Biodiesel Production from Waste Cooking Oil and Fresh Cooking Oil Using Commercial CaO Catalyst

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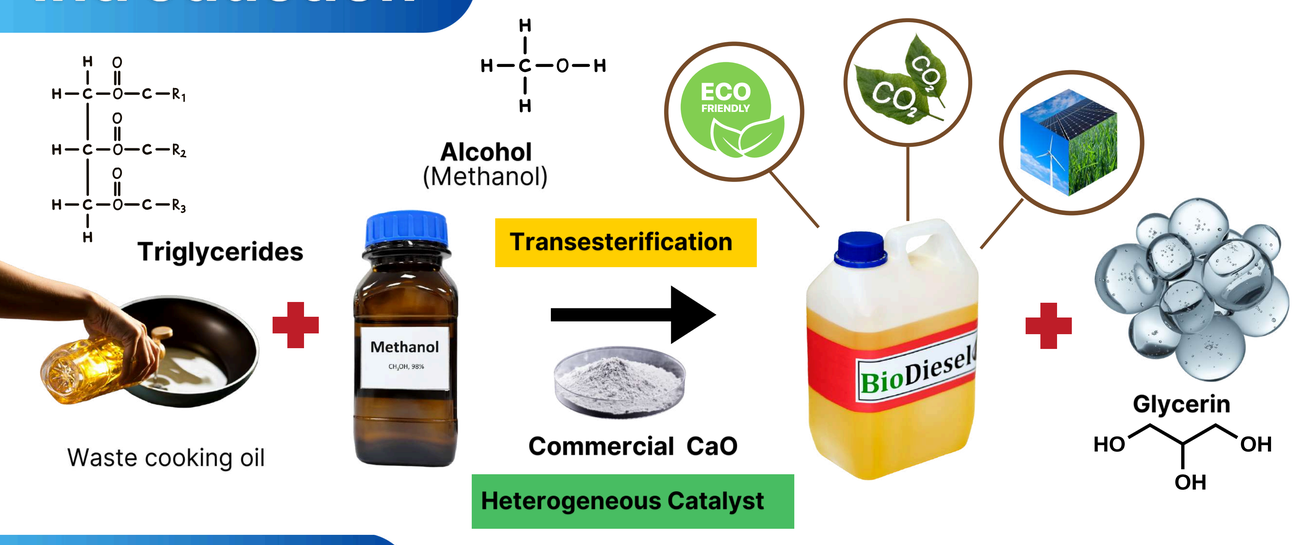
Abstract

This research aims to study the biodiesel production via heterogeneous transesterification from waste cooking palm oil (WCO) and fresh cooking palm oil (FCO) using commercial calcium oxide (Com CaO) as a catalyst. 0.5%wt. Com CaO catalyst calcined at 800 °C for 4 hour was used in the transesterification reaction. For biodiesel production experiment, the effect of methanol-to-oil ratio was studied under a control condition of reaction temperature 65 °C, time 3 hour and catalyst amount 0.5%wt. The biodiesel products from WCO and FCO were analyzed methyl ester content by Gas Chromatograph (GC). The obtained result showed that biodiesel was the major product and glycerin was the byproduct. It found that the highest methyl ester (ME) yield was achieved at 64.03% for WCO and 67.24% for FCO. In addition, fresh and used Com CaO catalysts were characterized by SEM-EDS and XRD. For fresh catalyst, calcined catalyst had rougher and more porous surface, compared to uncalcined catalyst. For used catalyst, it occurred the agglomeration of particles after washing with hexane. EDS result showed that fresh catalyst had Ca content (36.25%wt.) higher than used catalyst (16.46%wt. for WCO and 18.39%wt. for FCO).

