



ADDITION OF SAND IN ARTIFICIAL AQUIFERS TO IMPROVE CLEAN WATER INTO DRINKING WATER

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ABSTRACT

Water is a very important component for human life. The increasing number of people in Indonesia, such as in the city of Bekasi, will directly result in the demand for clean water for human daily needs getting higher. Quality of water to meet human needs must also be considered. In this case, the Bekasi government through PDAM Patriot Bekasi plays a role in fulfilling water for the needs of its people. However, water from PDAM is only used for clean water needs and cannot be consumed for drinking water. Therefore, this research will provide an alternative so that water is not only used for clean water but also can be used for drinking water by considering existing health standards referring to the Minister of Health Regulation No. 492/MENKES/PER/IV/2010 about drinking water and Minister of Health Regulation No. 416/MENKES/PER/IX/1990 about clean water. The research was carried out by filtration through two (2) samples for testing. The results showed that the use of sand in the filtration method was able to improve quality of PDAM water, both water clarity and color according to regulations as drinking water standards with an arrangement of using medium gravel, coarse sand, red brick, limestone, and fine sand.

Keywords: *Drinking water, Clean water, Artificial filtration*

1. PRELIMINARY

The need for clean water quality is increasing every day, especially in big cities in Indonesia. This is triggered by population growth which is so high that the need for clean water is very necessary. The narrower water catchment areas and the lack of green land make things worse. On the other hand, the cause of decline in quality clean water is also influenced by the number of negative activities carried out by humans, one of which is the activity of disposing of waste in river and water gutter.

Bekasi City Government through the Regional Drinking Water Company (PDAM) Tirta Patriot serves clean water in the North

Bekasi and East Bekasi areas. Water sources from PDAM Tirta Patriot are obtained from Bekasi river and Malang river.

With this source, PDAM Tirta Patriot is able to produce with a maximum capacity of 750 liters of clean water per day. However, most people only use clean water from PDAM to meet their daily needs and not for consumption. Society chooses clean water from other sources (bottled, refilled water, etc.) for consumption because they think the water quality is better than the water supplied by the PDAM. The quality of PDAM water is not clean, usually due to the distribution of PDAM water through pipes that are not installed properly or when the

hose is removed from the tank and when stored in the reservoir itself it looks dirty. This situation allows the quality of water produced in the PDAM area to decrease.

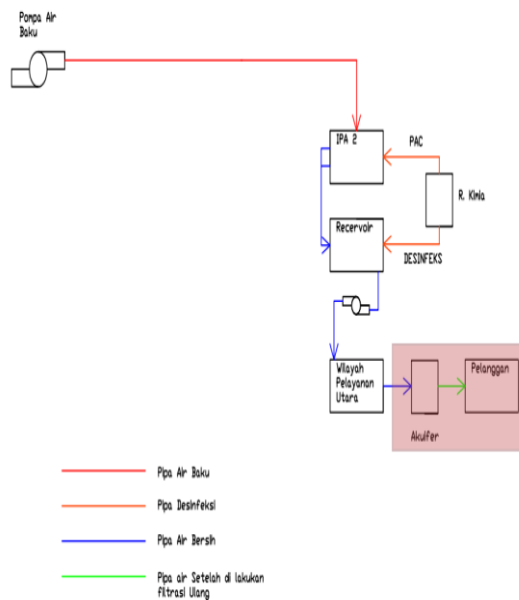


Figure 1. Schematic of Research Area

From the image above, it is known that raw water is pumped to the clean water production installation (IPA) and then forwarded to the reservoir building. However, before entering the reservoir building, the water passes through chemical mixing which aims to convert raw water into clean water. Furthermore, from the reservoir, it is distributed to the homes of PDAM water customers. From this distribution, water will pass through distribution pipes and can cause a decrease in PDAM water quality.

The task of PDAM is to produce drinking water, now the processed products of PDAM are still at the level of clean water. Regulations regarding differences in the quality standards of clean water and drinking water are contained in the Minister of Health Regulation for drinking water no. 492/MENKES/PER/IV/2010 and clean water standard No. 416/MENKES/PER/IX/1990. The difference in quality standards is in Table 1.

Table 1. The Difference in Quality Standards of the Minister of Health Regulation for Drinking Water and Clean Water

No	Parameter	Drinking Water Standard	Clean Water Standard
		No. 492/MENKES/PER/IV/2010	No. 416/MENKES/PER/IX/1990
1	Physic Parameter		
	Color	15	50
	Turbidity	5	25
2	Chemical Parameter		
	Nitrite	3	1
	Chlorine Total	≥ 0,2	≥ 0,2
	N. Ammonia	1.5	1.5
	Iron	0.3	15
	Ph	6.5-8.5	6.5-9.0

At PDAM Tirta Patriot Bekasi, the results from laboratory tests show that the water distributed to the society still does not meet the requirements for drinking water.

