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Utilization of Scallop Shells (*Placuna placenta*) for Potential Water Filter Prototype in Jaring Halus Village, Jaring Halus-Langkat District and the Characterization Test

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Abstract. Indonesia is a maritime country that has abundant marine wealth. Unfortunately, most fishers still live in poor conditions, including Jaring Halus Village, Secanggang District, Langkat Regency, North Sumatra Province. Previous research has shown that there is much coastal waste, such as Scallop Shells (*Placuna placenta*), that are not treated, even though it has the potential to help people who are experiencing water crises to get clean water sources. This study aimed to characterize the shells of Scallops and produce calcium carbonate as an activated carbon product to produce clean water. The method used to characterize the mashed scallop shells is X-Ray Diffraction (XRD). In this study, three different sizes, namely 25 µm, 90 µm, and 150 µm, will be compared, and the size and quality selected to produce the best calcium carbonate were tested at different temperatures, namely 800°C, 900°C, 1000°C, and 1100°C. In the x-ray diffraction analysis test, the smallest particle is 25 µm, which has the highest intensity compared to other sizes. The best particle size, which is heated/calcined at a temperature of 1100, has the highest intensity, which can remove all impurities and produce natural calcium carbonate, which is more stable. Based on the study results, it can be concluded that the best calcium carbonate is produced from particles with a size of 25 µm which are calcined at the highest temperature of 1100°C.

Keyword: scallop shells, shell, water filter prototype.

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1 Introduction

Oyster Shell (*Placuna placenta*) is a type of shellfish that is popular in Indonesia. The abundance of Scallops in Indonesia according to the Directorate General of Indonesian Capture Fisheries (2012) is 48,994 tons. Scallops are marine animals belonging to the Class *Bivalvia* (*Phylum Mollusca*) and are known as a cheap source of animal protein and rich in essential

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amino acids. *Simping* shells contain concrete composite materials, namely carbon (32.73%), Al2O3 (14.13 %), CuO (9.22 %), CaO (34.68 %), ZnO (5.08 %) and ZrO2 (3.03 %) and MoO2 (1.13 %) [1-3].

The market demand for Scallops is always increasing. One of the fishing areas that catch a lot of Oyster Shell is the Jaring Halus village. Oyster Shell are processed as food, but the shells of Scallops, which are leftover materials from production, cause a lot of waste. Scallop processing activities produce solid waste on average 100 kg per day in Jaring Halus village.

The large amount of Oyster Shell waste produced every day requires serious strategies and efforts to handle it so that it is useful and reduces the negative impact on environmental damage. Currently, the living conditions of the people in Jaring Halus village are very concerning. People live in poverty and have difficulty in getting clean and healthy water sources. Utilization of Scallop Shells solid waste must be carried out optimally. In addition to improving people's lives, it is also to obtain clean and healthy water sources.

Oyster Shell is marine animals that contain high calcium (CaO) and are alkaline [1]. Therefore, scallop shells can be used for the management of clean and healthy water from acidic water to produce alkaline and quality water. Various studies have been carried out related to the processing of Scallop shell waste. Previous research has shown that Scallop Shells waste can be processed into products that can increase pH and the addition of the right dose of Calcium Carbonate (CaO) can produce drinking water according to water quality standards. Before adding calcium from the that Scallop Shells, the water had an acidic pH, low electrical conductivity, and high turbidity values for BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand), and TSS (Total Suspended Solid). The greater the addition of scallop shells, the higher the pH, turbidity, and conductivity as well as lowering BOD, COD, and TSS so as to achieve the optimal dose [4-6].

In this study, the use of Scallop Shells (*Placuna placenta*) will be made into possible products, for example as activated carbon and calcium carbonate apatite (Hydroxyapatite) which serves as a water filter media material for the disposal of heavy metals in competition, as well as improving drinking water quality. However, in this study, it is still in the analysis stage of its potential use, namely the synthesis and characterization test of the potential of scallop shell flour into calcium carbonate products. Based on the results of the previous research, it is known that Scallop Shells powder can work as an environmentally friendly alternative adsorbent that can neutralize heavy metals [7-9].

Based on the description above, this research will be held to utilization and characterization of Scallop shells that have the potential for water filtration processes in Jaring Halus Village, Secanggang District, Langkat Regency, North Sumatra Province.

2 Methods

The research was conducted from April to October 2020 in Jaring Halus village, Secanggang Langkat District, North Sumatra. The tools used in this research are blender, analytical balance (Sartorius), mixer, sample plastic, cutting board, pliers, beaker glass, measuring cup (Pyrex), Petri dish, stirrer, stainless steel pan, stainless steel knife, gas stove, oven, 5 kg scale and mercury thermometer (0-100°C).

