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The Effect of Coconut Coir and Coconut Shell Charcoal Media Thickness on Reducing the Turbidity of Excavated Well Water in Gampong Lheu Blang, Darul Imarah District, Aceh Besar Regency in 2025

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ABSTRACT

Dug well water is often used by the community as a source of clean water, but its physical quality such as turbidity is still a problem. This study aims to determine the effect of variations in the thickness of coconut coir media and coconut shell charcoal on the reduction of turbidity of dug well water. The method used was an experiment with a Complete Random Design (RAL) with 3 media thickness treatments (2 cm, 3 cm, and 4 cm) and repeated 3 times each. Additional media in the form of gravel is used on a regular basis in each treatment. Turbidity measurements are carried out before and after filtration using a turbidimeter. The results of the study showed that there was a significant influence of the thickness of the media on the reduction of turbidity of dug well water. The thickness of 4 cm provides the most optimal results in reducing the level of turbidity. Coconut coir and coconut shell charcoal media are effectively used as natural and environmentally friendly filter alternatives to improve the water quality of dug wells.

Keywords : Coconut Coir, Coconut Shell Charcoal, Turbidity, Dig Well Water

INTRODUCTION

According to the Indonesian Minister of Health Regulation No. 2 of 2023 concerning Implementing Regulations of Government Regulation Number 66 of 2014 concerning Environmental Health and Health Requirements for Water, Air, Soil, Food, Facilities and Buildings, and Disease-Carrying Animals.[1]

Water is a substance or matter or element that is essential to all known life forms to date on earth, but not on other planets. Water covers almost 71% of the earth's surface. There are 1.4 trillion cubic kilometers (330 million miles3) available on earth. Water is mostly found in the sea (salt water) and in ice sheets (at the poles and mountain peaks), but it can also be present as clouds, rain, rivers, freshwater surfaces, lakes, water vapor, and sea ice. The water in these objects revolves along a water cycle, namely through evaporation, rainfall, and the flow of water above the ground surface (runoff, including springs, rivers, and estuaries) to the sea.[2]

Health development refers to the concept of a healthy paradigm, namely health development which gives the main priority to efforts to improve health (promotive) and disease prevention (preventive) services compared to efforts to provide healing or treatment (curative) and recovery (rehabilitative) services in a comprehensive, integrated and sustainable manner.[3] Studies in a number of European, Middle Eastern, and West Asian countries currently do not indicate the optimal drinking limit value for water turbidity, calcium and magnesium levels. In other words, it does not restrict its member states in implementing a requirement into their national regulations. Despite all these differences, all believe that excessive mineral or other saturated solids can be harmful to health. Unclean water should not exceed a certain threshold value for the content of substances that are harmful to health or even be kept to a minimum.

For areas that have not received clean water services from PAM, they generally use groundwater (wells), rainwater, spring water and so on. One of the means of providing clean water in rural areas that is widely sought by the government as a source of clean water is the dug well, this facility takes shallow groundwater so that its existence is seen as efficient and effective to meet the needs of family life. Groundwater is more widely used because it is easier to obtain and relatively safer from pollution when compared to surface water.[4]

Water from dug wells cannot necessarily be directly used because the water contained in the soil has been polluted by a lot of waste such as industrial waste, household waste, and pesticides that are widely used by farmers today. Turbidity in dug well water is caused by a variety of factors, including solid particles, microorganisms, and dissolved organic matter. This can potentially pose a health risk to its users. The level of turbidity of water varies greatly according to the structure or mineral content in the soil and at each location.

