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Calcination Of CaO Compounds From Cow Bone Waste And Tuna Fish Bones

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***Abstract*—Catalysts are needed in a chemical reaction. With the catalyst it will accelerate the rate of chemical reactions that occur. This will save time and cost compared to chemical reactances without catalysts. Catalysts are classified into two types: homogeneous and heterogeneous catalysts. CaO is a compound that is classified as a heterogeneous catalyst. CaO is a heterogeneous catalyst that has many advantages, namely reusable, safe waste disposal, raw materials that are easily obtained at a low cost and abundant innature. Tuna bones and cow bones have the potential as the basic ingredients of CaO compound synthesis. This is because the calcium content of tuna and cow bones is quite large. Its availability in nature is also very abundant. $CaCO_3$ content in tuna bones and cow bones is very potential to be used as a source of basic ingredients in the manufacture of CaO catalyst compounds. There are three stages in the CaO synthesis of tuna bones and cow bones. The first stage is the preparation of tuna bones and cow bones. The second stage is the calcination of tuna bones and cow bones with variations in time. The third stage is the analysis of CaO that has been produced in the previousstage. Compounds formed by calcination for 6 hours and 10 hours in tuna bones and cow bones are CaO compounds. This can be observed in the change in the color of the sample before calcination and after calcination which was originally brownish gray, turning white. If observed further then calcination is best in Cow Bone and Tuna Fish Bone is calcination with a temperature of 1000^o Cfor 10 hours, compared to 6-hour calcination compound this is because cao calcination compound 10 hours more stable marked by a sample color that is clean white. So it can be concluded that calcination at a temperature of 1000 ^{o}C with a length of 6 hours and 10 hours produces CaO crystals.**

Keywords—CaO; Cow Bone; Tuna Bone; Calcination

I. INTRODUCTION

In essence, the production process always wants good results and with a relatively short time. During production, chemical reactions generally occur over a long period of time, so it takes a substance that serves to increase the speed of the chemical reaction. This substance is called a catalyst in chemical reactions. A catalyst is a substance capable of increasing the speed of a reaction that does not change or affect the outcome of a reaction. That is, the substance called catalyst will not change but will remain the same both before and after the reaction. Although during the reaction it could be that the catalyst will experience different conditions only when the catalytic cycle is completed then the catalyst will return to its original condition [1].

The presence of catalysts in chemical reactions is needed. This is because of the ability of catalysts that can decrease the activation energy of a reaction, so that it will accelerate the rate of chemical reactions at a certain temperature, without experiencing changes or being used by the reaction itself. So with the use of catalysts in a chemical reaction it will save time and cost compared to chemical reactions without catalysts. The number of catalysts and their types are many. There is a classification of catalysts to make it easier to distinguish them, namely homogeneous catalysts and heterogeneous catalysts. This classification is based on the phase of the aggregation system of reactants, products and catalysts [2]. A homogeneous catalyst is a catalyst that has the same type of phase as the reaction system phase. If the reaction system phase is solid then the catalyst phase used must also be solid. If the type of reaction system phase is liquid then the catalyst phase used should be liquid. Heterogeneous catalysts are catalysts that have a different type of phase to the reaction system phase. If the reaction system phase is solid then the catalyst phase used must be liquid and vice versa.

One type of heterogeneous catalyst is CaO. CaO is one of the heterogen catalysts that have many advantages, namely reusable, safe waste disposal, raw materials that are easily obtained at a low cost andabundant innature. CaO can be synthesized from duck egg shell, quail egg shell [3], crab shell [4], camel bones [5], horse bones [6], Pig bones [7], and fish bones [8]. In addition, tuna bone waste and cow bones also have the potential as a source of CaO that can be synthesized. This is because the calcium content of tuna bone waste and cow bones is quite large. Its availability in nature is also very abundant.

