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Research Paper :

Performance study of diesel engine by using karanja methyl ester (biodiesel) and its blends with diesel fuel

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ABSTRACT

The results of the performance of a compression ignition engine (direct injected, 4-stroke 2-cylinder engine) by using karanja methyl ester from non-edible vegetable oil (*Pongamia glabra*) and its blends with diesel fuel have been presented in this paper. Short-term engine performance tests were conducted using four different blends of karanja methyl ester oil with diesel fuel from 20% to 100% by volume at three fuel temperatures (30, 50 and 70^0-C) and at two injection pressures (17640 kPa and 24010 kPa). The engine performance parameters studied were power output, brake specific fuel consumption (BSFC), brake thermal efficiency (BThE) and exhaust gas temperature (ExGT) by using diesel fuel alone and the above mentioned blend fuels. The performance of engine with blend fuel (20% karanja methyl ester and 80% diesel) was found to be better than the other blend fuels. But the values of power output, BSFC, BThE and ExGT in case of blend fuel B20 (20% karanja methyl ester and 80% diesel) were observed to be, respectively 3% more, 9% more, 12%more and 0.5% less than the diesel fuel at 70^0-C temperature and 24010 kPa pressure. The karanja methyl ester (blends of B20) can be used as an alternative diesel fuel replacement with little sacrifice in brake specific fuel consumption.

Key words : Vegetable oil fuel, Alternative fuel, *Pongamia glabra*, Karanja methyl ester (biodiesel), Diesel blend

Among the alternate fuels for the petroleum fuel, vegetable oil esters (biodiesel) have gained good promise and suitability for their use in compression ignition engine (Srivastava and Prasad, 2004). Biodiesel is a non-toxic and renewable in nature. Further advantages over petro-diesel include higher cetane number, no sulphur emission, low aromatics, low volatility and the presence of oxygen atoms in the fuel molecule. According to the report entitled "comprehensive analysis of biodiesel impacts on exhaust emissions" published by Environmental Protection Agency, US (2002), biodiesel fuel burns up to 70% cleaner with 93% lower total HC, 50% lower CO and 45% lower particulate matter in comparison with conventional diesel fuel (China *et al*., 2005).

The vegetable oil esters from edible oils may not be the right option for their substitution in diesel engine due to the lack of self-sufficiency of edible oil production in India. Hence attention has been diverted to test the suitability of non-edible vegetable oils for diesel engine (Bhatt, 1987). With the abundance of forest and tree-borne non-edible oils available in India, not much attempt has been made to use the esters of these non-edible oils as the alternative fuels for diesel engine. Karanja (*Pongamia glabra*) is one of the forest based tree-borne non-edible oils with large production potential of about 90 million tones per annum in India (Das,2005). The karanja tree belongs to the genus *Pongamia*. The tree, its seed and flowers have been very useful in Indian economy for a long time. The flowering season extends from February to April. The kernel of karanja fruit contains about 30-40% of oil. The oil yield is 20-30 % in village ghanis (indigenous mill) and 25 to 35 % in expeller. The fresh extracted oil is yellowish orange to brown and rapidly darkens on storage. It has a disagreeable odour and bitter taste. As this tree grows mainly in forest area and also in waste and fallow land, its cultivation would not produce any impact on food production but would in long way improve the environmental condition by massive aforestation. Therefore, an attempt is made in this paper to study the feasibility of karanja methyl ester and its blends with diesel fuel for a compression ignition engine.

METHODOLOGY

Tests were conducted at the Department of Farm Machinery and Power, Orissa University of Agriculture and Technology, Bhubnaneswar, Orissa, India. A 2-cylinder, four stroke, direct injected, water cooled and 7.4 kW power at 1500 rpm with injector pressure of 17640 kPa diesel engine was selected for the test. Tests were done on a laboratory test bench which consisted of a hydraulic dynamometer, a water tank, exhaust gas