ABSTRACT

Depleting petroleum reserves, rising petroleum prices, threat to the environment from exhaust emissions and global warming create an intensive international interest in developing alternate and renewable fuels for engines. The use of biodiesel is seriously considered as an alternate fuel. The study is done with a purpose of finding the optimum compression ratio for different proportion of biodiesel obtained from waste cooking oil. The compression ratio strongly affects the working process and provides an exceptional degree of control over engine performance. In conventional internal combustion engines, the compression ratio is fixed and their performance is therefore a compromise between conflicting requirements. A variable compression ratio engine offers the potential to study the effect of compression ratio of different blends of biodiesel under varying load.

The endeavour was to establish the modifications required in small, constant speed, direct injection diesel engines used widely for agricultural purposes so that these can be made to run on pure biodiesel with better performance and at the same time decrease emissions.

The suitability of waste cooking oil methyl ester as a bio fuel has been established in this study. Biodiesel has been produced from waste cooking oil by transesterification process. The performance, emission and combustion characteristics of a single cylinder, four stroke, variable compression ratio multi fuel engine when fuelled with waste cooking oil methyl ester and its 20%, 40%, 60% , 80% and 100% blends with diesel (on a volume basis) are investigated and compared with that of standard diesel. Experiments have been conducted at a fixed engine speed of 1500 rpm, 50% load and at compression ratios of 18:1, 19:1, 20:1, 21:1 and 22:1 and further for an engine speed of 1500 rpm, fixed compression ratio 21:1 and at different loading conditions.

The performance parameters evaluated include brake thermal efficiency, specific fuel consumption, brake power, indicated mean effective pressure, mechanical efficiency and exhaust gas temperature. The exhaust gas emission is found to contain carbon monoxide, hydrocarbon, nitrogen oxides and carbon dioxide. The impact of compression ratio on performance, emission and combustion characteristics has been investigated and presented. The optimum compression ratio which gives the best performance has been identified.

The results of the experiment have been compared and analyzed with standard diesel and it confirms that there is considerable improvement in the performance parameters as well as exhaust emissions. The results indicate longer ignition delay, maximum rate of pressure rise, lower heat release rate and higher mass fraction burnt at higher compression ratio for waste cooking oil methyl ester when compared to that of diesel. The brake thermal efficiency at 50% load for waste cooking oil methyl ester blends and diesel has been calculated and blend B40 has been found to give maximum thermal efficiency. The blends when used as fuel results in the reduction of carbon monoxide, hydrocarbon, carbon dioxide at the expense of nitrogen oxides emissions. It has been found that the combustion characteristics of waste cooking oil methyl ester and its diesel blends closely followed those of standard diesel.

Artificial Neural Networks (ANN) are used to predict the engine performance, emission and combustion characteristics of waste cooking oil biodiesel fuelled variable compression ratio engine. Separate models were developed for performance, emission and combustion characteristics. To train the network, compression ratio, blend percentage and load percentage have been used as input parameters whereas engine parameters such as brake thermal efficiency, specific fuel consumption, brake power, indicated mean effective pressure, mechanical efficiency and exhaust gas temperature have

been used as output parameters for the performance model and exhaust emissions such as carbon dioxide, carbon monoxide, hydrocarbon and NO_x have been used as output parameters for the emission model. The combustion model is developed in which compression ratio, blend percentage, load percentage and crank angle have been used as the input parameters whereas combustion pressure, heat release rate, ignition delay, combustion duration and mass fraction burnt have been used as the output parameters. This model is of great importance due to its ability to predict engine performance under varying conditions. It is an effort to comprehensively understand the modelling capability of ANN for these kinds of problems, which will really help in better prediction with the available experimental data.

ANN results showed that there is good correlation between the ANN predicted values and the experimental values for the different engine performance parameters, combustion characteristics and emission parameters.