



Innovation of Clean Water Treatment Facilities in HI Manambai Abdulkadir Hospital Environment

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Abstract

This study aims to determine the quality of clean water in terms of physical parameters, determine clean water treatment methods and clean water systems that can be applied at HL Manambai Abdulkadir Hospital. This study uses qualitative research by observing the water sources used by HL Manambai Abdulkadir Hospital. Observations were continued by checking the physical condition of the water taken at the control faucet of the Regional Hospital Drinking Water Company. The observations obtained were used as data for analysis. Then the researchers also conducted interviews and documentation. Based on article 2 of the Regulation of the Minister of Health of the Republic of Indonesia No. 416 of 1990 concerning Requirements and Supervision of Clean Water Quality from physical parameters shows that the quality of clean water at H. L Manambai Abdulkadir Hospital sourced from the Regional Drinking Water Company does not meet health standards (water is cloudy and brown in color). To improve the treatment of clean water quality at HL Manambai Abdulkadir Hospital, there are 3 systems offered by the researchers, namely: Slow Sand Filter System, Rapid Sand Filter System and Gravity-Fed Filtering System. From the three systems mentioned above, the researcher recommends a water purification system using a Rapid Sand Filter (Up Flow) with sand and gravel media. Due to the Rapid Sand Filter (Up Flow) can remove turbidity. Meanwhile, sand and gravel media are easy to obtain, and the price is affordable. So, when viewed from the needs and budget aspects of HL Manambai Abdulkadir Hospital, Rapid Sand Filter with sand and gravel media is a fast.

Keywords: *Health, Hospital; Clean Water Quality; Clean Water Treatment System (Slow Sand Filter System, Rapid Sand Filter System and Gravity-Fed Filtering System)*

Introduction

Health is an important part of the welfare of society.¹ Health is also one of the basic human needs in addition to clothing, food and shelter. Organized community efforts to improve health status are getting better day by day. One of the efforts to improve the degree of public health is to improve environmental sanitation, carry out routine health control in the community, individual education about personal hygiene, organizing medical and nursing services, preventing disease and developing social aspects that will support everyone in the community to have standards. strong life to improve their health status.

¹ <https://penabulufoundation.org/health-public/>, accessed on November 1, 2021 at 20.00 WITA.

To achieve a good level of public health, health care facilities are needed that can provide affordable health services for all levels of society in the context of improving health, maintaining health, treating disease, and restoring health. The provision of Health Service Facilities is the responsibility of the Central Government and Local Governments in accordance with the provisions of Law Number 36 of 2009 concerning Health which states that the Government is responsible for the availability of Health Service Facilities for the community to achieve the highest health status.²

Then in Article 4 of Government Regulation no. 47 of 2016 concerning Health Service Facilities divides the types of Health Service Facilities as follows: Health Worker's independent practice, community Health centers, Clinic, Hospital, Pharmacy, Blood transfusion unit, Health laboratory, Optical, Medical service facilities for the public interest and Traditional Health Care Facilities.

Based on Article 4 of Government Regulation no. 47 of 2016 concerning Health Service Facilities, the hospital is one type of health facility that can support the improvement of the health status of the community and individuals. Then in the explanation of article 4 letter d states that "hospital" is a health service institution that provides complete individual health services that provide inpatient, outpatient, and emergency services.

One of the health service facilities in the hospital is a clean water supply facility. This facility is a factor supporting the quality of service in hospitals. Clean water that meets in terms of quantity and quality will have a positive impact on the services provided at the hospital. Therefore, clean water is a necessity that cannot be separated from the various activities in the hospital. Because basically the hospital is a place of action and care for sick people who in their handling or services require clean water with quantity and quality that meets hospital service standards.

