Combination of Oil Palm Empty Fruit Bunch and Multi Media Layer Coir Filter to Treat Water in Mendalo Darat, Jambi

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Abstract. The Multi Media Layer Coir Filter is a method of treating liquid waste by utilizing soil as the main medium which is shaped like a brick block and arranged alternately between zeolites. Multi Media Layer System made of acrylic (33x33x36) cm filled with brick blocks (12x7x4) cm mix of volcanic soil, charcoal, palm husk (7.5: 1: 1: 0.5), a permeable layer is used zeolite (1-3 mm). Samples came from the wells of the residents of housing Mendalo mas, Mendalo land in Jambi. The research was conducted with variations in flow rates of 10, 20, 30, 60 mL/minute, and two ways, namely aeration and non-aeration, the best efficiency of the aeration process was 10 ml/minute to reduce pH, odor, color, TDS, turbidity. Hardness, Nitrite, Nitrate, Mn, Fe, Cd, Sulfate, Cl, E. Coli at aeration 7.7, Odorless, 29.90%, 52.62%, 59, 70%, 72.30%, 83.22%, 21.70%, 37.53%, 28.88%, 100% and non-aerated 7.2, Odorless, 25.80%, 59, 70%, 57.30%, 66.40%, 83.22%, 21.70%, 37.53%, 28.88%, 100%. From all values, the reduction efficiency of all parameters is fulfilled for potable water.

I. Introduction
The volume of water in the human body is an average of 65% of the total body weight, and this volume varies greatly from person to person, even varies between parts of a person’s body. Several organs in the human body that contain a lot of water, including the brain 74.5%, bone 22%, kidney 82.7%, muscle 75, 6%, and blood 83% \cite{1}\cite{2}. Groundwater contains both inorganic and organic substances and is therefore a good place for microorganisms to live. The autotrophic microorganisms are the first inhabitants of water containing inorganic substances, The dead cells are an organic material that allows the life of heterotrophic microorganisms.

The Multi Media Layer System has several advantages, including being able to reduce the values of BOD, COD, TSS, color, and eliminating odors simultaneously, having a high ability to receive and absorb water flowed into the system, 1000 - 4000 Lm2d-1 while conventional soil 10 - 40 Lm-2d-1, very effective for removing organic and inorganic components from domestic wastewater. This is

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because the soil used is black andisol soil which contains aerobic and anaerobic microbes that can degrade dissolved organic compounds in water [3].

Mendalo mas is one of the locations of several housing estates in Mendalo Darat. The Mendalo mas area used to be a swamp, where the water was yellowish to reddish, tended to be cloudy and oily, acidic, when exposed to the skin it felt gummy and had a slight odor in the water bodies. The local community generally uses water from PDAM, but the provision and range of services from the PDAM is limited, to meet the water needs of the population using well water and in general, the well water that the community uses is not suitable, not under clean water standards, therefore it is necessary to treat it. well water before it is used for daily needs.

This research was conducted to see the ability of the combination of Multi Media Layer System - Coir Filters for oil palm bunches using volcanic soil material from the foot of Mount Kerinci, zeolite, palm shell charcoal (Kumpe, Jambi), iron powder, and coir of palm bunches (Kumpe, Jambi) in water purification. turbid and yellow wells to be fit for drinking by utilizing natural potential. Under the health quality standards listed in the Regulation of the Minister of Health of the Republic of Indonesia Number 492 / MENKES / PER / IV / 2010 [4].

2. Materials and Methods

2.1 The Material of the Multi Media Layer

The soil mixture layer of Multi Media Layer system consists of material, volcanic soil (from Kerinci), charcoal, palm husk (7.5: 1: 1: 0.5), permeable layer is used zeolite (1-3 mm).

![Figure 1. Multi Media Layer System Combination Reactor Design - Coir Filter](image-url)
2.2 Treatment of the Sample
The well water that has been taken is done first by analyzing the water quality with physical parameters such as odor, turbidity, and several chemical parameters such as pH, Nitrite, Nitrate, metal identification, BOD, COD in the well water. To predict the capability of this filter media system, well water analysis is carried out before and after the aeration and non-aeration processes by varying the flow speed.

2.3 Analysis Method
All analysis of pH parameters, turbidity, nitrite, nitrate, Mn, Fe, Cd, TDS, Odor, Color, and E. Coli, according to the Indonesian National Standard (SNI) Determination of pH (SNI 06-6989.11-2004) [5], Determination Turbidity (SNI 06-6989.25-2005) [6], Determination of Nitrite Content (SNI 06-6989.9-2004) [7], Determination of Nitrate (SNI 06-2480-1991) [8], Determination of Manganese Metal (SNI 6989.5-2009) [9], Determination of Fe Metal (SNI 69-894-2009) [9], Determination of TDS, Determination of Odor, Determination of Color Content (SNI 69-8980-2011) [10], Determination of Cd Metal (SNI 2345-5-2011) [11] and E. Coli Determination [10].

