ABSTRACT
The use of vegetable oils as diesel fuel is nearly as old as diesel engine itself. The inventor of the diesel engine, Rudolf Diesel, reportedly used groundnut oil as a fuel for demonstration purpose in 1900. Fuel and energy crises and the concern of society for depleting world’s fossil fuel resources initiate various sectors to look for alternative fuels. One of the most promising fuel alternative is the vegetable oils and there derivatives. Vegetable oils can be used in CI Engine by various techniques as fuel modification by esterification, diesel vegetable oil blends. The objective of this paper is to evaluate the performance and emission characteristics of pongamia oil blends with diesel in CI Engine.

KEYWORDS Biodiesel, Transesterification, blends.

INTRODUCTION:
Diesel engines are the major source of transportation, power- generation, marine applications etc. But due to gradual depletion of world petroleum reserves and the impact of environmental pollution there is an urgent need for suitable alternate fuels for use in diesel engines. In view of this, vegetable oils like palm oil, cottonseed oil and neem oil, pongamia oil are considered as alternate fuels to diesel which are promising alternatives. They have the advantages like; they are renewable, eco-friendly and produced easily in rural areas. If these fuels serve the purpose of diesel to some extent they will be useful to the rural areas in providing employment as well as agriculture energy needs. If these fuels serve the purpose to a larger extent they will be good substitutes in industries, transportation etc. Oil technologists predict that over the next several decades, plant based oils will become just as essential for the transportation industry as fossil fuels, like gasoline and Diesel oil, that are today. Among the many different types of alternate fuels, vegetable oils and their esters come across as good choices. They are renewable, as the carbon released by the burning of vegetable oils is used when the oil crops undergo photosynthesis. The major differences between Diesel fuel and vegetable oil include, for the latter, the significantly higher viscosities and moderately higher densities, lower heating values, rise in the stoichiometric fuel/air ratio due to the presence of molecular oxygen and the possibility of thermal cracking at the temperatures encountered by the fuel spray in the Diesel engines. An intensive research is being conducted in developing Diesel engine fuels and lubricants based on vegetable oils. Because of the high viscosity of vegetable oils, they hinder fuel jet penetration and atomization, result in higher fuel consumption and leave gummy deposits on the engine components upon combustion. Therefore, vegetable oils cannot be used directly in diesel engines at room temperatures. In order to reduce the viscosity of the vegetable oils, three methods are found to be effective such as transesterification, mixing with lighter oil and heating. Besides that, preheating of vegetable oil to lower its viscosity to that of diesel eases the problem of the injection process. Heating is also essential to ensure smooth flow of fuel in the fuel system. The general perception is that higher heating temperatures reduce the viscosity of vegetable oils and offer gain in engine performance.

EXPERIMENTAL SET UP
The experimental setup consists of a single-cylinder, four-stroke, vertical water cooled, direct injection, natural aspirated, diesel engine connected to water brake dynamometer for loading of the engine. Experiments are conducted with pure diesel blends of pongamia oil at injection pressures of 180 bar, 200 bar and 250 bar injection pressure. The signals are interfaced to a computer through an engine indicator to obtain pressure-crank angle diagram. Provision is also made for interfacing air flow, fuel flow, temperatures and load measurement. The emphasis is on comparison of the engine performance, emissions and combustion with Diesel alone and blends of pongamia oil. The various components of the experimental setup shown in fig 1.

Preparation of blends:
The fuel selected for testing in the engine to find the performance of the engine is Pongamia oil. Pongamia oil is having kinematic viscosity 50.71 cSt. at 40°C. The blends of Pongamia oil and diesel are prepared on volume basis as follows:
B10: 10% Pongamia oil and 90% Diesel
B20: 20% Pongamia oil and 80% Diesel
B30: 30% Pongamia oil and 70% Diesel
B40: 40% Pongamia oil and 60% Diesel
B50: 50% Pongamia oil and 50% Diesel
The above mentioned blends are prepared using an emulsifier.
The instrument used for measuring volumes of each oil is measuring flask of capacity 500ml. Oils are measured according to the blend ratios and taken into the emulsifier. The time for complete mixing of oils varies with the blend and the least time among them is for blend B10. The blend B60 took more time for mixing. The energy content is 88–95 percent of that of diesel, but it improves the lubricity of diesel and raises the Cetane value, making the fuel economy of both generally comparable. The higher oxygen content of vegetable oil aids in the completion of fuel combustion, reducing emissions of particulate air pollutants, carbon monoxide and hydrocarbons.

RESULTS AND DISCUSSION

Fig.3 shows the variation of CO$_2$ with brake power output for pongamia oil and its blends with diesel in the test engine at an injection pressure of 200kg/cm$^2$. CO$_2$ emission of 50% blends having higher values compared with all other blends and diesel. The highest value of CO$_2$ at 25% blend of pongamia oil is 7.54% in respect to the value of 7.7% for diesel. Fig.2 shows the variation of fuel consumption with load on the engine. Emission with brake power output for pongamia oil and its blends with diesel in the test engine at an injection pressure of 180kg/cm$^2$. The CO$_2$ of 50% blend of pongamia oil has higher values compared with all other blends and is well comparable with diesel. The CO$_2$ of all blends and diesel increases with increase in brake power. Fig. 4 shows the variation of hydrocarbon emission with brake power output for pongamia oil and its blends with diesel in the test engine at an injection pressure of 200kg/cm$^2$. HC emission of 50% blend of pongamia oil has higher emission compared with all other blends. While, HC of Diesel and 25% blend of pongamia oil are near to pure diesel. Fig.5 shows the variation of NOx emission with brake power output for pongamia oil and its blends with diesel in the test engine at an injection pressure of 200kg/cm$^2$. NOx of 25% blend of pongamia oil is less that the diesel. 50% blend has less NOx emission compared with all other blends throughout all brake power loads. Fig. 5 shows the variation of NOx emission with brake power output for pongamia oil and its blends with diesel in the test engine at an injection pressure of 200kg/cm$^2$. Diesel has higher NOx emission compared with all other blends of pongamia oil. Fig. 6 shows the variation of nitrogen oxide emission with brake power output for pongamia oil and its blends with diesel in the test engine at an injection pressure of 250kg/cm$^2$. NOx of 25% blend of pongamia oil is less than that of diesel. 50% blend has less NOx emission compared with all other blends throughout all brake power loads. Fig. 7 shows the variation of smoke emission with brake power output for pongamia oil and its blends with diesel in the test engine at an injection pressure of 250kg/cm$^2$. Diesel has lower smoke emission compared with all other blends of pongamia oil.

CONCLUSIONS

- CO$_2$ emission of 50% blends having higher values compared with all other blends and diesel
- The CO of 50% blend of pongamia oil has higher values compared with all other blends and is well comparable with diesel
- NOx of 25% blend of pongamia oil is less than the diesel
- 50% blend has less NOx emission compared with all other blends throughout all brake power loads
Figure 2: variation of fuel consumption with load

Figure 3: Comparison of CO Emission Vs Brake Power

Figure 4: Comparison of HC Emission Vs Brake Power
Figure 5: Comparison of NO\textsubscript{x} Emission Vs Brake Power

Figure 6: Comparison of NO\textsubscript{x} Emission Vs Brake Power

Figure 7: Comparison of Smoke Level Vs Brake Power
REFERENCES


