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Sustainable Combustion Systems and Their Impact

Edited by
S.M. Ashrafur Rahman and Islam Md Rizwanul Fattah

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Article

Maximising Yield and Engine Efficiency Using Optimised Waste Cooking Oil Biodiesel

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Abstract: In this study, waste cooking oil (WCO) was used as a feedstock for biodiesel production, where the pretreatment of WCO was performed using mineral acids to reduce the acid value. The response surface methodology (RSM) was used to create an interaction for different operating parameters that affect biodiesel yield. The optimised biodiesel yield was 93% at a reaction temperature of 57.50 °C, catalyst concentration 0.25 *w/w*, methanol to oil ratio 8.50:1, reaction stirring speed 600 rpm, and a reaction time of 3 h. Physicochemical properties, including lower heating value, density, viscosity, cloud point, and flash point of biodiesel blends, were determined using American Society for Testing and Materials (ASTM) standards. Biodiesel blends B10, B20, B30, B40, and B50 were tested on a compression ignition engine. Engine performance parameters, including brake torque (BT), brake power (BP), brake thermal efficiency (BTE), and brake specific fuel consumption (BSFC) were determined using biodiesel blends and compared to that of high-speed diesel. The average BT reduction for biodiesel blends compared to HSD at 3000 rpm were found to be 1.45%, 2%, 2.2%, 3.09%, and 3.5% for B10, B20, B30, B40, and B50, respectively. The average increase in BSFC for biodiesel blends compared to HSD at 3500 rpm were found to be 1.61%, 5.73%, 8.8%, 12.76%, and 18% for B10, B20, B30, B40, and B50, respectively.

Keywords: biodiesel; waste cooking oil; transesterification; response surface methodology; central composite design

1. Introduction

Over the last few decades, the rapid decline of fossil fuels has become a significant problem. On the other hand, the energy demand is continuously rising owing to the rapidly expanding population coupled with the increased rate of urbanisation [1–3]. This scenario demands the adoption