COMPARISON OF UTILIZATION OF CLAMSHELL, RICE HUSKS, COCONUT CHOIR AS RAW MATERIAL MAKING OF MEMBRANES FOR SEA WATER DESALINATION

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ABSTRACT

Clamshell, rice husks, and coconut choir can be used as raw material for making membranes because they contain silica which is acted as main material. Membranes from clamshell, rice husks, and coconut choir can be used for sea water desalination. The objectives of the study were to determine the degradation of chlorida with clamshell, rice husks, and coconut choir as membrane material and to know the optimum flux (ml/cm^2.min) for the manufacture of silica membrane with 15 grams weight of membrane and 600 rpm. Membrane-making techniques using phase inversion technique and sintering. Membrane structure testing was done scanning electron microscope (SEM) energy dispersive x-ray (EDX) spectroscopy equipment. The results showed that 15 grams of membrane mass with 600 rpm velocity resulted 66,67% in optimum chloride rejection (R) with membrane material from coconut choir, since membrane material from rice husks was 61,08% and clamshell as membrane material was 53,87% optimum chloride rejection with same operation peak time 90 minute. The average flux optimum was 0, 48 ml/cm^2.min with rice husks as membrane material, then 0, 36 ml/cm^2.min with clamshell as membrane material and followed by 0, 22 ml/cm^2.min with membrane material from coconut choir. The presence of Si also can be detected from SEM EDX spectrophotometry equipment and might be affected to rejection and flow rate of clamshell, rice husks, and coconut choir as membrane material.

Keywords: silica, membrane, chloride.

1. INTRODUCTION

Drinking water is the basic human need most important for the survival and quality of human life, but not all regions have good water resources. The coastal areas and small islands in the middle of the high seas are very poor areas of clean water sources, resulting in the problem of meeting the needs of drinking water. The water resources in the area are generally of poor quality, such as brackish or salty ground water. Therefore, it is necessary technology capable of converting sea water into fresh water known as desalination process so that water can be consumed (Damayanti *et al,* 2010). One of the seawater desalination technologies is using of membrane technology. Membrane is a selective separator and has the ability to inhibit mass transfer rates that are specific to each chemical component (Damayanti[a] *et al,* 2011; Damayanti[b] *et al*., 2011). Generally membranes can be made from organic polymeric materials and inorganic compounds. However, most of the materials that are often used to make membranes are organic polymer materials because of their relatively simple manufacturing processes (Mulder, 1996). Membrane technology is relatively expensive because it requires a large amount of energy, expensive support equipment and high operational costs so that it needs to be made a membrane of basic material cheap and abundant presence in Indonesia, the membrane with raw materials shells. For coastal communities, the manufacture of nanopore silica membranes from seashell can be a solution because it is capable of converting sea water into fresh water with high salinity.

The advantage of membrane use is also in waste treatment operations that do not require too much energy because it does not involve phase change and less energy use in the form of heat so that the components in it can be maintained. In this study rice husks was used as a source of silica.

Silica is one of the important functional materials with wide application in various branches. Until now, most of the technology utilizes silica to improve colloidal stability of various particles (Nizami and Iqbal, 2001). One stage of membrane production is by means of centrifugation to obtain precipitated silica. The speed of the centrifuge is very influential on the density of silica precipitate (Chowdury *et al*., 2006). SiO_2 is a basic material membrane of 0.001 μm and is able to withstand particles of 50-1000 Da (Malli and Till, 2003). Based on the aforementioned matters, the idea arises from the use of silica from clamshell, rice husks, and coconut choiras a sustainable water purification membrane material for coastal communities.

2. RESEARCH METHODOLOGY

2.1 General

In this research will be tested the effectiveness of clamshell, rice husks, and coconut choir as raw material of marine water purification membrane with treatment given is variation of centrifuge speed and weight of silica. The parameters observed were salinity (Cl^-). Variations made in this research are silica mass variation and speed centrifuge. The resulting membrane in this study belongs to the category of nano pore membranes that separate solvents, monovalent, and small organic salts from divalent ions and larger species (Chowdurry *et al,* 2006).

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This research was conducted laboratory scale with batch system. Membrane characterization was analyzed using Fourier Transform Infrared (FTIR). This study used 15 grams of membrane mass with 600 rpm velocity from others study (Damayanti[a] *et al*., 2013; Damayanti[b] *et al*., 2013; Damayanti *et al*., 2016).

