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## The Effectiveness of Zeolite-Activated Charcoal in Reducing Iron and Manganese Levels in Well Water of Milala Housing in Pancur Batu District, North Sumatra

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### ABSTRACT

Dug wells are a means of providing clean water that belongs to shallow groundwater and generally contains high levels of iron (Fe) and manganese (Mn). The presence of high levels of iron in water is marked by yellow-brown water color and unpleasant odor. Excess iron can cause poisoning, intestinal damage, premature aging to sudden death, impaired absorption of vitamins and minerals, and hemochromatosis. Based on the observation of the researchers on the condition of the dug well water of the community in Milala Rumah Tengah Block E Simpang Gardu Subdistrict Pancur Batu, it can be seen that the dug well water is very yellow and the community uses it as a source of clean water. The results showed that the iron content of the dug well water in two houses before treatment was >4 mg/l and the manganese content in the first house was 2.60 mg/l and in the second house was 3.02 mg/l. After treatment using activated charcoal zeolite for ten days, the average iron content decreased to 0.08 mg/l (98%) and the average manganese content decreased to 0.26 mg/l (90%)

## INTRODUCTION

Water is one of the natural resources that has a very important function for human survival. From the point of view of public health, the need for water for hygiene purposes must meet quality requirements so that public health can be guaranteed. The Environmental Health Standard for Water Media for Sanitation Hygiene includes physical, biological, and chemical parameters that can be mandatory parameters and additional parameters. Sanitation Hygiene Water is used for personal hygiene maintenance such as bathing and brushing teeth, as well as washing food ingredients, eating utensils, and clothing. In addition, Sanitation Hygiene Water can be used as raw water for drinking water (Permenkes, 2017).

High iron (Fe) levels in water can cause yellow stains on clothes when used for washing and can cause health problems or disorders for people who consume it continuously (Risal Nur, 2011) such as causing damage to the intestinal wall. Excess iron (Fe) can cause poisoning where vomiting, intestinal damage, premature aging to sudden death, easy to get angry, joint inflammation, birth defects, bleeding gums, cancer, cardiomyopathies, kidney cirrhosis, constipation, diabetes, diarrhea, dizziness, easy fatigue, blackish skin, headache, liver failure, hepatitis, easy emotion, hyperactive, hypertension, infection, insomnia, liver pain, mental problems, metallic taste in mouth, myasthenia gravis, nausea, nevi, restless and irritable easily, parkinson's disease, rheumatism, schizophrenia, stomach ulcers, sickle-cell anemia, stubbornness, strabismus, vitamin and mineral absorption disorders, and hemochromatosis

Based on Makmur's research (2013) to reduce iron (Fe) levels in water with the cascade method, but the results of his research show that the cascade method has not been effective in reducing iron (Fe) and manganese (Mn) levels. Where the results of the study obtained iron levels after processing are 3.0 mg / l and manganese levels (Mn) 1.6 mg / l. These results have not met the requirements of Permenkes RI No. 492/MENKES/PER/IV/2010. Likewise, processing

using the zeolite filtration method is only able to reduce iron (Fe) levels to 0.6 mg / l, manganese levels (Mn) 0.93 mg / l. These results have not met the requirements in Permenkes RI No. 492 / MENKES / PER / IV / 2010 which states the maximum iron (Fe) content for clean water is 0.3 mg / l and manganese (Mn) maximum 1.0 mg / l. However, for the cascade combination method, the results of decreasing manganese levels (Mn) have met the requirements, while for decreasing iron levels have not met the requirements because the results of the study obtained average iron levels to 0.5 mg / l and average manganese levels to 0.5 mg / l.

Based on the researcher's temporary observations about the condition of the community's dug well water in Milala Housing, Central House, Block E, Simpang Substation, Pancur Batu District, it can be seen that the dug well water is very yellow and the community uses the water as their clean water source. Likewise, white school uniforms look yellowish-white. Seeing this situation, researchers are interested in conducting research to treat community dug well water to make it suitable for use as a source of clean water using ion exchange methods using zeolite-activated charcoal and activated resin-charcoal. Digging well water treatment using the two methods above is very easy to apply to everyday life because the tube to be used is small and can be connected to the existing water tap, so that mothers or all family members can use this tube, but whether activated zeolite-charcoal or the highest activated charcoal resin reduces iron (Fe) levels is unknown. For this reason, it is necessary to conduct research on the Comparison of the Ability of Zeolite-Activated Charcoal and Resin-Activated Charcoal in Reducing Iron (Fe) and Manganese (Mn) Levels found in Community Dig Well Water in Milala Housing, Central House, Block E, Simpang, Substation, Pancur Batu District.