The quantity and quality of hospital clean water really needs to be considered at any time and time so as not to cause new sources of infection for sufferers. With its very important role and very large impact, it is very necessary to pay attention to the quantity and quality requirements of water in hospitals. In terms of quantity, hospitals must be able to provide a minimum of 500 liters/bed/day of clean water with water quality that meets health standards. And in terms of clean water quality, it must include physical, chemical, and biological parameters that meet health standards as well (Effendi, 2003).³

Through Permenkes No. 416 of 1990 has stipulated the requirements and supervision of water quality in Indonesia, although in general it still causes problems, but specifically for hospitals there should be no more problems. Likewise, with RS. HL Manambai Abdulkadir, which is a type C hospital that has service units and supporting units, namely inpatient, isolation rooms, laboratories, radiology, emergency department, nutrition, poly, office, and ICU, which use clean water to carry out various activities. To meet the needs of clean water in each of these units, RS. HL Manambai Abdulkadir obtains clean water sourced from the Regional PAM (Drinking Water Company).

However, the fact is that the condition of the PAM water channeled to the HL Manambai Abdulkadir Hospital when viewed from a quality perspective, especially from physical parameters, still does not meet health standards. This is because the PAM water that is channeled is still brown (cloudy). This situation sometimes causes problems for hospital visitors. Some of the patient's families sometimes complain about the brownish color of the water entering the treatment room or inpatient room.

So, according to the researcher, it is interesting to study the Innovation of Clean Water Treatment Facilities in the HL Manambai Abdulkadir Hospital so that it can be known specifically regarding the

² <https://peraturan.bpk.go.id/Home/Details/38778/uu-no-36-tahun-2009>, accessed on November 3, 2021 at 10.40 WITA.

³ http://hukor.kemkes.go.id/uploads/produk_Hukum/PMK_No__7_Th_2019_ttg_KesehatanLingkungan_Rumah_Sakit., accessed on November 3, 2021 at 11.00 WITA.

quality of clean water in the HL Manambai Abdulkadir Hospital environment. Given the urgency of the quality of clean water which must be in accordance with health requirements in hospitals in general.

Based on the formulation of the problem above, the purpose of this study was to determine the quality of clean water, determine the clean water treatment methods and clean water treatment systems that can be applied at HL Manambai Abdulkadir Hospital.

Method

Research Time and Location

The implementation time of this research starts from August to October 2021. The study was conducted at the HL Manambai Abdulkadir Hospital located in Sumbawa Regency, West Nusa Tenggara Province. Observations and research were carried out on hospital clean water sources and clean water facilities which are water reservoirs sourced from PDAM water. Where the water from the shelter will be used to meet the needs of clean water for hospitals, both services and supporting services and other activities.

Types and Sources of Research Data

Data is an attribute attached to a certain object, which functions as information that can be accounted for, and is obtained through a data collection method/instrument.⁴ What is meant by data sources in research is the subject from which the data is obtained. In this study, researchers used primary data and secondary data.⁵ Primary data is data that is directly obtained from the first source at the research site.⁶ The primary data from this study is the result of direct observation at the location of the water reservoir (Ground tank), as well as direct observations on PDAM facilities (water faucets) as a physical test and collect information from relevant informants, namely the Head of Support and Head of the Environmental Health Installation of HL Manambai Hospital Abdulkadir. Secondary data is data sourced from documents, photographs and objects that can be used as a complement to primary data. The secondary data that the researcher uses in this research is data that comes from photos or pictures related to the research.

Research Design

In this study, researchers used a qualitative type of research. According to Denzin and Lincoln qualitative research is research that uses a natural background, with the intention of interpreting the phenomena that occur and is carried out by involving various methods that exist in qualitative research. The methods that are usually used are interviews, observations, and the use of documents.⁷

The study began by observing the water sources used by the HL Manambai Abdulkadir Hospital. Observations were continued by checking the physical condition of the water sample obtained from the PDAM water control faucet at the HL Manmbai Abdulkadir Hospital. Observations were made using a

⁴ Haris Herdiansyah, Interviews, Observations and Focus Groups as Qualitative Data Mining Instruments, (Jakarta: Raja Grafindo Persada, 2013) 8

⁵ Sugiono, Quantitative and Qualitative Research Methodology and R&D, (Bandung: Alfabeta, 2009) 225

⁶ Burhan Bungin, Social Research Methodology: Quantitative and Qualitative Formats, (Surabaya: Airlangga Universiti, 2005), p. 128

⁷ Lexy J Moleong, Qualitative Research Methods (Bandung: PT. Teen Rosdakarya, 2013), p.5.

simple physical test using the five senses (organoleptic test).⁸The results of observations obtained are used as data for analysis.