One of the declines that occurred was the factor of color water and turbidity level water in society.

Therefore, this research will provide another alternative to the society, especially PDAM water users to improve the quality of clean water in residents' homes. The researched water is PDAM water that has passed through various water distribution pipes that have changed water quality from the PDAM center to residents' homes. The method used to deal with the above problem is to utilize sand in the filtration method which is almost adapted to the Rainwater Storage Aquifer Building (ABSAH) to increase the color and clarity of water in the Minister of Health Regulation No. 492/MENKES/PER/IV/2010 about drinking water and Minister of Health Regulation No. 416/MENKES/PER/IX/1990 about clean water. The ABSAH method is a filtration method that is intended to filter rainwater, while in this research it is intended to filter

PDAM water in residents' homes and then filtered to then enter the residents' homes reservoirs.

2. THEORETICAL BASIS

Raw Water

Raw water is water that comes from surface water sources, groundwater basins and or rainwater that meets certain quality standard provisions as raw water for drinking water.

Clean Water

Clean water is healthy water that used to human activities and must be free from microbe that cause disease, free from chemicals that can pollute the clean water

Filtration Method

Filtration method is a physical separation method used to separate liquids with solids. The liquid that through the filtration process is called the filtrate, while the solids that accumulate in the filter are called the residue. The basic principle of this filtration is very simple, that is filtering the molecules of solids mixed in the liquids, then the level of purity of the filtrate obtained from the filtration depends on the quality as well as the pore size of the filter (filter used).

The following is an explanation of the materials that will be used in the screening process, including:

1. Gravel
Gravel is a small rock, usually crushed granite. The gravel size that is always used is between 2 and 75 mm.
2. Sand
According to SNI 02-6820-2002, fine aggregate is an aggregate with a maximum grain size of 4.75 mm
3. Limestone
Limestone is a sedimentary rock composed mainly arranged from calcium carbonate (CaCO_3) in the form of the mineral calcite.
4. Red brick
Red brick is a brick made from molded soil and then burned at high temperature so that it becomes completely dry, hardens, and has a red color.

Water Quality Standards

Clean water is water that does not cause disease to humans. Therefore, the water should be made to meet the health requirements, at least trying to approach the water requirements that have been determined (Kusnoputranto, 2000). The Minister of Health Regulation that used for drinking water at this time is No. 492/MENKES/PER/IV/2010 while The Minister of Health Regulation for clean water is No. 416/MENKES/PER/IX/1990.

3. RESEARCH METHOD

The research conducted is the manufacture of a simple water treatment device using a filtration system, which can be used on a household scale.

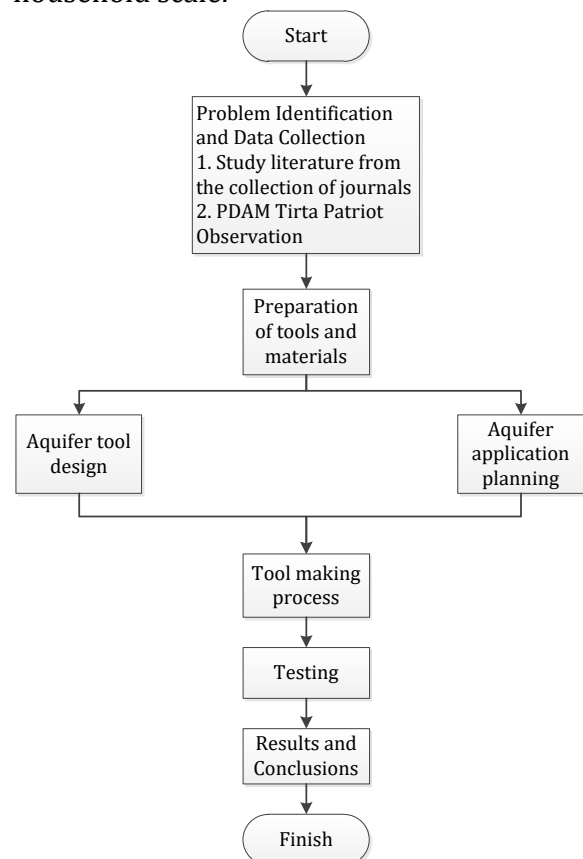


Figure 2. Flowchart

Research Method

This research was conducted by looking at the water sample variables used, that is water from PDAM Tirta Patriot customers whose address is at Perjuangan street No.99, Marga Mulya, Bekasi City, West Java

Research Time

This research was conducted in the morning at 08.00 WIB

Tools and Materials Used

The materials that will be used during the research include:

1. PDAM water
2. Coarse sand 3 mm
3. Gravel 1 cm
4. Broken bricks 5 mm
5. Limestone 1 cm
6. Wood charcoal
7. Bucket paint 5 Kg
8. Water faucet
9. Water faucet connection
10. Pipe glue
11. Filter screen
12. Hose ½ inch 3 meters
13. Leak-proof duct tape

Thickness Variation

The aggregate thickness plan that will be used.



