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Imperata cylindrica sp as Novel Silica-Based Heterogeneous Catalysts for Transesterification of Palm Oil Mill Sludge

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Abstract: Biodiesel from palm oil mill sludge (POMS) was prepared in the presence of novel silica-based heterogeneous catalysts derived from *Imperata cylindrica* sp. *Imperatacid* and *Imperatabase* are two types of heterogeneous catalysts derived from *Imperata cylindrica* sp and characterized using scanning electron microscopy, Energy Dispersive X-ray, Brunauer-Emmett-Teller surface area and pore size measurement. *Imperatacid* has particle size of 43.1-83.9 µm while *Imperatabase* in the range of 89-193 µm. *Imperatacid* was conveniently applied in esterification step to afford > 90 wt% oil in 1:3 (oil/methanol) and 10 wt% catalyst, followed by transesterification with 1 wt% *Imperatabase* and 1:1 (oil/methanol) for 1 h at 65℃ to afford 80% biodiesel with higher percentage of methyl palmitate (48.97%) and methyl oleate (34.14%) compare to conventional homogeneous catalyst. Reusability of the catalyst up to three times afforded biodiesel ranging from 78-80% w/w. The biodiesel was demonstrated onto alternative diesel engine (Megatech®-Mark III) and showed proportional increased of torque (ɽ) to biodiesel loading.

Key words: heterogeneous catalyst, biodiesel, catalyst support, palm oil mill sludge, transesterification

1 INTRODUCTION

The search for alternative renewable fuels has gain wide attention due to the depletion and limitation of traditional fossil energy resources. One of the approaches is via conversion of vegetable oils such as soybean oil and palm oil and also animal fats into biodiesel. Utilizing edible feedstock in biodiesel production has received great concern due to the global food crisis of biodiesel feedstock and food products[1]. The use of non-edible and waste vegetable sources as feedstocks has been intensified such as soapnut (Sapindus mukorossi), castor oil, cottonseed oil, Jatropha curcas oil, rubber seed oil and nagchampa oil for biodiesel production[1−7]. Used cooking oil is a common waste for biodiesel and cheaper compared to other feedstock[8]. Palm oil mill sludge (POMS) is another type of waste derived from palm oil mills industry and found abundant and unutilized in Malaysia. Fewer studies reported on the utilization of POMS for biodiesel production.

Transesterification is a significant process in the production of biodiesel. Homogeneous acid catalyst such as H_2SO_4 and HCl are commonly reported to accelerate the process for a higher yield of biodiesel[9−11]. A major drawback of employing homogeneous acid-catalysed transesterification is its corrosive properties towards machines and containers[12] as well as higher consumption of alcohol for excellent yield of biodiesel[13, 14]. Transesterification *via* homogeneous base catalysts, on the other hand, exhibits faster and non-corrosive reaction[15]. NaOH and KOH are common homogeneous base catalysts employed in transesterification for higher catalytic activity and quality of biodiesel[13]. The use of homogeneous base-catalyst, however, suffers from the formation of undesirable side reaction such as saponification which creates problems in product separation and ultimately lowers the biodiesel yield[12, 16].

Heterogeneous catalyst has become widely reported due to easy separation and higher yield production of biodiesel[14]. Resins, tungstated and sulphated zirconia, metal hydrogen sulphate, heteropolyacid and zeolite are few examples of heterogeneous acid catalysts reported[17−22]. Heterogeneous base catalysts such as magnesium and calcium oxide as well as sodium and potassium phosphate have also been reported for the production of biodiesel[23].

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