The main instrument in collecting qualitative writing data is the researcher himself (human instrument).⁹Data collection techniques used by researchers are interviews and documentation. Researchers observed physical conditions (taste, smell and color) on water samples taken from PDAM water control taps located at HL Manambai Abdulkadir Hospital.

Interview is a method of collecting data by means of question and answer which is done systematically and based on research objectives. Researchers conducted in-depth interviews with relevant informants, collected documents by observing and reviewing various references related to the research focus (idrud, 2007). The interview used is a guided free interview, where the interviewer brings a guide which is only an outline of the things being asked.

Thus the interview was conducted through questions that lead to the depth of information, conducted randomly and informally. The focus of the interviews in this study was to find information related to water sources, water quantity, water quality and water distribution processes at HL Manambai Abdulkadir Hospital. Documentation is a record of events that have passed, it can be in the form of writing, pictures or monumental works. In this study, documents were obtained in the form of images or photos related to the research location.

Data Analysis Technique

Data analysis is a process of compiling, organizing and processing data so that it can be used to view and assess research results. In this study, the data analysis used was qualitative data analysis. Qualitative data analysis is data analysis used to manage data that cannot be realized with numbers. In other words, data in the form of facts and reports are collected by linking existing theories, so that they can support existing qualitative data. Finally drawn to make a conclusion.

In this study, researchers observed physical conditions on color, taste and smell and then studied using the experimental method, namely researchers conducted studies and compared water samples obtained from hospital clean water sources (PDAM control taps) with clean water with guaranteed quality (mineral water). In addition, researchers also conducted interviews and took documentation to be processed so as to obtain credible results.

Result and Discussion

HL Manambai Abdulkadir Hospital Service Management

HL Manambai Abdulkadir Hospital is a hospital appointed by the Ministry of Health of the Republic of Indonesia as a regional referral center for Sumbawa Island, which has functions including providing medical services, medical and non-medical support services, nursing and midwifery care services, other health services, both in outpatient and outpatient care. hospitalization, or emergency department. In 2018 the HL Manambai Abdulkadir Hospital was accredited with the title "Four Stars". The description of service achievement in each unit based on the type of service is as follows. Types of outpatient services consist of polyclinic services. The types of polyclinic services provided by HL Manambai Abdulkadir Hospital are: Pediatric Clinic, Internal Medicine Polyclinic, Gynecology

⁸<http://bapelkescikarang.bppsdmk.kemkes.go.id/kamu/kurmod/Pengolahanair Bersih/mi-2a%20modul%20uji%20dan%20analysis%20air%20minimal.pdf>, accessed on November 10, 2021 at 20.00 WITA

⁹Umar Sidiq and Moh. Miftachuk Choiri, *Qualitative Research Methods in Education*, CV. Nata Karya, Ponorogo, First Printing, 2019, p. 13.

Polyclinic, Midwifery Polyclinic, Surgery Polyclinic, Dental & Oral Polyclinic, Cardiac Polyclinic, Pulmonary Polyclinic, Neuro Polyclinic, ENT Polyclinic, Eye Polyclinic, Physical Rehabilitation/Physiotherapy Polyclinic, VCT Polyclinic/HIV Counseling Test, Nutrition Polyclinic, and Psychiatry/Psychiatric Polyclinic.

