The characteristics of membrane chitosan from *Mytilus sp* and potential used in water treatment

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Abstract. The membrane is one of the effective separation technologies used in water treatment. The membranes from natural materials an alternative eco-friendly. One of the membranes used in water treatment is a chitosan membrane. This study aims to produce membranes from green mussel shells (*Mytilus sp*), beginning with making chitosan and characterizing chitosan. Chitosan was produced from No and Meyers method with some modification through 3 subsequent processes i.e. deproteination, demineralization, and deacetylation. Chitosan characteristics affect the ability of chitosan to become a membrane. Chitosan characterization includes the degree of deacetylation and molecular mass. The characteristics of chitosan are the degree of deacetylation was 88.23% and the analysis of FTIR on chitosan which has a functional group of NH and OH. The results of the characterization of the chitosan membrane obtained can be used as a reference in determining the optimum concentration of chitosan membranes in water treatment.

1. Introduction

The research has been done related to the potential use of green mussel shells (*Mytilus viridis Linnaeus*) as the raw material of chitosan for water treatment by Sinardi et al [1]. The characterization of chitosan-based functional groups showing amine and hydroxyl groups on the molecular structure of chitosan could potentially be used in water treatment.

Previous research related to the potential use of green mussel shells as a raw material for chitosan for water treatment in Sinardi et al [1]. The use of the chitosan membrane to reduce chemical oxygen demand (COD) and biological oxygen demand (BOD) of palm oil liquid waste was also successfully carried out by Wahyuni et al [2]. Current research on the use of green mussel shells as chitosan membrane raw material, wherein general chitosan membrane raw material comes from shrimp shells. Discovered the characterization of the chitosan membrane which can be used as a membrane to set aside turbidity in water treatment. Membrane filtration is a separation technique two or more components without the use of heat. These components will be separated based on the size and shape of the particles with the help of pressure and semi-permeable membrane [3].

One type of membrane used for the filtration process is cellulose chitosan membrane type. Chitosan is one of the materials most widely used as a membrane material because it can form the film, processing, and easy availability of abundant [4]. For example, membranes have been used in desalination [5,6].
2. Methodology

2.1. Materials
Shell materials were obtained from the wastes of green mussel shells, which were collected from Indonesian, 80 mesh crushed shells each one as much as 100 gr.

2.2. Preparation of chitosan
Chitosan extracted by adopt Knorr method [7] with some modifications. The Deproteination step was carried out with 3,3% NaOH 1:10 (w/v) at 65oC for 2 h, washed with deionized water to neutral pH, and dried at 60oC for 24 h. Demineralization with 1 N HCl 1:15 (w/v) at 50oC for 30 s, washed with deionized water to neutral pH, and dried at 60oC for 24 h. Deacetylation process with chitosan was prepared by alkali treatment of chitin using 60% NaOH 1:20 (w/v) in distilled water at 120oC for 1 h. The reactants were filtered, washed with deionized water to neutral pH, and dried at 80oC for 24 h.

2.3. The characteristic of chitosan

2.3.1. Degree of Deacetylation. The DD of chitosan was determined by a form infrared (IR) spectrum using the Fourier Transform Infrared (FTIR) spectroscopy. Chitosan samples prepared in the forms of KBr disk was prepared according to the method of Sabnis and Block [8]. Approximately 1 mg of chitosan powder and KBr 1% w/w mixture was then pressed to form pellets. The pellets of KBr have obtained footage and put into place the IR absorption spectra recorded the absorbance at 4000-650 cm\(^{-1}\). The DD of the chitosan samples was calculated using the standard method.

The hydroxyl group was the absorbance at 3450 cm\(^{-1}\) and the amide group was the absorbance 1655 cm\(^{-1}\). The DD of the chitosan samples was calculated using the following equation:

\[
%DD = \left[ 1 - \left( \frac{A_{1655}}{A_{3450}} \times \frac{1}{1.33} \right) \right] \times 100% \tag{1}
\]

Where \(A_{1655}\) was the absorbance at1655 cm\(^{-1}\) for the amide group and \(A_{3450}\) was the absorbance at 3450 cm\(^{-1}\) for the hydroxyl group.

3. Results and discussion
The results of this study are expected to provide information related to the utilization of waste of green mussel shells as raw material for the preparation of chitosan and made into membrane potential. Characteristics of chitosan, which are crucial to the membrane properties which can be used in the water treatment filtration process. According Xu et al [9] that chitosan, a relatively in biomaterial with film-forming ability, has been rapidly recognized for its potential in separation and purification technology in recent decades.

The process of chitin deacetylation enzymatically yields chitosan powder, brown color of 68gr. The use of enzymes in the deacetylation process results in more acetyl group disconnection, by the statement of Natsir et al [10] that substrate degradation results by enzymes in chitin are then used as an alternative source of nutrients in the deacetylation process. The DD of chitosan is obtained at 88.23% and the NH and OH functional groups contained in chitosan are active compounds that can be used in water treatment.

The results of SEM (Scanning Electron Microscope) photo recording chitosan visible surface of a small plate-shaped, stacked, and formed a crystal arrangement. This indicates that chitosan has a large surface area and effect to apply in water treatment because it increases the collision between chitosan with particles in water.
Figure 1. Results of FTIR of chitosan green mussel shells.

Figure 2. SEM results of chitosan green mussel shells.
The membranes are made of good quality raw materials such as chitosan and have the ability to skip a component easily and quickly than other components. It was proposed by Meriatna [11] that chitosan is a natural polymer having a structure similar to cellulose that can be formed into thin films.

Chitosan of green mussel shells has a characteristic that made the membrane potential to be used in water treatment. Some research has been done Kusumawati and Tania [12] illustrate that chitosan membranes have the ability as an ultrafiltration membrane to separate the dye rhodamine B with tension and power characteristics of high tensile strength with increasing concentrations of chitosan. The other study by Setiawan et al [3] concluded that the higher the concentration of chitosan, the greater the power value of tension and stretch the membrane and membrane permeability values will decrease.

This study is expected to provide alternative uses for waste green mussel shells as raw material for the chitosan membrane, thereby reducing the accumulation of solid waste that could potentially cause environmental pollution.

4. Conclusion

The chitosan from green mussel shells potential to make membranes for filtration processes in water treatment because it has a high degree of deacetylation and the functional group NH and OH.

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