The use of clam shell powder as a natural coagulant and zeolite sand as a media in the water purification process

(water turbidity and fe level) on a household scale

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Abstract

Dug well water with turbidity and high Fe level, requires a treatment. During this time, the purification process uses alum synthetic coagulant and PAC. The use of both coagulants causes drinking water contains alum residue and sludge/ mud toxicity. As an alternative, it utilizes clam shell and zeolite sand. This study aims to determine whether there is an effect of clam shell powder as a natural coagulant and zeolite sand as a media in the process of water purification in decreasing water turbidity and Fe level. The study was an experimental study with a pretest and post-test design, the population was dug well water and the sample was 40 liters containing turbidity and high Fe level. The study was conducted in the workshop at a department and examination of turbidity and Fe levels in the Regional Health Laboratory. Data were analyzed descriptively by comparing drinking water quality standards. The results showed that the first treatment reduced the turbidity from 37 NTU to 1 NTU and Fe Levels from 6.346 mg / l to 0.650 mg / l, in the second treatment, the turbidity dropped from 37 NTU to 0 NTU and Fe levels from 6,346 mg / l to 0,650 mg / l. It is recommended that drinking water that sourced from dug wells can use a filter with 5 kg clam shell powder and zeolite sand with 30 cm of thickness.

Keywords: Shell powder, zeolite sand, water purifier, Ferrum

Introduction

Water is the most important requirement for humans, especially as an ion solvent and helps the body's metabolic processes. The water that we drink is absorbed by the body along with the compounds and elements which are contained in it. Therefore, the substance of drinking water really needs to be considered to maintain human safety and health In general, raw water for drinking water treatment comes from river water which is generally still in a murky condition due to the presence of particles that can come from various sources such as rocks or degradation of organisms in water or leaves that fall into the water. One of the processing steps in the water treatment unit is the process of coagulation/flocculation to eliminate the turbidity in the form of suspended and colloid matter [1], [2]

Environmental pollution by heavy metals is a serious problem along with the increasing use of heavy metals in industries, such as the steel industry, paint industry and paper industry [3], [4] Heavy metals are widely used because of their properties that can conduct electricity and heat

and can form alloys with other metals (Callister, 2009; Clesceri et.al, 1999). It may contain various heavy metals such as Cr, Zn, Pb, Cd, Fe and so on. Even at low concentrations, the effects of heavy metal ions can have a direct effect until they accumulate in the food chain. As with other sources of environmental pollution, these heavy metals can be transferred over a very long range in the environment [6].

During this time, in the water treatment in the purification process uses alum synthetic coagulant and PAC. However, the use of the two coagulants caused new problems in drinking water containing alum residues as well as the toxicity of the sludge/mud that is formed. The use of alum as a coagulant produces a residue that can cause Alzheimer's disease [7]–[9]. In addition, the use of synthetic coagulants in several drinking water companies in Indonesia produces sludge and sediment that is discharged back into rivers without going through the processing stage first, causing new problems for the environment because synthetic coagulants are not easily to biodegrade [10], [11]

This has led the researchers to focus on the utilization of natural coagulant. One of the natural coagulants that are being developed is a good chitosan derived from waste shrimp, crab, and clam shells can be used as natural coagulants. The chitosan which is used as a coagulant has several advantages because it is non-toxic, easily to biodegrade, poly-electronic, and easily to interact with other organic substances such as protein [12]–[14]. This is coagulant, especially from clam shells which is an environmentally friendly material and has a high added value. This not only provides added value to the business of clam cultivation, but it can also tackle the problem of environmental pollution caused, specific problems issued and less good environmental aesthetics [15], [16].

Besides the clam shell, zeolite sand can also be used in the water purification process both for turbidity and Fe levels. The use of zeolite sand, if combined with clam shells, is expected to improve the physical and chemical quality of water, especially water turbidity and Fe level. In addition, the zeolite sand can be obtained easily and the price is also relatively inexpensive. Likewise, the clam shell can be obtained easily, whether there is at the edge of the beach and lake and also from the clam shells which the meat has been taken. Based on this, the researcher is interested in conducting a study about "The Use of Clam Shell as Natural Coagulants and Zeolite Sand in the Water Purification Process on A household Scale".

