DIFFERENCE SCALLOP SHELL (ANADARA GRANOSA) MEDIA WITH ZEOLITE IN REDUCING IRON (Fe) AND MANGANESE (Mn) LEVELS IN CLEAN WATER

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ABSTRACT

The availability of clean water is a problem, and a human need plays a role in the sustainability of life. Various references prove that changes and decreases in environmental quality can directly or indirectly cause disturbances to human health and the environment, including iron (Fe) and manganese (Mn). Excess water from clean water sources is often found in clean water sources in the community, especially dug well water. This research is analytic with a true experimental design that investigates the possibility of a causal relationship with a design with a treatment group and a control group and compares the treatment results with the control carefully. The population in this study was dug well water in Sapiria Village, Lembo Village, Makassar City. The sample in this study was 10 litres of dug well water. The results obtained from this study were asignificant decrease from several treatments using shellfish media, Zeolite, and a combination of shellfish and Zeolite with a sig value of 0.000 <0.05. For people who want to treat clean water using the filtration method (scallop shell media and Zeolite), the media to be used should be washed thoroughly before use. And cleaning is done periodically on the filter used Zeolite and the combination of shells and Zeolite with sig value 0.000 < 0.05. For people who want to treat clean water using the filtration method (scallop shell media and Zeolite), the media to be used should be washed thoroughly before use. And cleaning is done periodically on the filter used Zeolite and the combination of shells and Zeolite with sig value 0.000 < 0.05. For people who want to treat clean water using the filtration method (scallop shell media and Zeolite), the media to be used should be washed thoroughly before use. And cleaning is done periodically on the filter used.

Keywords: Shellfish, Zeolite, Dug well water

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INTRODUCTION

Dug wells are groundwater used as clean water by the community to meet clean water. However, the availability of drilled well water as a source of clean water is still strongly influenced by soil characteristics, seasons, and the distance of other pollutants to water facilities, which is a factor causing physical, chemical, and biological contamination in the water source.

Metal ions above the required standard usually cause groundwater quality in dug wells. It is found in the presence of manganese (Mn) and Iron (Fe) minerals which are often together, but iron is obtained more often than manganese (Joko, 2010).

Iron in the body is helpful for the formation of red blood cells. However, iron over the standard 1.0 mg/l will cause health problems such as causing diarrhoea, anaemia, and kidney damage (Kusnaedi, 2010). Therefore, efforts need to be made to improve the quality of dug well water with excessive iron and manganese levels.

Clean water treatment methods in reducing iron (Fe) and manganese (Mn) levels from various literature and previous studies have been carried out, including the aeration method, ion exchange, and filtration, but of course, these methods cannot always be directly applied to the community given the conditions Geography, especially the characteristics of the soil from

The region of a place is different. In addition, community readiness sometimes faces obstacles from location, economy, adequate knowledge of fibre technology. It is necessary to strive for a technological method that is easy to access, easy to obtain, efficient, and effective in dealing with the problems encountered.

Treatment efforts that are considered easy and can be carried out and adapted to local conditions, based on local wisdom, are water treatment by filtration using blood clamshells (*Anadara granosa*) filter media which are easily obtained in coastal areas containing calcium carbonate ($CaCO3$) can be used as a separator between water and metal ions (Niswati *et al.* 2010).

The processing method by utilizing silt material is effective, namely Zeolite, a natural rock or mineral that chemically includes silica. Minerals are expressed as hydrated aluminium silica, one of the most widely available natural ion exchangers, and have been widely used to remove iron (Fe) content. And yellow colour in groundwater or other water sources can improve water's physical quality, such as turbidity (Arda. 2011, in Pradana. 2018).

Previous research stated that shellfish filter media in water treatment could reduce iron (Fe) levels by 93.94% in groundwater (Putra et al., 2013). The shell filter media combinedwith activated carbon can reduce iron (Fe) levels by 86.94% (Luthfiah *et al*. 2015), while according to Pradana *et al*. (2018) that the media of shellfish, Zeolite (*ion exchanger*), and activated carbon with the up-flow method reduced iron (Fe) levels by 87.72% in dug well water.