Tuna until now is a fish that is widely exported abroad by the country of Indonesia. Products from processed tuna became the second largest export product from Indonesia which contributed about 15% of the total export value in 2011. The distribution of tuna exports from Indonesia is in Japan (35%), the United States (20%), Thailand (12%), European Union countries (9%), and Saudi Arabia (6%) [9]. FAO (2010) stated that globally in 2009 Indonesia became the largest tuna producing country, which is about 15% of the world's tuna needs can be provided by the Indonesian state [10]. In addition, there are several countries that are also the largest producers of tuna after Indonesia, namely the Philippines, China, Japan, Korea, Taiwan, and Spain. Data from the Ministry of Marine Affairs and Fisheries (2015) shows that until October 2015 Indonesia exported tuna fish amounting to 142,023 tons. If you look at the value of exports, it is about 491,891 million US$ [11]. Tuna fish products that are ready to export are tuna products that have been processed into fresh and whole products (loin and steak), frozen products, ambient products (tuna packaged in cans), and processed products (meatballs, abon, nuggets, sausages). Byproducts of tuna products that are ready to export will produce waste in the form of head, skin and bones. The increasing number of exports of tuna products, the amount of waste byproducts will also increase, this is a problem if left continuously. It takes a solution to utilize waste byproducts from tuna products one of them by processing it into cao compounds or hidroksiapatit. According to Ozawa and Suzuki (2002), tuna bones are a natural base ingredient for the manufacture of hydroxyapatite that is cheap and easy to obtain so it has the potential to be developed in the future [12]. In addition, according to Trilaksani (2006) bones have a considerable calcium content of about 84.22%. For fish bones have a calcium content of 36%, phosphorus 17% and magnesium 0.8%[13].

Cows are animals that are found in Indonesia. Cattle ranches are farms that have a relatively high demand. The beef cattle population increased rapidly from 2009 to 2019. In 2009 the number of beef cattle was about 12,759,838 tails and in 2019 increased to 16,930,025 tails. There has been an increase over 10 years of about two million [14]. The greater the number of demand for slaughtering cows, the greater the amount of waste produced will also be greater. One of the wastes from slaughtering cows is bone. Generally, the use of cow bone waste is predominantly used as raw material for making flour in the manufacture of fish feed and there are some that are used as raw materials for handicrafts. The composition of cow bones consists of elements calcium and phosphorus. The type of calcium is 7.07% in the form of $CaCO_3$ compounds, 1.96% in the form of CaF_2 compounds. And for the type of phosphorus, namely, 2.09% in the form of compounds Mg_3 $(PO4)_2$, and 58.30% in the form of compounds $Ca_3(PO_4)_2$ [15].

Based on the fact that the utilization of tuna bone waste and cow bones is still not maximal, and because the waste content of tuna fish bones and cow bones has calcium content that is used as a source of material for synthesis of CaO compounds, this study has the aim toproduce CaO compounds from natural waste of tuna fish bones and cowbones.

II. EXPERIMENT

2.1. Research Preparation

This research is a research with an experimental approach. This research is conducted by conducting experiments / experiments in the laboratory to produce products in the form of CaO. The research was conducted at UKI's Chemical Education Oratorium Lab, UKI's Mechanical Engineering Metallurgy laboratory and the Physics Research laboratory at LIPI Serpong. Tools used in research: Hammer, *Crussible*, Mortar, Digital balance sheet and *Furnace*. Materials used in the study is: Tuna fish bones, taken from kramat jati traditional market, East Jakarta 1 Kg, cow bones, taken from waste around the Universitas Kristen Indonesia (UKI), East Jakarta 1 Kg.