2.2 Silica synthesis

The synthesis of silica from mussel shells was done by using the proliferation technique. Drying process with oven at 120oC for 24 hours. The ascending process is done to find out the ash content. The spraying was done by furnace at 600°C for 30 hours for the shell and for 5 hours for ice husk.

3. RESULTS AND DISCUSSIONS

3.1 Chloride Rejection (%) of membrane material from clamshell, rice husks, and coconut choir

The results of calculation and rejection coefficient graph (R) can be seen in the following different membrane material from clamshell, rice husks, and coconut choir can be seen as follows in Figure-1.

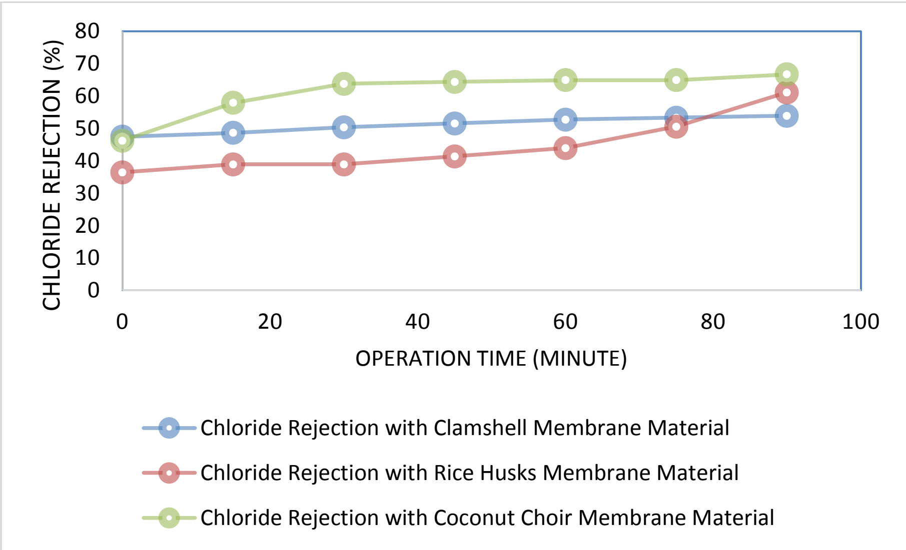

Figure-1. The comparison rejection, R (%) of many membrane materials from clamshell, rice husks, and coconut choir.

The results in Figure-1 showed that 15 grams of membrane mass with 600 rpm velocity resulted 66,67% in optimum chloride rejection (R) with membrane material from coconut choir, since membrane material from rice husks was 61,08% and clamshell as membrane material was 53, 87% optimum chloride rejection with same operation peak time 90 minute.

Figure-1 also showed that the value of chloride rejection coefficient increasingly longer. Starting at 0 min for each variation of membrane material respectively continued to increase until 90 minutes. Maximum rejection value (%) achieved at a variation of 600 rpm centrifuge speed was66, 67% for 90 minute with membrane material from coconut choir. Compare with other study, cellulase acetate from water hyacinth (*Eicchornia crassipes*) as membrane material can do chloride rejection up to 28% (Damayanti and Daia, 2017) and zeolite membrane material can do turbidity rejection with laundry waste water up to 90% (Damayanti *et al*., 2016).

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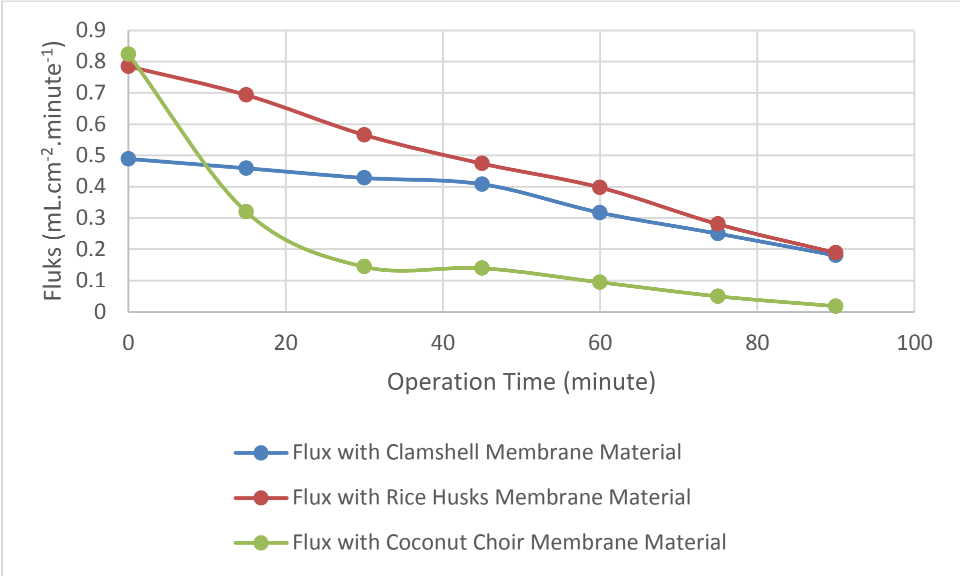