3. Result and Discussion
Results of Well Water Analysis after Aeration and Non-Aeration Treatment in a multi layer system Turbidity. The results of turbidity analysis using aeration and non-aeration methods at flow rates of 10, 20, 30, 60 mL/minute still do not meet the drinking water quality standards but after an experiment by reducing the flow rate from 2, 4, 6, 8 mL/minute the turbidity value is already at the threshold value of Permenkes RI No. 492 / Menkes / Per / IV / 2010 [12].

The results of the analysis of the turbidity of well water after passing through the system in the aeration and non-aeration processes decreased in each flow rate variation (10, 20, 30, 60) mL/minute from the initial turbidity value of 27.455 NTU. However, the value for decreasing the turbidity is still above the standard value for drinking water quality. Then try again to drain the well water into the tool by reducing the flow rate to (2, 4, 6, 8) mL/minute in aeration and non-aeration processes. The results were obtained that were already below the standard value of drinking water quality standards RI Regulation No. 492 / Menkes / Per / 2010.

![Figure 2](image_url)

**Figure 2.** Graph analysis of turbidity in aeration and non-aeration. (a) Efficiency of reducing turbidity levels in the Multi Media Layer System method with aeration and non-aeration processes at flow rates (10, 20, 30, 60) mL/minute (b) Efficiency of reducing turbidity levels in the Multi Media Layer System-Coir Filter method with the process aerated and non-aerated at flow rates (2, 4, 6, 8) mL/minute.
**Analysis Power of Hydrogen (pH)**

The Power of Hydrogen (pH) is the concentration of hydrogen ion (H⁺) in a liquid. pH is also an important chemical parameter in water analysis. A water pH lower than 6.5 increases the corrosivity of metal objects, creates a bad taste, and can cause some chemicals to become toxic which can be detrimental to health [5].

![Figure 3. Graphic of pH values before and after treatment with the Multi Media Layer System-Coir Filter in aeration and non-aeration processes.](image)

Based on the pH value of well water (Figure 3) before passing it to the Multi Media Layer System-Coir Filter system is 6.49. This pH value is below the standard value of drinking water quality Regulation No. RI No. 492 / Menkes / Per / IV / 2010, namely 6.5-8.5. This means that the pH in the well water does not meet drinking water quality standards. From the results of measuring the pH of well water that has been passed to the Multi Media Layer System-Coir Filter system with aeration and non-aeration processes, the pH value increased from 6.49 to 7.2 - 7.7. This shows that the hydroxyl ion concentration (OH⁻) is higher than the hydrogen ion concentration. This is due to the increase in OH⁻ ion from the denitrification process of Nitrobacter bacteria [4].

**Color Analysis**

The color of the water can be caused by the presence of organic and inorganic materials, due to the presence of plankton, humus, and metal ions (such as iron and manganese), as well as other materials. The presence of iron oxide causes the water to be reddish in color, the presence of manganese oxide causes the water to be brownish or black in color.

![Figure 4. Graphic color efficiency](image)
Total Dissolved Solids (TDS)
TDS consists of dissolved solids and suspended solids. The amount of dissolved solids consists of organic and inorganic compounds that dissolve in water, minerals, and salts. The effect of the total solid in the water consumed by the public will give an unpleasant taste to the tongue, nausea is mainly due to sodium sulfate and magnesium sulfate, and cardiac disease and toxemia occur in pregnant women and cause a decrease in the quality of health. The results of the TDS analysis can be seen in the figure 5.

[Figure 5. Grafic TDS Efficiency]

Hardness
Hardness is a property of water caused by the presence of valence metal ions (cations), for example Mg$^2+$, Ca$^2+$, Fe$^+$ and Mn$^+$. Total hardness is the hardness caused by the presence of Ca$^2+$ and Mg$^2+$ ions together

[Figure 6. Hardness analysis efficiency graph]

Nitrite Analysis
Nitrite This is a form between the oxidation of ammonia to nitrate or reduction of nitrate to ammonia. Nitrite can enter the water through industrial wastewater. Nitrates can bind iron from hemoglobin which forms methemoglobinemia in the body.
The decrease in nitrite concentration that was detected at all variations in the flow rate indicated that the nitrification process took place under aerobic conditions. In that condition, nitrite is oxidized by Nitrosomonas bacteria to nitrate, and then nitrite in anaerobic condition can be reduced to nitrogen by facultative anaerobic bacteria such as Denitrobacilus and Nitosococcus. The nature of nitrite which is unstable in the environment, will easily turn into nitrate in treated well water, and it is also possible that the total ammonia that is broken down into nitrite in the nitrification process is small, so that the resulting nitrite is low.

