Active Heterogeneous CaO Catalyst Synthesis from *Anadara granosa* (Kerang) Seashells for Jatropha Biodiesel Production

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Abstract. Heterogeneous catalysts are often used at large to produce biodiesel from non-edible vegetable crude oils such as *Jatropha curcas* oil (JCO). In this study, an active heterogeneous CaO catalyst was synthesized from a tropical biodiversity seashells *Anadara granosa* (*A.granosa)*. The catalytic efficiency of *A.granosa* CaO was investigated in transesterification of JCO as biodiesel. The *A.granosa* CaO catalyst was synthesized using 'Calcination – hydration – dehydration' protocol. The spectral characterization of the catalyst were investigated by employing FT-IR, SEM, BET and BJH spectrographic techniques. The experimental design was executed with four reaction parameters that include catalyst concentration (CC), methanol ratio (MR), transesterification time (TT) and reaction temperature (RT). The JCO transesterification reactions as well as impact of reaction parameters on the Jatropha biodiesel yield (JBY) were analyzed. The sufficiency of the experimental results conformed through sequential validation tests, as a result, an average of 96.2% JMY was noted at optimal parametric conditions, CC of 3wt. %, TT of 120 min, MR of 5 mol. and RT of 60ºC at a constant agitation speed of 300rpm. An average JMY of 87.6% was resulted from the *A.granosa* CaO catalyst during their recycling and reuse studies up to third reuse cycle.

1 Introduction

Ever increasing energy needs for the world's comprehensive developments emphasis on intrinsic and sustainable approaches into multiphase coherent and seamless research for the future[1]. On the contrary, despite substantial policy and research initiatives, the global warming, pollution as caused by the fossil fuel combustion emissions besides depletion of natural petroleum deposits reiterates search for renewable and alternate fuel and energy sources. In early 1980's the biodiesels were commercially launched as an alternate fuel in the view of minimizing the greenhouse exhaust gas emissions[2]. The renewable feed stocks such as edible and non-edible vegetable oils, algae oils, animal fat wastes etc.[3,4] were prominent in biodiesel production by their transesterification with methanol and a catalyst. To minimize the demand for edible oils and to maintain sustainable human food cycle, non-edible feed stocks such as *Jatropha curcas*, a euphorbia family plant mainly grown in tropical and sub-tropical regions, has accomplished both commercial and researcher's attention, besides the plants supplementary benefits[4].

A large number of homogeneous and heterogeneous catalysts were experimentally utilized in transesterification of various vegetable oils and among which heterogeneous catalysts demonstrated higher catalysis, stability, reusability and ease in production mechanisms[5,6]. An adequate usage of catalysts as synthesized from diverse sources of wastes is crucial as part of the sustainable and strategic management of wastes and so as the environmental concerns[7,8]. Many researchers have reported on calcium based catalysts synthesized by make use of direct calcination over a temperature range of 800^{o}C – 900^{o}C from domestic waste shells such as cockle shells[9], *Pomacea* sp. shells[10] derived CaO from mussel shells[11], waste chicken-eggshell[12], ostrich-eggshell[12] etc. and utilized effectively in transesterification. These reports emphasizes CaO catalysts prominence in catalysis of triglycerides of oils to biodiesel. Since the domestic chicken eggshells are notably abundant, economic synthesis of catalysts from theses waste shells encompasses the recycling of wastes for sustainability and environmental advantages as well. *Anadara granosa* (*A.granosa)* seashells are prominent and economic edible protein source in the Indo-Pacific tropical region especially from wetlands of Kuching[13] and Asajaya[14] areas in Sarawak state and also in other coastal areas of Malaysia. *A.granosa* shells are largely available in the region and locally known as 'Kerang'[13,14]. According to our literature review, any research was published on synthesis of heterogeneous CaO catalyst.

The present research reports on CaO synthesis with higher surface area form *A.granosa* seashells to produce an active CaO heterogeneous catalyst. 'Calcination – hydration – dehydration' protocol was employed for

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