Based on the description above, whether there is any effect of the clam shell powder as a natural coagulant and zeolite sand in the water purification process to reduce water turbidity and Fe level. The purpose of this study is to know the effect of clam shell powder as a natural coagulant and zeolite sand in the process of water purification to decrease water turbidity and Fe level.

Research Method

This research is an experimental study with a pretest and post-test design by conducting an experiment to pass water samples on the sieve media with the media of the clam shell powder as a natural coagulant and zeolite sand with different thicknesses. Then, look at the difference in physical quality levels of iron (Fe) in different thicknesses.

Pre-test Treatment Post-test

O_1 X O_2

This research is an experimental research with pretest and post-test design, the population in the study was dug well water which had high turbidity and Fe level, and the sample was 20 liters water for one treatment. The study was conducted in the workshop at a department and examination of turbidity and Fe levels in the Regional Health Laboratory. The data were analyzed descriptively by comparing drinking water quality standards / requirements.

Result and Discussion

The description of waste water and clean water samples are taken from the habitant's houses which physically showed that the water was turbid and there were signs of high Fe levels such as yellowing on white clothes that had been washed and there was sediment after settling for some time. To prove the presence of Fe content in water, thus an initial examination was carried out at the Health Laboratory of Padang.

Water Turbidity Examination Results

Treatment 1 with 30 cm of thicknesses of a filter media of zeolite sand and 3 kg of clam shell powder and treatment 2 (5 kg of clam shell powder, 30 cm of zeolite sand and one sample as a control). The results of turbidity examination with 3 kg of clam shell and 30 cm of thickness of zeolite sand, while the thickness of clam shell powder was 5 cm, 30 cm of zeolite sand. And after the treatment, it can be seen in the following table 1:

The turbidity examination results before and after the treatment of 3 kg of clam shell powder and zeolite sand with 30 cm of thicknesses

Table 1. Turbidity Before and After Treatment of Shell Powder and Zeolite Sand

Treatment	Turbidity (NTU)		Down	Efficiency (%)
	SBL	SSD		
I	37	1	2,70	**I**
II	37	0	100	**II**

Based on table 1 above, it shows that the turbidity before treatment amounts to 37 NTU as for the media of 3 kg of clam shell powder and zeolite sand with a thickness of 30 cm. After the treatment of 3 kg of clam shell powder and with 30 cm of thickness of zeolite sand, the turbidity dropped to 1 NTU, and the percentage decrease to 97.30%. Whereas the treatment with a media of 5 kg of clam shell powder and zeolite sand with a thickness of 30 cm, before the treatment the water turbidity was 37 NTU. After the turbidity treatment, it dropped to 0 NTU and the percentage decreased by 100%.

For the examination of Fe level in the treatment 1 with a thickness of 30 cm of a filter media of zeolite sand and 3 kg of clam shell powder and in the treatment 2 (5 kg of clam shell powder, 30 cm of zeolite sand and one sample as a control). The results of turbidity examination with 3 kg of media of clam shell powder and 30 cm of zeolite sand, while the thickness of the media of clam shell powder was 5 cm, 30 cm of zeolite sand and after the treatment, it can be seen in the following table 2:

The turbidity examination results before and after the treatment of 5 kg of clam shell powder and zeolite sand with 30 cm of thicknesses.

Table 2. The results of the examination of Fe Level before and after the treatment of 5 kg media of clam shell powder media and zeolite sand with 30 cm of thicknesses

Treatment	Turbidity (NTU)		Down	Efficiency (%)
	SBL	SSD		
I	6,346	0,65	5,696	I
II	6,346	0,119	6,227	II

Based on table 2 above, the data shows that the Fe levels before treatment was 6.346 mg/1. After the that treatment using media of 3 kg of clam shell powder and zeolite sand with a thickness of 30 cm, the Fe levels dropped to 0.650 mg / l and the percentage reduction was 89.76%. As for the treatment with 5 kg of clam shell powder and zeolite sand with a thickness of 30 cm, before the treatment the water turbidity was 6.346. After the treatment, the turbidity dropped to 0.119 mg / l and the percentage decreased to 98.12%.

