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Effectiveness of Coconut Charcoal Shell Activated Carbon Filtration to Lower Fe in Cisterns Water: A Case Study in Arsopura, Keerom Regency, Papua

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ABSTRACT: Clean water consumed daily should not contain excessive Fe (iron) because it can cause health problems. The Fe can be reduced by filtering using activated carbon such as those found in coconut shells. For this reason, this study will analyze the effectiveness of iron filtration in excavated well water in Arso Pura, Keerom Regency, Papua Indonesia. The method used is an experiment with Randomized Complete Block Design (RCBD). Purposive sampling was carried out on community dug well water in Arso Pura, Keerom Regency, Papua by measuring Fe levels before and after using coconut shell activated carbon and the use of miner areas of 2 Inches, 3 Inches and 4 Inches. The results of the Anova test, namely a p-value of 0.00<0.05, indicate that filtration with coconut shell charcoal and the addition of a cross-sectional area of the cross-sectional area have a significant effect or significantly different treatment on Fe (Mg / l). The result was with a cross-sectional area of 2 inches H with a decrease of 47.62%; 3 Inch to 59.05%, and 4 Inch to 63.81%. The results of the screening have not been able to meet the requirements for Fe levels in potable water. For this reason, a larger miner expansion mechanism and/or a different filtration approach is needed that must be carried out on the dug well water in Arsopuro to make it drinkable.

KEYWORDS: Dringking water, Fe grade, Coconut Shell Charcoal

BACKGROUND

Water is an important valuable resource for all forms of life. It is even regarded as the blood of the earth. While there is plenty of water to meet the demand of a projected population of around 9 billion, there is significant time and space variation in the global distribution of this valuable resource. As a result, there are water-rich and water-poor countries facing water pressure and water scarcity, which can lead to water-related conflicts and even 'water wars' in extreme situations. The World Health Organization (WHO) has identified unsafe drinking water as the world's leading killer (Jayawardena, 2022; 2023). The preciousness of water as described by Jayawardena is also due to the fact that the human body consists of more than 60% water in adults (Agustina, 2022).

The source of water used for human life is divided into two, namely natural sources and artificial sources. Natural sources include surface water and groundwater. Meanwhile, other antra made well water, drills and water that go through a purification process (Hartono, 2004). Furthermore, Hartono (2004) well water is surface water that is dug less than 15 meters, and generally does not meet the quality requirements both physically, biologically and chemically so that it cannot be consumed directly. On the basis that well water comes from various kinds of water that cannot be separated from human activities, often the water is polluted (Novaliani, 2022); can be iron (Fe) Manganese (Mn) and so on (Slamet, 2004, Novaliani, 2022). The contamination shows changes in color, smell and taste (Slamet, 2004) and can cause health problems (Slamet, 2004l Novaliani, 2022).

Besides harming the mineral Fe which is also needed in small quantities for the human body. Excess Fe for health can result in vascular disease including being a contributor to heart attack and buildup in the liver organs can result in liver cancer (Wardhana, 2004). for the dangers posed by substances in the water, the Government through the Minister of Health issued Ministerial Regulation No. 492 of 2010 which regulates the requirements and supervision of water quality by setting clean water quality standards. The standard for Fe is 0.3 mg/l and if it exceeds it it must require processing before being used for daily use.

Studies have revealed that the Fe content of water in Indonesia is excessive from the threshold (Mulyono, Wiwiek & Kriswandana, 2020; Hartono & Pratiwi, 2022; Sari, 2022), in Lampung (Sari, 2022); in Kendari (Hartono & Pratiwi); and including in Papua (Mulyono, Wiwiek & Kriswandana, 2020). Mulyono, Wiwiek & Kriswandana found Fe in the water of the Jayapura City Regional Drinking Water Company (PDAM) while Hartono & Pratiwi (2022); Sari (2022) in well water.

Researchers identified several techniques and ways of filtering water including (zeolite; corn cobs, sand and active wine (Efendi, 2003); for iron itself, including using corn cob charcoal (Simbolon, 2011); sago stem fiber (Hartono & Pratiwi, 2022); Zeolite and Ferrolite (Mulyono, Wiwiek & Kriswandana, 2020); and coconut shell charcoal (Idayani Sangadji et al (2017).

