### CHAPTER 5

Results & Discussions

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CHAPTER 5
RESULTS & DISCUSSIONS

5.1 INTRODUCTION

The experimental work is carried out in three stages of investigations. The various stages of investigation are as follows,

I Stage: Different Blends of Karanja Bio-Diesel.

II Stage: Grooved piston with diamond mesh cut and optimum blend of Karanja Bio-Diesel from I stage of investigation.

III Stage: Different percentages of EGR, optimum grooved piston from II stage of investigation and optimum blend of Karanja Bio-Diesel from I stage of investigation. The results are presented below, at 3/4 of rated load.

5.2 PERFORMANCE PARAMETERS

The performance parameters like brake thermal efficiency, brake specific fuel consumption, and exhaust gas temperatures are discussed below.

5.2.1 Brake Thermal Efficiency

The variations of brake thermal efficiency with brake power for different configurations are shown in Figure 5.1. It is observed that the brake thermal efficiencies with the three sets of investigations are in the order of 25.9%, 28.2%, and 27.6% respectively, whereas for the normal engine it is 26.0%. It is observed that the thermal efficiency goes on varying from first stage of investigation to the third stage of investigation by -0.38%, 8.46%, and 6.15% respectively, when compared with the
normal engine. It is found that second set of investigation is the optimum configuration for better thermal efficiency.

5.2.2 Brake Specific Fuel Consumption

The variations of brake specific fuel consumption with brake power for different configurations are shown in Figure 5.2. It is observed that the brake specific fuel consumption with the three sets of investigations are in the order of 0.36 kg/kW hr, 0.3 kg/kW hr, and 0.33 kg/kW hr respectively, whereas for the normal engine it is 0.34 kg/kW hr. It is evident that that the brake specific fuel consumption goes on varying from first stage of investigation to the third stage of investigation by 5.88%, 8.82% and 2.94% respectively when compared with the normal engine. It is found that the third set of investigation has the lowest brake specific fuel consumption.

5.2.3 Exhaust Gas Temperature

Figure 5.3 shows the comparison of exhaust gas temperature with brake power. It is observed that the exhaust gas temperatures with the three sets of investigations are in the order of 352°C, 360°C, and 328°C respectively, whereas for the normal engine, it is 341°C. It is observed that the exhaust gas temperature decreased by 3.8% from third stage when compared with the normal engine.

5.3 COMBUSTION PARAMETERS

The combustion parameters like ignition delay and peak pressure are discussed below.

5.3.1 Ignition Delay

The variation of ignition delay with brake power for different configurations is shown in Figure 5.4. It is observed that the ignition delay with the three sets of investigations is in the order of 10.8°CA, 10.2°CA, and 10.8°CA respectively,
whereas for the normal engine it is 11°CA. It is observed that the ignition delay goes on varying from first stage of investigation to the third stage of investigation by 1.82%, 7.3%, and 1.8% respectively when compared with normal engine. The maximum reduction in the ignition delay can be observed with the third set of investigation.

5.3.2 Peak Cylinder Pressure

The variations of peak cylinder pressure with brake power for different configuration are given in Figure 5.5. It is observed that the peak pressure with the three sets of investigations is in the order of 58.4 bar, 61.1 bar, and 58.3 bar respectively at 3/4 of the load, whereas for the normal engine it is 60 bar. It is evident that the peak cylinder pressure goes on varying from first stage of investigation to the third stage of investigation by -2.667%, 1.833%, and -2.833% respectively when compared with normal engine. It is also observed that the highest peak pressure is recorded in the second set of investigation.

5.4 EMISSION PARAMETERS

The emission parameters like smoke density, NO_x emission Hydro Carbon and Carbon Monoxide emission are discussed below.

5.4.1 Smoke Level

The Figure 5.6 shows the comparison of smoke level with brake power. It is observed that the smoke number with the three sets of investigations is in the order 2.3 BSU, 2.3 BSU and 2.4 BSU respectively and whereas for normal engine it is 2.46 BSU. It is evident that the smoke density goes on varying from the first set of investigation to the third set of investigation by 5.69%, 6.5% and 2.4% respectively when compared with normal engine.
5.4.2  **NO\textsubscript{x} Emission**

Figure 5.7 shows the comparison of NO\textsubscript{x} emission with brake power for different setups. It is observed from the figure that NO\textsubscript{x} emission for the three sets of investigations are 600 ppm, 548 ppm and 490 ppm respectively, whereas for normal engine it is 562 ppm. It is also observed that the NO\textsubscript{x} goes on decrease from first set of investigation to the third set of investigation by 6.76%, -2.5% and -12.8% respectively when compared with normal engine. The NO\textsubscript{x} emission is lowest with third set of investigation.

5.4.3  **Hydro Carbon Emission**

The comparison of Hydro Carbon Emission in the exhaust gas is shown in Figure 5.8. It is observed from the figure that HC emission for the three sets of investigations are 74 ppm, 70 ppm and 74 ppm respectively, whereas for normal engine it is 78.2 ppm. It is also observed that the HC goes on varying from first set of investigation to the third set of investigation by -5.37%, -10.49% and -5.37% respectively when compared with normal engine. For the second set of investigation a maximum reduction of Hydro Carbon Emission level is observed.

5.4.4  **Carbon Monoxide Emission**

Figure 5.9 shows the comparison of Carbon Monoxide Emission with brake power. It is observed from the figure that the CO emissions for the three sets of investigations are 0.14, 0.15 and 0.165 by volume respectively whereas for the normal engine it is 0.17 by volume. It is also observed that the CO goes on varying from first set of investigation to the third set of investigation by 17.6%, 11.8% and 2.9% respectively when compared with the normal engine. It is found that the third set of investigation is the optimum for the reduction of CO emission.
Fig: 5.1 Comparison of Brake thermal efficiency with different stages of investigation.

Fig: 5.2 Comparison of Brake specific fuel consumption with different stages of investigation.
Fig: 5.3 Comparison of Exhaust gas temperatures with different stages of investigation.

Fig: 5.4 Comparison of Ignition delay with different stages of investigation.
**Fig: 5.5 Comparison of Peak Pressure with different stages of investigation.**

**Fig: 5.6 Comparison of Smoke Densities with different stages of investigation.**
Fig: 5.7 Comparison of NO\textsubscript{x} Emissions with different stages of investigation.

Fig: 5.8 Comparison of Hydro Carbon emissions with different stages of investigation.
Fig: 5.9 Comparison of Carbon Monoxide emissions with different stages of investigation.