## METHODS

This type of research is a quasi-experimental research with a pre-testpost test design where in the early stages before the treatment will be carried out an examination of iron (Fe) and manganese (Mn) levels in the dug well sample water and in the second stage which will be tested to determine changes in the iron (Fe) content of the sample water after treatment or filtration using zeolite-activated charcoal and resin-charcoal.

Measurements are made after processing for ten days.

## RESULTS AND DISCUSSION

After processing using activated zeolite-charcoal, the results were obtained that there was a decrease in Iron (Fe) water levels in the first house dug well, starting from the first day to the tenth day measurement. The decrease in Iron (Fe) levels in dug well water fluctuates, this can be seen from table 1 below.

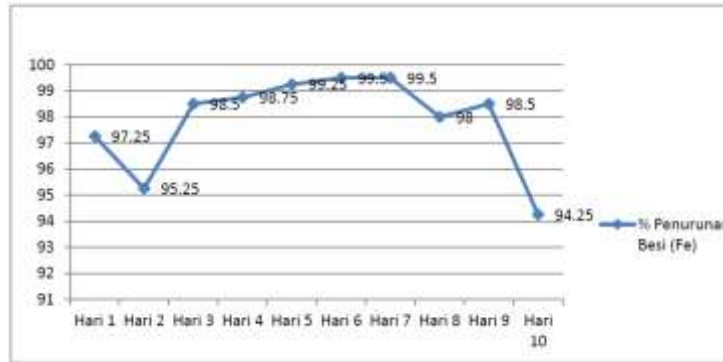
Table 1. Iron (Fe) Water Content of Dug Wells in Meliala Tengah Housing Community Before and After Processing with Zeolite-Activated Charcoal

Fe levels before treatment (mg/l)	Fe levels after treatment		decrease	% decrease
	days	levels Fe (mg/l)		
>4	1	0.11	3.89	97.25
>4	2	0.19	3.81	95.25
>4	3	0.06	3.94	98.50
>4	4	0.05	3.95	98.75
>4	5	0.03	3.97	99.25
>4	6	0.02	3.98	99.50
>4	7	0.02	3.98	99.50
>4	8	0.08	3.92	98.00
>4	9	0.06	3.94	98.50
>4	10	0.23	9.77	94.25
Average		0.08	3.92	98.00

Based on table 1. It is known that the Iron (Fe) content of dug well water before processing is >4 mg / l and after processing using activated zeolite-charcoal there is a decrease. The average decrease in Iron (Fe) levels for ten days was 0.08 mg/l and the average percentage decrease in Iron (Fe) levels was 98%.

If the results of the average examination of the decrease in Iron (Fe) levels are compared with the

maximum limit of iron content of drinking water according to Permenkes RI Number 492 / Menkes / PER / 2010 which is 0.3 mg / l, then the treatment of dug well water using zeolite-activated charcoal has been able to exceed this threshold value. The fluctuation in the percentage decrease in iron (Fe) content of dug well water is shown in the graphic below.



Picture 1. Graph of the Percentage Decrease in Iron (Fe) Content of Dug Well Water After Treatment Using Activated Zeolite-charcoal

In the graphic image above, the percentage of iron (Fe) content decrease after processing, the highest on the ninth day is 99.5% and the lowest is on the tenth day at 94.25%. To see the ability of

