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THE EFFECTIVENESS OF WATER FILTERS WITH ACTIVATED CARBON MEDIA OF BAGASSE SUGARCANE FOR REDUCING IRON LEVELS IN GROUNDWATER

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Abstract
Background: Clean water supply can be obtained from various sources, both groundwater and surface water. Groundwater often contains high levels of iron (Fe). Many residents are forced to use water which in terms of quality does not meet the requirements, one of which is the chemical elements in the form of high iron content which can cause diarrhea, anemia, kidney damage that ends in death.
Methods: This research is an experimental study to determine the effectiveness of bagasse activated carbon thickness in reducing iron (fe) levels in groundwater in Kebon Jeruk district, west Jakarta. This research was conducted at the workshop of environmental health department of health polytechnic of the ministry of health Jakarta. The water sample used was 45 liters, samples from electric pump wells treated with sugarcane bagasse activated carbon filtration with a thickness variation of 0 cm as control or without activated carbon bagasse, 30 cm, 45 cm, 60 cm, and 75 cm.
Result: results of chemistry laboratory research at the department of environmental health polytechnic of the ministry of health Jakarta on the content of iron (fe) in groundwater, iron content (fe) before processing by filtration method using bagasse pulp activated carbon as much as 2.99 mg / l against allowable iron (fe) levels for clean water quality requirements based on ministry of health regulation no. 32 in 2017, the maximum allowable content of 1.0 mg / l.
Conclusion: of the five treatments the most effective thickness of activated carbon reduces iron (fe), is at a thickness of 45 cm because it has been able to reduce iron levels below the maximum allowable level based on ministry of health regulation no. 32 in 2017 which is 1.0 mg / l.
Keyword: Water Treatment, Sugar Cane Bagasse, Fe Reduction, Environmental Health, Environmental Chemistry

Introduction

Water is an essential requirement for all living things on earth, both for animals, plants, and humans. In the human body, 60–80% consists of water. Water is used for various social needs. Water and health are two interrelated things. The quality of water consumed by the community can determine the degree of health of the community.

Minister of Health Regulation Number 32 the Year 2017 Concerning "Environmental Health Standard Quality Standards and Water Health Requirements for Sanitary Hygiene, Swimming Pools, *Solus Per Aqua,* and Public Baths." Physical water quality requirements are tasteless, odorless, and colorless. For chemical parameters, one of them is iron (Fe), which is a standard quality standard that is allowed only 1 mg / L.

Based on the results of the field survey, Kebon Jeruk is an area that was formerly a swamp and rice fields where the water is physically yellow, smelly, and tastes. The people in the area use clean water from groundwater sources for daily use. Testing groundwater quality in one of the groundwater sources in the area used by residents of Kebon Jeruk Village, Kebon Jeruk District, West Jakarta indicated that the results obtained at the initial examination were 2.99 mg / L (exceeding the accepted standard).

Therefore, treatment efforts are needed before the water is consumed so that it will not interfere with the human health. One of the most common and conventional methods of treatment is the filtration process. Filtration is a filtering process to remove suspended solids and reduce iron content through porous media. The public can apply simple filtration tools. One of the media that can be used is sugarcane bagasse which can be utilized as activated carbon.

Based on the description above, the authors are interested in researching to reduce levels of iron (Fe)

in groundwater in Kebon Jeruk Village, Kebon Jeruk District, West Jakarta with a filtration method using bagasse activated carbon media.

Method

This research is an experimental study to determine the effectiveness of bagasse activated carbon thickness in reducing iron (Fe) levels in groundwater in Kebon Jeruk Village, Kebon Jeruk District, West Jakarta. This research was conducted at the Workshop of Environmental Health Department of Health Polytechnic of the Ministry of Health Jakarta II. The water sample used was 45 liters, samples from electric pump wells treated with sugarcane bagasse activated carbon filtration with a thickness variation of 0 cm as control or without activated carbon bagasse, 30 cm, 45 cm, 60 cm, and 75 cm. With a discharge of 2 liters in 5 minutes, then, it was carried out five treatments with three repetitions in each treatment.

Results

The results of the initial examination of iron levels obtained values of the iron content of 2.99 mg/liter. The temperature of the groundwater sample after being measured was 30oC. Receiving the results of pH measurements of 7, it is concluded to possess normal pH (table 1).