Identification of clean water at HL Manambai Abdulkadir Hospital

To meet the need for clean water at the HL Manambai Abdulkadir Hospital, it was obtained from the Regional Drinking Water Company (PDAM). However, the distribution of PDAM water cannot be carried out for 24 hours due to the distribution schedule for each region. HL Manambai Abdulkadir Hospital received PDAM water distribution in the afternoon until early morning (17:00 – 05:00 WITA) which required the Hospital to build a water reservoir (ground tank) to meet the needs of clean water during peak hours of service, namely in the morning to evening.



Figure 1. Ground Tank Top View



Figure 2. PDAM manhole

Ground tanks or a reservoir located in the back area of the HL Manambai Abdulkadir Hospital with a size of 10 M x 20 M x 4 M is a means of storing hospital clean water sourced from PDAM. Then from the ground tank, clean water is channeled into reservoir tanks located at 5 points, to be distributed by a piping system to every room in need in the HL Manambai Abdulkadir Hospital.



Figure 3. interview process with Ayu Ade Mediani, Amd. KL as the head of the Health Installation.

From the results of interviews with Ayu Ade Mediani, Amd. KL as the head of the Environmental Health Installation (Ka. IKL) of HL Manambai Abdulkadir Hospital stated that “hospital water comes from PDAM water which is flowed into a holding tank or ground tank. However, the PDAM water that comes is often cloudy or brown in color. The cloudy water will just flow into the reservoir. From the reservoir, it will be channeled to all units in the hospital, including the inpatient treatment room. This is

where sometimes there are complaints from patients and their families regarding the water distributed to the brownish (cloudy) room.”¹⁰ This is also supported by field observations through sampling of water sourced from PDAM.



Figure 4. PDAM Water Sampling



Figure 5. Comparison of PDAM water with mineral water

Based on article 2 of the Regulation of the Minister of Health of the Republic of Indonesia No. 416 of 1990 concerning Requirements and Supervision of Clean Water Quality from physical parameters shows that the quality of clean water at HL Manambai Abdulkadir Hospital sourced from PDAM does not meet health standards (water is cloudy and brown in color).

HL Manambai Abdulkadir Hospital Clean Water Treatment System

1. Clean Water Treatment Facilities

To improve the quality of clean water at the HL Manambai Abdulkadir Hospital, several types of water treatment systems can be carried out as follows:

a. Slow Sand Filter (SPL)

Slow sand filter (SPL) is one of the simple alternative technologies that can be implemented by people in rural areas in meeting their clean water needs. Slow sand filter (SPL), which is a water treatment installation in the form of a filter tank that uses sand as a filter medium with very small grain sizes, but has a high quartz content.

In general, the slow sand filter applied in Indonesia is a conventional installation in an effort to reduce turbidity and Total Suspended Solid (TSS) raw water. The filtering process takes place by gravity, very slowly, and simultaneously on the entire surface of the media. The filtration process is a combination of physical processes (filtration, sedimentation and adsorption), biochemical processes and biological processes. Slow sand filters are more suitable for treating raw water, which has a moderate to low turbidity of less than 50 mg/L SiO dissolved oxygen. (dissolved oxygen) moderate to high.

The dissolved oxygen content is intended to obtain optimal biochemical and biological processes. If the raw water has a high turbidity content and a low dissolved oxygen concentration, then the slow sand filter system and concentration will require preliminary treatment, which is planned separately from this standard. The source of raw water comes from river water or lake water

¹⁰Results of interviews with Ayu Ade Mediani, Amd. KL as the head of the Health Installation, Sumbawa, On August 18, 2021 at 10.00 WITA.

or reservoirs. The slow sand filter tank (SPL) building is made of concrete, ferrocement, fiberglass or cement brick, which is equipped with a system of inlet, outlet, piping and control tubs. The type and capacity of the SST can be adjusted to the needs of the community, the quality of the raw water, and the continuity of the raw water source.¹¹