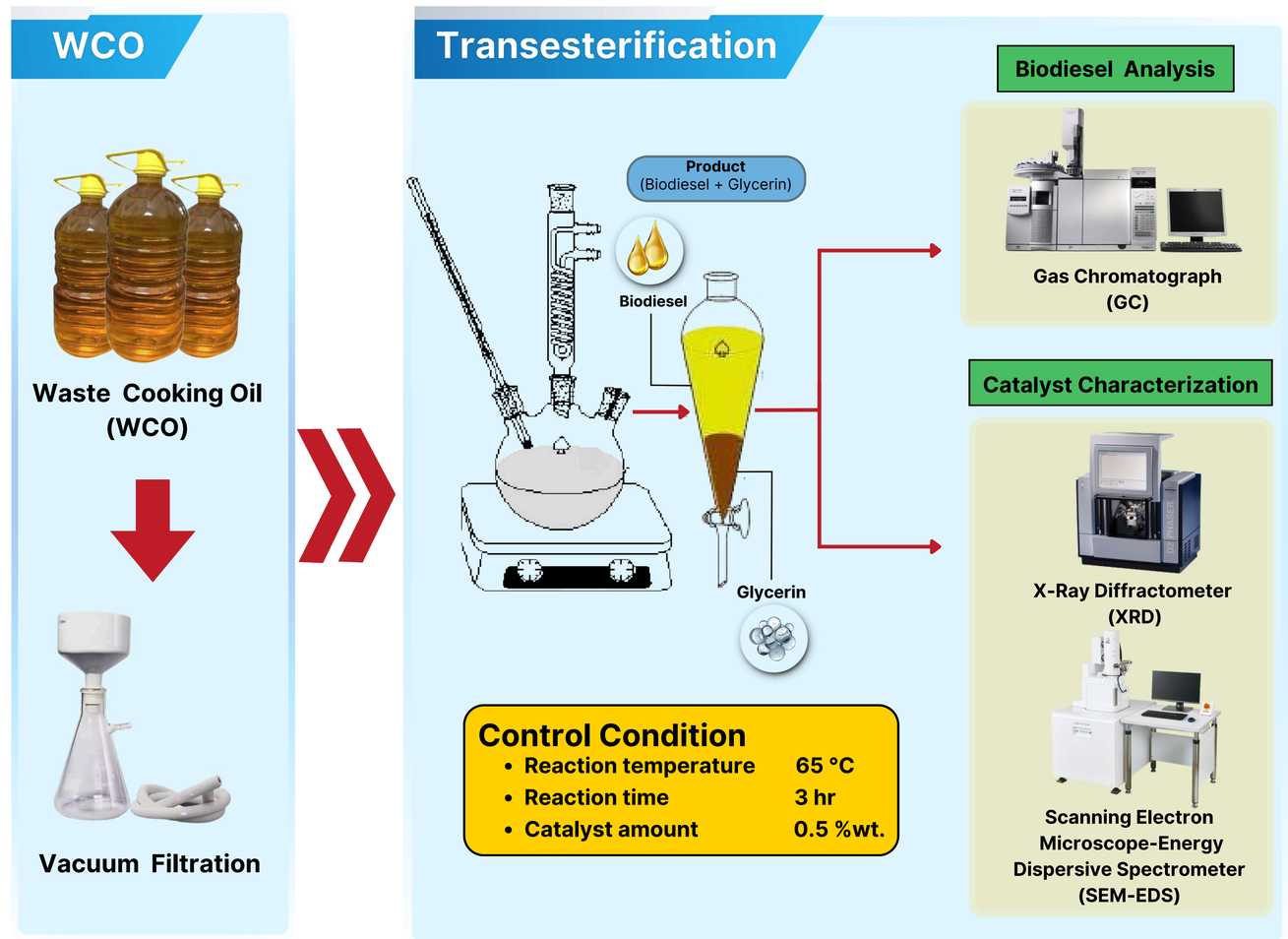
Introduction



Objectives

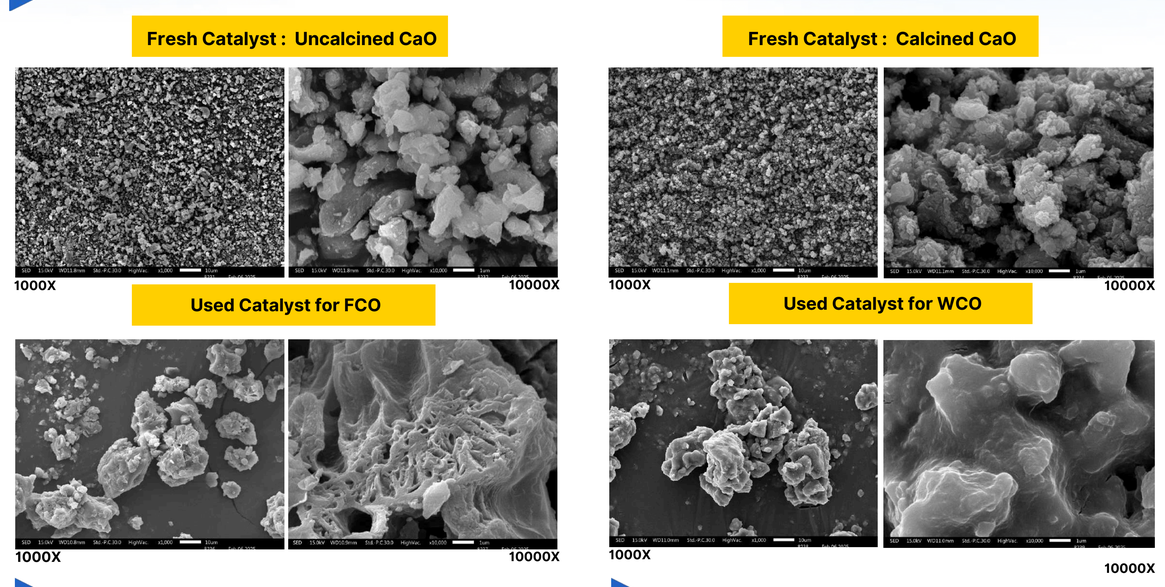
- To study the biodiesel production from waste cooking oil (WCO) and fresh cooking oil (FCO) using commercial CaO catalyst
- To study the effect of methanol/oil ratio on the biodiesel production efficiency from waste cooking oil (WCO) and fresh cooking oil (FCO) through heterogeneous catalytic transesterification reaction