2.2. Research Procedure

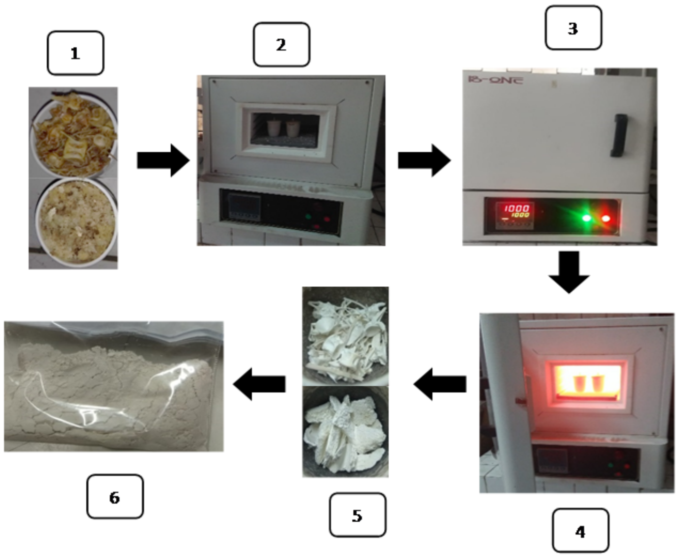
There are two stages in the research process, namely the first stage is the preparation and sterilization of cow bones and tuna bones. The second stage is the calcination of cow bones and tuna bones to be produced CaO.

A. Preparation and Sterilization of Samples

The cow bones used come from meatball waste around the Universitas Kristen Indonesia (UKI), while the tuna bones used are taken from the waste of the east Jakarta kramat jati market community. The type of beef cow is a type of Bali cow. As for tuna fish used is a large eye tuna fish. At this stage, the bonesof cows and tuna fish bones are each as much as 0.5 kg.Clean the cow bones and tuna bones using aquades. Then crush it using a hammer until it becomes a small flake of cow bone and a small flake of tuna bone.Next dry the small flakes of cow bones and small flakes of tuna bones in the sun.

B. Sample Calcination

Cow bones and tuna bones prepared in the previous stage were calcined using furnaces with temperature variationsof 900 °C and 1000°C for 6 and 8 hours for each sample.Then cooled. Furthermore, calcination results in the form of CaO cow bones and tuna fish bones are eroded using mortar.



Information:
1. Sample: Tuna's bones and cow's bones
2. The sample is inserted in the crucible and avoided in the furnace
3. Furnace heat up to 1000oC
4. Furnace heat for 6 hours and 10 hours
5. Samples of tuna bone and cow bone from Furnace
6. Powder samples of tuna and cow bones

Fig. 1. CaO Calcination Process

C. Analysis of Calcination Results

Analysis of calcination samples obtained by observing the color, sample size and efficiency of the resulting CaO.

III. Results And Discussion

3.1. Analysis of CaO Cow Bones

Cow bones that have been calcined at a temperature of 1000°C for 6 hours and 10 hours later observed changes that occur. The observed change is the difference in color before calcination with after calcination. Calcination results obtained from cow bones in furnaces at a temperature of 1000 °C can be observed in figure 2.

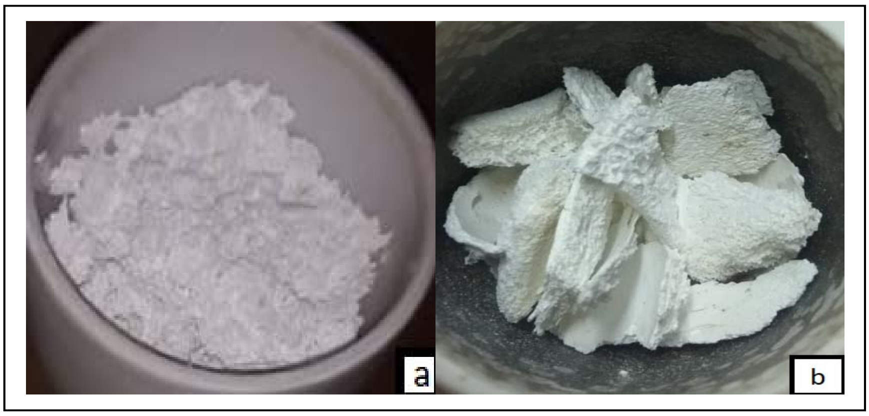


Fig. 2. CaO results in calcination of cow bones at a temperature of 1000 °C(a). For 6 hours (b). For 10 hours

