CHAPTER 7

CONCLUSIONS

7.1 GENERAL

In the present work different methods to improve the performance of vegetable oil methyl ester fuelled compression ignition (C.I.) engine different techniques were investigated and compared with the diesel fuel. Experiments were conducted with Pongamia methyl ester (PME) by various nozzle opening pressures, Diethyl ether (DEE) and Titanium oxide coated piston have been studied extensively through performance, emissions and combustion parameters. All the experiments were conducted at a constant speed of 1500 rpm. The following are the important conclusions drawn from the present investigations with in-cylinder turbulence effects on a direct injection diesel engine.

7.2 COMPARISON OF DIESEL ENGINE PERFORMANCE WITH PONGAMIA METHYL ESTER

- The brake thermal efficiency of 20% Pongamia methyl ester diesel blend is higher than B10 and B100 at full load and it is decreased due to low calorific value and high viscosity of blends compared to that of the diesel. The BSFC for the biodiesel and diesel blends are higher due to low calorific value of the biodiesel.
From the emission point of view, the CO emissions decreased by 25% for 20% PME and as compared to diesel fuel. The HC emissions for B20 were closer to diesel at full load.

The NO emissions increased by 17% for 20% PME due to more oxygen being present in the biodiesel, while the smoke emissions were reduced by 32% for B20 and 45% for neat PME at full load.

The peak pressure and heat release rate exhibit lower values, and the ignition delay and the combustion duration increased for PME blends as compared to that of diesel fuel.

7.3 COMPARISON OF DIESEL ENGINE WITH PONGAMIA METHYL ESTER BLEND USING DIFFERENT NOZZLE OPENING PRESSURES (NOP)

- The brake thermal efficiency of 20% PME with 200 bar NOP was increased by about 2.8% at full load compared to that of the B20 blend with the base engine and it is lower as compared to diesel fuel at 180 bar. The BSFC is slightly decreased for B20 blend at 200 bar NOP as compared with B20 at 180 bar at full load.

- The CO and HC emissions decreased by about 42% and 15% respectively for 20% PME with 200 bar NOP as compared to that of diesel fuel at 180 bar at full load.

- The NO emissions increased by about 10% at full load, while the smoke emissions decreased by 28% for 20% PME with 200 bar NOP at full load as compared to the base engine at 180 bar NOP.

- The peak pressure and heat release rate were increased by 3 bar and 4 J/°CA and the ignition delay and the combustion
duration were decreased for 20% PME at 200 bar NOP at full load compared to the base engine with B20 at 180 bar NOP.

7.4 COMPARISON OF DIESEL ENGINE WITH PONGAMIA METHYL ESTER BLEND USING TiO$_2$ COATED PISTON

- The brake thermal efficiency for 20% PME with TiO$_2$ coated piston increased by about 1.6% compared to that of the diesel fuel at full load. The BSFC was decreased for B20 with TiO$_2$ coated piston compared to that of diesel fuel at full load.
- The CO emissions for 20% PME decreased by 50% and HC emissions decreased by about 32% with the TiO$_2$ coated piston at full load compared to that of the base engine with diesel at full load.
- The NO emissions for 20% PME increased by about 20% at full load conditions with the TiO$_2$ coated piston operation, while the smoke emissions decreased by about 34% for 20% PME with the TiO$_2$ coated piston operation at the full load compared to that of diesel with the base engine.
- The peak pressure and the heat release rate increased by about 4 bar and 8 J$^\circ$CA respectively and the ignition delay and the combustion duration decreased for 20% PME with the TiO$_2$ coated piston operation compared to that of the diesel with the base engine.
7.5 COMPARISON OF DIESEL ENGINE WITH ESTER PONGAMIA METHYL ESTER BLEND USING WITH DIETHYL ESTER AS ADDITIVES

- The brake thermal efficiency for 10% DEE additive with 20% PME increased by about 1.4% compared to that of the 20% PME at full load.

- The CO emissions decreased by 42% and the HC emissions decreased by about 26% for 10% DEE additive with 20% PME at full load compared to that of the base engine with diesel at full load.

- The NO emissions were almost equal for 10% DEE additive 20% PME at full load conditions compared to that of diesel fuel at full load, while the smoke emissions decreased by about 17% for 10% DEE additive with 20% PME at the full load compared to that of diesel with the base engine.

- The peak pressure and the heat release rate increased by about 2.5 bar and 6 J/°CA respectively and the ignition delay and the combustion duration decreased for 10% DEE additive 20% PME as compared to that of the diesel with the base engine.

Finally, it is concluded that the 20% Pongamia methyl ester blend with TiO₂ coated piston engine operation gave a better performance and considerable reduction in exhaust emissions and also the combustion properties are improved. This may be due to more heat retention in the ceramic coated piston compared to that of the other two techniques. The NO emissions for 10% DEE with B20 blend are almost equal to that of diesel fuel with the base engine.
7.6 SCOPE FOR THE FUTURE WORK

The following are suggested as future work for the investigations on the use biodiesel in a DI diesel engine.

- A Study on the diesel engine with hydrogen induction can be conducted.
- A Study on the use of an oxygenated fuel like ethanol and methanol as dual fuel in a DI diesel engine.
- A Study on the diesel engine with LPG induction can be conducted.