Response surface methodology (RSM) based multi-objective optimization of fusel oil -gasoline blends at different water content in SI engine

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ABSTRACT

The main objective of this study is to determine the optimal blend ratio of fusel oil–gasoline before and after water extraction (FBWE10, FBWE20, FAWE10, and FAWE20) regarding the performance and emissions of spark ignition engine using response surface methodology (RSM). The multi-objective optimization is applied to maximize the brake power, brake thermal efficiency and minimize the brake specific fuel consumption (BSFC), NOx emission, HC emission and CO emission. The water content of fusel oil has been extracted by employing rotary extractor method. The experimental of this study has been carried out with different fusel oil–gasoline blends, different throttle valve opening position (15%, 30%, 45% and 60%) and different engine speed (1500, 2500, 3500 and 4500 rpm). All the developed models for responses were determined to be statistically significant at 95% confidence level. The study results reveal an improvement in heating value of fusel oil after water extraction with FAWE20 (80 vol% gasoline fuel, 20 vol% fusel oil after water extracted) as the optimally blended fuel. The best condition of engine parameters with FAWE20 were 55.4% of WOT for load and 4499 rpm engine speed. In additional of the optimal values with a high desirability of 0.707 were 62.511 kW, 241.139 g/kW h, 36%, 1895.913 ppm140.829 ppm and % for brake power, BSFC, BTE, NO_x, HC and CO emissions respectively. The reduction of water content in fusel oil has a statistical significance influence to increases BTE, NO_x emission and decreases the BSFC, HC and CO emissions.