JURNAL KESEHATAN LINGKUNGAN
JURNAL DAN APLIKASI TEKNIK KESEHATAN LINGKUNGAN

ISSN 1829-9407 (Print)
ISSN 2581-0898 (Online)

Volume 20, No. 1, Januari 2023; Page: 37-42; *DOI: https://doi.org/10.31964/jkl.v20i1.602*

EFFECT OF SILICA SAND FILTER MEDIA SIZE VARIATION TOWARDS TURBIDING REDUCTION OF CLEAN WATER IN PT. XYZ

Rahma Izzatul Fitri, Neneng Yetty Hanurawaty, Naomi Djuhriah
Poltekkes Kemenkes Bandung Department of Environmental Health
Jl. Babakan Loa No. 10A, Cimahi City, West Java 40511
E-mail: rhmaizzatul@gmail.com

Article Info

Article history:

Received November 14, 2022
Revised November 15, 2022
Accepted January 1, 2023

Keywords:

Clean water
Filtration
Turbidity
Silica sand
Size of filter media

ABSTRACT

Effect of Silica Sand Filter Media Size Variation Towards Turbiding Reduction of Clean Water in PT. XYZ. Turbidity is a condition in which the water contains many suspended particles of material that can cause health problems such as itchy skin, red and itchy eyes, and digestive disorders. Based on the initial inspection results, the turbidity value exceeds quality standard Permenkes No. 32/2017, which is 45.2 NTU. The high turbidity value causes the turbid water to need special treatment, one of which is by filtration with silica sand slices as filter media. This study is experimental research using a pre-posttest without a control design. This research aims to determine the effect of turbidity reduction on the variation of silica sand filter media (5–6 mesh), 7–10 mesh, and 11–18 mesh with a height of 60 cm. The population of this research is clean water at PT. XYZ, with as many as 36 samples used in this research. The results of effective and efficient turbidity reduction are on silica sand media measuring 5–6 mesh, with an average percentage of turbidity reduction of 80.49%. The conclusion of this study is the effect of silica sand filter media size variation on turbidity drop of clean water in PT. XYZ. It is recommended for the industry to apply clean water treatment with the filtration method using 5–6 mesh silica sand media, and further researchers are expected to conduct a test regarding the lifetime of the silica sand media that will be used.

INTRODUCTION

Water is one of the natural resources that has a very important role in survival for humans and it is certain that life will not exist without water. Water is widely used in sanitary hygiene purposes for personal and industrial hygiene. The increasing population density and the fulfillment of industrial water quantity causes water demand to also increase. Increasing water demand must be followed by improving the quality of clean water used [1].

Water quality is a component that describes the suitability or suitability of water with the type of use such as the use of water in daily activities. Some industries even make water as the main raw material in the production process. Clean water used by PT. XYZ comes from 2 sources, namely drilled wells and springs (mountain water). The results of observation and inspection found that clean water in one of the industrial wells had turbid characteristics, there was small floc in it as well as the presence of yellow water piping due to rust. The initial turbidity value of 45.2 NTU has exceeded the value of clean water quality standards according to Permenkes No. 32 of 2017.

Turbidity is measured using the light effect to determine the state of raw water with the NTU scale. Turbidity in water can be caused by the presence of organic matter such as clay, silt deposits, colloidal and other microscopic organic particles. Suspended organic or inorganic solids cause water to turn more turbid. These organic substances can come from weathered rocks, metals or weathering from plants or animals. Turbid water treatment so that it returns to clarity can be done according to the level of turbidity in the water [2].

The process of water treatment in turbid conditions depends largely on the degree of turbidity. The higher the turbidity level of water, the more special treatment or handling is needed to return to clarity. One form of processing is purification with a filtration process (filtration) which has advantages, is cheap in maintenance and maintenance, and the technology is quite simple. Filtration is the process of removing particles / floc in water. In the filtration process, solid particles suspended in the fluid are removed physically or mechanically by passing them through the filter medium [3]. In this study, the water treatment process was carried out by water purification method, namely the filtration method using silica sand.

