Abstract

In this comparative study, different waste cooking oils were assessed for their efficiency to get converted into biodiesel. Waste oil samples were collected from food industries, local restaurants and roadside food stalls, and filtered to remove food residues. Physicochemical analysis of the samples was performed by measuring their density, acid value and saponification value. Various pretreatment procedures i.e., heating, glycerolysis, metal (zinc dust, $SnCl_2$, $MnCl_2$ and $FeCl_3$. $2H_2O$) catalyzed glycerolysis and acid (H_2SO_4, H_3PO_4 and HCl) treatments were carried out to reduce the free fatty acid number of oils. The impact of all the reaction parameters including time, temperature, catalyst, methanol and glycerol concentration was observed. Maximum reduction in acid number (0.41 mg KOH/g) was achieved with metal (zinc dust) catalyzed glycerolysis (1.25 mg KOH /g) and acid (H_2SO_4) treatment. Pre-treated waste cooking oil was subjected to biodiesel synthesis with different alkalis (KOH, NaOH, and $NaOCH_3$) and lipases, free (9.07U/mL/min) and immobilized (6.61 U/mL/min) lipase. Maximum product formation was obtained by using 1% KOH, 4% free lipase and 6% immobilized lipase, 97%, 92% and 85% respectively. Two different purification procedures including wet wash (hot water washing) and dry wash (using silica and amberlite as adsorbents) were employed to eliminate unreacted methanol, catalyst and soaps from the product. Purified biodiesel was characterized by GCMS analysis that showed the highest amount of octadecenoic acid methyl esters (62%) followed by octadecadienoic (12%) and hexadecanoic acid methyl esters (9%). Fuel properties of produced biodiesel, i.e., carbon residue, kinematic viscosity, distillation temperature, flash, fire, pour and cloud point, were in standard ASTM ranges. Emission properties including NOx, SOx and NO_2 of lipase biodiesel were found better than alkali and conventional diesel.