Based on the ability or potential of several filter media that have been carried out, of course, it is necessary to compare this media. Through filtering processing efforts by using both filter media with an up-flow drainage system (water flow through the filter media from bottom to top) which is expected to show more specific and optimal results

in producing treated water as clean water that has passed each different filter media. Blood clamshells (*Anadara Granosa*) and natural Zeolite will see the difference in the decrease results, which is more optimal than the two filter media that will be tested in processing separately.

The results of observations and analysis of preliminary laboratory tests that have been carried out show that one of the dug wells in Kampung Sapiria, Lembo Village, Tallo District, Makassar, has iron (Fe) and manganese (Mn) levels that pass the standard. Iron (Fe) content of 5, 59 mg/l and a manganese (Mn) content of 1.68 mg/l. This result has exceeded the specified clean water requirements, namely 1.0 mg/l for iron (Fe) and 0.5 mg/l for manganese (Mn).

MATERIAL AND METHOD

The type of research used is an actual experiment with the research location being carried out at the Environmental Health Department Campus, Poltekkes, Ministry of Health, Makassar.

The population in this study is dug well water located in Sapiria Village, Lembo Village, Tallo District, Makassar City, with the required number of water samples as much as 120 litres.

The data from the laboratory results were processed using a computer/calculator and analyzed using a one-way ANOVA statistical test to determine the significant difference.

RESULTS

Table 1. Results of Examination of Manganese (Mn)Levels initial and Control Samples

Parameter	Control	Average Concentration (mg/l)	
		Initial Sample	Control
Manganese(Mn)	1	1.32 mg/l	1.47 mg/l
	2	1.32 mg/l	1.33 mg/l
	3	1.32 mg/l	1.37 mg/l
	Average	1.32 mg/l	1.37 mg/l

Source: Primary data, 2021

Based on table 1, the initial Manganese (Mn) examination results were 1.32mg/l, while for the control, it was 1.37 mg/l.

Table 2. Results of Examination of Iron (Fe) Levels inInitial and Control Samples

Parameter	Control	Average Concentration (mg/l)	
		Initial Sample	Control
Iron (Fe)	1	0.80 mg/l	0.93 mg/
	2	0.80 mg/l	1.08 mg/
	3	0.80 mg/l	1.05 mg/
	Average	0.80 mg/l	1.02 mg/

Source: Primary data, 2021

Based on table 2, the initial examination of iron (Fe) levels was 0.80 mg/l, while for thecontrol, it was 1.02 mg/l.

Table 3. Average Decrease in Manganese (Mn) Levels Using Clamshell Media

Parameter	Clamshell	Average Concentration (mg/l)		Average
		Initial Sample	Test	
Manganese (Mn)	1	1.32 mg/l	0. 21 mg/l	1.05 mg/l
	2	1.32 mg/l	0.22 mg/l	
	3	1.32 mg/l	0.36 mg/l	

Source: Primary data, 2021

Based on table 3, the highest decrease in manganese (Mn) levels occurred in experiment 1 of 0.21 mg/l, and the lowest decrease occurred in experiment 3 of 0.36 mg/l.

Table 4. Average Decrease in Iron (Fe) Content Using Clamshell Media

Parameter	Clamshell	Average Concentration (mg/l)		Average
		Initial Sample	Test	
Iron (Fe)	1	0.80 mg/l	0. 44 mg/l	0.30 mg/l
	2	0.80 mg/l	0.46 mg/l	
	3	0.80 mg/l	0.59 mg/l	

Source: Primary data, 2021

Based on table 4, the highest decrease in iron (Fe) levels occurred in experiment 1 of 0.44 mg\l,and the lowest decline occurred in experiment 3 of 0.59 mg\l.

Table 5. Average Decrease in Manganese (Mn) Levels Using Zeolite Media

Parameter	Zeolite	Average Concentration (mg/l)		Average
		Initial Sample	Test	
Manganese (Mn)	1	1.32 mg/l	0.36 mg/l	0.84 mg/l
	2	1.32 mg/l	0.38 mg/l	
	3	1.32 mg/l	0.38 mg/l	

Source: Primary data, 2021

Based on table 5, the highest decrease in manganese (Mn) levels occurred in experiment1 of 0.36 mg\l, and the lowest decline occurred in experiments 2 and 3 of 0.38 mg\l.

