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Invitation to be the reviewer for the 7th Mechanical Engineering Research Day (MERD'20)

3 messages

PROFESOR MADYA DR MOHD FADZLI BIN ABDOLLAH <mohdfadzli@utem.edu.my> Thu, Aug 6, 2020 at 10:03 AM

To: "nurhamzah.said@gmail.com" <nurhamzah.said@gmail.com>

Dear Nur Hamzah Said,

We would be grateful if you, as an expert in the field, would accept our invitation to be one of the reviewers for the 7th Mechanical Engineering Research Day (MERD'20). We realize that there are increasing demands on all of our time, and thus we thank you in advance for considering this offer.

The event details can be accessed through http://merd20.utem.edu.my.

You are expected to review 1-2 extended abstracts (maximum 2-pages per abstract) submitted for MERD'20 from 24 to 30 August 2020. An email invitation to the review assignment will be emailed in due course.

If you decline this invitation, we would appreciate a response via this email before 10 August 2020. If there is no response after this date, we presume that you will accept this invitation.

Thank you in advance for your cooperation.

With kind regards,

Mohd Fadzli Bin Abdollah, DEng, CEng MIMechE (UK), MJSAE (Japan)

MERD'20 Chief Editor

Associate Professor

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Nur Hamzah Said <nurhamzah.said@gmail.com> Mon, Aug 17, 2020 at 9:09 PM
To: PROFESOR MADYA DR MOHD FADZLI BIN ABDOLLAH <mohdfadzli@utem.edu.my>

I accept the invitation.
[Quoted text hidden]

PROFESOR MADYA DR MOHD FADZLI BIN ABDOLLAH <mohdfadzli@utem.edu.my> Mon, Aug 17, 2020 at 9:17 PM
To: Nur Hamzah Said <nurhamzah.said@gmail.com>

Assalamualaikum & Salam Sejahtera,

Thanks. Wassalam.

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From: Nur Hamzah Said <nurhamzah.said@gmail.com>
Sent: Monday, August 17, 2020 9:09 PM
To: PROFESOR MADYA DR MOHD FADZLI BIN ABDOLLAH <mohdfadzli@utem.edu.my>
Subject: Re: Invitation to be the reviewer for the 7th Mechanical Engineering Research Day (MERD'20)

[Quoted text hidden]

Corbiculla Fluminea shell as solid catalyst for transesterification of *Hevea Brasiliesis* oil via microwave irradiation

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Keywords: Hevea Brasiliensis; rubber seed oil; heterogeneous; microwave

ABSTRACT – Hevea Brasiliensis oil or generally known as rubber seed oil (RSO) was utilized as fuels with the aid of heterogeneous catalyst from waste clams (Corbiculla fluminea) using microwave irradiation. The two step esterification-transesterification process reduces the acid value of RSO from 104.7 mgKOH/g total acid number to 0.435 mgKOH/g. The optimum yield of fatty acid methyl ester (FAME) was reached up to 94.56% under optimal conditions of 12:1 methanol molar ratio, catalyst loading of 7 wt% oil, 7 minutes of reaction time and 400 watt microwave power input. All fuel properties were analyzed according to respective standard and found within the requirements.

1. INTRODUCTION

Malaysia is the leading rubber producer and generated around 199,600 ton/year rubber seed oil. The seeds are the waste of rubber trees which normally being dumped to the forest thus made this plant as a promising source for producing a quality biodiesel. Recently, research attention has been shifted towards the use of heterogeneous catalyst for the transesterification of vegetable oil [1]. This is due to its significant advantages over homogeneous catalyst such as elimination of multiple purification steps, ease of catalyst recovery, higher catalytic activity, catalyst reusability, and consequently lowering of production cost [2]. *Corbiculla fluminea* one of waste mollusk shell can be easily found in the land and freshwater. All these shells are mainly composed of carbon carbonate ($CaCO_3$) which will convert into calcium oxide (CaO) by calcination process to assist the microwave irradiation transesterification process. Recent studies have shown that microwave irradiation technique is an economic, simple and energy efficient method in biodiesel production [3]. Experimental investigation was conducted to examine the performance of the methyl ester production of high free fatty acid (FFA) RSO using waste *Corbiculla fluminea* clams as a renewable fuel. A modified household microwave has been established to perform the transesterification procedure. Moreover, these biodiesel fuels also will be compared with the standard diesel fuel to authorize its performance.

2. METHODOLOGY

2.1 Material selection and catalyst preparation

Crude rubber seed oil with a very high acid value was purchased from the local company (Kinetics Chemical Sdn Bhd, Malaysia). Waste *Corbiculla fluminea* were obtained from the seafood restaurants in Melaka, Malaysia. The preparation of heterogeneous calcium oxide catalysts and the properties of methyl ester of crude RSO were reported according to the procedure of previous paper [4]. The catalyst characterization was carried out using Bruker AXS S8 Tiger XRF Spectrometry.

