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Proceedings of

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(ICRTME -2025)

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ICRTME25-230

Multi Objective Optimization of Diesel Engine Parameters with biodiesel Using Advanced Machine Learning and Evolutionary Algorithms

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ABSTRACT

This research presents a comprehensive multi objective optimization study for diesel engine performance parameters using three distinct algorithmic approaches: response surface methodology (RSM), Genetic algorithm (GA) and Random Forest based machine learning models. The optimization simultaneously maximizes brake mean effective pressure (BMEP), brake thermal efficiency (BTE) and mechanical efficiency while minimizing specific fuel consumption (SFC), carbon monoxide (CO), nitrogen oxides (NOx) and hydrocarbon (HC) emissions. The optimal operating conditions of engines with biodiesel is identified as injection timing 12.3 BTDC, injection pressure 1000 bar, engine load 98%, EGR rate 0% and fuel blend 15%.The advanced optimization methods achieved a 9.95% improvement in overall objective function performance compared to conventional data analysis approaches, demonstrating significant potential for enhanced engine efficiency and reduced emissions.

Keywords: Optimization, Biodiesel, Engine Parameters, Machine Learning Algorithms, Diesel Engine

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ICRTME25-231

CRDI Engine Parameter Optimization Using Lemongrass Biodiesel Blends

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ABSTRACT

Using the central composite design method, experimental work is conducted using a design matrix created by design expert software. Engine load, fuel injection pressure, fuel injection time, exhaust gas recirculation, and fuel blends are the input parameters taken into consideration when creating the design matrix. Different ratios of diesel and lemongrass biodiesel are combined to create the fuel. The blend ratios that were developed were B15, B30, B45, and B60. The experimental work was carried out in a common rail direct injection diesel engine using a predefined design matrix. After thorough investigation, the ideal engine parameters were determined to be 0% exhaust gas recirculation, 55% biofuel blend, 900 MPa blended fuel injection pressure, compression process injection close to TDC, and engine operating at full load. Torque, brake power, friction power, brake mean effective pressure, brake thermal efficiency, mechanical efficiency, specific fuel consumptions, volumetric efficiencies, carbon monoxide, hydrocarbon, and NOx are engine output parameters that are taken into consideration for the optimal setup identifications. With an RSM desirability of 0.75, the engine parameters were optimized depending on the anticipated engine outcome. Furthermore, it was found that the ANN model has a higher prediction accuracy than the RSM model.

Keywords: Lemongrass biofuel, CRDI engine, ANN, RSM, Thermal efficiency, Emissions

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