

## ABSTRACT

Mahua and simarouba oils with free fatty acid (FFA) level of 13 and 1.43%, respectively, were mixed at different proportions (25:75, 50:50 and 75:25 v/v). Based on fuel properties 50:50 v/v oil mixture (MSO) having FFA content of 7.19% was selected as a feedstock for biodiesel production. Because of high FFA, the MSO was pretreated before transesterification reaction. Following the response surface methodology, the optimized process parameters for the pretreatment of MSO to reduce its FFA content below 1% were 0.21 v/v methanol to oil ratio, 1.42% v/v  $\text{H}_2\text{SO}_4$  catalyst concentration and 62.11 min reaction time. The transesterification process parameters for pretreated MSO were 0.18 v/v methanol to oil ratio, 0.54% w/v KOH and 30 min reaction time. Both the processes were carried out at a reaction temperature of 60 °C with vigorous stirring. This process gave an average yield of biodiesel (MSB) around 97%. The fuel properties of MSB, HSD and their blends along with MSO were determined and were found to comply with the requirements of the latest American, European and Indian standards for biodiesel. The performance and emissions of a 10.3 kW constant speed diesel engine were studied by running the engine with MSB, HSD and their blends at different engine loadings. The results showed that BSFC and EGT increased, whereas BTE decreased with increase in MSB proportion in the blends as compared to HSD alone. However, with increase in engine load, BTE and EGT increased whereas BSFC reduced for MSB, HSD and their blends. The CO and HC emission reduced, whereas  $\text{CO}_2$  and  $\text{NO}_x$  increased with increase in MSB percentage in the blends. Based on performance and emissions, MSB blends up to 10% was found suitable for running the diesel engine. Hundred hours testing of the diesel engine with MSB10 and HSD was carried out. As compared to HSD fueled engine, lesser carbon deposits on cylinder head, piston crown and fuel injector, and lower concentrations of Cu, Zn, Fe, Pb, Mg and Al except Mn and Ni in the lubricating oil of the diesel engine were found with MSB10 fueled engine due to its better combustion and additional lubricity.

**Keywords:** mixture of oils, biodiesel, performance, emission, carbon deposits, metal addition.