**Nitrate Analysis**

Nitrites are usually present in surface water in small concentrations, and may reach high concentrations in groundwater. The presence of NO3 in water is closely related to the Nitrogen cycle, in nature. In this cycle it can be seen that Nitrate can occur both from the N2 atmosphere and from the fertilizers used and from the oxidation of NO2- by bacteria from the Nitrobacter group.
In Figure 8, it is found that the Nitrate levels before and after being flowed to the Multi Media Layer System - Coir Filters device are already at the quality standard value of drinking water in the Republic of Indonesia Regulation No. 492 / Menkes / Per / IV / 2010, namely 50 mg / L.

**Mn Analysis**
Manganese is one of the most abundant metals on the earth's surface, which is about 0.1% of the earth's crust. Manganese naturally occurs in surface and groundwater, but human activities also contribute a lot to contamination of manganese in water. Manganese can bind to nitrates, sulfates and chlorides and dissolves in water. MnO2 precipitates will stain white materials / objects. The presence of this element can cause odor and taste in drinks.

The value of the Mn content obtained also has met the standard quality value for drinking water standards RI Permenkes No.492 / Menkes / Per / IV / 2010, namely 0.3 mg / L. When compared to the level of efficiency of manganese reduction in aeration and non-aeration processes, the best is in the aeration process.

**Fe Analysis**
The presence of iron in water can cause water to become colored, smelly, and tasteless. As many as 3 respondents (15%) stated that the well water smelled fishy and had a cloudy red color.
Sulfate Analysis
Problems caused by the presence of sulfate in water are odor and corrosion problems in the piping resulting from the reduction of sulfate to hydrogen sulfide under anaerobic conditions. The laxative effect on sulfates occurs at concentrations of 600-1000 mg/L, if Mg+ and Na+ are cations that combine with $\text{SO}_4^-$, which will cause nausea and want to vomit.

![Graph of aerated and non-aerated Sulfate Efficiency Analysis](image)

**Figure 11.** Graph of aerated and non-aerated Sulfate Efficiency Analysis

Cd Analysis
The content of cadmium (Cd) in clean water according to Permenkes RI No. 492 / Menkes / Per / IV / 2010, the maximum Cd level allowed in clean water is 0.003 mg/L. When compared with the Permenkes standard, the highest percentage of samples do not meet the requirements for clean water.

![Graph of analysis of Cd efficiency in aerated and non-aerated](image)

**Figure 12.** Graph of analysis of Cd efficiency in aerated and non aerated

Cl Analysis
Measurement of chloride content in the well water sample in Mendalo Jambi, this value is still below the threshold of the Ministry of Health's Quality Book Standard, which is 250 mg/L, and it can be seen that the of Multi Media Layer System - Coir Filters tool can reduce the Cl levels in well water.
**E.Coli Analysis**

These bacteria are active which utilize organic compounds as a growing medium. E. Coli grows at a temperature of 10-40 °C, with an optimum temperature of 37 °C and a pH of 4.0-9.0[13]. Size 2.0-6.0 µm in length and 1.1-1.5 µm in width, single arranged, paired with peritic flagella. The results of the analysis of E. coli bacteria [14] in well water can be seen in Figure 14 below.

The results of the analysis of the MPN (Most Probability Number) E. Coli before processing using the Multi Media Layer System - Coir Filters have an average of 3 cells / 100 mL, after passing through the system in non-aeration processes with various flow rates (10, 20, 30, 60) mL / minute also
obtained the same results as the initial value before flow into the appliance, namely 3 cells / 100 mL, did not experience a decrease in the value of E. Coli before being flowed into the appliance. This is due to the existence of various sizes of E. coli trapped in the tool, that in the river water there are many E. coli sizes that are bigger than well water E. coli, while the E. coli value of well water in the aeration process in all variations The flow rate was obtained by E. Coli bacteria of 0 cells / 100 mL. It has been a long time since the quality standard value of Permenkes No.492 / Menkes / Per / IV / 2010.

4. Conclusions
Based on drinking water quality standards according to Permenkes RI No. 492 / Menkes / Per / IV / 2010, the well water of a teak Padang resident before passing through the system, the turbidity parameter has not met the standard for drinking water suitable for consumption. The efficiency of the tool mixed with rice husks in well water treatment, for the aeration process at various parameters, the value of the reduction efficiency of all parameters is satisfactory for potable water.

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