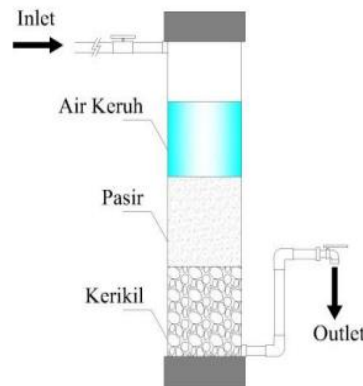


Figure 6. Slow Sand Sieve

b. Quick Sand Filter (SPC)

Quick sand filter or (SPC) is a water filter that can produce more water discharge at the end of the filtration process. However, this filter is less effective in controlling odors and tastes in filtered water. In addition, due to the rapid flow of water, a layer of bacteria that is useful for removing pathogens will not form as well as what happens in a slow sand filter. So, it will require a more intensive process of disinfection of germs.

The difference between the SPL slow sand filter system and the SPC fast sand filter system is where the water enters and leaves. If the SPL water enters from above, namely sand, then it goes down to the pipe which is located parallel to the gravel filter media. While the SPC water enters from the bottom pipe or which is parallel to the gravel, then the water goes to the top sand and comes out of there. So simply, SPL water flows from top to bottom, while up SPC water flows from bottom to top.

A fast sand filter, like a slow sand filter, consists of a layer of sand on the top and gravel on the bottom. However, the direction of water filtration is reversed when compared to the Slow Sand Filter, namely from bottom to top (up flow). Clean water is obtained by filtering raw water through a layer of gravel first and then passing through a layer of sand.¹² In addition, the Quick Sand Filter is generally able to backwash or wash the filter without having to disassemble the entire filter.

¹¹ Dra. Tuti Kustiasih, Module for Socialization and Dissemination of Standards Guidelines and Manuals for Slow Sand Filter Installation, Research and Development Center for Settlement Research and Development, Ministry of Public Works, PUSKIM, Bandung, Issue 1, 2014, p. 4-5

¹²Eka Wahyu Andriyanto, (2010) "Test Physical Model of Simple Water Treatment with Gravity Filtering with sand filtration" <http://repository.umy.ac.id/bitstream/handle/123456789/4601/F.%20BAB%20II.pdf?sequence=6&isAllowed=y>, accessed on November 10, 2021 at 10.00 WITA.

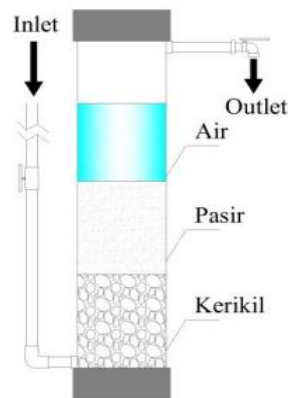


Figure 7. Quick Sand Sieve

c. Gravity-Fed Filtering System

Gravity-Fed Filtering System is a combination of fast sand filter (SPC) and slow sand filter (SPL). Clean water is produced in two stages. First the water is filtered using a Quick Sand Filter (SPC). The filtered water and then the results are filtered again using a Slow Sand Filter.

With the two times of filtering, it is hoped that the quality of the clean water produced can be better. To anticipate the discharge of filtered water that comes out of the Fast Sand Filter, can be used multiple / multiple Slow Sand Filters.¹³ On the other side *Gravity-Fed Filtering System* has several drawbacks, namely, from an economical point of view, it requires relatively larger costs because it combines two processing systems.

Then the manufacture of the Gravity-Fed Filtering System pays attention to the water discharge produced from the first filter (SPC) which produces a larger water discharge than the second filter (SPL), so to compensate for the water discharge that comes out of the first filter, it is necessary to add a filter (multiple filter). filter).

