



9. CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions

- The design and commissioning of the hydrogen generator was successfully completed in that it was able to supply the engine with a mixture of hydrogen and oxygen.
- The average torque from hydrogen-enhanced fuelling was 9% higher as compared to conventional petroleum fuelling.
- The average BMEP from hydrogen-enhanced fuelling was 15% higher as compared to conventional petroleum fuelling.
- The average NO_x emissions from hydrogen-enhanced fuelling were 19% lower as compared to conventional petroleum fuelling while the average specific emissions were 28% lower.
- The average CO emissions from hydrogen-enhanced fuelling were 22% lower as compared to conventional petroleum fuelling while the average specific emissions were 26% lower.
- The average CO₂ emissions from hydrogen-enhanced fuelling were 6% higher as compared to conventional petroleum fuelling while the average specific emissions were 2% lower.

Table 9.1 below contains a summary of the maximum performance and emissions results for both fuels.



Table 9.1: Maximum Performance and Emissions Results

| Parameter | Unit | Hydrogen-Enhanced | Petroleum |
|--------------------------|------------------------|--------------------------------|--------------------------------|
| Torque | [Nm] | 5.96 @ 1280 rpm, $\frac{1}{2}$ | 5.027 @1480 rpm, $\frac{1}{2}$ |
| BMEP | [kPa] | 55.40 @1280 rpm, $\frac{1}{2}$ | 46.72 @1480 rpm, $\frac{1}{2}$ |
| NO _x | [ppm] | 1509 @1280 rpm, $\frac{1}{2}$ | 2654 @1480 rpm, $\frac{1}{2}$ |
| CO | [ppm] | 57606 @1740 rpm, $\frac{1}{2}$ | 78040 @1960 rpm, $\frac{2}{3}$ |
| CO ₂ | [ppm] | 91842 @1880 rpm, $\frac{2}{3}$ | 89147 @1480 rpm, $\frac{1}{2}$ |
| Specific NO _x | [ppm.W ⁻¹] | 1.889 @1280 rpm, $\frac{1}{2}$ | 3.407 @1480 rpm, $\frac{1}{2}$ |
| Specific CO | [ppm.W ⁻¹] | 58.58 @2100 rpm, $\frac{2}{3}$ | 71.17 @1840 rpm, $\frac{1}{2}$ |
| Specific CO ₂ | [ppm.W ⁻¹] | 113.8 @1280 rpm, $\frac{1}{2}$ | 114.4 @1480 rpm, $\frac{1}{2}$ |

9.2 Recommendations

- Modify and, if necessary, redesign the hydrogen generator so as to produce more hydrogen by using the existing generator as a basis upon which to improve.
- Develop and commission the apparatus required to measure the flow rate of hydrogen that is being supplied to the engine from the generator.
- Repeat the tests with this equipment in order to determine the hydrogen flow rate and hence the equivalence ratio under hydrogen-enhanced fuelling.
- Explore these results so as to validate or disprove the trends exhibited by the current set results.
- Determine the THC concentrations for hydrogen-fuelling so as to compare these results to those of petrol.