For this reason, special research is needed to find out the mineral content in the water source, in areas that have a source of spring water, the soil surface research can be carried out quickly, compared to areas

without a source of spring water where it is possible to do it through drilling first. Rapid countermeasures can be done by filtering water using several natural or artificial or modern clean water filtration techniques.[5]

Water purification is the process of converting polluted or dirty water into hygienic, clean, or clear water. This process is important to reduce water pollution and improve its quality. Water purification is beneficial in reducing turbidity, eliminating odors, and improving the color of the water, so that water becomes more suitable for use.[6]

Filtration is one of the right methods in water purification, where filtration is a filtration process to remove suspended substances from water through porous media by passing them through a filtration medium that includes solids so that solid particles in water can separate. In the selection of water purification materials, it also determines whether or not the water purification results will be used, natural purification materials that are commonly used for the water purification process, including; pebbles, coconut coir, and coconut shell charcoal.[7]

Coconut coir is one of the biomass that is easy to obtain and is a by-product of agriculture. The composition of coir in coconuts is about 35% of the total weight of coconuts. Coconut coir consists of fiber and cork (pitch) that connects one fiber with another. Coconut fiber as a biosorbent to remove heavy metals from the water is quite high because coconut fiber contains lignin (35%-45%) and cellulose (23%-43%). Coconut fiber has great potential as a biosorbent because it contains cellulose which in its molecular structure contains carboxyl groups and lignin which contains phenolic acid which takes part in metal binding ((Adawiyah et al., 2021). The nutrient content contained in coconut coir is: water 53.83%, N 0.28% ppm, P 0.1 ppm, K 6.726 ppm, Ca 140 ppm, and Mg 170 ppm.[8] These nutrients are needed by plants for their growth and development.

Coconut shell charcoal that is used as activated carbon is a material from a source with carbon content, which undergoes a certain process so that the pores are open and have high absorption, making it effective as an adsorbent in water treatment. According to Sulisyanti (2018), coconut shell charcoal that is used as activated carbon has characteristics that are highly reactive to particles that come into contact with it. Its numerous pore structures of a certain size play a role in capturing and trapping very fine pollutant particles. Activated carbon of coconut shell charcoal is composed of cellulose, carbon, moisture content, and dust content, so it functions in purifying waste.[9]

Research conducted by Suriani on the Utilization of Coconut Fiber and Activated Carbon as Filtration Media in RPH Wastewater Treatment showed significant results. This study shows that the combination of coconut fiber and activated carbon is effective in reducing pollutants in the wastewater of the Slaughterhouse (RPH). The initial COD value obtained of 877 mg/L was successfully lowered to 161 mg/L with an effectiveness of 81.64%, while the initial TSS of 562 mg/L decreased to 22 mg/L with an effectiveness of 96.08%. This process also helps to neutralize the pH of the waste, so that it is close to the standard of quality. These results indicate that the combination of coconut fiber and activated carbon is an efficient medium for RPH wastewater treatment.[10]

Based on the above background, the author is interested in a research entitled "The Effect of Coconut Coir and Coconut Shell Charcoal Media Thickness on Reducing the Turbidity of Dig Well Water".

RESEARCH METHODS

This study is a quantitative study with an experimental design using a Complete Random Design (RAL) to evaluate the effect of variations in the thickness of the filtration medium on the reduction of turbidity of dug well water. The main filtration medium consists of coconut coir and coconut shell charcoal with a thickness of 2 cm, 3 cm, and 4 cm, respectively, as well as an additional medium in the form of 2 cm thick gravel which is used constantly in each treatment.

Three treatments were tested, each repeated three times to improve the reliability of the results. Treatment randomization is done to avoid subjective bias, using random number tables or software assistance.

The subject of the study was water from a well-dug in Lheu Blang Village, Darul Imarah District, Aceh Besar, as much as 19 liters. The research was carried out in the laboratory in February–March 2025.

RESULTS AND DISCUSSION

Result

The results of the research from the thickness of coconut coir media and coconut shell charcoal are as follows.

Table 1
The average amount of decrease in the turbidity level of the dug well water after treatment Coconut Coir Media And Coconut Shell Charcoal

No	Treatment	The repetition						sum	Average
		1		2		3			
		f	%	F	%	f	%		
1.	Control	7	0	6,8	0	6,7	0	20,5	7
2.	2 cm	6,5	7,14	6,4	5,88	6,3	5,97	19	6,4
3.	3 cm	5,1	27,14	5	26,47	4,8	28,36	15	5
4.	4 cm	3,7	47,14	3,5	48,53	3,3	50,75	10,5	3,5

Source: Primary Data, Experimental Results in 2025

Information:
- The thickness of the media consists of a combination of coconut coir and coconut shell charcoal with thicknesses of 2 cm, 3 cm, and 4 cm.
- Control is dug well water without filtration media treatment. – Each treatment was tested 3 times (repetition).
- The unit of turbidity of water is measured using a turbidimeter in an NTU (Nephelometric Turbidity Unit).

