Preparation Of Cao Catalyst From Eggshell With Koh Impregnation And Its Application In The Production Of Biodiesel From Used Cooking Oil

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Abstract. The high CaO content in chicken egg shells can be used as a raw material for heterogeneous catalysts by the calcination process. This study aims to determine the effect of CaO catalyst impregnation temperature and the effect of catalyst addition in the production of Used Cooking Oil Biodiesel. Catalyst preparation was carried out with Kalsinsi Temperature variations of 7000C, 8000C and 9000C, which were then used for the manufacture of biodiesel from used cooking oil with variations of 0.5, 1.0 and 1.5% of the weight of the oil, oil mole ratio: methanol (1:12) and reaction temperature of 60 oC. In this study, the best calcination temperature concentration was obtained at 9000C, with a face area of 5μm and CaO content of 94% each, while the best catalyst was added to 1% of the catalyst from the oil weight with an oil yield of 62.%, density of 889kg/m3, Cetane number 39 and viscosity of 39 cP. The results of the biodiesel analysis obtained met the SNI 7182: 2015 standard.

Key words: Eggshells, Catalyts,Biodiesel

1.Introduction

The mandatory biodiesel journey in Indonesia is an important step in reducing dependence on fossil fuels and supporting environmental sustainability. This policy requires the use of biodiesel as part of the diesel fuel blend, with the main goal of reducing carbon emissions and improving air quality. The mandatory change in specifications from B30 to B35 has been stated in the Decree of the Director General of New, Renewable Energy and Energy Conservation, Ministry of Energy and Mineral Resources Number 207.K/EK.05/DJE/2022. This policy was issued on December 28, 2022. In addition, it has been stated in the Circular Letter of the Directorate General of New, Renewable Energy and Energy Conservation (EBTKE) Number: 10.E/EK.05/DJE/2022 which was also stipulated on December 28, 2022. Both regulations were signed by the Director General of EBTKE, Ministry of Energy and Mineral Resources, Dadan Kusdiana.

Biodiesel is generally made using base catalysts such as KOH and NaOH because these compounds have higher catalysts than other catalysts. The use of this

N. L. Husni et al. (eds.), *Proceedings of the 8th FIRST 2024 International Conference on Global Innovations (FIRST-ESCSI 2024)*, Advances in Engineering Research 261,
https://doi.org/10.2991/978-94-6463-678-9_34

base catalyst has the disadvantage that it is difficult to separate from the reaction results and cannot be used again and becomes waste and has an impact on the environment [1].

To overcome this, the manufacture of biodiesel is made using a natural catalyst that is heterogeneous in nature which provides the same effectiveness as a homogeneous catalyst. One of the catalyst materials is CaO which is obtained from the eggshell calcination process [2]. The increase in egg consumption in Indonesia from year to year has increased by 3.57%, this certainly has the potential to produce eggshell waste. [3]. The utilization of eggshell waste at this time has the potential as poultry feed, organic fertilizer and several small industries change eggshell waste into handicrafts' [4]

Calcination of egg shells with controlled combustion can produce CaO compounds that can be used for various chemical processes, including as catalysts [6] [7],[8] [9]. The use of catalysts made from egg shells is in the biodiesel conversion process from vegetable oil.

One of the advantages of CaO is that it is solid so that it is easy to separate at the end of the reaction in the biodiesel manufacturing process. CaO can be obtained commercially on the market, but commercial CaO is difficult to obtain in a pure state and is relatively expensive. Therefore, to overcome this problem, CaO from natural sources is an effort to utilize waste. Natural sources such as limestone, animal bones, and shells contain a lot of CaCO3 and can then be decomposed into CaO at certain temperatures [10] , [11]

Biodiesel production can be carried out using CaO catalyst with a catalyst concentration of 2-5% at a temperature of 55-65oC with a reaction time of 1-3 hours with a mole ratio of oil: methanol (1: 12).[9].[10],[11]

Based on the description above, researchers consider it necessary to develop the use of egg shell waste as a catalyst in the conversion of biodiesel from used cooking oil in efforts to produce alternative energy and utilize waste that has the potential to pollute the environment..

