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Performance of diesel engines burning alternative fuels

By

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Ph.D. abstract

The rapid increasing worldwide demand for the energy, increasing fuel consumption, increasing fuel prices, the progressive depletion of fossil fuels and emissions generated from burning of fossil fuel emitted to the atmosphere. These pollutants have hazardous effects on the environment and the health, all these have led to an intensive search for alternative fuels for diesel engine such as vegetable oils.

The work in this thesis is divided into three parts: (a) Extraction of jatropha oil from jatropha seeds and production of biodiesel by transesterification, (b) Performance and emissions of a diesel engine fuelled with diesel-biodiesel blends and (c) Performance and emissions of a diesel engine fuelled with unheated and preheated jatropha oils.

Jatropha oil is extracted from jatropha seeds by some methods such as screw pressing, hydraulic pressing and solvents. Vegetable oils have higher viscosity and causes problems in engines, so, we convert jatropha oil to biodiesel by transesterification and preheating it at different inlet temperatures.

In this research, a single zone, zero dimensional model is used to predict the effect of engine load on performance parameters of a diesel engine operated with diesel- biodiesel blends, jatropha oil and preheated jatropha oil. Performance parameters are to be studied and compared with diesel fuel such as cylinder pressure, cylinder temperature, cumulative work done, thermal efficiency and specific fuel consumption. A comparison was made between engine cylinder pressure from experimental results and theoretical work, this comparison was made to confirm the reliability of model.

The experimental study is conducted on a Kirloskar diesel engine using jatropha biodiesel and its blends with diesel fuel (B5, B20, B40, B70 and B100), preheated

jatropha oil at different preheating temperatures (50, 70, 80 and 90°C) and unheated jatropha oil. The performance and emissions characteristics are evaluated by operating the engine at different loads and rated constant speed of 1500 rpm. The performance parameters evaluated are thermal efficiency, specific fuel consumption, exhaust gas temperature, volumetric efficiency, air- fuel ratio and cylinder pressure.

For diesel- biodiesel blends, increasing the percentage of biodiesel in diesel-biodiesel blend, results an increase in specific fuel consumption and exhaust gas temperature, a decrease in thermal efficiency, volumetric efficiency, air-fuel ratio and cylinder pressure as compared to diesel fuel. For preheated jatropha oil, increasing oil preheating temperature, results in an increase in thermal efficiency, volumetric efficiency, air- fuel ratio and cylinder pressure, a decrease in specific fuel consumption and exhaust temperature as compared with unheated jatropha oil.

For diesel- biodiesel blends, increasing the percentage of biodiesel in diesel-biodiesel blend, results in an increase in NO_x emissions and oxygen concentrations, a decrease in CO emissions, CO_2 emissions and HC emissions as compared to diesel fuel. For preheated jatropha oil, increasing oil preheating temperature, results an increase in CO_2 emissions, NO_x emissions and oxygen concentrations, a decrease in HC emissions and CO emissions as compared with unheated jatropha oil.

The preheating temperature of $90^{o}C$ is the optimal jatropha oil fuel preheating temperature for our case study. The performance and emissions were favorable. Blends of diesel – biodiesel up to 20% biodiesel percentage by volume are recommended because of the improvement in performance and emissions as compared to diesel fuel.