The material used is scallop shell powder from the Jaring Halus village of Secanggang District, Langkat Regency. The scallop shells that have been removed are cleaned and then cooled with 500 mL of air solution for 1 kg of scallop shells for ± 1 hour at a temperature of 100°C. After cooling the Scallop shells are dried again and dried for one day in the sun. After that, the scallop shells are mashed by pounding using a pestle until smooth. Smooth scallop shells then sifted. Scallop shell powder measuring 25 μm, 90 μm, and 150 μm will be tested and characterized using X-Ray Diffraction. X-Ray Diffraction is a method used to characterize a material. The characterization uses X-Ray Diffraction analysis which is used to determine the grain/particle size, identify the structure and size of a crystal. Three particle sizes will be selected which produce the best calcium carbonate which will be tested at different temperatures, namely 800°C, 900°C, 1000°C, and 1100°C.

3 Result and Discussion

People who work as fishermen in Jaring Halus Village, Secanggang District, Langkat Regency, North Sumatra Province live in poverty. Every day, the community in this village produces solid waste, the rest of the processing of Oyster Shell an average of 100 kg per day. Currently, the Scallop Shells solid waste in Jaring Halus village has not been processed and requires serious handling so as not to have a negative impact on the community in the environment. In this study, the Scallop Shells will be characterized and utilized for its potential as a water filter so that the community in Jaring Halus village can get a source of clean and healthy water.

In this study, Scallop Shells were crushed and sieved to obtain three particle sizes, namely 25 μm, 90 μm and 150 μm. Each scallop particle was characterized using X-Ray Diffraction. X-Ray Diffraction is a method used to characterize a material. Characterization using X-Ray Diffraction analysis is used to determine the grain/particle size, identify the structure and size of a crystal.

In this study, the Scallop Shells which was mashed in the form of flour could crystallize well. All peaks of the X-Ray Diffraction pattern were identified as calcium carbonate. X-ray diffraction of 25 μm, 90 μm and 150 μm sitting shell powder from calcium carbonate can be seen in Figure 1.

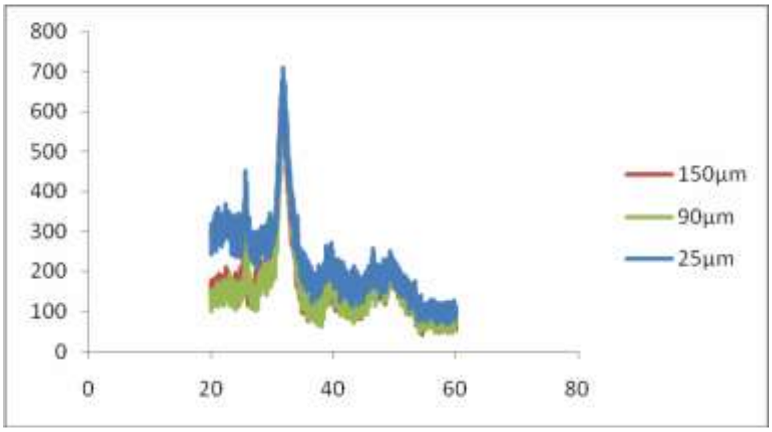

Figure 1. X-Ray Diffraction X graph of 25 μm, 90 μm, and scallop shell powder 150 μm before being calcined at various temperatures.

Based on Figure 1, it is known that the sample with a size of 25 μm has the highest intensity compared to other sizes, namely 90 μm and 150 μm. Next, the sample with the highest intensity was selected to be heated at a temperature of 800°C - 1100°C.

In Figure 2, there is an X-Ray Diffraction Spectrum from Scallop Shells with standard calcite peaks conducted by Li and Ortiz. [10-12].