Silica sand or commonly referred to as quartz sand is the result of weathering rocks that contain major minerals such as quartz. The sand is used to remove physical properties of water, such as turbidity or muddy water and eliminate odors in water [4]. In previous research conducted by Aziz (2014), using a slow sand filter in the form of single media can reduce the level of turbidity levels that are quite high by 99.75%. The study was conducted using a silica sand media size of 0.6 – 1 mm with a media thickness of 20 cm [5].

In Darmono's research (2005), the most optimal size of silica sand media is θ≤0.5 mm. The higher the porosity of silica sand, the higher the absorption rate. In line with other studies conducted by Pinem (2019), the use of silica sand filter media with a thickness of 60 cm resulted in turbidity reduction efficiency of 97.54% [6].

Based on the description above, researchers are interested in conducting research aimed at determining the effect of variations in the size of silica sand filter media (5-6 mesh, 7-10 mesh, and 11-18 mesh) on reducing turbidity values with a thickness of each filter media of 60 cm and using a down flow filtration system. It is expected to be an alternative for PT. XYZ to treat clean water in accordance with the requirements of predetermined quality standards.

MATERIALS AND RESEARCH METHODS

This study is an experiment that aims to determine the value of turbidity reduction in clean water using variations in the size of silica sand filter media. The research design used was *pre-posttest without control*. The type of treatment given is a variation in the size of silica sand filter media (5-6 mesh, 7-10 mesh, and 11-18 mesh) with each media thickness of 60 cm. The sampling technique is carried out by *grab sampling* technique, which is taking samples at a certain time and place. Data collection tools in this study are turbidity, ruler, and labeling equipment on samples.

The research was conducted in the area of industrial clean water treatment. The study population came from an industrial borewell, and the study sample was some water from one of the problematic industrial wells. The sample size of the study based on Gomez's calculations was 36 samples (for pretest 18 samples and posttest 18 samples). The design of the research tool uses 3 pieces of filter tubes measuring 4 inches with a height of 100 cm, the amount of flow used is 0.0178 L / second.

The sampling procedure is carried out by opening the tap and letting it flow for 2-3 minutes at a certain flow speed, then rinse the sample bottle 3 times rinse. The next step, bring the sample bottle close to the sample water faucet in an inclined position so that the sample water enters through the walls of the bottle and wait until the sample bottle is fully filled. After the bottle is fully filled, the sample water is taken to the laboratory for turbidity examination.

Research data from the results of turbidity value examination in the laboratory for pre-posttest samples as many as 36 samples. The data obtained is then *coded* and then processed and analyzed using SPSS software. Data analysis used includes univariate analysis and

bivariate analysis. Univariate analysis aims to find out the pictures of the variables studied, explain and describe each research variable, so that the average turbidity decrease can be known using variations in the size of silica sand filter media measuring 5-6 mesh, 7-10 mesh, 11-18 mesh. Bivariate analysis was performed using the *one-way* anova test.

RESULTS OF RESEARCH AND DISCUSSION

The study was conducted by looking at the turbidity value before and after treatment which aimed to determine the results of reducing turbidity in clean water samples. The sampling time was carried out in May 2022 at 09.00-11.00 WIB and 2 repetitions were carried out per day. Pretest samples are taken from the reservoir water of borehole 4 and posttest samples are taken simultaneously after the water comes out after filtering. The water sample is sent to the Regional Health Laboratory to be checked for turbidity value. The results of the examination and the percentage of turbidity value reduction using variations in the size of silica sand media before and after treatment can be seen in table 1 and table 2.

Table 1. Turbidity Value Examination Results Using Variations in the Size of Silica Sand Media Before and After Treatment

Repetition	Turbidity Examination Results (NTU)					
	Filter 1 Size 5-6 mesh		Filter 2 Size 7-10 mesh		Filter 3 Size 11-18 mesh	
	Pretest	*Posttest*	*Pretest*	*Posttest*	*Pretest*	*Posttest*
1	35.15	7.31	35.18	5.66	35.16	4.5
2	35	7.08	34.9	5.56	35	6.29
3	35.6	6.17	35.21	5.78	36.2	5.23
4	35.91	7.28	35.82	5.68	35.8	4.83
5	36.11	6.83	36.12	6.22	36.1	4.5
6	35.36	6.9	35.24	5.82	35.26	4.81
Average	35.52	6.93	35.41	5.79	35.59	5.03

Based on table 1. It can be seen that the highest average turbidity reduction value is found in filter 3 with an average value before treatment of 35.59 NTU and an average value after treatment of 5.03 NTU.