From figure 2, it can be observed that the bones of cows are calcined for 6 hours and the 10 hours both produce a color change that was once a brownish gray, to a clean white color. The discoloration is an indicator of the change in compounds found in cow bones that were once $CaCO_3$ now changed to CaO. This is in accordance with previous research conducted on Malau & Adinugraha research (2020)[16]. $CaCO_3$ compounds heated at 1000 °C decay and turn into CaO. The decay event is caused by the provision of a temperature high enough to result in the release of carbon. The chemical reactions that occur are as follows.

$$CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)} \quad (1)$$

When compared to samples calcined for 6 hours and 10 hours, it can be concluded that both produce CaO compounds. But to proceed to the stage of synthesis of hydroxyapatite CaO compounds used is a CaO compound from calcination results for 10 hours. This is because the longer the sample is dikasinasi, it will produce better CaO quality [17].

3.2. Analysis of CaO Tuna Bone

Tuna bone waste that has been calcined at a temperature of 1000°C for 6 hours and 10 hours later observed changes that occur. The observed change is the difference in color before calcination with after calcination. Calcination results from tuna bones at a temperature of 1000 °C can be observedin figure 3.

From figure 3 can be observed tuna bones calcination results at a temperature of 1000 °C for a time of6 hours and 10 hours both resulting in tuna bones that have changed color from orange to brown color turned white. This white color indicates that the Tuna Bone which was originally $CaCO_3$ has been changed to CaO. This is in accordance with previous research conducted on Malau & Adinugraha research (2020). $CaCO_3$ compounds heated at 1000 °C decay and turn into CaO. The decay event is caused by the provision of a temperature high enough to result in the release of carbon.

Fig. 3. CaO results from calcination of Tuna Bone at a temperature of 1000 ^oC(a). For 6 hours (b). For 10 hours

When compared to samples calcined for 6 hours and 10 hours, it can be concluded that both produce CaO compounds. But to proceed to the stage of synthesis of hydroxyapatite CaO compounds used is a cao compound from calcination results for 10 hours. This is because the longer the sample is dikalsinasi it will produce better CaO quality (Nya Daniaty Malau, 2021).

3.3. Comparison of the Quality of CaO produced

Calcination performed at a temperature of 1000^{o}C for 6 hours and 10 hours on Cow Bone and Tuna Fish Bone which is done both produce CaO compounds this can be observed from discoloration that occurs that initially gray brownish, to clean white. If observed further then calcination is best in Cow Bone and Tuna Fish Bone is calcination with a temperature of 1000^{o}C for 10 hours, because CaO compound calcination is 10 hours more stable than 6-hour calcination compounds. In research conducted Malau (2021) found that calcination done on limestone for 10 hours proved better purity than calcination done for 6 hours. This is because the compound ($Ca(OH)_2$) formed as an impuritie of the CaO compound produced is less than the calcination result for 6 hours. The appearance of compounds ($Ca(OH)_2$) is caused by the interaction of CaO compounds produced with air. So thatit can becollected cao compounds the best calcination results and deserve to be continued to the synthesis stage is a compound that is calcined for 10 hours.

IV. CONCLUSION

Calcination performed at a temperature of 1000oC for 6 hours and 10 hours on Cow Bone and Tuna Fish Bone which is done both produce CaO compounds this can be observed from discoloration that occurs that initially gray brownish, to clean white. If observed further then calcination is best in Cow Bone and Tuna Fish Bone is calcination with a temperature of 1000oC for 10 hours, compared to 6-hour calcination compounds this is because CaO compound calcination 10 hours more stable marked by the color of the sample is increasingly clean white.

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