THE EFFECTIVENESS OF USING "KRUENG BARO" CORAL AND SHELL POWDER AS NATURAL COAGULANTS TO REDUCE FE LEVELS IN CLEAN WATER

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Abstract

Water is a vital need for human life, so it must always be available for daily life needs. Therefore, clean water is needed that meets health requirements, especially chemical requirements, one of which is tolerable levels of Fe in clean water. This study aims to test the effectiveness of natural filtration and coagulation using media of "Krueng Baro" coral and shell powder to reduce Fe levels in clean water. The research design was a one-group pretest-posttest design. Filters with shell powder media and coral stones were made in the workshop and water quality analysis was carried out in the laboratory. Water samples were included in three treatments: 1) 40 cm of coral and 40 cm of shell powder; 2) 30 cm of coral and 30 cm of shell powder; 3) 20 cm of coral and 20 cm of shell powder. Water was passed through the filter media, then the Fe levels was compared using the ANOVA test. The results of the analysis showed a p-value = 0.012 so it was concluded that there were differences in Fe levels in different media. It was concluded that "Krueng Baro" coral and shell powder proved effective in reducing Fe levels naturally through filtering and coagulation processes.

Keywords: clean water; Fe content; filtration; coagulation; coral stone "Krueng Baro"; shell powder

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1. Introduction

Water is the most important requirement of human life [1], especially as an ion solvent and supports metabolic processes in the body. [2] The water you drink is then absorbed in the body along with the compounds and elements in it. Therefore, it is important to pay attention to drinking water to maintain human safety and health. [3] In general, raw water for drinking water treatment comes from river water which is generally still in a cloudy state due to the presence of particles originating from various sources such as: rocks, degradation of organisms in the water. One of the processing stages in a water treatment unit is the coagulation or flocculation process in order to remove turbidity due to suspended matter and colloids. [4]

In water treatment units, especially in the purification process, synthetic coagulants are generally used, namely alum and PAC. [5] However, the use of these two coagulants causes new problems in drinking water, namely the presence of alum residue and sludge toxicity. [6] The use of alum as a coagulant produces residues that can cause Alzheimer's disease. [7] In addition, the use of synthetic coagulants in several drinking water companies in Indonesia results in sludge and sediment being dumped back into the river without going through the processing stage first, causing new problems for the environment because synthetic coagulants are not easily biodegradable.

This is what encourages researchers to focus on the use of coagulants from natural materials. One of the natural coagulants being developed is chitosan, both from shrimp, crab and clam shell waste, which can be used as a natural coagulant. Chitosan has the advantages of being non-toxic, easily biodegradable, polyelectronic in nature, and easily interacts with other organic substances such as proteins. [8] Chitosan, especially from mussel shells, is an environmentally friendly material and has a high added value. This not only provides added value to the clam farming business, but can also overcome the problems of environmental pollution caused, as well as maintain environmental aesthetics.

Apart from shell shells, coral can also be used in the water purification process [9], both for turbidity and for Fe content. The combination of coral and shellfish is expected to improve the physical and chemical quality of clean water, especially water turbidity and Fe content. In addition, coral can be obtained easily and the price is relatively cheap. Likewise, shells can be obtained easily from beaches and lakes.

Based on the explanation above, it is necessary to conduct research that aims to determine the effectiveness of Krueng Baro coral and shellfish powder as natural coagulants to reduce Fe levels in clean water.

2. Methods

This research was conducted at the Department of Environmental Health, Poltekkes Kemenkes Aceh from July to November 2020. This type of research was an experimental study using a one-group pretest-posttest design. The treatment given was the use of coral and shell powder as coagulants in the clean water production process. Filters with shell powder media and coral stones were made in the workshop and water quality analysis was carried out in the environmental health laboratory, Poltekkes Kemenkes Aceh.

Water samples were included in three treatments, namely treatment I with a thickness of 40 cm coral and 40 cm of shell powder; treatment II with a thickness of 30 cm coral and 30 cm of shell powder; and treatment III with a thickness of 20 cm coral and 20 cm of shell powder. The number of replications was determined based on Federer's formula [10], namely $(n-1)(t-1) > 15$. Because the number of treatments $(t) = 3$, the number of replications $(n) = 6$.

Water was passed through the shell powder filter media as a natural coagulant and coral with different thicknesses, then the Fe content is compared using the ANOVA test.

3. Results And Discussion

Figure 1 shows the construction of water storage and coagulation that has been built at the research site.

a b

Figure 1: Water storage and coagulation (a. Water storage in tanks; b. Water filtration and coagulation construction)

Table 1 shows that coral and shells with thicknesses of 40 cm, 30 cm, and 20 cm with 15 repetitions can reduce Fe levels from 5.2476 ppm to the lowest, namely 2.4747 ppm.