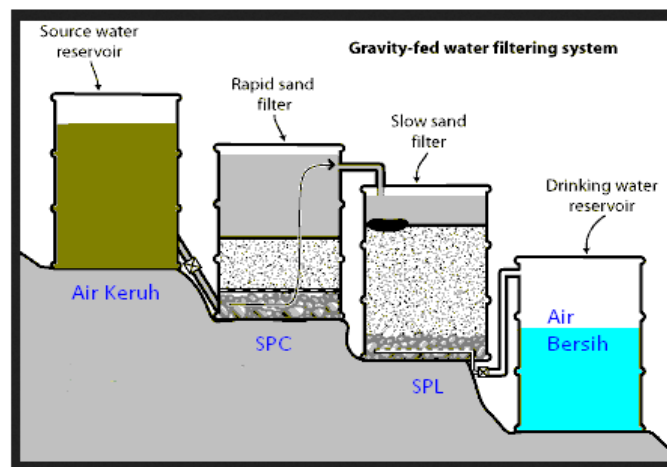


Figure 8 Gravity-Fed Filtering System

¹³ Satriyo Wibowo, Water Purification Techniques, https://www.academia.edu/34929643/TEKNIK_PENJERNIHAN_AIR_Oleh_Satriyo_Wibowo, accessed on 15 November 2021 at 23.00 WITA.

Processing Media

To support the optimization of the water treatment system, processing media are needed, including:

1. Sand

Sand is a good filter media and can be used in the cleaning process because of its nature in the form of free, porous, degraded and uniform grains. Sand grains that have pores and gaps that are able to absorb and hold particles in water. In addition, sand grains also have the advantage of being easy to procure and relatively cheap. Sand serves to filter dirt and water, separate the remnants of floc and separate iron particles formed after contact with air. During filtering, colloids or suspended in water will be held in the porous media so that water quality increases (Fransisca in Krisnawati, 2009).

The sand used must meet good quality because the quality of the filter material will affect the filtering results. The grain size of the sand used affects the absorption of water. The smaller the size of the sand, the aggregate structure or mineral group will be more dense so that the filtering results will be better to a certain extent. The requirements of the sand used are that the sand must be clean, not mixed with soil and dirt. Sand before being used as a filter media, should be washed thoroughly.

2. Zeolite

Zeolites are crystalline alumina silica with a three-dimensional structure, and are formed from tetrahedral alumina and silica with cavities inside containing metal ions, usually alkaline or alkaline earth and water molecules that can move freely. Zeolites function as adsorbents and molecular filters, as well as ion exchange (ion exchange) in water treatment. (Kusnaedi, 2010). Zeolites are tetrahedral alumina silica crystals that have a three-dimensional framework structure. Zeolites are classified as nanoporous materials with pore sizes between 0.3-1.5 nm. So that zeolites can be used as adsorbents, ion exchangers, and catalysts (Aubach, et al, 2003). In addition, zeolite can also be used as a support for electronic devices, namely as a semiconductor material (Kalogeras and Dova, 1998).

3. Activated Charcoal

Activated charcoal or activated carbon is a kind of adsorbent material in the form of a powder derived from materials containing carbon such as coal and coconut shell (absorbent), black in color, in the form of granules, rounds, pellets, or powder. Activated charcoal is a natural ingredient, usually made from coconut shell charcoal which has been activated using pressurized steam and other additives to increase the adsorption capacity.

How to activate this charcoal is to heat it for a while at a high temperature and to remove compounds that are not needed by the flow of steam. The required temperature is 900°C. Another activation method is to scrape the charcoal using chemicals, including phosphoric acid, iron chloride, and others. Medium level chemicals can be used to soak the charcoal and followed by drying, until heating at a temperature of 500° C (Soekardi, 2012)

4. Krikil

The gravel functions as a buffer / retainer in the filtering process, so that the sand, zeolite and activated charcoal media are not carried away by the filtered flow, so that blockages can be avoided. According to Kusnaedi (2006), gravel is a rock larger than 2 mm. Gravel has an irregular shape but its size can be equalized through the gravel analysis sieving process. According to Asmadi et al (2011), the requirements for gravel as a sand retaining medium must be clean, hard, durable, and round.

