Utilization of Cuttlefish Bone

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Utilization of Cuttlefish Bone as The Alternative Source of Heterogenic Alkali Catalyst

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Abstract. This research aims to determine characteristic of heterogeneous alkali catalyst which produced from cuttlefish bone. The catalyst was made by calcination process at 800 °C for 4 hours. The characterization was done by XRD (X-ray diffractometer) and SEM-EDS (Scanning Electron Microscopy- Energy Dispersive X-ray). XRD result showed heterogeneous alkali catalyst from cuttlefish bone have high crystallinity with lime mineral phase. In comparison with calcium oxide powder, the cuttlefish bone catalyst has the highest crystallites (6000) than calcium oxide powder (4000). SEM-EDS result showed the microstructure of cuttlefish bone heterogeneous base catalyst morphologically have dissimilar particle shape and size comparing to tohor lime heterogeneous base catalyst. Cuttlefish bone catalyst particle size is smaller than catalyst from tohor lime. Morphologically showed the difference is cuttlefish bone catalyst has tidy-clots form while tohor lime catalyst has slab-shaped. These particle shape and size will affect to catalyst properties, which smaller particle size will be affected to effectivity of catalyst activity. From EDS result showed main mineral compound of cuttlefish bone catalyst is calcium attain 93%.

1. Introduction

Biodiesel is an alternative fuel that can be produced from any source which contain fatty acid, such as vegetable oils or animal fats [1]. Biodiesel produced by transesterification reaction between linear monohydroxy alcohol (methanol, butanol, or ethanol) and triglyceride of fatty acid producing fatty acid methyl ester (FAME) as main product and glycerol as by-product, in presence of catalyst (acidic or basic)[2,3].

Homogeneous base catalysts such as potassium or sodium hydroxide are generally used on biodiesel production. It has high reaction rate and high FAME yields in mild tempreature with short process time. However, homogenous catalysts are highly sensitive to free fatty acid (FFA) commonly contained on non-edible oil which can lead to saponification, also hard to separate from reaction mixture, so it cannot be reused and will be wasted. In contrast, heterogenous base catalyst is a catalyst had different phase in the liquid reaction mixture which has solid-form, so it easy to be divided after the reaction is done and possible to be reused [3,4]. Furthermore, heterogenous base catalysts are less-sensitive to FFA and water [5].

Calcium oxide (CaO) is heterogenous base catalyst with high activity, lower solubility, non-toxic, high stability, cheap, and enviromentally safe [4,5]. In addition, CaO could support to produce high FAME yield. Also, CaO can be derived from calcium carbonate ($CaCO_3$) through calcination process at optimum temperature ≥800°C [3,4]. Cuttlefish bone is waste products of cuttlefish that mainly composed of $CaCO_3$ and chitin [6]. Hence, cuttlefish bone is potentially as alternative source of CaO catalyst. The objective of this study is to determine characteristic of heterogeneous alkali catalyst which produced from cuttlefish bone.

2. Material and Methods

This research was conducted at Chemical and Biochemical laboratory, Fishery Product Technology Departement, Faculty of Agriculture, Physic Laboratory, Faculty of Mathematic and Science, Sriwijaya University, and Laboratory of Forensik Polda Palembang. The material used on this research are cuttlefish bone and tohor lime (comercial calcium oxide powder). Calcination of Cuttlefish bone and tohor lime refer to [5], cuttlefish bone was washed with water and distilled water, then mashed into powder and dried in the oven at 105 °C for 24 hours. The calcination process of cuttlefish bone powder and tohor lime was done at 800 °C for 4 hours. The calcinated cuttlefish bone and tonor lime was characterized by XRD (X-ray diffractometer), and SEM-EDS (Scanning Electron Microscopy- Energy Dispersive X-ray).

3. Results and Discussion

3.1. Characterization by XRD (X-ray diffractometer)

XRD result of tohor lime catalyst Fig. 1 and cuttlefish bone catalyst Fig. 2 showed sharp peaks mean both catalyts have high crystalinity. The 2θ value of each catalyst was seen in the range 18-70. Highest peak of tohor lime reach 4000 cps intensity and intesity of cuttlefish bone catalyst attain more high, extend to 6000 cps. Thus, cuttlefish bone catalyst had more well crystal structure than tohor lime.

