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Effect of temperature and injection pressure on brake thermal efficiency of CI engine by biodiesel blends

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ABSTRACT

This paper presents the results of investigations carried out on performance of Karanja methyl ester and its blends with diesel from 20%, 40%, and 60% by volume for running a diesel engine. Performance tests were carried out to evaluate and compute exhaust gas temperature. The engine was tested with the above test fuels and at two injection pressures *i.e.* 180 kg/cm² and 245 kg/cm² and temperatures of 30, 50 and 70^{0}C. Statistical analysis was done by using Factorial Completely Randomized Design (FCRD). The increase in power output, brake thermal efficiency and reduction in brake specific fuel consumption were observed. Injection pressure and fuel temperature were found to have significant effects on engine performance parameters. Brake thermal efficiency decreased with the increase in the concentration of karanja methyl ester in diesel and increased with the increase in fuel temperature and injection pressure. Blend of karanja esterified oil (B_{20}) was found a suitable alternative fuel for diesel.

Key words : *Pongamia pinnata*, Karanja methyl ester, Biodiesel blends, Engine performance tests, Exhaust gas temperature

Though the concept of biodiesel is not new, but the journey towards the substitution of diesel by biodiesel is serious concern now. It is due to the gradual reduction in the crude oil sources, which can not be recovered at any cost. The concept of energy security also plays an important role to choose a renewable source, which can manage the high demand of diesel and also help in decreasing the import of crude oil from different countries. Which alone accomplish the major economy of India. In India, the pattern of consumption of diesel is 80% and petrol 20%, which shows the importance of diesel in Indian economy. With abundance of forest resources and plant based non-edible oils being available in our country; attempt is made to use esters of these oils as substitute for diesel. Karanja oil is one such non-edible oil. It is produced from karanja seeds. The annual production potential of karanja seed in our country is nearly 200 million tonnes from which 55 million tonnes of oil can be produced (Bringi, 1995) Hence, it was decided to use this non-edible oil for further investigation which could provide a suitable substitute for diesel to be used in diesel engines of tractors, power tillers and pump sets for agricultural work.

Thus, study undertaken on biodiesel is, therefore, a timely initiative from the Department of Farm Machinery and Power, College of Agricultural Engineering and Technology, Orissa University of Agricultural and Technology to address technical, socio-economic and environmental concerns.

METHODOLOGY

Preparation of methyl ester of karanja oil and their blends by transesterification :

Biodiesel is produced from vegetable oils by converting the triglyceride oils to methyl esters with a process known as transesterification. In the transesterification process alcohol reacts with the oil to release three "ester chains" from the glycerin backbone of each triglyceride. The reaction requires heat and a strong base catalyst KOH to achieve complete conversion of the vegetable oil into the separated esters and glycerin. The glycerin can be further purified for sale to the pharmaceutical and cosmetic industries. The mono-alkyl esters become the biodiesel, with one-eighth the viscosity of the original vegetable oil (Bhatt, 1987, Bhatt and Mathur, 2002).

The proportions of reactants for the transesterification process are as follows:

Karanja oil	=	100kg
Methanol	=	23.74kg
Potassium Hydroxide	=	1.3 kg

The input amount of karanja oil determines the batch size, and the other components are calculated from the following formulae:

CH_3OH = 0.280 x KO, and

KOH = 0.013 x KO

where, CH_3OH = Quantity of methanol required, kg

KO = The desired amount of karanja oil to be processed, kg, and

KOH = Quantity of KOH required, kg