Idayani Sangadji et al (2017) showed coconut shell charcoal with a thickness of 25 cm, on average it can reduce Fe levels by 40%. Meanwhile, at the thickness of coconut shell charcoal 30 cm, it decreases by 60%. Meanwhile, Zainul Ikhwan (2012) quoted by Subamia, Wahyuni & Widiasih (2017) revealed a pre-experiment where there were 5 sieve treatments, namely with a thickness of 3 Cm, 6 Cm, 9 Cm, 12 Cm, and 15 Cm. Data were analyzed using the Friedman test with alpha 0.05. Based on the results, it is known that the effectiveness of utilizing the size of coconut shell charcoal as a filter medium against reducing iron content in pond water is with a thickness of 6 cm, and manganese with 9 cm.

Based on the problems mentioned above, this study focuses on filtering iron with coconut shell charcoal media in well water in Arso Puro, Keerom Regency, Papua Province. The reason for choosing coconut shell charcoal is that coconut shells are generally found in almost all of Indonesia, including at research sites.

METHOD

This study using the Randomized Complete Block Design (RCBD) method or a randomized group design is an experiment where the factors tried are more than one factor and uses RAK as an experimental design. This design is chosen if the experiments used are not uniform, so they need grouping. The sample of this study is the Well Water dug by the People of Arso Pura Village. Sampling was carried out by purposive sampling at one dug well in Kampung Arso Pura, Keerom Regency, then an examination of samples was carried out before and after filtration with activated carbon from Batok Kelapa.

1. Implementation

In its implementation, the author divides into two activities: the implementation of treatment and examination of samples before and after filtration with activated carbon Coconut Shells in the laboratory.

2. Tools Anf Material

Table 1. Tools and material

Alat	Bahan
One hacksaw	PVC pipe 2-inch length 60 cm
One drill with ½ inch eye	PVC pipe ½ inch length 160 cm
One cutter knife	1 sheet of fine sandpaper number 5000
Stopwatch	2 pcs stop faucet size ½ inch
Measuring cups	4 pcs of 2-inch thread Dop.
stationery	7,5 cm thick foam to taste
papers	4 pcs ½ inch PVC Dop.
	2 pcs PVC Glue.
	Coconut charcoal unknown

3. Made the Filtering Tools

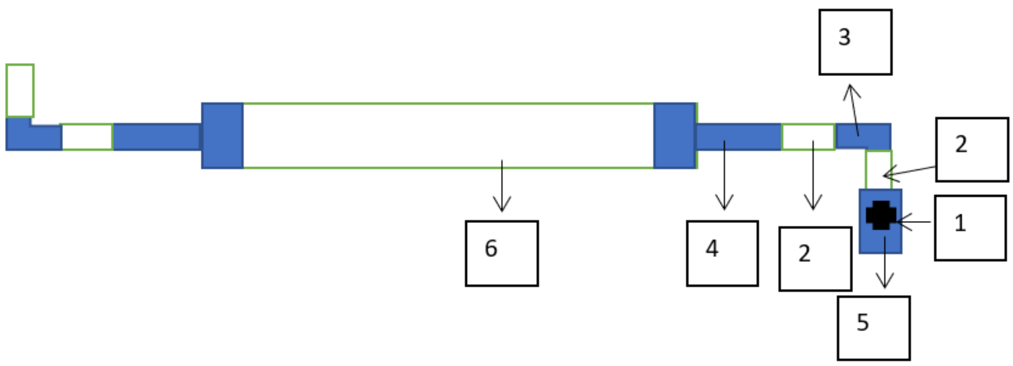

Figure 1. Filtering Tools

\Description: 1. Stop faucet 1/2 inch; 2.PVC pipe 1/2 inch; 3. Elbow PVC 1/2 inch; 4. PVC straight pretentious 1/2 inch; 5.2 inch PVC hubcap; 6. PVC pipe 2 inch

The steps of making a sieve are as follows:

1) Cut a PVC pipe 30 cm long by 2 pieces with a hacksaw.
2) Hole 4 pieces of 2-inch PVC Dop symmetrically with a drill bit size of 1/2 inch
3) Cut 1/2 inch pipes as many as 8 pieces with a size of 20 cm each 1/2 inch
4) PVC dop mounted with 1/2 inch PVC straight Supported by 1/2 inch pipe on a 2 inch
5) PVC pipe hubcap that has been perforated and then glued Installed 1/2 inch PVC elbow on PVC pipe 1/2 that has been installed hubcap.
6) Then install another 1/2 inch PVC elbow with a 1/2 inch PVC pipe.
7) A faucet stop is installed at one end of the pipe that is 1/2 inch in size.
8) Cut foam/round sponge into 4 pieces more than 2 inches in diameter. Cut more so that it can be used as a buffer from coconut shell charcoal at the time of continuous filtration.
9) Insert foam/sponge at one end of a 2-inch PVC pipe.
10) Install the hubcap on the foamed pipe/sponge.
11) Entering the material, namely the coconut shell arasng that has been pureed into the msing of each 2-inch PVC pipe.
12) Each foam/sponge is installed on a pipe that has been inserted in coconut shell charcoal. Each hubcap is placed on a 2-inch PVC pipe that has been filled with coconut shell charcoal. All joints are glued PVC pipes.

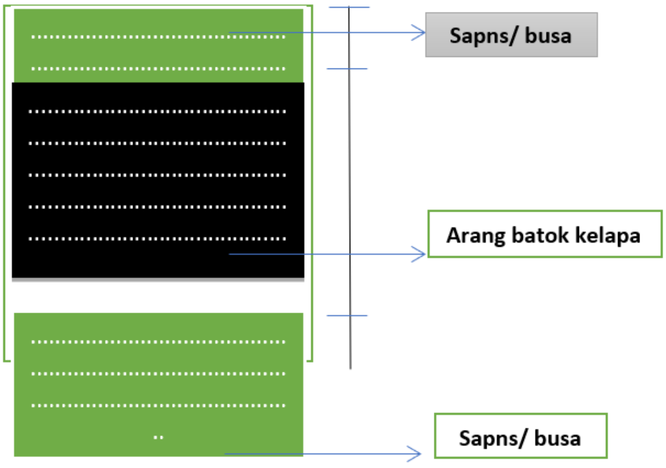

Figure 2. Filteration on Pipe

4. Coconut Charcoal activated carbon manufacturing procedure

a. Buy coconut shells at the coconut seller's place or in the market
b. Dry the coconut shells until they are completely dry so as to make the burning process easier
c. Burn the coconut shells until they become charcoal but do not turn to ashes
d. Mash until smooth coconut shells have become charcoal.
e. Sift or strain coconut shells with a size of 18-20 mesh
f. Put the sifted coconut shell charcoal powder into a colander.

5. Steps for assessment/measurement of Fe levels in cross-sectional area treatment

Table 2. Treatment Steps 1-3

Treatment 1: 2 inch	Treatment 2: 3 inch	Treatment 3: 4 inch
Turn on the pump. Flow the ketandon water to the charging limit. All water faucets (1,2and, 3) are off. Open faucets 2 and 3.	Treatment 2 begins with treatment 1 at point 10. Faucets 1 are closed, and faucets 2 and 3 are open. Then let stand for 10 minutes.	treatment 3 it begins with offender 2 on point 9. Faucets 1 are closed, and faucets 2 and 3 are open. Let stand for 12 minutes.