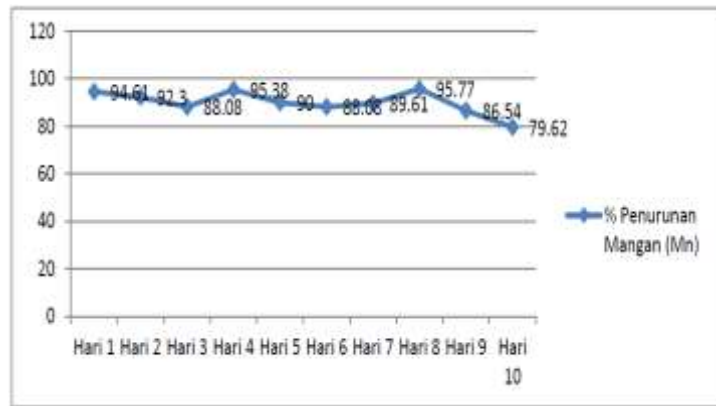
activated zeolite-charcoal in reducing Manganese (Mn) levels of dug well water can be seen in table 2 below.

Table 2. Manganese (Mn) Water Content of Dug Well of Meliala Tengah Housing Community Before and After Processing with Zeolite-Activated Charcoal

Mn levels before treatment (mg/l)	Mn levels after treatment		decrease	% decrease
	days	levels Mn (mg/l)		
2.60	1	0.14	2.46	94.61
2.60	2	0.20	2.40	62.30
2.60	3	0.31	2.29	88.08
2.60	4	0.12	2.48	95.38
2.60	5	0.26	2.34	90.00
2.60	6	0.31	2.29	88.08
2.60	7	0.27	2.33	89.61
2.60	8	0.11	2.49	95.77
2.60	9	0.35	2.25	86.54
2.60	10	0.53	2.07	79.62
Average		0.26	2.34	90.00

Based on the table above, it is known that the manganese (Mn) level of well water before treatment was 2.60 mg/l and after treatment using activated zeolite there was a decrease. The average decrease in manganese (Mn) levels for ten days was 0.26 mg/l and the average percentage of manganese (Mn) reduction was 90%. The average decrease in

manganese (Mn) levels was lower than the maximum limit of iron levels in drinking water according to Pemenkes RI Number 492/Menkes/PER/2010 which is in the range of 0.4 mg/l, so the treatment of well water using activated zeolite has been able to exceed the permissible threshold value. The fluctuation of the percentage of iron (Fe) reduction in well water can be seen in the graph below.



Picture 2. Graph of the Percentage Decrease in Manganese Content (MN) of Dug Well Water After Treatment Using Activated Zeolite-Charcoal

In the graph above, the percentage of manganese (Mn) reduction after processing is highest on the eighth day at 95.77% and the lowest is on the tenth day at 79.62%.

Based on research results that have been carried out on well water treatment using activated zeolite filters, the iron metal content has been successfully reduced below the drinking water standard in Permenkes 492/Menkes/Per/IV/2010 which is in the range of 0.02-0.23 mg/l. For manganese (Mn), activated zeolite filters have also been successfully reduced. From the first day to the ninth day, manganese levels were below the drinking water standard in Permenkes 492/Menkes/Per/IV/2010 which is in the range of 0.11-0.35 mg/l

The decrease of iron and manganese levels in well water using activated zeolite occurs due to the ability of the water treatment unit used in the study, where the first housing tube contains chlorine and then the water is passed to a filter containing active sand, manganese, activated carbon and then the water is passed to the second housing tube containing zeolite. The oxidation reaction produces ferric hydroxide or manganese dioxide compounds that are very fine clumps (micro flock) that are insoluble in water, so they can be filtered on a filter containing active sand, manganese and activated carbon and zeolite in the housing tube. According to Said (2005), chlorine (Cl<sub>2</sub>) and hypochlorite ions (OCl<sup>-</sup>) are strong oxidizing agents so that even under low pH conditions and low dissolved oxygen, they can oxidize quickly.

## CONCLUSION

After conducting research, several conclusions can be drawn, namely:

1. The iron (Fe) content of dug well water before contact with activated zeolite-charcoal was >4 mg / l and after contact for ten days obtained an average decrease to 0.08 mg / l. The manganese (Mn) content of dug well water before contact was 2.60 mg / l and after contact obtained an average decrease to 0.26 mg / l. Treated water is below the quality standards of drinking water quality requirements contained in Permenkes / Menkes / Per/IV / 2010.
2. The average decrease in iron (Fe) content of dug well water after being treated using activated zeolite- activate charcoal for ten days is 98% and the average decrease in manganese (Mn) content is 90%.

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