Mesoporous acidic catalysts synthesis from dual stage and rising co-current gasification char: application for FAME production from waste cooking oil

ABSTRACT

The main purpose of this work is to investigate the application options of the char produced from gasification plants. Two promising mesoporous acidic catalysts were synthesized using char as a support material. Two char samples were collected from either a dual-stage or a rising co-current biomass gasification plant. The catalysts produced from both gasification char samples were characterized for their physiochemical and morphological properties using N2 physorption measurement, total acidity evaluation through TPD-NH3, functional groups analysis by FT-IR, and morphology determination via FESEM. Results revealed that the dualstage char-derived mesoporous catalyst (DSC-SO4) with higher specific surface area and acidic properties provided higher catalytic activity for fatty acid methyl esters (FAME) production from waste cooking oil (WCO) than the mesoporous catalyst obtained from char produced by rising co-current gasification (RCC-SO4). Furthermore, the effects of methanol/oil molar ratio (3:1–15:1), catalyst concentration (1–5 wt.% of oil), and reaction time (30–150 min) were studied while keeping the transesterification temperature constant at 65 °C. The optimal reaction conditions for the transesterification of WCO were 4 wt.% catalyst concentration, 12:1 methanol/oil molar ratio, and 90 min operating time. The optimized reaction conditions resulted in FAME conversions of 97% and 83% over DSC-SO4 and RCC-SO4 catalysts, respectively. The char-based catalysts show excellent reusability, since they could be reused six times without any modification.

Keyword: Dual-stage gasification char; Rising co-current gasification char; Post-sulfonation; Characterization; Transesterification; Biodiesel