Prepare measuring cups 500 ml 2 pieces. Open faucet 1. Accommodate water from faucets 2 and 3 into a 500 ml measuring cup of 100 ml liters. Close faucet 1. Check the sample water collected on a 500 ml glass. Repeat 3 times.	Prepare measuring cups 500 ml 2 pieces. After 10 minutes open the faucet 1. Accommodate the water that comes out of faucets 2 and 3 into a 500 ml measuring cup. A total of 100 ml liters. Close faucet 1. Check the sample water accommodated on a measuring cup of 500 ml liters. Repeat 3 times	Prepare measuring cups 500 ml liters of 2 pieces. After 12 minutes, open faucet 1. Collect the water that comes out of faucets 2 and 3 into a measuring glass of 500 ml liters as much as 100 ml liters. Close faucet 1. Check the sample water held on a measuring cup of 500 ml liters. Repeat 3 times

RESULT

1. General Overview

Measurement of the effectiveness of coconut shell charcoal to reduce the Fe Iron content in well water is carried out with and without treatment (coconut shell charcoal). The results obtained are shown in table 3 and figure 3 below:

Table 3: Fe Content Analysis Results with and without using Coconut Shell Charcoal Filter Media

	Repetition			Sum (Mg/l)	Average (Mg/l)	Decline	
	1	2	3			(Mg/l)	%
No Traetment	1.05	1.00	1.10	3.15	1.05	-	
Treatment							
2 inch	0.55	0.50	0.60	1.65	0.55	0.5	47,62
3 inch	0.40	0.45	0.45	1.30	0.43	0.62	59,05
4 inch	0.35	0.40	0.40	1.15	0.38	0.67	63,81

Source: Data Primer

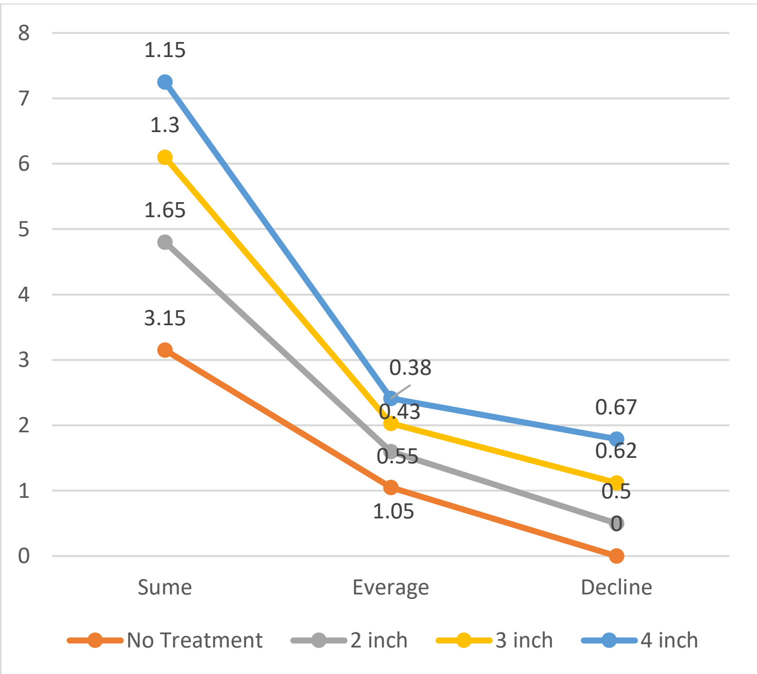

Figure 3: Decline Fe Level with coconut charcoal media filtration

Source: Data Primer

THE table and figure above show that Fe levels at no treatment showed any decrease in Fe levels from three repetitions. Meanwhile, in good treatment with a cross-sectional area of 2, 3 and 4 inches, there was a decrease, namely successively, 0.55 mg / l (47.62%); 0.62 mg/l (59.05%) and 0.67 mg/l (63.81%).

2. Anova one Way Analyze

The following are the results of the analysis of the iron content of Fepada well water using Anova One Way:

Table 4. Results of one-way Anova analysis on Fe Levels Using Well Water Coconut Shell Charcoal Media

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.291	3	.430	23.206	.000
Within Groups	.148	8	.019		
Total	1.439	11			

Source: Data Primer

The table above is the result of Anova's analysis The effect of cross-sectional broad treatment (0, 2 Inch, 3 Inch and 4 Inch) on Fe (Mg/l). In the results of the Anova test above, it can be seen that the signification value is smaller than 0.05 ($P<0.05$) which is $0.00<0.05$ so that H0 is rejected with the conclusion that the Cross-sectional Area Treatment has a significant influence or different treatment of Fe (Mg / l).