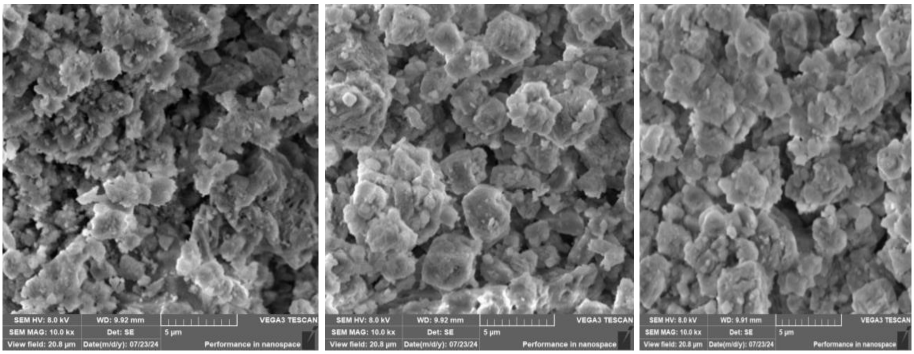
2. Research Methods

This research focuses on the development of CaO catalyst for biodiesel production from used cooking oil by utilizing eggshells as a catalyst raw material, which is one way to reduce environmental problems. The tools used in this study are Nabertherm Type L311B410 Flap Door Furnace, oven, magnetic stirrer, mortar, pestle and other glass tools. The raw materials used in this study are used cooking oil and chicken eggshell waste taken from household industries, KOH (purity: 99.9%) p.a MERCK.

3. Results And Discussion

3.1 Determination of CaO Catalyst Surface Morphology Using the Scanning Electron Microscope (SEM) Method

The characterization of the catalyst obtained from the calcination of eggshells was performed using a Scanning Electron Microscope (SEM), an electron microscope that utilizes an electron beam to visualize the surface morphology of objects or materials by detecting high-energy reflected electrons. The morphological characteristics of CaO derived from calcined eggshells at temperatures of 700, 800, and 900°C can be observed in Figure 1 at a magnification of 10,000 times. The primary objective of this characterization is to determine the surface morphology of the catalyst, particularly concerning its pore size and structure.



a b c

Fig.1 Surface morphology of CaO catalyst using Scanning Electron Microscope (SEM) a) 700oC, b) 800oC, c) 900o

From the morphological results of the catalyst face size with variations in impregnation temperature, it can be said that the eggshell imgregation temperature affects the pore size where at a temperature of 9000C it contributes a pore size of 5 µm. While at temperatures of 700 and 800 it contributes 2 µm. This is due to the effect of heating contributing to the release of compounds that are converted into gas phases.

3.2. Catalyst Testing with X-Ray Diffraction

The next step in the characterization process is to use X-ray diffraction (XRD) analysis to determine the material's crystal structure. Figure 2 illustrates the surface and morphology of the catalyst anode's photostructure. X-ray diffraction (XRD) is an analytical technique used to determine the crystalline phase in a material by figuring out the parameters of the lattice structure and to obtain particle size. It also helps identify and analyze functional groups in a compound molecule.

