Abstract

Reliable energy supply from sources with lower carbon footprint is required for ensuring sustainable growth. Significant work is being undertaken globally for developing alternative fuels for transportation sector in order to ensure energy security and reduce global and local pollution impact of fossil fuels. In present research, biodiesel produced from Karanja oil was characterized in order to investigate its suitability as alternative diesel engine fuel. Effect of fuel injection pressure, start of injection timing and pilot injection on the engine performance, emissions and combustion characteristics of mineral diesel and Karanja biodiesel blends was investigated in a single cylinder research engine. For evaluating the effect of fuel injection parameters on engine performance, emissions and combustion characteristics, engine was operated at various injection pressures (300, 500, 750 and 1000 bar) with different start of injection (SOI) timings. Effect of Karanja biodiesel and its mineral diesel blends on performance, emissions, particulates and combustion characteristics at different engine speeds and loads was investigated in a medium duty transportation DICI engine vis-à-vis mineral diesel. CO, HC, NOx and particulate emissions of 5, 10, 20, 50% biodiesel blends and 100% biodiesel were compared with mineral diesel. Effect of 20% blend of Karanja oil methyl ester (KOME20) on long-term engine wear and durability was studied in a 250 hour long endurance test. Effect of KOME20 on lubricating oil degradation has also been studied vis-à-vis mineral diesel by analyzing tribological properties of lubricating oil samples drawn from the crankcase at regular intervals of 20 hours during the endurance test.

Detailed investigations of performance, emissions and combustion characteristics of Karanja biodiesel blends confirmed acceptable performance of biodiesel blends (upto 20%) without any significant modifications in the existing engine hardware. Speed-torque characteristics of lower biodiesel blends were identical to mineral diesel. Lower wear of valves, pistons, piston rings, liners and small end of connecting rods for KOME20 fuelled engine was observed however higher wear was observed for big end bearings of connecting rod, main bearings and crank pins. Investigation of tribological properties of lubricating oil samples showed that biodiesel encourages oxidation and polymerisation of lubricating oil base-stock. Finally, Karanja biodiesel blend (upto 20%) can be used in existing diesel engines with modifications in the lubricating oil formulation, without any major modifications in the engine hardware.