Table 1: Results of examination of Fe and Mn levels with a thickness of coral and shell powder of 40 cm, 30 cm and 20 cm

Location	Fe levels (Mean)
Water before going to the water storage (reservoir)	5.2476
Water after from the water storage	4.9338
Water after water storage and coral	4.7573
Water after storage, coral and shell powder 40 cm	**2.4747**
Water after shelter, coral and shell powder 30 cm	3.4693
Water after shelter, coral and shell powder 20 cm	3.1876
Total	4.0117

Table 2: Results of the difference test using ANOVA

		Sum of Squares	Df	Mean Square	F	p-value
Fe levels	Between Groups	94.041	5	18.808	3.130	0.012
	Within Groups	504.794	84	6.009		
	Total	598.835	89			

Table 2 shows that there were differences in Fe levels between filtering systems, which was indicated by the value of p = 0.012. Thus, there was an effect of the treatment of Krueng Baro coral and shells on the decrease in Fe levels.

It could be explained that the Fe levels before entering the reservoir was significantly different from the Fe levels after filtering with coral media and shell powder with a thickness of 40 cm, 30 cm and 20 cm. It could be interpreted that the thickness of coral and shell powder had a different effect on Fe levels. In this case, 40 cm thickness was the most effective screening structure.

The results of this experimental research are expected to have a significant contribution to the development of appropriate technology, especially to realize the provision of clean water for households that meets chemical requirements [11], as it is known that chemical requirements are important besides physical and biological requirements. Thus, this finding can be an alternative reference method in filtering clean water

for household needs; while at the same time enriching references regarding efforts to improve water quality in general, such as the quality of river water [12,13] and the quality of groundwater sources [14], which can be used for household water needs.

4. Conclusion

Based on the results of the study it can be concluded that "Krueng Baro" coral and shell powder have proven effective in reducing Fe levels naturally through filtering and coagulation processes.

5. References

Sumantri A. Kesehatan Lingkungan (Environmental Health). Jakarta: Kencana Prenada Group; 2015.
Yulia. Air bagi Kehidupan (Water for Life). Tangerang: Binus University, Faculty of Engineering; 2015.
WHO. Drinking-water. Geneva: World Health Organization; 2022.
IWA. Coagulation and Flocculation in Water and Wastewater Treatment. London: IWA Publishing; 2018.
Rosariawari F, Mirwan M. Effektifitas PAC dan Tawas untuk Menurunkan Kekeruhan pada Air Permukaan (Effectiveness of PAC and Alum to Reduce Turbidity in Surface Water) [Internet]. 2018 [cited 2018 Aug 2]. Available from: https://core.ac.uk/download/pdf/19209805.pdf
Ahmad AL, Sethupathi S, Hameed BH. Coagulation of residue oil and suspended solid in palm oil mill effluent by chitosan, alum and PAC. Chemical Engineering Journal. 2006;118(1-2):99-105.
Krupińska I. Aluminium Drinking Water Treatment Residuals and Their Toxic Impact on Human Health. Molecules. 2020;25(641):1-13.
Bija S, Yulma, Imra, Aldian, Maulana A, Rozi A. Sintesis Biokoagulan Berbasis Kitosan Limbah Sisik Ikan Bandeng dan Aplikasinya Terhadap Nilai BOD dan COD Limbah Tahu di Kota Tarakan. JPHPI.2020;23(1);86-92.
Herlina S. Metode Slow Sand Filter dan Pengukuran MPN Coliform Sebagai Upaya Peningkatan Kualitas Air Sungai di Pekapuran Raya Banjarmasin. Malang: UNISMA; 2018.
Federer WT. Experimental Design Theory and Application. Calcutta: Oxford & IBH; 1967.
Kovács E, Omanović D, Pižeta I, Bilinski H, Frančišković-Bilinski S, Tamás J. Chemical Water Quality Changes along a Stream at an Abandoned Pb-Zn Mining Site. European Chemical Bulletin. 2013;2(1):11-14.
Faiku F, Haziri A, Gashi F, Troni N, Haziri I. Assessment of River Water Quality Lumbardh of Deçan (Kosovo). European Chemical Bulletin. 2015;4(3):169-176.
Ati EM, Abbas RF, Ajmi RN, Zeki HF. Water Quality Assessment in The Al-Musayyib River/Euphrates System Using the River Pollution Index (RPI). European Chemical Bulletin. 2022;11(5):53-58.
Ratthore JS, Choudhary V, Sharma S. Implications of Textile Dyeing and Printing Effluents on Groundwater Quality for Irrigation Purpose Pali, Rajasthan. European Chemical Bulletin. 2014;3(8):805-808.