

Biodiesel Development, Performance, Emissions, Combustion and Wear Investigations on a Medium-Duty Transportation CIDI Engine

ABSTRACT

The world is presently confronted with the twin crises of fossil fuel depletion and environmental degradation. Search for an alternative fuel, which promises a harmonious correlation with sustainable development, energy conservation, efficiency and environmental preservation, has become highly pronounced in the present scenario. Vegetable oil's physical and chemical properties are close enough to mineral diesel and may be used as alternative to diesel, but long-term use of vegetable oils or their blends pose various operational and durability problems in the engine, and need to be modified (biodiesel). Transesterification is found to be an effective technique for the vegetable oil formulation as a fuel. The present work deals with the development to the end use of biodiesel in transportation diesel engine. Rice-bran (agricultural waste material) is modified into biodiesel using chemical process of transesterification (alkali-catalyzed). Process parameters for transesterification of rice-bran oil are optimized. Characterization of the rice-bran biodiesel thus produced is carried out and most of the important properties of biodiesel are found close to mineral diesel. Detailed engine tests (performance, emission and combustion investigations) with developed fuel on a medium duty transportation diesel engine have shown improved performance of rice-bran oil biodiesel. 20% biodiesel (B20) is found to be optimum biodiesel blend and is selected for long-term endurance test. Various tests conducted for assessing the physical condition of engine parts and lubricating oil tribological properties have shown lower wear, lower carbon deposits and less deterioration of lubricating oil for biodiesel fuelled engine compared to mineral diesel fuelled engine.

The exhaustive engine tests and tribological investigations provide adequate relevant evidence that rice-bran biodiesel can be used as an alternative fuel in the existing engines without substantial engine hardware modification. Overall, use of biodiesel in diesel engines will not only enhance engine durability but also tackle the problem of fossil fuel depletion, energy security, environmental pollution and green house gas emissions.