PERFORMANCE EVALUATION OF IC ENGINE USING BIODIESEL FROM DIFFERENT FUEL SOURCES

A DISSERTATION

Submitted in partial fulfillment of the

Requirement for the award of the degree

of

MASTER OF TECHNOLOGY

in

ALTERNATE HYDRO ENERGY SYSTEMS

By

SIDDHARTH JAIN

ALTERNATE HYDRO ENERGY CENTRE
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
ROORKEE, 247667 (INDIA)
JUNE, 2008

ABSTRACT

Economic development in developing countries has led to huge increase in the energy demand. In India, the energy demand is increasing at a rate of 6.5% per annum. The crude oil demand of the country is met by import of about 78%. Thus, the energy security has become key issue for our country. Biodiesel, as an eco-friendly and renewable fuel substitute for diesel has been getting the attention of researchers/ scientists all over the world. The research has revealed that upto B_{20}, there is no need of any engine modification and little work is reported in the literature on the suitability and sustainability of biodiesel production from Jatropha as non-edible oil source.

On the same pace of advancement of research, the present study has dealt with the production of biodiesel from Jatropha oil and waste cooking oil and performance evaluation of a 2 kVA diesel genset (DG) system using blends of straight vegetable oil of Jatropha oil with diesel and methanol and blends of biodiesel from Jatropha & waste cooking oil with diesel at part/full load of the engine generating set. It was found that 88% & 92% yield of biodiesel (methyl ester) can be obtained from Jatropha and waste cooking oil respectively under the optimum condition of methanol to oil ratio of 30:70 (v/v), temperature 50^0C, 400rpm and catalyst concentration. The kinetic study has indicated that both esterification and transesterification are of first order rate reaction only, meaning thereby that methyl ester yield has been used to study the reaction behavior. The engine performance has indicated that BSFC for B_{100} was 14.8% and 17.8% higher than diesel while using biodiesel from Jatropha and waste cooking oil respectively at full load conditions due to high specific gravity and low NCV. On the other hand the BTE for B100 was 0.5% and 0.7% less than diesel while using biodiesel

from Jatropha (24%) and waste cooking oil (23.8%) respectively at full load conditions due to lower calorific value and higher viscosity. The brake thermal efficiency (BTE) of B30 blend (24.6%) was almost same to that of diesel (24.5%) for biodiesel from Jatropha oil while in case of waste cooking oil BTE of B20 blend (24.9%) was same to that of diesel. The BSFC for the blends of Jatropha oil with methanol (70:30) and diesel (60:40) is 9% & 28.6% higher than diesel respectively while the BTE for the same was 2.8% & 2.1 % less than diesel respectively.

Techno economic analysis shown that the production cost of biodiesel is Jatropha and waste cooking oil is Rs.27/- and Rs.21.5/- per litre respectively as compared to Rs.36/- per litre of diesel while the cost of energy generation is Rs.12.25/- and Rs.10.50/- per kWh for biodiesel from Jatropha and waste cooking oil respectively as compared to Rs.14.20/- per kWh of electricity for diesel.

It is further expected that with more production of Jatropha oil and more availability of waste cooking oil and considering carbon emission under CDM mechanism, the cost of biodiesel substantially can be come down.

In view of the above, it is recommended that biodiesel from Jatropha oil and waste cooking oil may be used in neat form, i.e., B_{100} without any modification in the existing engine and without the need of diesel. However performance of the system should be evaluated on long term basis to see the need of modification in the engine. Lot of work is required to be done on the effect of long term storage of biodiesel on its quantity, container material as well as to search for an additive to biodiesel to overcome the problem of freezing in cold climate.