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Response Surface Optimization of Brake Thermal Efficiency and Specific Fuel Consumption of Spark-Ignition Engine Fueled with Gasoline–Pyrooil and Gasoline–Pyrooil–Ethanol Blends

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Abstract

The present study explores the performance of high-density polyethylene (HDPE) pyrooil and ethanol blends with gasoline in SI engine using statistical modeling and analysis using response surface methodology (RSM) and the Anderson–Darling (AD) residual test. The pyrooil was extracted from HDPE through pyrolysis at 450°C and then distilled to separate the liquid fraction. Two blends were prepared by combining pyrooil and gasoline, and pyrooil–ethanol mixture (volume ratio of 9:1) and gasoline, both at volumetric concentrations ranging from 2% to 8% to evaluate brake thermal efficiency (BTE) and specific fuel consumption (SFC) in a SI engine. An experimental matrix containing speed, torque, and blend ratio as independent variables for both blends were designed, analyzed, and optimized using the RSM. The results show that a 4% blend of pyrooil with gasoline (P4) and a 6% blend of pyrooil–ethanol mixture with gasoline (P6E) were optimum for an SI engine. Also, the experimental findings show that the P6E blend exhibits 11% higher BTE and 11.82% lower SFC compared to base fuel (pure gasoline), and 7.55% higher BTE and 6% lower SFC than P4. From the AD test, the residuals for BTE and SFC follow a normal distribution. The results conclude that distilled HDPE pyrooil could be used in SI engines at concentrations of P4 and P6E without requiring engine modification.

Meta Tags

Topics

Spark ignition engines | Fuel consumption | Gasoline | Ethanol | Engine efficiency | Combustion and combustion processes | Statistical analysis

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