The Ability of *Avicennia Marina* in Decreasing Salinity and COD Levels in the Bio-Desalination Process

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Abstract: ***The increasing of residents and increasingly rapid knowledge of technology, the more people demanded it to meet their needs, especially the need for clean water. The worsening quality of clean water has resulted in a reduction in the supply of clean water that was naturally available in the universe. It has been a matter of peerage technology that helps in dealing with the crisis of clean water but leaves a million problems that cause other natural damage, it was necessary to initiate clean water treatment which later would not cause losses or concentrated waste which can damage the natural environment. Bio-desalination using Avicennia marina plants was one of the alternative choices in seawater processing that does not cause concentrated waste where the salt content contained in water would be physically absorbed into plant tissue in a passive transport method. The purpose of this experiment was to determine the ability of Avicennia marina plants for decreasing salinity and COD by bio desalination processes in a reed bed system reactor with batch operation system. The desalination process using Avicennia marina plant has been proven to reduce salinity levels relatively quickly where the ability of the plant for 14 days can reduce salinity. The results showed that the reduction salinity reached 54.74 % at an initial salinity concentration of 15 ‰ by Avicennia marina, and it reached 48.98% at an initial salinity concentration of 25 ‰. The reduction of COD in desalination process using Avicennia marina were 87.55 % and 16.80 % at an initial sanility concentration of 15 ‰ and 25 ‰, respectively. In conclusion, Avicennia marina has a potential to be used in bio-desalination in a reed bed system reactor.***

Keywords: Bio-Desalination, *Avicennia Marina*, Salinity, COD

1. Introduction

One method for obtaining fresh water from water can be conducted done by distillation. Distillation was done conducted by evaporating seawater, condensing the steam and accommodating the fresh water. While The desalination method was to distribute salt in the sea air. Desalination can be done carried out by deionizing air, reverse osmosis and ash charcoal filters. These methods require considerable costs and large amounts of energy. Another alternative was to use plants that can desalinate the sea water.

Although the current water desalination method can provide fresh water, desalination was becoming more controversial because the hazardous environment includes high water and highly concentrated wastewater. For millions of years, microorganisms, adaptation experts, have survived on earth without excessive use of energy and resources or the use of the surrounding environment.

This has prompted researchers to try to use biological processes for sea air and this field has been developed exponentially since then. Here, the term bio-desalination was offered to complement all techniques that have roots to produce fresh air from a salt solution. In addition to discussing and categorizing the bio-desalination process for the first time, this discussion also reveals unexplored were as of research in bio-desalination that have the potential to be used in air treatment [1].

Mangrove plants can reduce salt levels in the water. This desalination process was carried out to maintain the salt balance in the plant. The increasing levels of chloride ions in the mangrove tissue occured during this process. Increases occur in the root tissue of all mangrove plants [2].

The use of the phytotechnology concept for the purpose of desalination of seawater / brackish water was a technological concept that has not been widely understood. Bio-desalination reactors which adapt from reedbed systems commonly used in constructed wetlands (CWs). The CW system was a phytotechnology for managed air treatment. The main advantage of this CWs system was simple construction. The process that occurs was a combination of biological, physical and chemical processes. How much the ability of the bio-desalination reactor with this reedbed system does not require much research to get the desired results.

This research was carried out with a reed bed system by combining mangrove plants with free water surface in an artificial reactor for laboratory scale testing. The aim of the research was to determine the reduction of salinity and COD level in bio-desalination process using a reed bed system reactor with batch system operation.

2. Material and Methods

This research uses *Avicennia marina* plants or commonly called fire-fire trees and also artificial saline water made from a solution of NaCl pro analysis (Merck, Germany). The preparation stage was divided into 3 stages, the first stage was preparing the a reed bed system reactor and the second stage was preparing plants and the last stage was arranging the reactor.

The first stage of saline water solution was obtained from the pro-analysis NaCl which was dissolved with aquadest with concentrations of 15 ‰ and 25 ‰. Where at a concentration of 15 ‰ needed 105 gr NaCl /reactor and 25 ‰ needed 175gr NaCl /reactor.

Then each reactor was filled with gravel. The bottom layer was gravel with diameter of 2 cm and the high of gravel layer was 5 cm. After then, the layer filled with 2 L of water. Second layer, the gravel with a diameter of 1 cm and the high of layer was 5 cm. The saturated water in second layer was 1.8 L. Finally, the upper layer was fine sand as high as 10 cm with 3 L of water.