Based on Table 1, the average increase in turbidity of dug well water was found in treatment with a thickness of 4 cm of coconut coir and coconut shell charcoal, which was 48.53%. This shows that the thicker the filtering medium, the more effective its ability to filter impurities particles. Treatment with a media thickness of 3 cm and 2 cm showed a decrease in turbidity of 26.47% and 5.88%, respectively. Meanwhile, in the control treatment (without filtering media), there was no reduction in turbidity (0%) due to the absence of a filtration process.

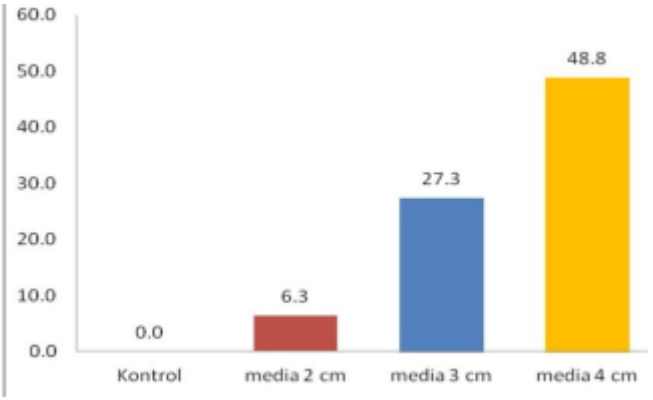

Figure 1 Percentage Reduction in Turbidity in Dig Well Water Based on Thickness of Coconut Coir Media and Coconut Shell Charcoal

Based on figure 1, it shows that the percentage (%) with the highest amount of turbidity reduction in dug well water is 4 cm thick, which is 48.8%. Meanwhile, the lowest percentage of turbidity reduction in dug well water is at a thickness of 2 cm, which is 6.3%. To find out whether coconut coir and coconut shell charcoal have an effect on reducing turbidity in dug well water, a one-way anova statistical test was carried out. The results of the test can be seen from table 2 below:

Table 2
Results of One-Way Anova Statistical Test on the Effect of Coconut Coir Media Thickness and coconut shell charcoal against the reduction of turbidity of dug well water

Variabel	Number of Variants	DK	Rate-to-Rate Varian	F	P value
Intergroup	20.549	3	6.850	283.437	000
In a Group	.193	8	.024		
Total	20.742	11			

Source: Primary Data in 2025

Based on the results of the Anova One Direction statistical test, a p value of 000< 0.05 was obtained, so it can be concluded that coconut coir and coconut shell charcoal have an effect as a reduction in turbidity in the water of the dug well. Because there is a decrease in the turbidity value of the test, it will be followed by an LSD (least significance different) test which aims to find out the difference in the effect of concentration between treatments. The results of the LSD (least significance different) test can be seen in the following table.

Table 3
LSD Test Results of the Effect of Coconut Coir Media Thickness and Coconut Shell Charcoal Against the Reduction of Turbidity of Dig Well Water

Concentration	Concentration/ Treatment	Average Difference	Std. Error	P value
Control	Media 2 cm	.43333*	.12693	.009
	Media 3 cm	1.86667*	.12693	.000
	Media 4 cm	3.33333*	.12693	.000
Media 2 cm	Control	-.43333*	.12693	.009
	Media 3 cm	1.43333*	.12693	.000
	Media 4 cm	2.90000*	.12693	.000
Media 3 cm	Control	-1.86667*	.12693	.000
	Media 2 cm	-1.43333*	.12693	.000
	Media 4 cm	1.46667*	.12693	.000
Media 4 cm	Control	-3.33333*	.12693	.000
	Media 2 cm	2.90000*	.12693	.000
	Media 3 cm	-1.46667*	.12693	.000

Source : One-Way Anova Analysis 2025

Based on table 3, the Post Hoc LSD test was used to identify significant differences between various water filtration treatments of dug wells using coconut coir and coconut shell charcoal with different thicknesses, namely 2 cm, 3 cm, and 4 cm. The results of this analysis showed that all combinations of treatments produced a significance value (p-value) of 0.000 and were marked with an asterisk symbol (*), which means that there was a statistically significant difference between the treatments.

