Synthesis, characterization, and catalytic activity of sulfonated carbon-based catalysts derived from rubber tree leaves and pulp and paper mill waste

Abstract

Sulfonated carbon-based catalysts derived from rubber tree leaves, and pulp and paper mill waste were synthesized and characterized. Three types of catalyst synthesized were sulfonated rubber tree leaves (S-RTL), pyrolysed sludge char (P-SC) and sulfonated sludge char (S-SC). Sulfonated rubber tree leaves (S-RTL) and sulfonated sludge char (S-SC) were prepared through pyrolysis followed by functionalization via sulfonation process whereas, P- SC was only pyrolyzed without sulfonation. The characterization results indicated sulfonic acids, hydroxyl, and carboxyl moieties were detected in S-RTL and S-SC, but no sulfonic acid was detected in P-SC. Total acidity test showed S-RTL had the highest value followed by S-SC and P-SC. The thermal stability of S-RTL and S-SC were up to 230oC as the loss was associated with the decomposition of sulfonic acid group, whereas, P-SC showed higher stability than the S-RTL and S-SC. Morphology analysis showed that S-RTL consisted of an amorphous carbon structure, and a crystalline structure for P-SC and S-SC. Furthermore, traces of metal components were also detected on all of the catalysts. The catalyst catalytic activity was tested through esterification of oleic acid with methanol. The results showed that the reaction using S-RTL catalyst produced the highest conversion (99.9%) followed by P-SC (88.4%) and lastly S-SC (82.7%). The synthesized catalysts showed high potential to be used in biodiesel production.