Because of the significant treatment, further tests were carried out which in this case used the Different test with the following results:

Table 5. HSD Turkey Analise level decrease of Fe with coconut charcoal shell

Container area	N	Subset for alpha = 0.05	
		Treatment	No treatment
4 Inch	3	.3833	
3 Inch	3	.4333	
2 Inch	3	.5500	
0	3		1.2000
Sig.		.481	1.000

Source: Data Primer

The table above is the result of the real difference test (Tukey) broad cross-sectional treatment of Fe (Mg/l) parameters. If the treatment is located in the same subset it means that the treatment is not significantly different.

3. Water discharge produced by filtration

The following is the water discharge produced by each filter with a difference in the cross-sectional area:

Table 6. Water Discharge produced by filtration of well water using coconut shell charcoal media

Container Area	**Water discharger ml/d**
2 inch	0,0083
3 inch	0,015
4 inch	0.025

Source: Data Primer

The table above shows that the water discharge with a cross-sectional area of 2 inches is 0.0083 ml/d, the cross-sectional area of 3 inches is 0.015 ml/d and the cross-sectional area of 4 inches is 0.025 ml/d.

4. Comparison Fe levels after filtration with coconut charcoal with quality standard health water of Indonesia Minister of health

Table 7. Comparison of well water filtration results using coconut shell charcoal media with clean water standards of the Indonesian Ministry of Health

Treatment	Result (mg/l)	Quality standard of Fe (mg/l)	Information
2 inch	0,5	0.3	Ineligible
3 inch	0.43		Ineligible
4 inch	0.38		Ineligible

Source: Data Primer

The table above shows that all well water filtration treatments with coconut shell charcoal media do not meet the requirements for clean water in Arso Puro, Keerom Regency in 2020

DISCUSSION

The results of research conducted to reduce the iron content of Fepada well water in Arso Puro using activated carbon medium coconut shell charcoal with a difference in cross-sectional area showed that there was a significant decrease, this can be seen in table 4, in the anova test results above it can be seen that the signification value is smaller than 0.05 ($P<0.05$) which is 0.00 <0.05 so that H0 is rejected with the conclusion The cross-sectional Area screening treatment exerts a significant influence or significantly different treatment on Fe (Mg/l). Activated carbon or activated charcoal is a porous solid containing 85-95% carbon, produced from carbon-containing materials by heating at high temperatures. Activated charcoal can be made from all carbon-containing materials, both organic and inorganic as long as the material has a porous structure (Sudrajat and Salim, 1994). Activated charcoal can be made from ordinary charcoal derived from plants or mining goods. The material of such materials is various types of wood, sawdust, sekampadi, danbatubara (Pari, 1995).

Activated carbon is most often used as an absorbent (adsorbent) material. Absorption is determined by the surface area of the particles and this ability can be higher if activated charcoal or activated carbon materials using chemicals or by heating at high temperatures.

Adsorption is the process of collecting soluble subtansiter in solution by the surface of an absorbent object in the manater into a physical chemical bond between the substance and its absorbent (Sembiring, 2003). Adsorption occurs on the surface due to the forces of atoms and molecules on that surface. Absorbing substances are called adsorbents, while absorbent substances are called adsorbates. Adsorbents can be both solid substances and water substances. Solid adsorbents include silica gel, alumina, platinumhalus, cellulose, and activated charcoal. Adsorbate can be solid, liquid and gaseous substances. Adsorbent is a highly porous material. The location of the adsorption process occurs on the walls of the pores or certain locations in the adsorbent particles. Since those pores are usually very small, the area of the inner surface becomes several orders larger than that of the outer surface. Separation occurs because of differences in molecular weight or because differences in polarity cause some molecules to adhere to that surface more tightly than other molecules (McCabe in Setiati, 2004).

The level of Fe Iron contained in well water in Arso 4 has decreased because it is filtered using a filter with activated carbon media. Activated carbon has the ability to adsorb organic substances contained in the water, this we can see in table 1. In this study, activated carbon filters with a cross-sectional area of 2 inches dapart reduced the level of Fe iron in water by 47.62%, sieves with a cross-sectional area of 3 inches could decrease by 59.05% and sieves with a cross-sectional area of 4 icnh could reduce 63.81%. This indicates that the ability of activated carbon to adsorb solutes in well water so that there is a decrease in Fe iron content.

