ABSTRACT

The limited resources and non-renewable nature of petroleum fuels have now become a matter of great concern. Hence, there is an urgent need to identify some alternative liquid fuels which are non-fossil and renewable in nature, and are capable of substituting partly or wholly the highly demanded diesel fuel.

The objective of the present work is to use alternative, renewable fuels which are performing better than standard diesel in terms of performance and emission characteristics. Alternative, renewable fuels namely poon oil, paradise oil and eucalyptus oil are used as diesel fuel substitutes in the present work.

Poon oil and paradise oil are tested for their fatty acid composition by means of gas chromatography test and found that they contain linoleic fatty acid and oleic fatty acid as their major fatty acids respectively. The presence of linoleic fatty acid in vegetable oil will influence in the decrease of cetane number, whereas, oleic fatty acid will influence in the increase of cetane number. An attempt is made to study the effect of these oils on engine performance and emission characteristics in a single cylinder direct injection diesel engine by adopting different methods.
In the first phase, poon oil, paradise oil and their diesel blends were used as diesel fuel substitutes. Blending of poon oil and paradise oil with standard diesel has been shown to be an effective method to reduce engine problems associated with the high viscosities of poon oil and paradise oil. These oils were blended with standard diesel in 20 %, 30 %, 40 %, 50 % and 100 % concentrations. Results indicated a slight decrease in brake thermal efficiency and a reduction in engine NO\textsubscript{x} emissions. An increase in hydrocarbon, carbon monoxide and smoke emissions has been observed with an increase of poon oil and paradise oil concentration in the fuel blends.

In the second phase, the methyl esters of poon oil and paradise oil were blended with standard diesel in 20 %, 30 %, 40 % and 50 % concentrations. The results show that the engine performance and combustion process of the blends and neat esters were similar to those of standard diesel with a slightly lower brake thermal efficiency, a shorter ignition delay, and a lower premixed combustion phase. All the methyl esters and their diesel blends demonstrated reductions in carbon monoxide, hydrocarbon and smoke emissions. The NO\textsubscript{x} emissions increased for all the methyl esters and their diesel blends.

In the third phase, another form of renewable oil known as essential oil was tested. The eucalyptus oil was blended with standard diesel and then with methyl esters. Eucalyptus oil is blended in 20 %, 30 %, 40 % and 50 % concentrations. They demonstrated slightly higher brake thermal efficiency and lower hydrocarbon, carbon monoxide and smoke emissions. However,
there is an increase in NO\textsubscript{x} emission of these blends. Eucalyptus oil-methyl ester blends performed better than eucalyptus oil-standard diesel blends.

In the fourth phase, to substitute 100% standard diesel with eucalyptus oil, an ignition enhancer was used. Di-ethyl ether (DEE), as an ignition enhancer was aspirated along with the intake air at different flow rates while eucalyptus oil was injected in conventional method. To improve the engine performance further, DEE flow rate and injection timing of eucalyptus oil were optimised. At optimum conditions, the engine performance like brake thermal efficiency, NO\textsubscript{x} and smoke emissions were improved compared to the other tested methods.

In the final phase, a statistical model was developed to predict the ignition delay, an important engine parameter by using fatty acid composition of the given methyl ester and validate the model with present experimental data and published data.