Biodiesel Production from Commercial Vegetable Oil via Ultrasonic-assisted Homogeneous Catalytic Transesterification

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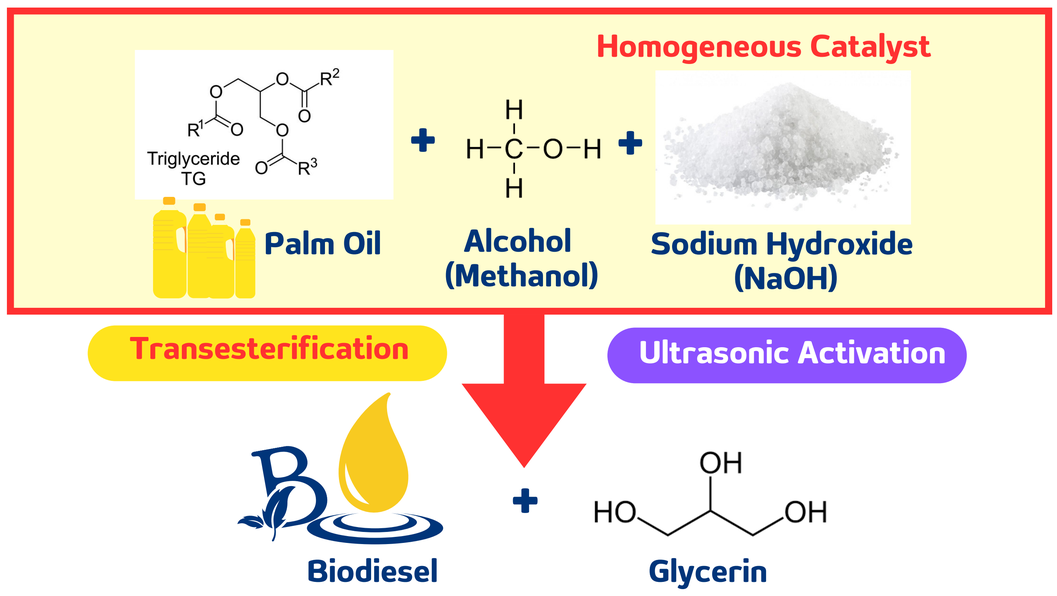
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Abstract

The research project aims to investigate the alkali-catalyzed transesterification from commercial vegetable oil in ultrasonic bath, with varying the effects of reaction time (20, 30 and 40 min) and catalyst concentration (0.77 %wt. and 1.54 %wt.). Sodium hydroxide (NaOH) was used as the homogeneous catalyst. The experiments were conducted at a molar ratio of methanol to oil of 6:1, catalyst concentration of 0.77 %wt., and reaction temperature of 52 °C. After the reaction completed, the biodiesel product was separated, and analyzed for percentage methyl ester (ME) yield using Gas Chromatograph (GC). The result showed that the percent yield of methyl ester were 93.29%, 94.41%, and 96.22% at reaction time of 20, 30, and 40 min, respectively. For this study, a NaOH catalyst of 0.77%wt. and a reaction time of 40 min provided the highest percent yield of methyl ester in ultrasonic-assisted system.

Introduction



Objective

To investigate the effects of NaOH catalyst concentration and reaction time under ultrasonic-assisted transesterification on biodiesel production from commercial vegetable oil

Experimental



Results & Discussion

Biodiesel Production

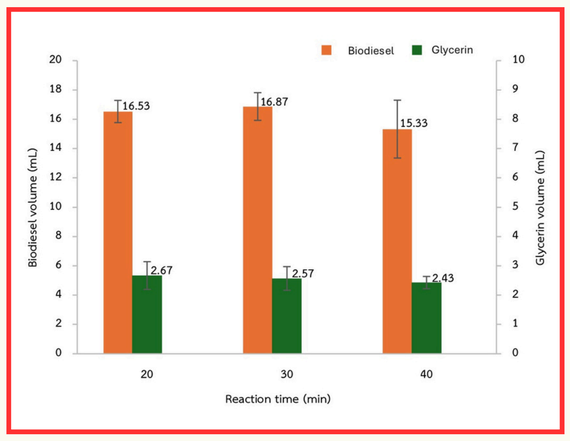
Table 1 Studied condition

Variable	Studied Range
Reaction time	20, 30 and 40 min
NaOH catalyst concentration	0.77 and 1.54 %wt.

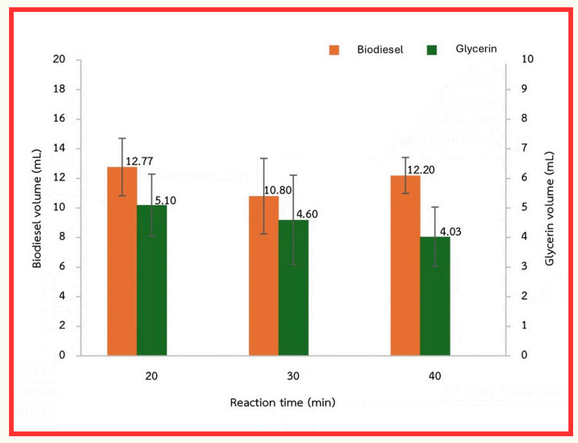
Table 2 Effects of catalyst concentration and reaction time on biodiesel and glycerin volumes

Catalyst Concentration (%wt.)	Reaction Time (min)	Biodiesel Volume (mL)				Glycerin Volume (mL)			
		Run no.1	Run no.2	Run no.3	Average	Run no.1	Run no.2	Run no.3	Average
0.77	20	16.0	16.2	17.4	16.53	3.2	2.3	2.5	2.67
	30	15.8	17.2	17.6	16.87	2.5	3.0	2.2	2.57
	40	14.4	14.0	17.6	15.33	2.6	2.5	2.2	2.43
1.54	20	11.5	11.8	15.0	12.77	5.6	3.9	5.8	5.10
	30	8.0	13.0	11.4	10.80	3.0	4.8	6.0	4.60
	40	13.00	10.8	12.8	12.20	4.1	3.0	5.0	4.03

NaOH Catalyst 0.77 %wt.



NaOH Catalyst 1.54 %wt.



Gas Chromatograph (GC)

NaOH Catalyst 0.77 %wt.

Table 3 Effect of reaction time on methyl ester yield

Reaction Time	Run	%Methyl Ester Yield	Average
20 min	No.1	104.06	93.29
	No.2	77.96	
	No.3	97.84	
30 min	No.1	82.83	94.41
	No.2	101.84	
	No.3	98.57	
40 min	No.1	85.56	96.22
	No.2	99.74	
	No.3	103.35	

Conclusion

Ultrasonic-assisted biodiesel production from commercial vegetable oil showed the optimal performance at 0.77 %wt. NaOH catalyst and 40 minutes of reaction time, with providing the highest methyl ester yield of 96.22%.

Reference

Teo, C. L. and Idris, A. (2014), Rapid alkali catalyzed transesterification of microalgae lipids to biodiesel using simultaneous cooling and microwave heating and its optimization, Bioresource Technology, 174, 311–315.