From the description above, the three water treatment systems can be applied. The sand and gravel media are more recommended because both media are easy to obtain and sourced from nature (not manufacturing).

The System That Can Be Applied to the HL Manambai Abdulkadir Hospital

In selecting the treatment units to be used in the water treatment plant at HL Manambai Abdulkadir Hospital, the water quality, technical and economic aspects can be considered.

1. Water quality

Treatment units are selected based on water quality parameters that do not meet quality standards and must be reduced. This selection is based on prediction models for the selection of water treatment units.

2. Technical aspect

Some considerations from a technical point of view are:¹⁴(1) The efficiency of the processing unit with respect to the parameters to be derived; (2) the flexibility of the treatment system to fluctuating water quality; (3) Ease of operation and maintenance in the long term; (4) Ease of construction.

Economic aspect; (1) Initial investment, operation and maintenance costs; (2) the area of land required; (3) Optimizing the number of treatment units to reduce water quality parameters to be reduced.

In line with the description above, the researcher also conducted interviews with Lalu Ashari Cahyadi, SKM as the Head of the Support Division of the HL Manambai Abdulkadir Hospital. The results of interviews that have been carried out refer to "environmental health installation units often report that there is turbidity in water sourced from PDAM, especially during the rainy season. This has become a concern for hospital management, but the current budget is very limited due to the pandemic conditions, making the budget focused on handling Covid 19. However, management does not rule this out because we know that water is the main supporting factor in hospital services. . We are trying to solve this problem immediately, even with a limited budget."¹⁵



Figure 9. Interview with Lalu Ashari Cahyadi Skm as the Head of Support for the HL Manambai Abdulkadir Hospital

After conducting the interview, the researcher tried to analyze the health condition of the hospital's clean water environment with a water purification treatment system that was in accordance with the needs and capabilities of the HL Manambai Abdulkadir Hospital. The recommendation from the

¹⁴ Miftahul Huriyah Lasaka, Fast Filter Clean Water Treatment Model Using Permanent Storage, Thesis, Makassar, University of Muhammadiyah Makassar, 2017, p. 35-36.

¹⁵ Results of an interview with Lalu Ashari Cahyadi Skm as the Head of Support for the HL Manambai Abdulkadir Hospital, Sumbawa, on August 18, 2021 at 11.30 WITA.

researchers is a water purification system using a Quick Sand Filter (Up Flow) with sand and gravel media. Due to the Quick Sand Filter (Up Flow) the cost of making is not too expensive, easy to make, and can eliminate turbidity in the water. Meanwhile, sand and gravel media are easy to obtain and the price is affordable. So when viewed from the aspect of needs and budget aspects of the HL Manambai Abdulkadir Hospital, the Quick Sand Filter with sand and gravel media is a fast clean water treatment system/facility,

Conclusion

Based on the results of the research that the researcher wrote, it can be concluded that: (1)Based on article 2 of the Regulation of the Minister of Health of the Republic of Indonesia No. 416 of 1990 concerning Requirements and Supervision of Clean Water Quality from physical parameters shows that the quality of clean water at HL Manambai Abdulkadir Hospital sourced from PDAM does not meet health standards (water is cloudy and brown in color); (2) For clean water treatment at HL Manambai Abdulkadir Hospital there are 3 systems offered by the researcher, namely: Slow Sand Filter System, Fast Sand Filter System and *Gravity-Fed Filtering System*; (3)Of the three systems above Researchers recommend a water purification system using a Quick Sand Filter (Up Flow) with sand and gravel media. Due to the Quick Sand Filter (Up Flow) can remove turbidity. Meanwhile, sand and gravel media are easy to obtain, and the price is affordable. So when viewed from the aspect of needs and aspects of the budget of the HL Manambai Abdulkadir Hospital, the Quick Sand Filter with sand and gravel media is a fast, precise and economical treatment system for clean water facilities.

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