The turbid water cannot be consumed by humans because of the high dissolved solid material. In addition, the effect on health is that it can interfere with kidney function due to the nature that settles. [17]–[20]. So, the turbid water must be treated first by using filtering techniques. The regular filtering techniques can reduce water turbidity, but the results were still not effective [21]–[23]. Therefore, it is practiced with a variety of media such as zeolite sand and clam shells. Zeolite sand and clam shells are the main filtering media besides fibers and foam. This media was inserted into a filtering tub made of 8 inch of paralons. Through this experiment, two treatments were made based on thickness that is the thickness of the filter media of 30 cm zeolite sand and 3 kg of clam shell), and (5 kg of clam shell powder and 30 cm of zeolite sand), tested by looking at turbidity parameters and Fe levels with twice attempts.

The results of the study showed that the turbidity of raw water before being put into the media filter of clam shell powder and zeolite sand was 37 NTU. The turbidity of well water for household drinking water needs was exceeded from the maximum levels that have been set that was 5 NTU. But, after being processed with clam shell powder and zeolite sand, the average of turbidity was 1 NTU (treatment 1), and 0 NTU (treatment 2). The turbidity after treatment showed that it reduced from maximum levels that have been set.

The results showed that the water content of the well before putting it into the filter media of clam shells powder and zeolite sand was 6,346 mg / I. The Fe levels of well water for household drinking water exceeded the maximum specified level of 0.3 mg / I. Meanwhile, after the treatment with the filter media of clam shell powder and zeolite sand, the average of Fe level was 0.650 mg / I (treatment 1), and 0.119 mg / I (treatment 2). The Fe levels after processing with the filter media of 3 kg clam shell powder and zeolite sand with a thickness of 30 cm, it was above the quality standard for household drinking water needs. However, for a thickness of 60 cm, it has not been able to reduce Fe levels below the specified quality standard.

This can be caused by several things, including the air contact during the sampling, the errors in analyzing water samples and the weaknesses in filter design.

The three forms of treatment can reduce the turbidity and Fe levels up to 98.12%. When it is compared with existing regulations, it is far from the specified quality standard. In general, the repetition of the two most effective treatments was the second repetition, except for the second repetition of Fe levels. The Fe can be reduced not only due to zeolite sand media, but also strongly influenced by free oxygen contact [24]–[26]. The filter design greatly influences the generation of free oxygen contact, in the second filter the empty space was bigger than other filters.

Several problems are associated with the use of this chemical. Thus, natural coagulants may bring about beneficial results in water treatment processes. The interest in the use of natural coagulants is increasing from time to time, especially to reduce water and wastewater treatment problems in developing countries to avoid health risks [22]. The filter media of clam shell powder and zeolite sand can not only reduce the turbidity and Fe parameters, but also physically it also smelly and the color can also change. Before the experimental water was put into the tool, the water smelled unpleasant and had a taste. But after coming out of the tool, the water did not smell and taste anymore. The odor / turbidity levels were checked by mixing a glass of turbid / smelly water with a glass of clean water. If the turbidity / odor disappear, it means that the turbidity / odor level is low. On the contrary, if it still smells, the water still cannot be consumed. This is likely influenced by the excavation of clam shells that are able to absorb dirty water. Clam shell powder is able to absorb chemicals and microorganisms contained in dirty water [27]–[30]. After a long period of use of the clam shell powder, this clam shell powder is no longer effective because the surface of the media has been covered, so if there is such a case, the media of clam shell powder needs to be washed again with clean water or replaced it with a new one.

Conclusion

The turbidity of raw water before it was processed with filter media of clam shell powder and zeolite sand was 37 NTU and the Fe Level was 6.346 mg / l. The filter media of 3 kg of clam shell powder and 30 cm thickness of zeolite sand can reduce water turbidity of 100% and Fe level of 98.12%. The filter media of 5 kg of clam shell powder and 30 cm thickness of zeolite sand can reduce water turbidity of 100% and Fe level of 98.12%.

Further research needs to be done using a bubble aeration process to contact the air in reducing Fe levels. It needs further research with other parameters such as manganese and aluminum. Clean water that filtered with sand must still be filtered or added with disinfectant, if the results of bacteriological examination are positive.

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