Table 6. Average Decrease in Iron (Fe) Content Using Zeolite Media

Parameter	Zeolite	Average Concentration (mg/l)		Average
		Initial Sample	Test	
Iron (Fe)	1	0.80 mg/l	0. 59 mg/l	0.21 mg/l
	2	0.80 mg/l	0.66 mg/l	
	3	0.80 mg/l	0.52 mg/l	

Source: Primary data, 2021

Based on table 6, the highest decrease in iron (Fe) levels occurred in experiment 3 of 0.52 mg\l,and the lowest decline occurred in experiment 2 of 0.66 mg\l.

Table 7. Average Decrease in Manganese (Mn) Levels UsingClamshell and Zeolite Media

Parameter	Clamshell and Zeolite	Average Concentration (mg/l)		Average
		Initial Sample	Test	
Manganese(Mn)	1	1.32 mg/l	0.47 mg/l	0.79 mg/l
	2	1.32 mg/l	0.57 mg/l	
	3	1.32 mg/l	0.55 mg/l	

Source: Primary data, 2021

Based on table 7, it can be explained that the highest decrease in manganese (Mn) levels occurred in experiment 1 of 0.47 mg\l, and the lowest decline occurred in experiment 2 of 0.57 mg\l.

Table 8. Average Decrease in Iron (Fe) Content UsingShellfish and Zeolite Media

Parameter	Clamshell and Zeolite	Average Concentration (mg/l)		Average
		Initial Sample	Test	
Iron (Fe)	1	0.80 mg/l	0. 74 mg/l	0.6 mg/l
	2	0.80 mg/l	0.73 mg/l	
	3	0.80 mg/l	0.85 mg/l	

Source: Primary data, 2021

Based on table 8, the highest decrease in iron (Fe) levels occurred in experiment 2 of 0.73 mg\l, and the lowest decrease occurred in experiment 3 of 0.85 mg\l.

DISCUSSION

1. Reduction of Iron (Fe) and Manganese (Mn) Levels in Clean Water Using ClamshellMedia

Based on the research results, the results of the dug well water in Sapiria Village, Tallo District, Makassar City, for iron (Fe) levels before treatment were 0.80 mg/l while for Manganese (Mn) levels of 1.32 mg/l. After processing using zeolite media, the average decrease for iron (Fe) content was 0.21 mg/l, while for Manganese (Mn) was 0.84 mg/l.

Zeolites are crystalline aluminosilicates of group IA and group IIA elements, such as sodium, potassium, magnesium, and calcium, the structure of zeolites is complex, that is, polymers. Inorganic crystals are based on the infinitely extended tetrahedral framework ofAlO4 and SiO4 and are linked to each other by division with oxygen ions. This skeletal structure contains channels filled with cation and water molecules. Cations are actively mobile and generally act as ion exchangers. Overall this Zeolite has a negative charge (Kusnaedi, 2010).

This negative charge causes the Zeolite to be able to bind cations. Thus, it can be used to bind cations in water, such as iron (Fe), aluminium (Al), or magnesium (Mg) which are commonly found in groundwater. By flowing raw water in the zeolite filter, the cations will be bound by the Zeolite, which has a negative charge. In addition, zeolites also quickly release cations and are replaced with other cations. For example, zeolites release sodium and are replaced by binding calcium or magnesium. Thus, zeolites function as ion exchangers and adsorbents in water treatment.

Based on its nature, adsorption will occur under normal conditions. The vacuum in the zeolite crystal is filled with free water molecules around the cations. When the zeolite mineral is heated, the water will come out so that the Zeolite can function as a gas or liquid absorber.

The ion exchanger in the cavity or electrolyte framework helps maintain the neutrality of the Zeolite. These ions can move freely so that the ion exchange that occurs depends on the size and charge and the type of Zeolite.

2. Reduction of Iron (Fe) and Manganese (Mn) Levels in Clean Water Using Zeolite Media

Based on the research results, the examination results of dug well water in Sapiria Village, Tallo District, Makassar City, for levels of Iron (Fe) before treatment were 0.80 mg/l while for Manganese (Mn) levels of 1.32 mg/l. After processing using zeolite media, the average decrease for iron (Fe) content was 0.21 mg/l, while for Manganese (Mn) was 0.84 mg/l.