The second stage was to prepare mangrove plants by separating each type of mangrove and then cleaning it by washing the remaining mud attached to the roots, then acclimatizing it using saline water for 24 h.

The last stage of the mangrove plant was planted as deep as 10 cm along the roots to the stem, then given saline water up to 10 cm high and acclimatization for 24 h and glucose solution to obtain COD 250 levels. Next, test the measurement stage on day 0 in the sample in the inlet and outlet, and continued with sampling every 2 days.

3. Result and Discussion

This experiment was carried out for 14 days using *Avicennia* plants and salinity solutions with different initial concentrations of 15 ‰ and 25 ‰. The results of this experiment indicated that the *Avicennia marina* plants can reduce salinity levels in both concentrations. Salinity was one of the parameters in determining water quality, both surface water and groundwater. Salinity was the level of salinity or the level of dissolved salts found in water in salt per sea water.

According to [3] classification or classification of the salinity level of samples for salinity parameters was divided into the following:

- Fresh water with a value <0.5 ‰,
- Brackish water with salinity ranges from 0.5 ‰ - 30 ‰,
- Salt water 30 ‰ - 50 ‰and
- Very salty water or sea water has a salinity of more than 50 ‰.

The results showed that the entire sample was still limited to the brine water area, and the optimal point of the decrease in salinity was on 0 – 4 day. The previous experiment was usually done for 12 weeks but the researcher took 14 days. Because to know the fastest optimal time from the ability of these plants

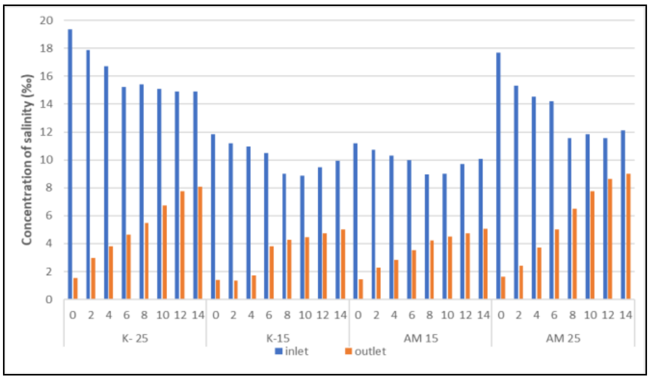

Figure 1: Result of the decreasing of salinity

This experiment compared the concentration of high brackish (25 ‰) and low brackish (15 ‰) without *Avicennia marina* plant as control treatment and also with *Avicennia marina* in a reed bed reactor to reduce salinity and COD level. Based on **Figure 1,** it was explained that *Avicennia marina* gives a high response to the decrease in salt levels in water and an increase in salinity in plants, this indicates that the bio-desalination process at saline water content occurs in the initial stages. Flowers et al. [4] reported that in the early stages of adaptation to high salinity or an increase in salinity when an increase in the salt concentration in a liquid takes place, the ion uptake rate was related to the rate of growth of the plant. In the process, mangroves take salt as nutrients as their growth needs.

The results of a salinity decreasing in plants showed a decrease in salinity in the entire sample tested. This showed the occurrence of the bio-desalination process in saline water. The highest decrease in salinity levels occurred in the first 4 days, while in the following days fluctuations occurred due to differences in environmental factors that occur every day, where some environmental factors that affect were the temperature in the water which can have an effect on the solubility of dissolved substances in the water, then plant type factors.

Whereas the control sample found a decreasing in salinity levels even without the plants being given, this was caused by physical process factors of filters which were composed of gravel and sand. So as long as this bio-desalination process takes place there was a simultaneous physical, chemical and biological process that can support success in the bio-desalination process.

