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Biodiesel production from edible oil wastewater sludge with bioethanol using nano-magnetic catalysis

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Currently, most sludge from the wastewater treatment plants of edible oil factories is disposed to landfills, but landfill sites are finite and potential sources of environmental pollution. Production of biodiesel from wastewater sludge can contribute to energy production and waste minimization. However, conventional biodiesel production is energy and waste intensive. Generally, biodiesel is produced from the transesterification reaction of oils with alcohol (i.e. Methanol, ethanol) in the presence of a catalyst. Homogeneously catalyzed transesterification is the conventional approach for large scale production of biodiesel as reaction times are relatively short. Nevertheless, homogenous catalysis presents several challenges such as high probability of soap formation in the presence of water and free fatty acids and difficulty of separation and reusability. The current study aimed to reuse wastewater sludge from the edible oil industry as a novel feedstock for both monounsaturated fats and bioethanol for the production of biodiesel. Preliminary results have shown that the fatty acid profile of the oilseed wastewater sludge is favorable for biodiesel production with 48% (w/w) monounsaturated fats and that the residue left after the extraction of fats from the sludge contains sufficient fermentable sugars after steam explosion followed by an enzymatic hydrolysis for the successful production of bioethanol [29% (w/w)] using a commercial strain of *Saccharomyces cerevisiae*. A novel nano-magnetic catalyst was synthesized from mineral processing alkaline tailings, mainly containing dolomite originating from cupriferous ores using a modified sol-gel technique. Both the catalytic properties and reusability of the catalyst were investigated. A maximum biodiesel yield of 64% was obtained, which dropped to 52% after the fourth transesterification reaction cycle. The proposed approach has the potential to reduce material costs, energy consumption and water usage associated with conventional biodiesel production technologies. It may also mitigate the impact of conventional biodiesel production on food and land security, while simultaneously reducing waste.

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