some drawbacks, such as the phase separation problem, low cetane number, and high latent heat of vaporization, hinder its utilization in diesel engines. This study attempted to improve the usability of methanol in diesel engines using n-octanol and diethyl ether as cosolvents and ignition improvers. The experimental part was divided into two stages. First, the stabilities of pure methanol and hydrous methanol, with waste cooking oil biodiesel as a base fuel, were investigated under different temperatures: 10 °C, 20 °C, and 30 °C. The results demonstrated that the pure methanol/waste cooking oil biodiesel mixtures remained stable at all temperatures. To improve the solubility of the hydrous methanol/waste cooking oil biodiesel blends, n-octanol was applied as a cosolvent. Next, the engine combustion and emission features were assessed using three ratios of pure methanol/waste cooking oil biodiesel blends with n-octanol and diethyl ether additives. The three combinations included 15%, 25%, and 35% methanol with 10% n-octanol and 2.5% diethyl ether. The waste cooking oil biodiesel was produced via the transesterification method, and the final product was characterized using Fourier transform infrared spectroscopy, gas chromatography–mass spectrometry, and thermogravimetric analysis. The fuels were evaluated via thermogravimetric analysis, and their physicochemical properties were determined according to the American Society for Testing and Materials standards. The highest cylinder pressure, heat release rate, and pressure rise rate were lower for the methanol/waste cooking oil biodiesel/n-octanol/ diethyl ether blends compared with the waste cooking oil biodiesel. In addition, the thermal efficiency reduced, while the brake specific fuel consumption increased for the mixtures compared with the waste cooking oil biodiesel. Relative to engine emissions, the nitrogen oxide levels also reduced, while the carbon monoxide and smoke opacity increased for the combinations compared with the waste cooking oil biodiesel.