Figure-2. The comparison flux (mL.cm^{-2}.minute^{-1}) of many membrane materials from clamshell, rice husks, and coconut choir.

The results showed, different with rejection, at the beginning the highest flux reached from coconut choir membrane material was 0.82 mL.cm^{-2}.minute^{-1}followed by rice husks membrane material was 0.78 mL.cm^{-2}.minute^{-1}then lastly clamshell membrane material 0.48 mL.cm^{-2}.minute^{-1}at 0 minute operation time. But after 90 minute, rice husks membrane material has been shown the highest flux was 0.19 mL.cm^{-2}.minute^{-1} followed by clamshell was 0.18 mL.cm^{-2}.minute^{-1} and lastly coconut choir membrane material 0.018 mL.cm^{-2}.minute^{-1}. In average, the highest performa has been showed by rice husks membrane material was 0.48 mL.cm^{-2}.minute^{-1} followed by clamshell membrane material was 0.36 mL.cm^{-2}.minute^{-1} then lastly coconut choir membrane material was 0.22 mL.cm^{-2}.minute^{-1}.

3.2 Testsof Silica Membrane Structure by using Scanning Electron Microscope (SEM) energy dispersive x-ray (EDX)

This study follows showed SEM EDX images from clamshell, rice husks, and coconut choir can be used for sea water desalination.

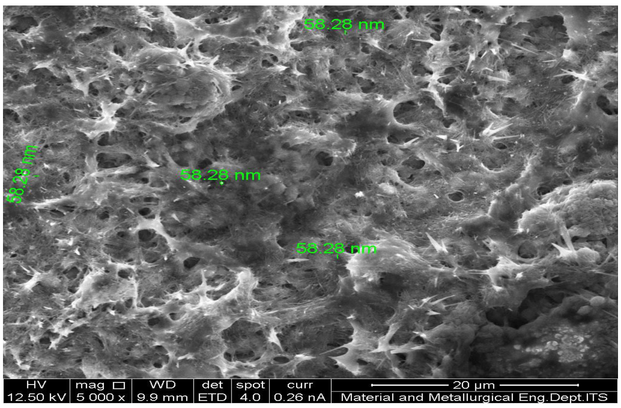


Figure-3. SEM EDX membrane from clamshell material.

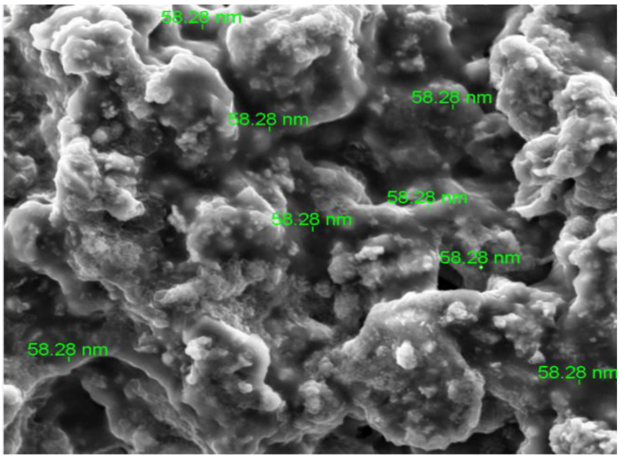


Figure-4. SEM EDX membrane from rice husks material.