Table 1: Preliminary Examination of Soil Water Samples before Treatment

No	Initial Inspection of	Results
1	Iron (Fe)	2.99 mg / l
2	Temperature	30 ^{0}C
3	pH	7

Results of measurement of iron (Fe) levels after treatment using activated carbon media of sugarcane bagasse with thickness 30 cm obtained 1.19 mg / l, and depth 45 cm obtained 0.89 mg / l, 60 cm thickness obtained 0.78 cm and 75 cm thickness obtained 0.72 cm. Because with a thickness of 30 cm, 45 cm, 60 cm, and 75 cm can reduce levels of iron (Fe). Then, it will proceed to the actual test (Table 2).

Table 2: Preliminary Test Using the Variation of Activated Carbon Thickness of Sugarcane Bagasse

No	Variation Thickness of Activated Carbon Sugarcane Bagasse (cm))	Iron (Fe Levels Before Treatment (mg /l)	Iron (Fe) Levels After Treatment (mg / l)
1	30 cm	2.99	1.19
2	45 cm	2.99	0, 89
3	60 cm	2.99	0.78
4	75 cm	2.99	0.72

The results of measurement of iron content (Fe) after treatment using bagasse activated carbon media the first treatment with a thickness of 0 cm obtained the result of a decrease in iron content (Fe) by 1, 84 mg / l. While at a thickness of 30 cm the result is a decrease of 1.10 mg / l and at a thickness of 45 cm the result is a decrease of 0.93 mg / l and at a thickness of 60 cm the result is a decrease of 0.72 mg / l and at a thickness of 75 cm the result is a decrease of 0.70 mg / L.

Measurement of iron content (Fe) after treatment using bagasse activated carbon other carbon media with a thickness of 0 cm obtained the result of a decrease in iron content (Fe) of 1.89 mg / l. While the thickness of 30 cm obtained a reduction of 1.16 mg / l and at a thickness of 45 cm obtained a decrease of 0.89 mg / l and at a thickness of 60 cm obtained a reduction of 0.71 mg / l and a thickness of 75 cm the result was a decrease of 0.69 mg / L (Table 3).

The results of measurements of iron content (Fe) after treatment using bagasse activated carbon media third treatment with a thickness of 0 cm obtained the result of a decrease in iron content (Fe) of 1.83 mg / l. While at a thickness of 30 cm the result is a decrease of 1.18 mg / l and at a thickness of 45 cm the result is a decrease of 0.87 mg / l and at a thickness of 60 cm the result is a decrease of 0.70 mg / l and at a thickness of 75 cm the result was a decrease of 0.68 mg / L (Table 3).

Table 3: Iron (Fe) Content in Ground Water after Treatment by Using Thickness Activated Carbon

No.	Variation Thickness of Activated Carbon Sugarcane Bagasse (cm))	Iron (Fe Levels Before Treatment (mg / l)	Iron (Fe) Levels After Treatment (mg / l)		
			1	2	3
1.	0 cm	.99	1.83	1.89	1 .83
2.	30 cm	.99	1.18	1.16	1.18
3.	45 cm	.99	0.87	0.89	0.87
4.	60 cm	.99	0.7	0.71	0.7
5.	75 cm	.99	0.68	0.69	0.68

There is a correlation of decreased levels of iron (Fe) with variations in the thickness of activated carbon of sugarcane bagasse. The thicker sugarcane activated carbon media, the iron (Fe) content decreases. The highest reduction percentage in bagasse activated carbon media is 75 cm thickness with iron (Fe) reduction percentage of 76.92%.

Of the six variations in the thickness of bagasse activated carbon, the bagasse activated carbon medium with a thickness of 45 cm has been effective

in reducing iron (Fe) levels to 0.90 mg / l. These results have shown that iron (Fe) levels are below the quality standard stipulated in the Minister of Health Regulation No. 32 of 2017 concerning Environmental Health Standard Quality Standards for Sanitary Hygiene Water Media, which is 1 mg / l. The thicker sugarcane activated carbon media used, the more effective in reducing iron (Fe) levels (Table 4).