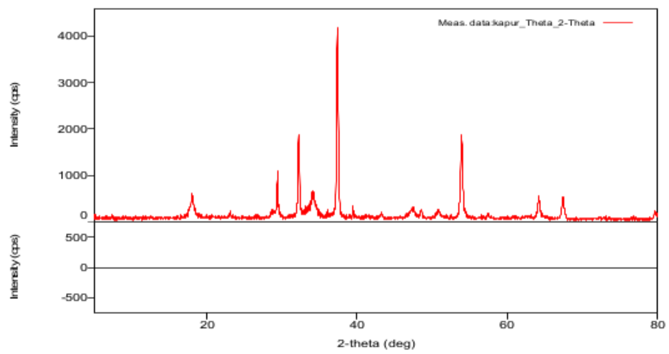

Figure 1. XRD of tohor lime catalyst

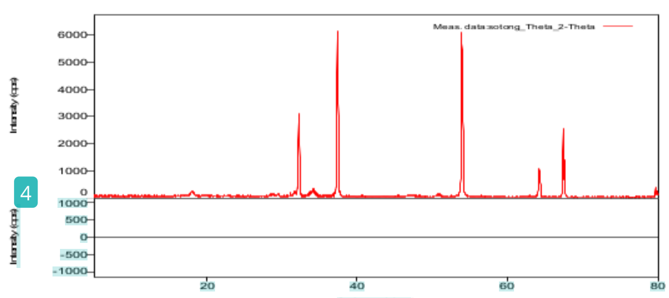

Figure 2. XRD cuttlefish bone catalyst

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3.2. EM-EDS (*Scanning Electron Microscopy- Energy Dispersive X-ray)*

SEM analysis (Fig.3, Fig.4) showed the microstructure of tohor lime catalyst and cuttlefish bone catalyst. Morphologically, tohor lime powder has slab-shaped and cuttlefish bone catalyst has tidy-clots form. Furthermore, cuttlefish bone catalyst has more porous in structure than tohor lime powder. The appearance of both catayst on 5 µm magnification exhibit particle size of cuttlefish bone is smaller than tohor lime catalyst. Small size of catalyst particle will more easy to binding with reactant active site because it has more wide surface and the reaction is more effective.

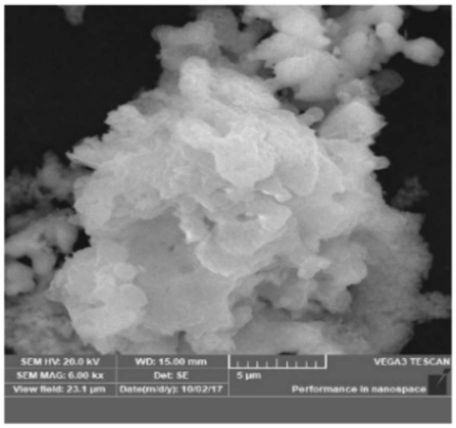

Figure 3. SEM of tohor lime catalyst

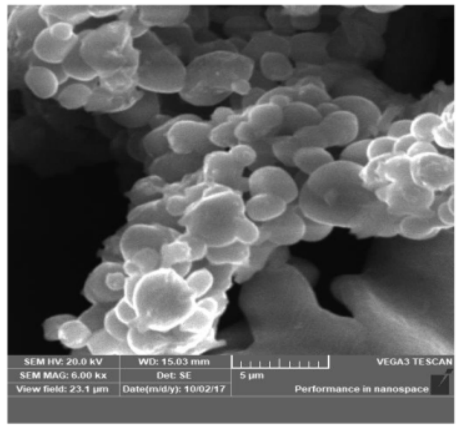

Figure 3. SEM of cuttlefish bone catalyst

EDS result showed on table 1 and 2 that tohor lime catalyst contains more calcium (94%) than cuttlefish bone catalyst (93%). Also, tohor lime catalyst contain 5% oxygen and cuttlefish bone contains 5% oxygen and 1% nitrogen. High percentage of calcium content indicate that calcination process on CaO forming is going well. Nitrogen content on cuttlefish bone catalyst due to cuttlefish bone contain 92% calcium carbonate ($CaCO_3$) and the others main content is organic matter (8%) [6].

Table 1. EDS Component of Tohor lime catalyst

Compound	Mass (%)
Calcium	94 %
Oxygen	5 %

Table 2. EDS Component of Cuttlefish bone catalyst

Compound	Mass (%)
Calcium	93 %
Oxygen	5 %
Nitrogen	1 %

4. Conclusion

XRD result showed that cuttlefish bone catalyst has more hight intensity (6000) than tohor lime catalyst (4000). Thus, cuttlefish bone catalyst had more well crystality structure and high crystal phase. Tohor lime catalyst has slab-shaped and cuttlefish bone catalyst has tidy-clots form, also particle size of cuttlefish bone is smaller than tohor lime catalyst. Cuttlefish bone catalyst contains calcium 93%, oxygen 5% and nitrogen 1%. While tohor lime catalyst contains calcium 94% and oxygen 5%.

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