ALUM AS AN EFFECTIVE CHEMICAL FOR PURIFYING WATER THROUGH A SIMPLE FILTERING MECHANISM

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Abstract

Clean water is a vital necessity in everyday life, however, sometimes there are obstacles in the supply of water to households due to the murky condition of dug well water. One of the chemicals that has the potential to be used to reduce turbidity is alum. So research is needed which aims to test the effectiveness of alum to purify dug well water using a simple filtering mechanism. This experimental study used the same well water sample and then separated it into three groups: filtering mechanism I used alum, mechanism II used quicklime and the third was a control. After going through the filtering process, an examination of the turbidity level of the three water samples was carried out. Furthermore, a comparative analysis was carried out between the three using the Anova test. The results of the analysis showed that the highest level of turbidity was the control, followed by filtering mechanism II using quicklime and the lowest was mechanical filtering I using alum. The mean turbidity level scores of the three respectively were 510.00, 317.67 and 201.00. While the p values for each comparison were: control vs quicklime = 0.000, control vs alum = 0.000, while quicklime vs alum = 0.003. Based on the results of the study it can be concluded that alum is a good chemical for purifying water with a simple filtering mechanism.

Keywords: clean water; filtering mechanism; turbidity level; alum; quicklime

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1. Introduction

Clean water is one of the most basic needs for human life. Therefore, humans need a source of clean water that can be obtained from groundwater and surface water. However, not all raw water can be used to meet drinking water needs. Only raw water that meets the quality requirements for drinking water can be used [1].

The environment has the potential to be polluted by organic, inorganic and heavy metal substances. The existence of these contaminants will disrupt the existing ecosystem, including humans. Therefore, environmental sustainability of contaminants must be maintained and continue to receive attention from the surrounding community, which is an element of the environment itself. One way that can be used to reduce contaminants in the environment is to use chitosan as an adsorbent [2].

Many people still use ground water (wells), river water, rain water, springs and others as a source of drinking water. So that during the dry season, it is often found that the quality of ground water and river water used by the community does not meet the requirements as healthy drinking water, even water from several places is not suitable for drinking because it is cloudy mixed with mud. Dirty and polluted water is the cause of infectious diseases such as; abdominal typhus, cholera, diarrhea and bacillary dysentery. Although bacteria that cause infectious diseases can be killed by boiling water, there are also harmful substances, especially metals that can cause poisoning, which cannot be removed in this way, but can be treated with alum, lime, ferrous sulfate ($FeSO_4$), polyaluminium chloride (PAC), moringa seed powder, rice husk powder, and others. However, the public and industry players are not yet aware of this, bearing in mind that its use and research in Indonesia has not been sufficiently developed. After all, people still think that using these materials is very time consuming and costly [3-7].

Clean water treatment is a technical effort carried out to provide protection to water sources by improving the quality of the original water until it becomes the desired quality with the aim that it is safe for use by people who consume clean water. In general, the stages of the water purification process itself consist of aeration, pre-sedimentation, coagulation-flocculation, sedimentation, disinfection and reservoir. The coagulation process is a major part of the entire clean water treatment process, which aims to bind colloidal water particles into flocs (clumps of dirt) which will later settle to the bottom of the purification tank to produce clear water. In addition to paying attention to the characteristics of water quality, there are three other factors that affect the success of the coagulation process, namely the type of coagulant used, the dose of coagulant, and the mixing process. Ramadhani [3] reported that alum at a dose of 20 mg/L of sample water was able to reduce turbidity by 93.44%, color content by 87.55%, and TSS by 93.366%.

The results of a preliminary study in Lamjabat Village, Aceh show that in general villagers have dug wells behind their houses. These dug wells are not used by the community because of the murky and smelly water conditions. Many people use water from the company for their daily needs. The results of interviews with several people indicated that after the tsunami, the groundwater in Lamjabat village became murky and smelly. Based on the above background, research is needed which aims to determine the difference in effectiveness between alum and quicklime to purify dug well water using a simple filter.