High levels of turbidity in water are caused by the presence of live or dead algae or other organisms and generally turbidity is also caused by mud or clay, suspended objects containing metals, algae and bacteria. This all causes the water to become cloudy, smelly and colorful due to the presence of impurities that decompose in the water in large enough quantities [7].

Table 2. Percentage of Turbidity Reduction Before and After Treatment

Repetition	Turbidity Examination Results (NTU)					
	Filter 1 Size 5-6 mesh		Filter 2 Size 7-10 mesh		Filter 3 Size 11-18 mesh	
	Decrease (NTU)	%	Decrease (NTU)	%	Decrease (NTU)	%
1	27.84	79.20	29.52	83.91	30.66	87.20
2	27.92	79.77	29.34	84.07	28.71	82.03
3	29.43	82.67	29.43	83.58	30.97	85.55
4	28.63	79.73	30.14	84.14	30.97	86.51
5	29.28	81.09	29.9	82.78	31.6	87.53
6	28.46	80.49	29.42	83.48	30.45	86.36
Average	28.59	80.49	29.63	83.66	30.56	85.86

Based on table 2. It can be seen that the highest average percentage of turbidity reduction is found in filter 3 with a large percentage of 85.86%.

The process of removing turbidity in clean water occurs through a combination of *mechanical straining* and adsorption. Inside the filter layer of the sand there are small cavities that allow water to pass as a flow in the silica and zeolite sand medium. Fine particles that cannot escape

from these cavities will be retained and thus can free water from its dirty content. In addition, filtration and adsorption mechanisms also occur. The cavity between the sand grains and zeolite will act as a filter, then fine dirt will be filtered in the cavity between the media grains and will remain retained in the cavity because of the adhesion of the sand grains that bind dirt [8].

Silica sand or commonly referred to as quartz sand, is the result of weathering rocks that contain major minerals such as quartz. Sand is used to remove physical properties of water, such as turbidity or muddy water and eliminate odors in water [9]. The filtering mechanism with quartz sand media is by mechanical particle containment, namely by separating particles in water through the pores of the filter media and resulting in a large diameter addition. The greater the diameter of the media pores and the surface area of the media, the greater the adsorption power of the media against dirt particles in the water. But over time, more and more dirt particles attached to the media will make the media quickly saturated so that it requires washing or replacing the media so that the filtration process can run properly again.

Tableau 3. Hasil Uji *One Way* Anova

Levene Statistic	F	Say
Decrease in turbidity	11.479	0.001

The results of *the one way* anova test show that the calculated F value is 11.479 and the *p value* is 0.001. The decision criteria taken is that if *the p value* <0.05 (5%) then Ho is rejected which means that there is an effect of variations in the size of silica sand filter media on reducing turbidity in clean water at PT. XYZ.

The size of the filter media is one of the factors that affect the filtration process. Filtration is a filtration process to remove suspended solids from water through a porous medium [10]. The working principle of filtration is to filter particles in water by filtering through porous media. The state of the media that is too rough or too fine will cause different sizes of cavities and pores. The pore size itself determines the ability to filter fine particles contained in clean (raw) water. Pore holes that are too large will increase the rate of filtration and will also cause the escape of fine particles to be filtered. Conversely, pore holes that are too fine will increase the ability to filter particles and can also cause *clogging* (blockage of pore holes by retained fine particles) that is too fast.

The small size of the filter media has a gap between small media so that it can filter turbidity with a fairly high efficiency. The smaller the size of the media used in the slow sand filter, the greater the resistance to particles in the water so that it can increase the effectiveness of the filtration process.

