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Compatibility Effects of Waste Cooking Oil Biodiesel Blend on Fuel System Elastomers in Compression Ignition Engines

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Abstract
Alternative energy sources, such as biodiesel, play a vital role in environmental protection. Waste cooking oil (WCO) biodiesel has promising applications in compression ignition engines. A major problem regarding biodiesel implementation is the deterioration and materials incompatibility of existing fuel system components with biodiesel. Variations in the composition of fuel prompted by the inclusion of biodiesel cause a variety of issues in diesel engine fuel systems where the elastomer is generally utilized as the fuel hose material and sealings. In this experimental work, the effects of the diesel and WCO biodiesel blends (B8, B16, B24, and B100) on Buna-N, ethylene propylene rubber (EPR), and polystyrene (PS) were examined by the immersion test, which was conducted for 160 h at various immersion temperatures of 30, 60, and 80 °C, respectively. The study also showed that the use of elastomer materials like Buna-N, EPR, and PS in diesel engines fueled up to 20% WCO biodiesel blends is advantageous; the overall compatibility improves by 100% compared to that obtained using neat diesel. The outcome revealed remarkable behavior changes, including a minor increase in volume and a slight loss in tensile strength and hardness compared to that observed using neat diesel fuel. The expansion of rubber materials increases over 60 °C, although the rate of this process decreases above 80 °C. It has been found that the expansion of rubber materials is unaffected by the acid concentration of the WCO biodiesel blends but significantly affected by the moisture content.

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