Experimental

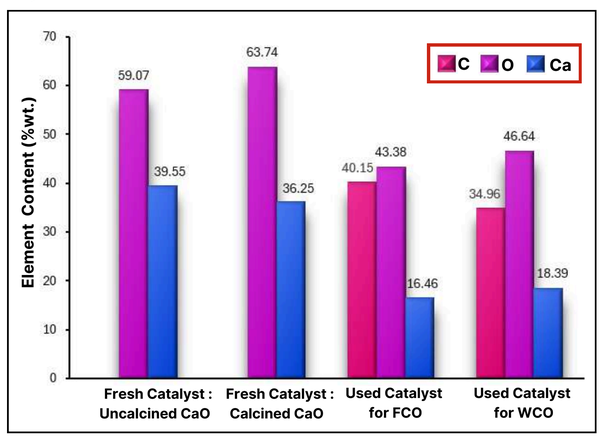


Results & Discussion

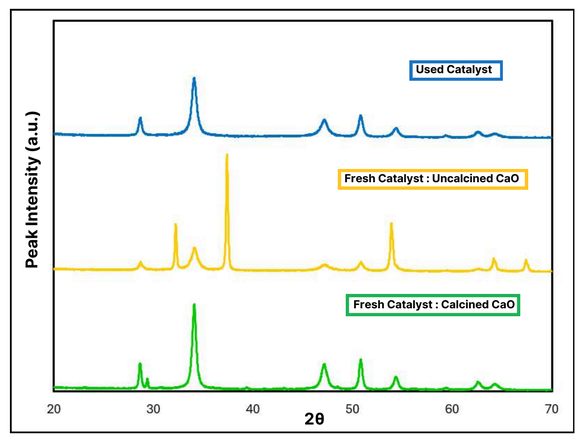
SEM : Surface Morphology



EDS : Elemental Analysis

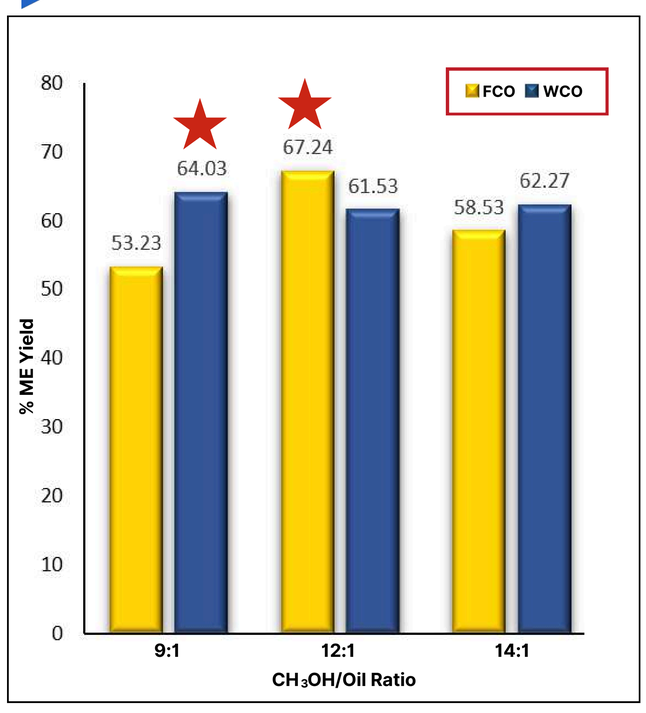


XRD : Crystalline Phase & Structure



Biodiesel Production from WCO and FCO

Effect of Methanol/Oil Ratio



CH_3OH/Oil Ratio	Fresh Cooking Oil (FCO)	
	Biodiesel (ml)	Glycerin (ml)
9:1	73.19	5.84
12:1	75.34	4.23
14:1	82.83	8.72

CH_3OH/Oil Ratio	Waste Cooking Oil (WCO)	
	Biodiesel (ml)	Glycerin (ml)
9:1	80.46	5.16
12:1	77.37	7.08
14:1	80.20	8.14

Conclusions

- The highest biodiesel efficiency achieved at 12:1 CH_3OH/oil ratio with ME yield of 67.24% for FCO, and at 9:1 CH_3OH/oil ratio with ME yield of 64.03% for WCO.
- The production of biodiesel from waste cooking oil (WCO) is more efficient than the ones from fresh cooking oil (FCO), especially using at lower CH_3OH/oil ratio (9:1).

Acknowledgement

Department of Industrial Chemistry, Faculty of Science, Chiang Mai University

Reference

P. A. Ozor, V. S. Aigbodion, N. I. Sukdeo, "Modified calcium oxide nanoparticles derived from oyster shells for biodiesel production from waste cooking oil", Fuel Communications, 2023, 14, 100085.