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CTCI Science and Technology Research Scholarship

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Simultaneous utilization of waste cooking oil for Cu-containing wastewater treatment and biodiesel production

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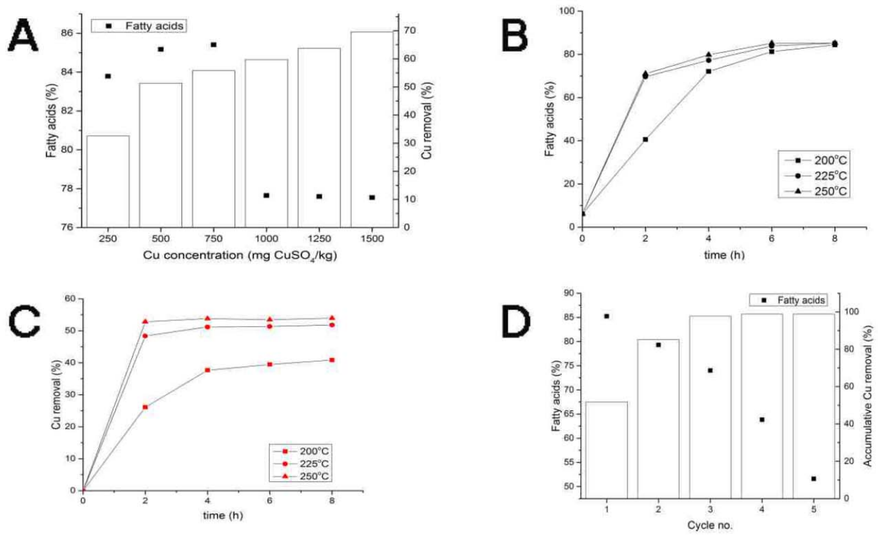
Research focus

Water recycling is a solution for overcoming limited water availability. Commonly, wastewater was treated first to remove pollutants before being recycled. This study focused on the exploration of the possibility in reusing Cu-containing wastewater for fatty acids production from waste cooking oil without any pretreatment. Produced fatty acids then will be utilized to produce biodiesel.

Results



Oil hydrolysis using synthetic Cu-containing wastewater at (A) different initial Cu concentration (250-1500 mgkg; 250°C for 8 h), (B-C) different temperature (200-250°C; Cu concentration: 500 mg/kg) and (D) 5 recycling of aqueous phase. All reaction used fix water:oil molar ratio at 30:1.

A. Effect of initial Cu concentration

Higher initial Cu concentration resulted in the higher removal percentage due to greater concentration gap as the driving force. However, excessive Cu might decrease fatty acids yield by means of Cu soap formation.

B. Effect of temperature on fatty acids yield

Increasing temperature drove the reaction towards equilibrium fatty acids yield. Reaction time profile at 225 and 250°C were approximately similar because of small changes in the water polarity and self-ionization behavior.

C. Effect of temperature on Cu removal

Cu removal was enhanced at higher reaction temperature mainly due to the increasing reaction kinetic and faster increase in the fatty acids concentration.

D. Aqueous phase recycling for maximum Cu removal

Maximum accumulative Cu removal of 98.9% was achieved by 5 consecutive recycling of aqueous phase. Glycerol accumulated in the aqueous phase from each cycle inhibited fatty acids production in oil hydrolysis reaction.

E. Biodiesel production from produced oil hydrolysate

Oil hydrolysate containing fatty acids about 85% (as oleic acid) and Cu (72.2 mg Cu/kg oil) was introduced into subcritical methanol esterification and transesterification with methanol:saponifiable oil molar ratio of 12:1. At 175°C and 1 h reaction, biodisel yield of 74.4% was achieved. Ash content in the biodiesel was 0.016 wt.%, which is low enough than the ASTM D6751-09 standard (0.02 wt.%). Reaction optimization and study on the mechanism are still in progress.

Research experiences

Preparation of activated carbon from agricultural waste, subcritical water process for sugar-based activated carbon production, adsorption of heavy metal by rice straw, modification of bentonite using sugar-based and natural surfactants for organic pollutant adsorption, biodiesel production through subcritical and supercritical transesterification, analysis of bioactive compounds from herbal plants.

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