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3. Reduction of Iron (Fe) and Manganese (Mn) Levels in Clean Water Using Clamshelland Zeolite Media

Based on the results of the examination, the level of Iron (Fe) before processing was

0.80 mg/l while the level of Manganese (Mn) was 1.32 m/l. After processing using a combination of shellfish media with Zeolite, the average decrease for iron (Fe) content was 0.6 mg/l, while for Manganese (Mn) was 0.79 mg/l.

Shellfish shells contain calcium carbonate ($CaCO_3$), so they can be used as a water separator with metal ions.

The calcium carbonate ($CaCO_3$) content in clamshells is even higher when compared to limestone, eggshells, ceramics, or other materials.

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The process that occurs in the processing stage is capturing ions contained in the water (dissolved metals, sodium, ammonia) and replacing them with something else that is already attached to the ion exchange site of the media so that ion-free water passes. Combining the two media used will significantly decrease Manganese (Mn) and Iron (Fe) levels.

In essence, the decrease in iron content in water changes from a water-soluble form to a water-insoluble state. Therefore the product of this oxidation reaction always produces a precipitate. Given this, its application is usually accompanied by filtering. This filtering process is carried out when the iron content is lower than five mg/l.

The principle of reducing iron content is the process of oxidation and precipitation. The process is that iron in the form of ferrous dioxide first becomes ferrous, then precipitates by forming a ferric hydroxide precipitate. This process quickly occurs at pH

+ 7 where the solubility is minimum.

Based on the design research that has been made by making a filtering device from PVC pipes, that are assembled as simply as possible because it does not use backwash. This is only simple filtering using media. Filtration uses the up-flow direction. Up-flow filtration is a water treatment system passing through a filter media with the flow direction. If the filter is dirty from the bottom to the top, the washing process will occur automatically by opening the drain valve. This process is called backwashing.

The water sample is distributed through the pipe, from the bottom to the top, so that the water pressure is obtained utilizing gravity. The advantage of the up-flow filtration system is that the filtering residence time in the water is more extended than down-flow so that filtration is more effective in reducing levels of contaminants such as Fe and Mn.

Filter media is also influential in the filtration process; or other words, filter media is a material used for filtration and is part of the filter that causes a filtration effect. The filter media consists of materials that fill or are arranged in the filter (Asmadi *et al.*, 2011). There are two types of filter media used in this study: clamshells (*Anadara granosa*) and Zeolite. Both media are treated the same or homogeneous with the size of the same media.

Before being used as a filtering medium, the two media were pre-treated, such as washing shells and drying; after drying, the press was then crushed to the size of a zeolite where the Zeolite used was activated washing using a salt solution.

This research's most influential filtration principle is the deposition process in slow filters or filters with flow direction from bottom to top. The space between the grains of the sand media serves as a small settling basin. Particles with even small sizes, colloids, and several kinds of bacteria will settle in the space between grains and stick to the grains of sand due to physical effects (adsorption).

In addition, the size of the filter media in the filtration process affects the yield of water that goes through the filtering processor. It is also known as the effective particle size. To find out the real difference in the filter media used, the size of the filter media used should not be different, or it is called homogeneous. The shells obtained are not only used directly. Still, they are made to the size of zeolite media by grinding the shells before use, but if there is shell powder during the grinding process, the rest is separated and uses a shell the size of a zeolite so that all media are homogeneous.

Water that passes through the filter media is deposited and netted on the surface of the filter media layer.

Based on the examination results, the most effective medium in reducing Manganese (Mn) levels was mussel shell media, which could facilitate the average removal of 1.05 mg/l from the initial sample of 1.32 m/l. Meanwhile, for iron content (Fe),the most effective medium in reducing iron (Fe) levels is to use a combination of clamshells and Zeolite with an average removal of 0.6 mg/l from the initial sample of 0.80mg/l.

Based on the results of statistical tests, the one-way ANOVA test is used to determine differences in more than two interventions with replication. On the results of the examination of levels of Iron (Fe) and Manganese (Mn) levels using filter media of shellfish, Zeolite, and a combination of media for the arrangement of shells-zeolite and control, Sig. 0.000 < 0.05 so that the hypothesis is accepted, it shows that there is a significant difference for the levels of iron (Fe) and Manganese (Mn).

CONCLUSION

This study concludes a significant decrease in iron (Fe) and Manganese (Mn) levels in clean well water through filtration processing using shells, Zeolite, and a combination of shellfish and Zeolite.

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