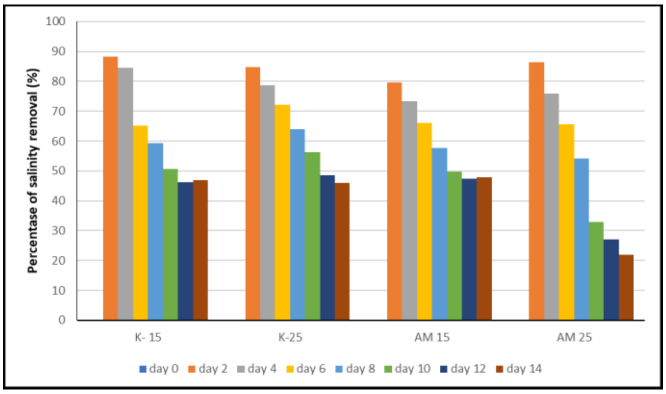

Figure 2: Percent removals of salinity

Figure 2 depicted the removal that occurs was as follows, the ability of the plant for 14 days can reduce salinity with the results of *Avicennia marina* at a initial concentration of 15 ‰ was 54.74%. Meanwhile, the reduction of salinity was 48.98% at a initial salinity concentration of 25 ‰ with *Avicennia marina* in a reed bed reactor. Percentage of the salinity removal decreased in salinity level high, it could occur due to mangroves were able to accumulate salt at maturity, until it reached the point of death on the leaves with an ultrafiltration mechanism. Ultrafiltration was the process of separation using the pores of the plant itself as a membrane.

Scholander [5] states that *Avicennia* has greater ability to absorb salinity than Rhizophora mucronata, this was also corroborated by the statement of [6] that *Rhizophora mucronata* was better at small salt water levels, while *Avecennia* can live with optimum conditions at 50 ‰ level.

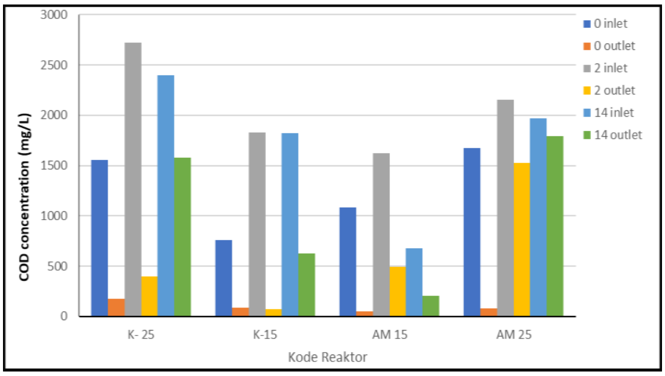

Figure 3: The decreasing of COD levels

Figure 3 showed that the levels of COD values contained in the sample experienced a decrease in the inlet and outlet. This explained that the bio-desalination process was going well in each reactors. However, when compared to *Avicennia marina* plant samples, the concentration of 15 ‰ has a lower COD value than the *Avicennia marina* plant sample with a concentration of 25 ‰. This was due to in the lower concentration of COD, the process that occured was also getting better.

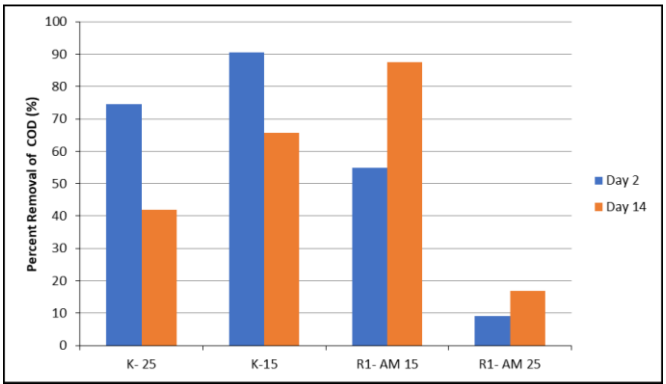

Figure 4. The Result of Percentage Removal of COD Levels

Figure 4 described the decrease in COD value on the second day of all control samples has a higher value than the sample with plants. However, on the 14th day at the end of the experiment the outlet values at concentrations of 15 ‰ and 25 ‰ experienced an increase compared to controls. This indicated that the dropping occurs every day on the outlet side of each sample with the treatment of adding *Avicennia marina* plants.

4. Conclusion

The bio-desalination process that occurs was the process of transferring saline levels from the media to the plant media by passive transport by showing a decrease in the salinity and COD results in each tested sample. The results of *Avicennia marina* at an initial salinity concentration of 15 ‰ by 54.74%. It reached 48.98% at an initial salinity concentration of 25 ‰ with *Avicennia marina*. The reduction of COD concentration were 87.55% and 16.80% at an initial salinity concentration of 15 ‰ and 25 ‰ for 14 days of operation in batch, repectively.

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