Table 4: Effectiveness of variations in the thickness of activated carbon of sugar cane pulp in decreasing iron (Fe) content in clean water

no.	Variation of Activated Carbon Thickness of Sugarcane Bagasse (cm)	Decreased Iron (Fe) Level After Treatment (mg /l)	RI Health Standard Quality Standard No. 32 The year 2017	Effectiveness of Iron (Fe)
1.	0 cm	1.85	1	Not Effective
2.	30 cm	1.15	1	Not Effective
3.	45 cm	0.90	1	Effective
4.	60 cm	0.71	1	Effective
5.	75 cm	0, 69	1	Effective

Discussion

Based on the results of an examination conducted at the Chemical Laboratory of the Department of Environmental Health Health Polytechnic of the Ministry of Health Jakarta II, the content of iron (Fe) in groundwater before treatment was 2.99 mg / L. This is because the water used was from groundwater in the area of the former swamps and rice fields that have a high water content of iron (Fe). Following the Minister of Health Regulation No. 32 of 2017 Concerning "Quality Standards for Environmental Health and Water Health Requirements for Hygiene, Swimming Pool, Solus Per Aqua and Public Baths." The physical parameters of clean water are tasteless, odorless, and colorless. One of the chemical parameters is iron (Fe) with a maximum permissible level of only 1 mg / L, so the sample water from Kebon Jeruk Sub-District Kebon Jeruk Sub-District, West Jakarta does not meet the clean water quality requirements. Physically, the water is brownish yellow, smells of rust and leaves brown sediment marks around the bathroom floor.

The presence of iron content in groundwater is caused by groundwater being in contact with various materials contained in the earth, so that groundwater, in general, contains dissolved cations and anions and some inorganic compounds. The ions that are often found in groundwater are iron.[1]

Iron (Fe) levels in clean water must not reach zero because of iron compounds in the human body function as forming red blood cells, where the body needs 7 - 35 mg/day.[2] Fe substances that exceed the dose required by the body can cause health problems. This is because the human body cannot excrete Fe, so for those who often get blood transfusions, their skin color becomes black due to the accumulation of Fe. Drinking water containing iron tends to cause nausea when consumed. Also, large doses can damage the intestinal wall. Death is often caused by damage to this abdominal wall. Fe levels of more than 1 mg / l will irritate the eyes and skin. If the solubility of iron in water exceeds, 10 mg / l will cause the water to smell like rotten eggs. Iron (Fe) is corrosive, therefore if groundwater containing high iron content will leave sediment in the water pipes and leave stains on the walls or water reservoirs.[3]

Based on the results of preliminary tests conducted using variations in the thickness of activated carbon of sugarcane bagasse to reduce levels of iron (Fe) in groundwater by the filtration process. The results obtained that sugarcane bagasse activated carbon can reduce iron (Fe) content in groundwater. The results of the decrease in iron (Fe) at a thickness of 30 cm by 1.19 mg / l, a thickness of 45 cm by 0.89 mg / l, a thickness of 60 cm by 0.78 mg / l and a thickness of 75 cm by 0.72 mg / l l. From the results of preliminary tests, it has been proven that bagasse activated carbon can reduce iron (Fe) levels. Then proceed to the actual trial with a thickness of 30 cm, 45 cm, 60 cm, and 75 cm in the actual test using control with 0 cm bagasse carbon thickness.

Based on the results of research conducted using variations in the thickness of activated carbon bagasse to reduce levels of iron (Fe) in groundwater by the filtration process, the results obtained that sugarcane bagasse activated carbon can reduce iron (Fe) content in groundwater. The results of the average reduction in iron (Fe) can be seen in Appendix 4 which is at a thickness of 30 cm at 1.15 mg / l, a thickness of 45 cm at 0.90 mg / l, a thickness of 60 cm at 0.71 mg / l , 75 cm thickness of 0.69 mg / l and control of 1.85 mg / l.