2.2 Biodiesel production

A two-step transesterification process is proposed in order to reduce the very high FFA of raw RSO to less than 3% [5]. Acid esterification process was carried out at 60^{o}C to 65^{o}C using water bath for at least 90 minutes. Sulfuric acid (H_2SO_4) of 1 % v/v in reference to the mass of oil (80g) and methanol (MeOH) with 6:1 molar ratio (alcohol to oil) is the optimum value selected to reduce the FFA concentration. The mixture was then poured into the separating funnel for phase separation. The treated RSO was washed with hot distilled water to remove all unwanted contaminant and acids.

Batch microwave irradiation transesterification were based on previous experiment [4]. The process was performed using modified 1000 Watt 2450Hz household Samsung brand microwave. The FAME obtained was analyzed with gas chromatography-mass spectrometry (GCMS-Agilent Technologies 6890 N) with inert mass selective detector 5975. The total yield obtained from the biodiesel was calculated according to Equation (1). The physical and chemical properties of FAME including kinematic viscosity, density, flash point, acid value, and water content were analyzed according to ASTM methods

$$\text{Volume yield\%} = (\text{Volume of product/Volume of oil fed}) \times 100 \quad (1)$$

3. RESULTS AND DISCUSSION

Calcium oxide (CaO) derived at a high calcination temperature of 900^{o}C from the waste shell provides an

optimized CaO and produced a high biodiesel yield. Low calcination temperature (below 600ºC) is not sufficient for the formation of CaO.

Table 1 Chemical composition of calcined *Corbiculla fluminea*.

Formula	CaO	Na_2O	SrO	SO_3	MgO
Concentration (%)	94.78	1.92	0.33	0.32	0.28

The elemental compositions of the calcined catalyst determined by XRF is shown in Table 1. Calcium was found dominating component in the catalyst. Minor elements such sodium oxide (Na_2O) and magnesium oxide (MgO) were also observed in the sample.

3.1 Methyl ester analysis

The *Hevea Brasiliensis* biodiesel composition identified by GC-MS with respect to the retention time is tabulated in Table 2. The major FAMEs were 10,13-Octadecadienoic methyl ester followed by 9-Octadecenoic methyl ester. The significant of important variables such as catalyst concentration and molar ratio of methanol to oil on the FAME yield was summarized in Table 3.

Table 2 Chemical composition of *Hevea Brasiliensis* biodiesel.

Peak #	**Retention Time**	**FAME**	**GC-MS %yield**	**Common Name**
1	7.653	C16:0	10.235	Myristic acid
2	12.3657	C18:1	15.157	Oleic acid
3	12.39658	C18:1	3.125	Oleic acid
4	12.4215	C18:1	14.254	Oleic acid
5	13.058	C18:2	38.63	Linoleic acid
6	138719	C18:3	13.22	Linolenic acid
	Total		94.621	

A high biodiesel yield of 94.56 was achieved under optimized parameters such as 7 wt% catalyst loading, methanol to oil ratio of 12:1, 7 minutes of reaction time and at microwave exit power 400 watt. It is observed that most of heterogeneous catalyst produces is slightly having lower yields compared with homogeneous catalyst which could yield more than 99%, but this method offers more advantages especially when dealing with low grade feedstock. Effects of methanol to oil ratio is very important in determining the biodiesel yield. The excessive amount of methanol will decrease the yield of biodiesel due to the reversible process in transesterification reaction. Although stoichiometric ratio requires three moles of methanol for each mole of oil, an excessive amount of MeOH is needed to maintain the equilibrium towards the direction of methyl ester formation. The RSO FAME fuel properties were complying with the ASTM D6751 and EN 14212 standards and qualifies for use in diesel engines.

4. CONCLUSIONS

A reusable solid catalyst from waste *Corbiculla fluminea* clams was developed by calcination process for effective biodiesel synthesis. A high *Hevea Brasiliensis* biodiesel yield of 94.56% was obtained under 12:1 MeOH to oil ratio, catalyst loading of 7 wt.% and 7 min reaction time at 400 Watts microwave power. Corbiculla fluminea shells have a potential to be a green promising heterogeneous catalyst for biodiesel production.

Table 3 Effect of process variables on biodiesel yield.

Catalyst (wt%)	**Reaction time (min)**	**Methanol:Oil**	**FAME Yield (%)**
5	7	6	75.14
		9	81.02
		12	83.2
7	7	6	89.25
		9	91.96
		12	94.56
9	7	6	92.52
		9	91.11
		12	90.23
12	7	6	71.23
		9	86.27
		12	83.87

Table 4 Physico-chemical properties of RSO biodiesel.

Properties	**ASTM limits**	**Testing procedures**	**Diesel**	**Measured Value**
Specific gravity at 30ºC	0.82-0.90	ASTM D4052	0.85	0.87
Flash point (ºC)	130 (min)	ASTM D93	68	181.2
Acid value (mg KOH/g)	0.8	ASTM D974	-	0.435
Kinematic Viscosity (mm^2/sec) at 40ºC	1.9 – 6	ASTM D445	2.6	4.73
Calorific value (MJ/kg)	-	ASTM D240	45.5	45.1

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