

DEEP EUTECTIC SOLVENT-ASSISTED BIODIESEL PRODUCTION FROM PLUM KERNEL OIL: IMPACT ON REACTION RATE AND FUEL QUALITY

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ABSTRACT

Plum kernel oil (PKO) is a promising feedstock for biodiesel production as it is obtained from plum kernels that are a significant by-product of the fruit processing industry. The kernels contain a high oil content (up to 46.9%) with a favorable fatty acid profile dominated by oleic acid (over 70%). This study investigates the effect of the deep eutectic solvent (DES) triethanolamine:menthol (TEA:M, 1:2 mol/mol) on the reaction rate of PKO methanolysis and the resulting biodiesel properties. The reaction was catalyzed by 35CaO/CFA-Z (35% CaO supported on coal fly ash-derived zeolite). The oil was recovered using a screw press with an 8 mm nozzle. Methanolysis was conducted at 60 °C, with a 6:1 methanol-to-oil molar ratio, and 9% catalyst and 5% DES (by oil mass). The addition of TEA:M significantly accelerated the process, achieving a fatty acid methyl ester (FAME) content of 98.4% within 75 min, compared to a mere 7.7% without the DES. The resulting biodiesel exhibited a density of 867 kg/m³, kinematic viscosity of 3.92 mm²/s, acid number of 0.33 mg KOH/g, iodine value of 99.3 g I₂/100 g, and water content of 255 mg/kg. The FAME, mono- (MAG), di-(DAG), and triacylglycerol (TAG) contents were 98.25%, 0%, 0.20%, and 0.11%, respectively. All properties complied with the EN 14214 standard and were comparable to biodiesel produced without DES. Consequently, TEA:M is recommended as an effective additive to accelerate PKO methanolysis without compromising fuel quality.

Keywords: biodiesel, deep eutectic solvent, methanolysis, physicochemical properties, plum kernel oil.

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