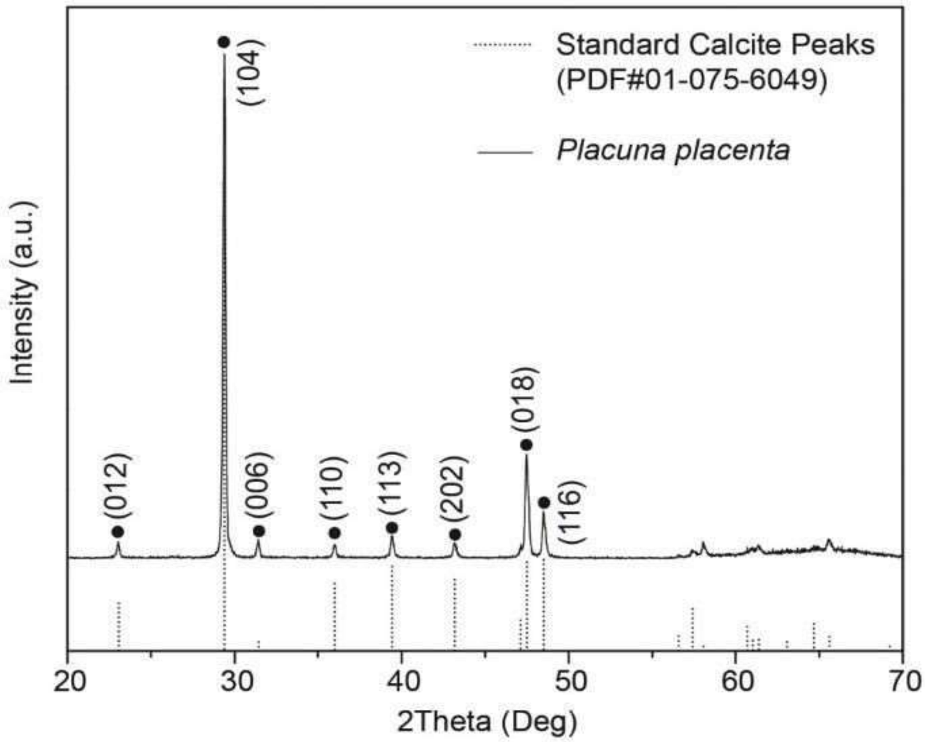

Figure 2. XRD (X-ray diffraction) spectrum of Scallop shell with calcite peak standard [4]

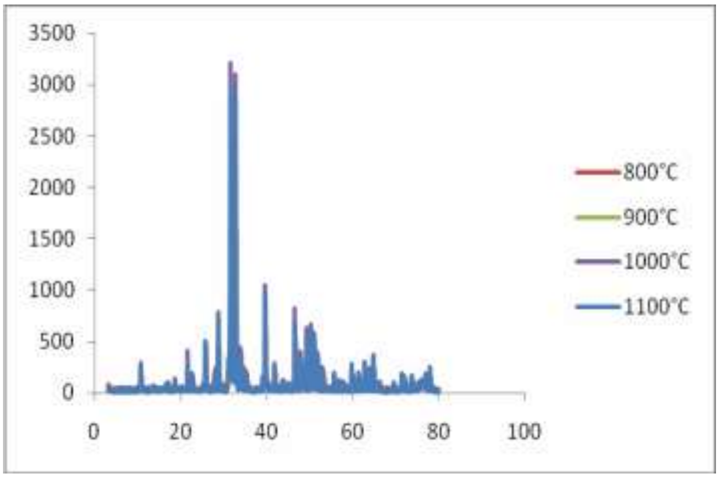

Figure 3. X-ray diffraction graph of 25 μm calcined at different temperatures

Figure 3 shows the X-ray diffraction pattern of the scallop shell heated at various temperatures, namely 800°C, 900°C, 1000°C, and 1100°C. From the results of the x-ray diffraction analysis above, it is seen that there is a gradual increase in crystallization in the particle size of the calcium carbonate crystals associated with an increase in temperature with the given heat treatment. The scallop shell powder produced in this study began to recrystallize at a temperature of 800°C without breaking it down into other compounds from the calcium carbonate family.

In this diffraction pattern, it is also seen that there is a gradual increase in the degree of peak sharpness with increasing temperature. From the graph, it can be seen that the sample with a temperature of 1100°C has the highest intensity compared to other temperatures. Meanwhile, calcination at 1100°C was detected to have small impurities and was most suitable for producing the best hydroxyapatite.

The results of the XRD analysis showed the presence of other hydroxyapatite phases such as $CaCO_3$ and $Ca(OH)_2$. According to the researchers, the calcium content of the three different samples and the highest was owned by particles measuring 25 μm with a temperature of 1100°C. These results confirm the previous discussion regarding the effect of heat treatment temperature on the crystal size of calcium phosphate. When the scallop shell is heated gradually from 800°C to 1100°C, there is a macroscopic (i.e. color) change and a microstructural change which includes recrystallization of the scallop mineral.

4 Conclusion

In this study, three different particle sizes were compared, namely 25 μm, 90 μm, and 150 μm which were tested at different temperatures, namely 800°C, 900°C, 1000°C, and 1100°C. In the x-ray diffraction analysis test, the smallest particle, which is 25 μm, has the highest intensity compared to other sizes. The best size which is heated/calcined at a temperature of 1100°C has the highest intensity. Based on the results of this study, it can be concluded that the particle size and the highest temperature that produces the best calcium carbonate is the size of 25 μm which was tested at the highest temperature of 1100℃.

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