A decrease in iron (Fe) content in clean water occurs because the activated carbon properties of sugarcane bagasse have proper absorption of metal content in water.[4] Besides, to increase the absorption capacity

of activated carbon from sugarcane bagasse is to do activation or immersion using a chemical solution that is NaOH 1% which aims to enlarge the pores of activated carbon so that iron (Fe) levels can be absorbed into the pores of activated carbon.[5]

After processing water containing Iron (Fe) by filtration method, ie filtering using bagasse activated carbon media it is known that the percentage of Iron (Fe) reduction in table 6.6, the highest average reduction in Iron (Fe) content is found in activated carbon of sugarcane bagasse with a thickness of 75 cm with a percentage of 76.92% (0.69 mg / L). Whereas sugarcane bagasse activated carbon with a thickness of 30 cm can reduce iron content by a rate of 61.53% (1.15 mg / L), a thickness of 45 cm can reduce iron content by a percentage of 69.89% (0.90 mg / L), and a thickness of 60 cm can reduce iron content by a percentage of 76.25% (0.71 mg / L). Bagasse activated carbon with a thickness of 30 cm, 45 cm, and 60 cm has decreased levels of Iron (Fe) whose percentage is lower than the use of bagasse activated carbon thickness 75 cm.

The decrease in iron content in clean water obtained from the use of bagasse activated carbon with a filtration system, due to the adsorption process, which is the process of collecting dissolved substances in the solution by the surface of the absorbent object.[6] Bagasse activated carbon as an adsorbent has high micro pores because previously sugarcane bagasse was able to absorb sugar. Iron (Fe) content that is contained in clean water when flowed with sugarcane bagasse activated carbon filter will be absorbed. The high micropores of activated carbon increase the process of adsorption of iron (Fe) in clean water.[7] Therefore, the processed water has decreased its iron content, and the water becomes more apparent than the previous brownish-yellow raw water.

The highest decrease in iron (Fe) content was found in experiments with bagasse activated carbon with a thickness of 75 cm with a percentage reduction of 76.92% (0.69 mg / L) and was in accordance with the quality standard, thickness 45 cm and 60 cm had decreased and according to quality standards while the thickness of 30 cm has decreased but not in accordance with quality standards. The higher the thickness of sugarcane activated carbon, the greater the surface area of absorption (*adsorbent*) so that more iron (Fe) is absorbed. This is consistent with the results of the research conducted before. The research showed the percentage reduction in Fe by activated carbon from bagasse with a media thickness of 10 cm reaching an average of 77.53% and a thickness of 20 cm reaching an average of 94.17% higher the wider the adsorption zone media.[8]

In control, there is a decrease because the control tube only contains gravel and sponge media. Gravel and sponge media can filter iron (Fe) levels in clean water, but their use is not following established quality standards. From the results of research conducted by Indah Nuyrhayati shows that gravel media has the ability to reduce iron levels.

Based on the theory of effectiveness, which is a measure that states how far (quantity, quality, and time) has been achieved, the greater the percentage produced, the higher the effectiveness. From the results of the study, it is noted that the thickness of activated carbon of sugarcane bagasse is the most effective in reducing the level of iron (Fe) to 0.90 mg / l, namely the thickness of activated carbon bagasse 45 cm and 120 minutes contact time, for higher thickness results obtained more effective. The use of contact time is 120 minutes, based on research conducted before.[9] It is declared effective because after being compared with the stipulated regulations namely The Ministry of Health Regulation number 32 of 2017 Concerning Environmental Health Standard Quality Standards and Water Health Requirements for hygiene, swimming pools, and public baths which states that the level of iron (Fe) allowed in groundwater is 1 mg / L.

Conclusion

Levels of iron (Fe) in groundwater before treatment is 2.99 mg / L. after being treated with 5 treatments and 3 repetitions using a variation of the thickness of bagasse activated carbon 0 cm (without bagasse activated carbon media) decreased by 1.85 mg / L, thickness of 30 cm decreased by 1.15 mg / L, thickness 45 cm decreased by 0.90 mg / L, thickness of 60 cm decreased by 0.71 mg / L and thickness of 75 cm decreased by 0.69 mg / L. Decrease in iron (Fe) levels by using variations in the thickness of activated carbon of sugarcane bagasse obtained the highest difference in decreasing iron (Fe) levels at a thickness of 75 cm with a reduction percentage of 76.92%. The most effective thickness of activated carbon of bagasse is 45 cm thickness as it can reduce below the maximum allowed level according to the Ministry of Health Regulation number 332 of 2017 where the maximum allowable level is only 1 mg / L.

Declaration

Ethical Clearance: Ethical clearance was obtained from the Environmental Health Department of Health Polytechnic of the Ministry of Health Jakarta II. We also wish to thank all the participants who contributed to this study.

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