Table 2. Aggregate Thickness Variation

No	Layer Material	Sample 1	Sample 2 (m ³)
1	Medium Gravel	PDAM Costumer Water	0.0045
2	Coarse Sand		0.0045
3	Red Brick		0.0045
4	Large Gravel and Limestone		0.0045
5	Coarse Sand		0.0045
6	Red Brick		0.0045
7	Fine Sand		0.0045

Making Tools

Here are steps for making a filtration device in table 3.

Table 3. Making Tools

No	Picture	How to Make
1		Prepare the tools to be used such as 7 bucket paint 5 liter paint buckets and 1 bucket paint 5 liter that has been installed with a faucet for filtering water out, water filter, leak-proof glue, and tape
2		Next, prepare the materials that will be used for the filter itself, such as sand, gravel, charcoal, limestone, and red brick.

No	Picture	How to Make
3		<p>Break the large aggregate such as red bricks and limestone, then sieve the aggregate with a large sieve size 0,5 cm for red bricks and 1 cm for limestone. After obtaining the aggregate with specified size, then wash the aggregate that will be used first.</p>

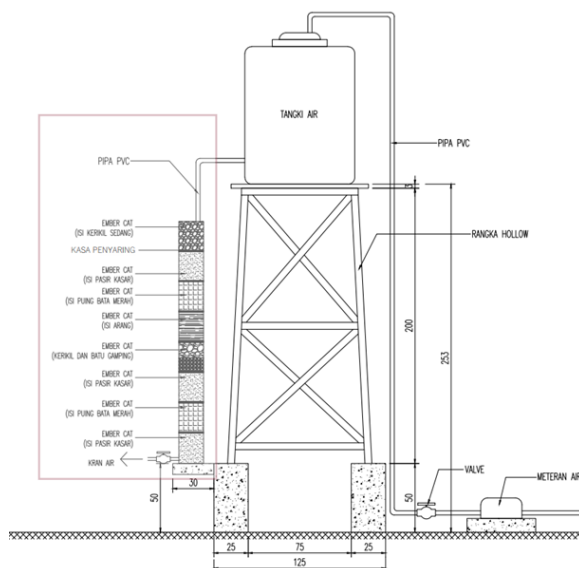


Figure 3. Tool Installation Arrangement

4. RESULTS AND DISCUSSION

Here are the results analysis from the laboratory regarding filtration carried out in one of the customers' homes of PDAM Tirta Patriot without using aquifers

Table 4. The Results of Research Sample from Resident's Homes

No	Parameter	Unit	Score
			Sample 1
1	Physic Parameter		
	Color	TCU	2
	Turbidity	NTU	0.892
2	Chemical Parameter		
	Nitrite	mg/l	0.024
	Chlorine Total	mg/l	0,02
	N. Ammonia	mg/l	Good
	Iron	mg/l	0.56
	Ph		7,51

From table 4 it can be explained that before entering the filtration water for customer water there are 2 parameters that do not meet the requirements for drinking water, namely iron content with a value of 0.56 mg/liter and Total Chlorine 0.02

Table 5. The Results of Research Sample 2 After Passing the Artificial Aquifer.

No	Parameter	Unit	Score
			Sample 2
1	Physic Parameter		
	Color	TCU	Good
	Turbidity	NTU	0.74
2	Chemical Parameter		
	Nitrite	mg/l	0.052
	Chlorine Total	mg/l	0,028
	N. Ammonia	mg/l	0,1
	Iron	mg/l	0.08
	Ph		7,45

The laboratory results show that the results meet all the requirements according to the Minister of Health Regulation for drinking water No. 492/MENKES/PER/IV/2010 and clean water standard No. 416/MENKES/PER/IX/1990

From the comparison table above, the following results were obtained:

Table 6. Comparison Results

No	Parameter	Unit	Sample 1	Sample 2	Quality Standard
1	Physic: Color Turbidity	TC U NT U	2 0.892	Good 0.74	15 5
2	Chemical: Nitrite Chlorine Total N. Ammonia Iron Ph	mg /l mg /l mg /l mg /l	0.024 0.02 Good 0.56 7.51	0.052 0.28 0.1 0.08 7.45	3 > 0.2 15 0.3 6.5-8.5

5. CONCLUSION

From the results of the conclusion that:

1. By utilizing sand, it can improve the color clearer or better without using sand and water turbidity decreased from 0.892 NTU to 0.74 NTU.
2. Utilization of sand in artificial aquifers can improve the quality of clean water into drinking water for PDAM customers

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