2. Methods

This research was an experimental study that compares the effectiveness of alum ($KAl[SO4]_2$) and quicklime (CaO) to purify water, using a simple filter. The research was conducted in Lamjib Village, Meuraxa District, Aceh; while the laboratory examination was carried out at the Department of Environmental Health, Poltekkes Kemenkes Aceh.

The sample was dug well water taken from the village. The same water was fed through two different simple filtering mechanisms. First, using chemicals in the form of alum, while the second uses quicklime.

The procedure for filtering water is as follows:

a) Put 20 liters of water into the container, then put 20 grams of alum into the water, then stir until the alum and water are combined.

b) Application of alum into filtered water is done by effective mass with fast stirring (100, 120, 140 and 160 rpm) for 1 minute and continued with slow stirring (20, 40, 60 and 80 rpm) for 15 minutes.

c) Provided a tub with a depth of 1 meter as a container.

d) A filter tub is made from used drums, equipped with a faucet with a height of 5 cm from the bottom of the tub

e) Palm fiber, sand, thick palm fiber, fine sand, coconut shell charcoal, gravel, and stones with a diameter of 2-3 cm are included.

f) After the filter is ready, water mixed with alum (mechanism I) or water mixed with quicklime (mechanism II) is added.

g) The water was settled for 60 minutes and examined for turbidity using a turbidimeter.

h) Comparison of water turbidity from mechanism I and mechanism II was carried out. In the comparison process, one control was added, then analyzed using the Anova test.

3. Results and Discussion

Table 1 shows that the lowest level of turbidity was filtered water by mechanism I which used alum, followed by product mechanism II which used quicklime, while control water had the highest turbidity. Meanwhile table 2 shows that based on the results of the difference test using ANOVA, there was a significant difference (p-value <0.05) among the three water samples. Thus, filtering water using quicklime produces water that was significantly different from the control water. However, by using alum, the filtering produced water that was significantly different from both the control water and the product water filtered using quicklime. Thus the best screening mechanism was to use alum.

Table 1: Comparison of water turbidity levels between filtering mechanisms I, filtering II and controls

Sample	Mean score
Control	510.00
Filtering mechanism II (quicklime)	317.67
Filtering mechanism I (using alum)	201.00

Table 2: Results of analysis of differences between screening mechanisms I, screening mechanism II and control

Sample	Mean difference and p-value		
	Control	Filtering mechanism II (quicklime)	Filtering mechanism I (alum)
Control		192.33 (0.000)	309.00 (0.000)
Filtering mechanism II (quicklime)	192.33 (0.000)		116.67 (0.003)
Filtering mechanism I (alum)	309.00 (0.000)	116.67 (0.003)	

In this study, simple dug well water filtering using alum or using quicklime can be carried out smoothly. Based on the interpretation above, it is clear that simple filtering of water using alum gives the best results. In this case, the filtered product is closest to the normal level of water clarity. While filtering using quicklime still shows cloudy results.

Thus it can be assumed that alum is very effective in reducing water turbidity, which in turn can be used to realize the fulfillment of clean water needs for households. Clean and healthy water is one of the basic daily needs for every home. Clean, clear and colorless water is needed in every home for various purposes such as washing, cooking, drinking water, bathing and so on. In some places, currently the need for water is increasing, while the health and hygiene quality of water is decreasing [8,9].

Water consumed by the public must meet health requirements because water is the best medium for the development of microorganisms. In purifying water, alum is better than lime. This further strengthens the belief that alum can be recommended as a chemical that is suitable for use in simple water filtration mechanisms in households. In addition to its effectiveness, bargaining is easy to find, cheap in price, and the mechanism can be applied easily in households with simple tools and materials [9].

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 [10], 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 [11,12] and the quality of groundwater sources [13], which can be used for household water needs.

4. Conclusion

Based on the results of the study it can be concluded that alum is a good chemical for purifying water with a simple filtering mechanism.

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