Overall, the results of reducing the turbidity value after passing through the filter media have met the requirements according to Permenkes No. 32 of 2017, so it can be said that all variations in media size sizes are fairly successful and effective in reducing the turbidity value in industrial clean water. However, there are several components for the industry that can be taken into consideration in its application. The components that need to be considered are: 1). Long filtration process time (media contact time), Filtration water comes out faster than other variations because variation 1 has a media size that is not too small and too large so that it can reduce the turbidity value and the filter results come out faster than other variations, but it is still in the same range, which is at 4 minutes, and 2). Filter media size, The size of the filter media is not too small. This is because the smaller the size of the media used in the filtration process will make the filtration process better, but over time it will make the filter media saturate faster so that filter media must be replaced more often so that filtration can run again optimally.

CONCLUSIONS AND RECOMMENDATIONS

The largest decrease in the size of silica sand filter media was in silica sand filter 3 with a large percentage of 85.86%. Based on the results of data analysis, it was found that there was an influence of variations in the size of silica sand filter media on reducing turbidity in clean water at PT. XYZ (*p value*=0.001).

It is recommended to the industry to consider several components in the application of filter media. And for the next researcher, it is expected to conduct further research on the *lifetime* of the silica sand filter media used.

REFERENCES

1. Abuzar SS, Pramono R. Direct Filtration Menggunakan Saringan Pasir. Pros SNSTL I. 2014;(September):89–95.
2. PUTRI TM. EFEKTIVITAS ARANG AKTIF TEMPURUNG KELAPA DAN RESIN TERHADAP PENURUNAN KESADAHAN DAN KEKERUHAN AIR SUMUR GALI DI DESA SAMBIROTO PRACIMANTORO WONOGIRI. Angewandte Chemie International Edition, 6(11), 951–952. 2021.
3. Khambali, Iva Rustanti dan ES. Modul Ajar Penyehatan Air. 2019.
4. Artidarma BS, Fitria L. Pengolahan Air Bersih dengan Saringan Pasir Lambat Menggunakan Pasir Pantai dan Pasir Kuarsa. 2021;09(2):4–6.
5. Aziz HA. Penurunan Total Suspended Solid (TSS) Dan Kekeruhan Pada Air Terkontaminasi Abu Vulkanik Gunung Kelud Menggunakan Reaktor Slow Sand Filter (Saringan Pasir Lambat) Single Media. 2014;1–13.
6. Pinem KI. Pengaruh Rate Filtrasi dan Ketebalan Media Pasir Silika Terhadap Penurunan Nilai Kekeruhan dan Peningkatan Nilai pH dalam Filtrasi Air Gambut. 2019.
7. Munfiah S. KEEFEKTIFAN KARBON AKTIF TEMPURUNG KELAPA, ZEOLIT DAN PASIR AKTIF DALAM MENURUNKAN KEKERUHAN AIR. Adv Drug Deliv Rev [Internet]. 2017;135(January 2006):989–1011. Available from: https://doi.org/10.1016/j.addr.2018.07.012%0Ahttp://www.capsulae.com/media/Microencapsulation - Capsulae.pdf%0Ahttps://doi.org/10.1016/j.jaerosci.2019.05.001
8. Nurmalia D, Elystia S, Sasmita A. Pengaruh Diameter Pasir Silika dan Zeolit pada Saringan Pasir Lambat dalam Menurunkan Parameter Kekeruhan Air Sungai Siak. J Online Mhs Fak Tek [Internet]. 2019; 6:1–8. Available from: https://jom.unri.ac.id/index.php/JOMFTEKNIK/article/view/24486
9. Ningrum SV. Penggunaan Media Filter Pasir Silika Dan Karbon Aktif Untuk Menurunkan Kekeruhan, Tds, Kesadahan Dan Besi Pada Reaktor Filter. 2020.
10. Siringoringo CF. Filtration), Pengaruh Perbedaan Tekanan Terhadap Kinerja Plate and Frame Filter Press Pada Filtrasi Ampas Tahu (The Effect of Different Pressure on the Plate and Frame Filter Press Performance on Tofu Waste). 2019.