CHARACTERIZATION OF NANOPARTICLES FROM Polymesoda Erosa CLAMSHELL POWDER FOR MATERIAL APPLICATION

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ABSTRACT
Composite materials are materials that are made of two or more materials that remain separate and differ on a macroscopic level while forming a single component so as to produce a composite material that has different mechanical properties and characteristics from the material it forms. Particle composite materials consist of particles held together by a matrix. In this study, an epoxy resin matrix was used with Polymesoda erosa clam shell nanopowder filler. Nano-sized fillers have many advantages over macro-sized ones. The nano-sized particles will have a high surface area, thereby increasing the mechanical strength of the material. The powdered nanoparticles produced will be analyzed using Fourier Transform Infrared (FTIR), Transmission Electron Microscope (TEM), and Scanning Electron Microscope (SEM). Based on the results of SEM and TEM, the nanopowder of clamshell has a size below 100 nm. The FTIR results of the powdered shellfish showed the presence of carbonate bonds C-O, C=O, and Ca-O.
Keywords: Composite, Clam Shell, Nanoparticle, Polymesoda Erosa, TEM.

INTRODUCTION
In recent years, polymer composites have had a special appeal due to their valuable use in the automotive, shipping, sports equipment, and electronics industries. Composite materials are used instead of steel and ceramics to benefit from their flexible design, low cost, and light mass. In addition, polymer composites also have good specific properties, a low coefficient of thermal expansion, and good resistance and strength. Polymer is a commonly used matrix material because of its clear scope for enhancing its mechanical properties. To increase the strength of the polymer, a reinforcing material is used. Fiber is one of the reinforcing materials used in polymers. In addition, metal and non-metallic powders are also often added to polymer blends, such as clamshells, palm fruit fiber, eggshell powder, and snail shell powder. One of the polymers that are often used as a matrix in making composites is epoxy. Epoxy is a thermosetting polymer formed by the reaction of epoxy resin and amino hardener. Epoxy resin is a good chemical compound that is resistant to corrosion, has strong adhesive properties, low traction, and a relatively low price, so it is widely used in various applications. However, it is very unfortunate that these clamshells are a waste product that is still rarely used. Seeing such great potential, it is necessary to look for more uses for the clamshells, such as their use as a filler in composite boards. This research is intended to maximize the use of Polymesoda erosa clamshell as a filler in composite boards. The reason for choosing this Polymesoda erosa is not only to maximize its use as a filler in particleboard but also because it contains high calcium carbonate, making it suitable for improving the mechanical properties of particleboard.

EXPERIMENTAL
Material and Chemical Preparation
Raw material for Polymesoda erosa clamshells as raw material was obtained from various places around Medan, North Sumatera, Indonesia. Nanoparticle sizing was conducted at the Chemical Engineering Operation Laboratory and Chemical Industrial Process Laboratory in the Department of Chemical Engineering, Universitas Sumatera Utara, Indonesia.

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Methods and Characterization

The *Polymesoda erosa* clamshells were washed until clean, then dried under sunlight for one week. These shells are manually smashed to reduce their size. To obtain a smaller size, the clamshells are milled with a ball mill for 4 hours until the shells become powder. Then sieved using a 200 mesh sieve. The result of the sieve was calcined using a furnace at a temperature of 700 °C for 4 hours. Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), and Fourier Transform Infrared (FTIR) were used to examine the morphological properties of *Polymesoda erosa* clam shell nanoparticles.

RESULTS AND DISCUSSION

Characterization of Nanoparticle using SEM (Scanning Electron Microscope)

The purpose of the SEM characterization of powdered clam shell nanoparticles is to examine the particle size and morphology of the nanoparticles produced. Meanwhile, nanoparticle characterization using SEM aims only to determine the morphology of clamshell nanoparticles. The results of the characterization of clamshell nanoparticles are shown in Fig.-1 in macro terms, however, the presence of nanoparticles in the sample is still unclear.

![Fig.-1: Characterization of Nanoparticles using SEM](image)

Characterization of Nanoparticles using TEM (Transmission Electron Microscope)

The characterization of the powdered clam shell nanoparticles using TEM aims to characterize the microstructure of the clamshell nanoparticle. Fig.-2(a) at the macro level shows variations in the size of the powdered clam shell nanoparticles with a reference particle diameter of 500 nm. It appears that the majority of the particle diameter sizes are below 500 nm. Fig.-2(b) at a micro-level shows the variation in the size of the powdered shellfish nanoparticles with a reference particle diameter of 100 nm. It can be seen that the diameter of the nanoparticles is even below 100 nm. According to Kuswandi (2017), the size of the nanoparticles is usually between 1-1000 nm.

![Fig.-2: Characterization of Nanoparticle using TEM by the Size of (a) 500 nm (b) 100 nm](image)

Characterization of Nanoparticles using FTIR (Fourier Transform InfraRed)

TEM is used to determine the functional groups and changes in functional groups of the materials or compounds used in the powdered clam shell nanoparticles. The characterization of the nanoparticle was
done in this discussion. In Fig.-3, it can be seen that the sharp peak at 1450 cm\(^{-1}\), which is the absorption peak, corresponds to the symmetrical strain vibration of C-O carbonate.\(^{11}\) The absorption peaks at 1650 cm\(^{-1}\) and 2350 cm\(^{-1}\) correspond to the symmetrical strain vibration C=O. Two peaks at 950 cm\(^{-1}\) and 875 cm\(^{-1}\) correspond to the bending vibrations of the carbonate C-O bond. After calcination, calcium carbonate thermally breaks down into calcium oxide and loses carbonate. Thus, it causes a decrease in the characteristic peaks of carbonate in the IR spectrum of the synthesized calcium oxide. It reduced the intensity of the corresponding carbonate absorption bands seen at 2200 cm\(^{-1}\), 1650 cm\(^{-1}\), 1450 cm\(^{-1}\), 920 cm\(^{-1}\), and 800 cm\(^{-1}\) on the IR spectrum of calcium oxide from the shells. The sharp peak of about 500 cm\(^{-1}\) in the infrared spectrum corresponds to the Ca-O functional group of the shellfish nanopowder. The peak intensity of Ca-O decreases as calcium carbonate decomposes to calcium oxide.\(^{11}\) The absorption band in the range of 3651-3870 cm\(^{-1}\) in the infrared spectrum corresponds to the hydroxyl groups. The peak of the hydroxyl group absorption usually comes from the presence of calcium hydroxide. Calcium hydroxide is formed when a hydroxyl group is present as a result of atmospheric moisture absorption during FT-IR analysis. Because the compounds are highly hydrophilic, this phenomenon is common.\(^{12}\)

![Fig.-3: Characterization of Nanoparticles using FTIR](image)

**CONCLUSION**

Nano-sized fillers have many advantages over macro-sized ones. The nano-sized particles will have a high surface area, thereby increasing the mechanical strength of the material. The process of making Polymesoda erosa clam shell nanoparticles involves one main process, namely calcination. Based on the results of SEM and TEM, the nanoparticle had a size of under 100 nm. The FTIR results of the nanoparticle show the presence of carbonate bonds C-O, C=O, and Ca-O.

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