Sieve using the difference in cross-sectional area, namely the cross-sectional area of 2 inches, 3 inches and 4 inches to reduce iron levels Fetak there is a noticeable difference. This can be seen in table 5 of this study. In this case, there are several factors that affect the absorbency of adsorption, namely:

1. Adsorben Characteristic

Activated charcoal which is an adsorbent is a porous solid, which consists mainly of free carbon elements and each of them is covalently related. Thus, the surface of activated charcoal is non-polar. In addition to composition and polarity, pore structure is also an important factor to pay attention to. The structure of the pore is related to the surface area, the smaller the pores of activated charcoal resulting in the larger the area. Thus the speed of adsorbs increases. To increase the speed of adsorption, it is recommended to use mashed activated charcoal. The amount or dose of activated charcoal used should also be observed.

2. Absorption Characteristic

Many compounds can be adsorbed by activated charcoal, but their ability to adsorb is different for each of them. Adsorption will increase in size according to the increase in the size of the absorption molecules of the same structure, such as homologous series. Adsorption is also influenced by functional groups, functional group positions, double bonds, chain structure of absorption compounds.

3. Temperature

In the use of activated charcoal, it is recommended to observe the temperature during the process. Factors affecting the temperature of the adsorbs process are the viscosity and thermal stability of the absorption compound. If heating does not affect the properties of the absorption compound, such as discoloration or decomposition, then the treatment is carried out at its boiling point. For volatile compounds, adsorbs are performed at room temperature or whenever possible at lower temperatures.

4. pH

For organic acids, adsorbs will increase when the pH is lowered, that is, by the addition of mineral acids. This is due to the ability of mineral acids to reduce the ionization of these organic acids. Conversely, if the pH of organic acids is raised, namely by adding alkali, the adsorbs will decrease as a result of the formation of salts.

5. Contact Time

When activated charcoal is added in a liquid, it takes time to reach equilibrium. Stirring also affects the tangent time. Stirring is intended to give activated charcoal particles the opportunity to intersect with the absorption compound. For solutions that have high viscosity, it takes a longer tangent time (Sembiring, 2003). The longer the contact time can allow the process of diffusion and attachment of direct dsorbatber molecules better. The concentration of organic and metallic substances in the water will decrease when there is enough contact. Contact time is usually around 10-15 minutes.

The volume of activated carbon or the cross-sectional area used in this study did not significantly affect the decrease in iron contained in water because the volume of activated carbon or the cross-sectional area is not a factor that affects the effectiveness of activated carbon to adsorb solutes. In this study, researchers found that the cross-sectional area affects the discharge of the water produced. In this study, the activated carbon filter of coconut shells could not reduce Fe iron levels up to the standard of the Indonesian Ministry of Health No.492 / MENKES / PER / IV / 2010 which was 0.3 mg / l. This is due to the flow velocity used in the study because the researcher did not regulate the flow speed, the flow speed itself affects the contact time of water with activated carbon so that Fe iron absorption is more effective.

In table 6, it can be seen that the filter with a cross-sectional area of 2 inches of water discharge is 0.0083 ml/second, the cross-sectional area of 3 inches of water discharge is 0.015 ml / second and the cross-sectional area of 4 inches of water discharge is 0.025 ml/second. The larger the cross-sectional area, the greater the water discharge produced.

CONCLUSION

1. The level of Fe before receiving treatment was 1.05 ml.
2. The Level of Fe dropped after receiving treatment with a difference in cross-sectional area of 2 inches of 47.62%
3. Fe levels dropped after receiving treatment with a 3-inch cross-sectional area difference of 59.05%.
4. Fe Levels dropped after receiving treatment with a difference in 4-inch cross-sectional area of 63.81%
5. Fe Levels do not meet the requirements of the Ministry of Health's healthy water quality standards after being filtered using a sieve with a cross-sectional area of 2 inches, 3 inches, and 4 inches.

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