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Waste ostrich- and chicken-eggshells as heterogeneous base catalyst for biodiesel production from used cooking oil: Catalyst characterization and biodiesel yield performance

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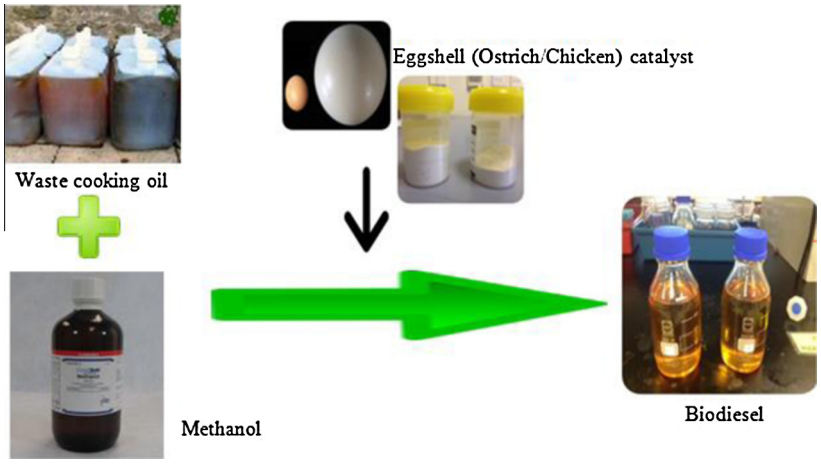
HIGHLIGHTS

- Ostrich-eggshell waste as the raw material to synthesize calcium oxide heterogeneous base catalyst.
- Biofuel, biodiesel is produced from waste cooking oil via two steps transesterification reaction.
- Biodiesel yield was 96% and 94% for calcined ostrich- and calcined chicken-eggshells under same optima reaction condition.
- Biodiesel produced from calcined ostrich-eggshell and calcined chicken-eggshell satisfied ASTM D6751.

GRAPHICAL ABSTRACT



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ABSTRACT

The primary goal of this paper is to investigate the catalyst characterization and biodiesel yield of a biodiesel converted from a used cooking oil source via heterogeneous catalysts derived from very rare type of eggshell: ostrich-eggshell (ostrich-eggshell derived CaO). It also aims to compare the performance of CaO catalyst derived from both waste ostrich-eggshell and the conventional chicken-eggshell, and to find the optimum conditions for biodiesel production. The prepared catalysts were then characterized by using XRD, FT-IR, BET, SEM, TGA and CO_2-TPD. The parametric effects on the biodiesel production, such as catalyst concentration, molar ratio of methanol to oil, reaction temperature, reaction time, speed and reusability of the catalyst were investigated. The experimental result showed that 1.5 wt.% catalyst, 12:1 M ratio of methanol to oil, 65 °C reaction temperature, 2 h reaction time with speed of 250 rpm gave the best results. It was found that the ostrich-eggshell derived CaO catalyst shows higher surface area, higher basicity and smaller particle size. The maximum biodiesel yield is 96% and 94% for calcined ostrich-eggshell and chicken-eggshell, respectively. The CaO catalyst derived from waste calcined ostrich and chicken-eggshell maintained a good catalytic activity even after being repeatedly used for 5 cycles with yield around 70%, which implies potential saving and affordable biodiesel production possibilities.

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