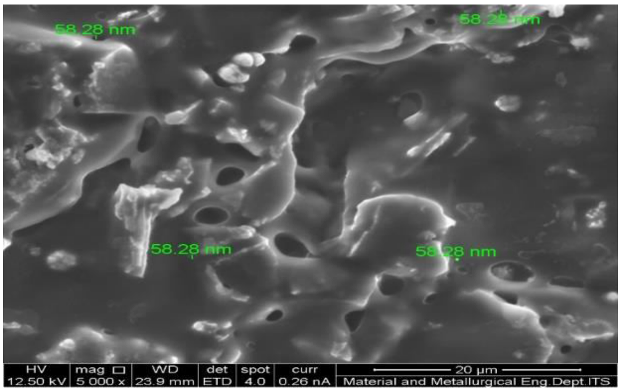
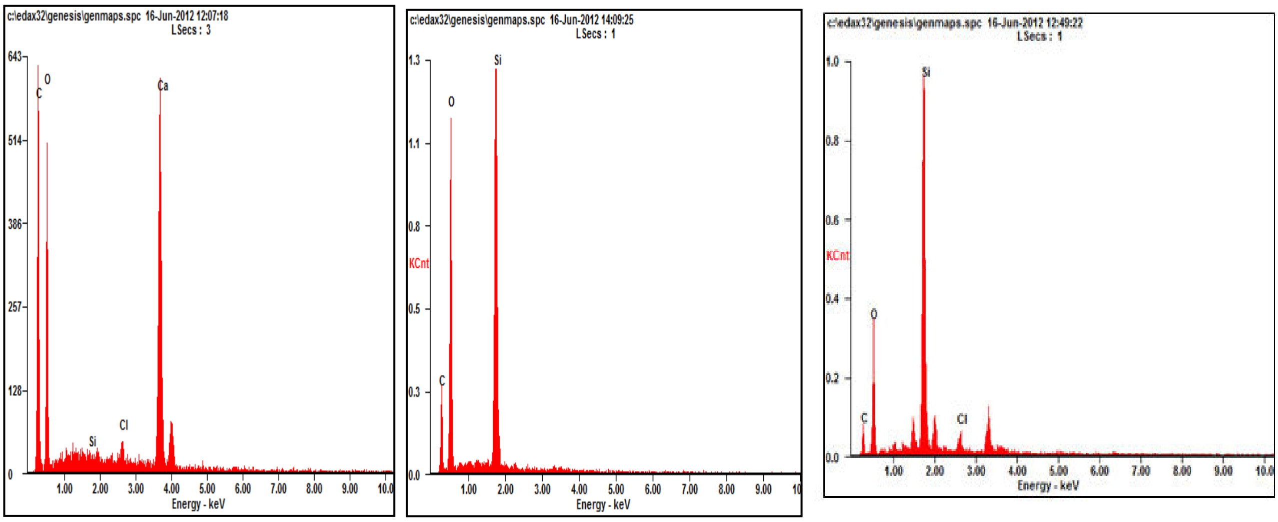


Figure-5. SEM EDX membrane from coconut choir material.

Based onfigures (Figure-3, Figure-4, and Figure-5) show some functional groups in the sample. The average of pore size of three figures were about 58 nm.



(a) (b) (c)

Figure-6. Diafractogram membrane material clamshell (a), Diafractogram rice husks (b), Diafractogram coconut choir (c).

Figure-6 can be seen that the presence of Si also can be detected from SEM EDX spectrophotometry equipment from three membrane material, membrane material from clamshell (a), Diafractogram from rice husks (b), Diafractogram from coconut choir (c). The maximum quantity Si showed by membrane material from rice husks, followed by membrane material from coconut choir then lastly followed by membrane material from clamshell which might be affected to rejection and flowrate, Flux of material.

4. CONCLUSIONS

Optimum rejection value, R (%), from 15 grams of membrane mass with 600 rpm velocity resulted 66,67% with membrane material from coconut choir, since membrane material from rice husks was 61,08% and clamshell as membrane material was 53,87% optimum chloride rejection with same operation peak time 90 minute. The average flux optimum was 0,48 ml/cm^2.min with rice husks as membrane material, then 0,36 ml/cm^2.min with clamshell as membrane material and followed by 0,22 ml/cm^2.min with membrane material from coconut choir. The presence of Si also can be detected from SEM EDX spectrophotometry equipment. The maximum quantity Si showed by membrane material from rice husks, followed by membrane material from coconut choir then lastly followed by membrane material from clamshell which might be affected to rejection and flow rate, Flux, of clamshell, rice husks, and coconut choir as membrane material.

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