Any increase in the thickness of the filter media significantly affects the turbidity of the dug well water. The thickness of 4 cm provides the most optimal results in reducing turbidity compared to the 3 cm and 2 cm media. Meanwhile, the control group showed significant differences with all treatments, confirming that the use of coconut coir media and coconut shell charcoal had an important role in improving the physical clarity of the water.

Discussion

Based on the results of the study, it can be seen that the variation in the thickness of coconut coir media and coconut shell charcoal has an effect on reducing the turbidity level of dug well water. The average decrease in turbidity of dug well water in treatment with a media thickness of 2 cm was 6.3%, 3 cm was 27.3% and in 4 cm treatment was 48.8%. The highest reduction in water turbidity was at 4 cm treatment by 48.8% which shows that the thicker the filter medium, the greater the ability of the medium to reduce the level of turbidity of water.

The results of the one-way Anova statistical test showed that the p value was 0.000 < 0.05, so it can be concluded that there is a significant influence between the variation in the thickness of coconut coir media and coconut shell charcoal on the reduction of turbidity of dug well water. Therefore, Ho was rejected because it was known that media with a thickness of 2 cm, 3 cm, and 4 cm had an effect on reducing water turbidity.

Based on the results of the LSD test, it showed that all treatments were significantly different from each other, which was marked by a significance value of p < 0.05 (marked with an asterisk *). Treatments with a thickness of 4 cm showed the most effective results as they resulted in a reduction in turbidity of 48.53%, which is the highest number compared to other media treatments. This decrease occurs because coconut coir has porous fibers that are able to resist fine particles, and coconut shell charcoal has pores that are effective in absorbing pollutants. The thicker the filtration medium, the higher the filtering ability, so that the turbidity of the water decreases greater.

CONCLUSIONS AND SUGGESTIONS

Conclusion

1. There was an influence of the thickness of coconut coir media and coconut shell charcoal with a thickness of 2 cm, 3 cm, and 4 cm in the reduction of the turbidity of the dug well water.
2. There is an effect of variations in the thickness of coconut coir media and coconut shell charcoal on the reduction of turbidity of dug well water in 2025, where a thickness of 2 cm provides a decrease of 5.88%.
3. There is an effect of variations in the thickness of coconut coir and coconut shell charcoal media on the decrease in turbidity of dug well water in 2025, where a thickness of 3 cm provides a decrease of 26.47%.
4. There is an effect of variations in the thickness of coconut coir media and coconut shell charcoal on the reduction of turbidity of dug well water in 2025, where a thickness of 4 cm provides a decrease of 48.53%.
5. From the results of the research, the most effective media thickness in reducing turbidity of dug well water in 2025 is 4 cm thickness, which is 48.53%

Suggestions

1. For the Community
   The community can use coconut coir and coconut shell charcoal as a simple filter medium to reduce the turbidity of dug well water. The use of these natural materials is safer, cheaper, and environmentally friendly, and can be an effective alternative to water purification, especially for areas with cloudy well water quality.
2. For Education Institutions
   The results of this research can be used as additional information material in the learning process, especially in courses or training related to environmental health and clean water management. This research can also be a reference for similar research conducted by students in the future.
3. For Further Research
   a. It is hoped that further research can be carried out with more diverse media thickness variations and different contact times to find out more optimal results in reducing water turbidity.
   b. Further research is also expected to add other test parameters such as odor, color, and chemical content to obtain more comprehensive results in assessing the quality of filtered water.
   c. It is also recommended to conduct repeated media effectiveness tests for a certain period of time to determine the durability and efficiency of the continuous use of filter media.

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