CHAPTER 7

CONCLUDING REMARK AND FUTURE SCOPE

7.1 Conclusions

The experimental and Taguchi-Grey analyses have been performed for comparative study and optimize the diesel engine performance and emission attributes using blended biodiesel fuels, water emulsified fuels, and nano additive incorporated fuels. The effect of engine power, engine speed, and various fuel samples are experimentally investigated and also investigated according to the L16 orthogonal array designed by Taguchi experimental design method. The optimum engine setting parameters are obtained for various engine power, speeds, and fuel samples. The Grey optimization technique is also applied for optimum performance and emission responses.

From the present Taguchi-Grey-based experimental analysis following inferences are obtained:

- The engine BSFC was reduced, and BTE, exergy efficiency, EDR, EGT, and sustainability index were observed to be increased with an increase in engine power and speed for each fuel sample.
- The engine emission parameters, i.e., NO, CO, CO_2, HC, and smoke emissions, were observed to be increased with increased engine power and speed.
- The S/N curve of GRG of SOB and OPB blended fuel declared that 14 N-m engine torque, 1400 rpm engine speed, and diesel fuel was the optimum engine setting for engine performance and emission characteristics. The

performance and emission parameters with OPB20 and SOB20 fuel were comparable with diesel fuel.

- The S/N curve of GRG of water emulsified fuel declared that 14 N-m engine torque, 1800 rpm engine speed, and WiDE5 were the optimum engine setting for optimum engine performance and emission characteristics.
- The engine performance parameters, i.e., BSFC, BTE, exergy efficiency, and sustainability index and emission parameters, i.e., CO_2 emissions, were observed to be enhanced with 5% water emulsified OPB20 and SOB20 fuel compared to OPB20 and SOB20 fuel.
- The engine performance parameters, i.e., EDR, EGT, entropy generation rate, and emission parameters, i.e., NO, CO, HC, and smoke emissions, were observed to be reduced with 5% water emulsified OPB20 and SOB20 fuels compared to OPB20 and SOB20 fuel.
- The engine BSFC and EGT were observed to be reduced, and BTE, exergy efficiency, EDR, sustainability index, and entropy generation rate was observed to be enhanced with the incorporation of Al_2O_3 and CNT nano additive. The effect of incorporation of CNT nano additive has been observed to be higher than Al_2O_3 nano additive.
- The engine CO_2 emissions were increased, and HC, CO, NO, and smoke emissions were reduced by incorporating Al_2O_3 and CNT nano additive.
- The S/N curve analysis o GRG revealed that the 14 N-m engine torque, 1400 rpm engine speed, and diesel fuel were optimum for overall performance and emission parameters. The result obtained with CNT nano additive incorporated water emulsified biodiesel blended fuel was comparable to diesel fuel.

- The S/N curve of GRG of CNT combined water emulsified OPB20 and SOB20 fuel revealed that 14 N-m engine torque, 1400 rpm engine speed, and CNT incorporated 5% water emulsified SOB20 fuel was the optimum engine setting for overall optimum performance and emission parameters.
- At 14 N-m engine torque, 1400 rpm engine speed, and with CNT incorporated 5% water emulsified SOB20 fuel, the engine BTE, exergy efficiency, EDR, EGT, entropy generation rate, NO, and CO_2 emissions have been observed at 1.66%, 1.30%, 7.50%, 1.0%, 7.54%, 4.26%, and 27% higher. However, BSFC, CO, HC, and smoke emissions have been observed at 1.81%, 1.05%, 67.64%, and 50% lower than diesel fuel.
- With 14 N-m engine torque, 1400 rpm engine speed, and CNT incorporated 5% water emulsified SOB20 fuel, the engine BTE, exergy efficiency, EDR, entropy generation rate, and CO_2 emission have been observed at 9.91%, 7.95%, 3.03%, 3.04%, and 6.01% higher. However, BSFC, EGT, NO, CO, HC, and smoke emissions have been observed at 7.07%, 3.36%, 15%, 64.51%, and 40% lower than SOB20 fuel.

The results of an experimental investigation of diesel engine performance and emission parameters with various fuels (OPB blend, SOB blend, WiDE, Al_2O_3 incorporated water emulsified biodiesel blend, and CNT incorporated water emulsified biodiesel blend fuel) showed that the 20% blending of biodiesel provides the best engine performances and the lowest emissions when compared to other mentioned blends. However, when it comes to diesel engine applications, SOB20 fuel is seen to be superior to OPB20 blend fuel. Further enhancing engine efficiency and emissions is the 5% water emulsion (NO emissions). Adding Al_2O_3 and CNT nano additive to water-emulsified biodiesel blended fuels greatly enhances engine performance and emission

characteristics. CNT additive has a more noticeable impact than Al_2O_3 additive regarding engine performance and emissions results. Eventually, among all considered fuel samples, CNT, including 5% water-emulsified SOB20 fuel, is superior in improving emissions and engine performance and may be utilized for diesel engine use without modification.

7.2 Future scope

- Other experiments may be performed with other modern nonedible biodiesels like microalgae biodiesel and banana peel biodiesel.
- Other experiments may be performed with nano additives like CeO_2, MnO, and Graphene power.
- The energy-economic and exergy-economic investigation may be performed using various life cycle assessment tools.
- The stability of water emulsified and nano-additive incorporated fuel is one of the major concerns that affect its successful exhibition. Further research is required to achieve the long-term stability of water-emulsified and nano-additive incorporated fuel.
- The nano additive existence in exhaust gases is the major concern of applying nano additive incorporated fuel. Further research must assess its effect on the atmosphere and living things and its filtration from exhaust gases.