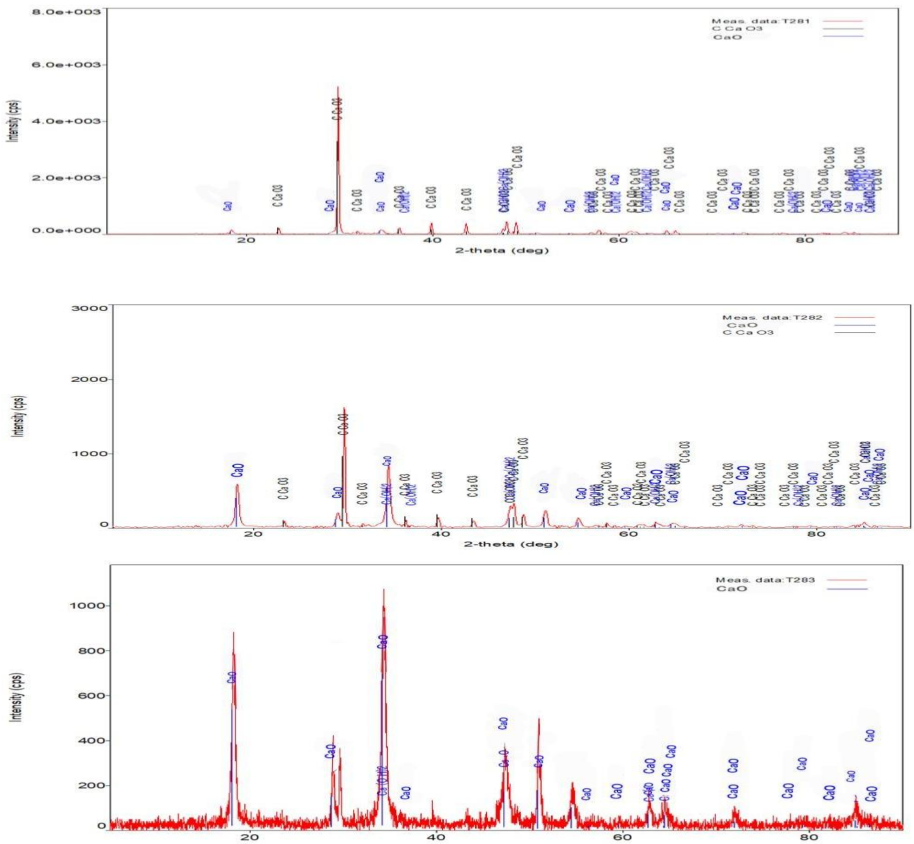


Fig. 2. XRD Analysis Graph of CaO Catalyst a) 700oC, b) 800oC c) 900oC

X-Ray Diffraction (XRD) test was conducted to determine the mineral content contained in the chicken egg shell sample after calcination at a temperature of 900oC, qualitative analysis was carried out using XRD. The image below shows the main component contained in the catalyst is CaO. This is indicated by the presence of sharp peaks which prove that the CaO component has a crystal structure. The degree of crystallinity from the XRD test results is 94.64%.

3.3. Characterization of Biodiesel with Variations in CaO Catalyst

The results of the use of CaO catalyst from egg shells in the biodiesel manufacturing process are taken from the characteristics of the catalyst with a calcination condition of 9000C, with variations of 0.5, 1.0 and 1.5% of the weight of used cooking oil. The results of the analysis of biodiesel are given in table 1.

In the process of making CaO catalyst from chicken egg shells for transesterification of used cooking oil, biodiesel yield data was obtained from the results of the research that had been carried out. With variations in catalyst making at an impregnation temperature of 60°C, it can be seen in Table 1

.**Tabel 1,** Analisys Result of Biodiesel

Temperature	Composition	time	Volume	Yields	Density	Viscosity	Cetane	Flash
0C	%	Menit	mL	%	kg/m^3	cP	Number	point
		30	22.9	22.9	844	2	32	160
		60	60.8	60.8	846	2.5	39	155
	1	90	46.4	46.4	843	4	45	157
		120	21.9	21.9	842	6	40	210
		30	28.8	28.8	845	3	39	155
		60	55.8	55.8	844	4	42	160
60	1.5	90	54	54	841	4.5	40	158
		120	25.1	25.1	842	5	42.5	165
		30	21.4	21.4	845	5	40	150
		60	49.9	49.9	841	5.4	42.5	165
		90	44.4	44.4	843	6.0	35	155
		120	21.1	21.1	845	6.5	30	152

CONCLUSION

Based on the results of the research that has been carried out, the following conclusions are obtained: 1. The optimal temperature in the manufacture of CaO catalysts from chicken eggshells in this study is 900ºC, at this temperature the CaO produced by the calcination process, starting from a temperature of 700 has seen the presence of CaO but there is still CCaO3 content. As the temperature increases to 800 and 900 CaO is formed better, seen from the results of heating 900 has formed pure

CaO.

2. The optimum percentage in the process of making biodiesel in this research is 1% of the weight of the oil used and produces a biodiesel yield of 62.17% with a reaction time of 60 minutes.

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