Effectiveness of Varying Eggshell and Zeolite Thickness in Reducing Iron Content of Well Water in Jebugan, Klaten

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Abstract

Iron (Fe) levels in the human body can cause harm to both health and the environment which can cause public health problems. Fe levels based on the results of preliminary tests carried out in Jebugan Klaten Village were 2.58 mg/l, these results exceed the clean water quality standards for sanitation hygiene. One way that can be done is by a filtration process using egg shells and zeolite. The aim of this research is to determine the effect of variations in the thickness of egg shells and zeolite on reducing Fe levels in clean water in Jebugan Village, Klaten. This type of research is an experiment with a pre-posttest with control design. The research location was Jebugan Village, Klaten and filtration tests and measurements of iron levels were carried out at the Regional Health Laboratory of the Sukoharjo City Health Service. The research was carried out from September 2023 to February 2024. The number of samples required in this research is 28 liters. The processing uses filtration with varying thicknesses of egg shell and zeolite of 5 cm, 10 cm and 15 cm. Data analysis used the Shapiro-Wilk statistical test and One Way Anova. The results of the research showed that there was an influence of variations in the thickness of egg shell and zeolite on decreasing Fe levels (p-value of 0.001) with the average result of decreasing Fe levels for each thickness variation being 1.396 mg/l (3.45%); 0.887 mg/l (38.69%); 0.415 mg/l (71.34%); and 0.076 mg/l (94.76%). It is recommended that residents of Jebugan Village, Klaten use water treatment by filtration using zeolite and egg shells with a thickness of 15 cm so that the iron (Fe) content in the water meets health quality standards.

Keywords: Eggshell, Zeolite, Iron Content

INTRODUCTION

Water is a natural resource that is very important for living creatures. Raw water for domestic, irrigation and industrial needs is very important because many life processes cannot take place without water (Makbul et al., 2023). Indonesia is ranked fourth in the world with unequal availability of clean water. This is a big problem that affects all aspects of life, including people's health and welfare (Lestari et al., 2021).

Data from the Central Statistics Agency shows that the current achievement of adequate access to clean water in Indonesia has only reached 72,55%, still below the 100 percent target of the Sustainable Development Goals (SDGs), with 33,4 million people lacking clean water and 99,7 million people lacking clean water. million people do not have access to good sanitation facilities (Kurniawati et al., 2020). An imbalance between human needs and the availability of clean water will soon occur because the availability of clean water is decreasing even though the potential or reserves are very limited (Yüksel et al., 2021).

The high iron content in water that continues to be left will cause public health problems because some people use this well water for cooking and also as drinking water. Iron will accumulate in important organs, including the liver and brain, which can cause serious damage to these two organs (Silviana et al., 2020). If accumulated in the body Fe can cause several health problems, for example in humans cause irritation of the skin and eyes, interfere with breathing and cause cancer in the long term (Kurniawan et al., 2020).

Oral ulceration, baby blue syndrome, altered reproductive potential, and gastric cancer are examples of diseases caused by high Fe content in water (Zhang et al., 2019). To reduce iron levels in clean water, one method can be used, namely filtration (Jundulloh et al., 2021; Wołowiec et al., 2019) . Eggshells can be used as heavy metal adsorbents to reduce heavy metal content in the environment and the adsorption capacity of eggshells on lead metal contamination is better than the adsorption capacity of activated carbon (Misfadhila et al., 2018).

Eggshells are high in nutrients (Hasibuan et al., 2021). As much as 97% calcium is contained in chicken eggshells. This high calcium content is known as a calcium carbonate compound which is very good as a raw material for making the utilization of liquid organic fertilizer (POC) and can raise the pH of soil and water media (Defvi et al., 2023).

Filtration is the physical, chemical and biological filtering of particles. This is done to separate or filter particles that are not deposited in sedimentation through porous media (Pradopo et al., 2021). The inside of the eggshell cuticle consists of hydroxyapatite crystals with pores containing mucopolysaccharide protein acid. Important groups of amino acids, including carboxyl, amine, and sulfate, have the ability to bind metal ions (Faradila et al., 2020).

Meanwhile, zeolite can be an ion exchanger, adsorption and catalyst. Zeolite is a three-dimensional tetrahedral alumina silica network that produces hollow crystals that have relatively structured cavities filled with alkaline earth metals for charge balance. Water molecules are carried into a network of channels in these cavities (Daulay et al., 2019). Poor water quality and especially drinking in rural areas is a major risk factor for human health, so researchers contribute to evaluating the chemical quality of water resources in these environments in terms of heavy metals in this case, namely Fe (Barbieri, 2019).

Regulation of the Minister of Health of the Republic of Indonesia Number 2 of 2023 concerning Environmental Health for Sanitation Hygiene purposes establishes water quality standards which indicate that clean water meets health requirements. Iron (Fe) levels must be less than the quality standard of 0,2 mg/L. If the iron content exceeds this value, clean water

does not meet the requirements and must be treated before being used for daily purposes, especially for consumption (Ministry of Health Republic of Indonesia, 2023). Meanwhile, based on a preliminary study of sample test results in the laboratory, from 1 sample studied, namely Jebugan Village, the result was 2,58 mg/l, which came from a drilled well, indicating that Jebugan Village has an iron content that exceeds the maximum limit set by Regulation of the Minister of Health of the Republic of Indonesia number 2 of 2023 for Sanitation Hygiene.

Based on the description above, researchers want to conduct research on reducing Fe levels in well water in Jebugan Village, Klaten Regency by differentiating the effect of filtration thickness with eggshell and zeolite media.

METHODS

This type of research is an experimental research with pretest-posttest with control group. This research will be conducted on September 2023-February 2024 in Jebugan Village, Klaten to conduct filtration tests and for the measurement of iron (Fe) levels carried out at the Regional Health Laboratory of the Sukoharjo City Health Office. The population of the study is all borehole water obtained iron content of 2.58 in settlements in the Jebugan District area of Klaten Regency.

The technique used in sampling in this study was total sampling. Data collection was carried out directly by visual observation of the color and turbidity of well water, measurement of iron levels in the laboratory, and recording data related to this study in the form of treatment thickness and recap of final results.

The total number of samples taken is 4 liters with 6x repetitions so that 24 liters are needed for treatment then 1 liter is needed for control as much as 25 liters, so that the minimum number of samples taken is 28 liters.

Tools and materials in the form of washed and dried eggshell and zeolite filter media, then put in a filter tank with a combination of eggshell and zeolite filter media measuring 0 cm; 5 cm; 10 cm and 15 cm and repeated 6 times, then sample water is put into the filter tank, each tank is filled with 7.5 liters and contacted with filter media for 60 minutes. After the filtration process is complete, 1000 ml of filtered water is taken and put into an aqua bottle to check the Fe content, temperature and pH with a spectrophotometer, check the temperature with a thermometer and check the pH with a pH meter and calculate its effectiveness.

Data analysis with bivariate analysis using the Anova test, to find out the effect between eggshell thickness of 5 cm and zeolite 5 cm, eggshell 10 cm and zeolite 10 cm, and eggshell 15 cm and zeolite 15 cm on reducing well water iron levels). This research has been approved by the Health Research Ethics Committee of the Faculty of Health Sciences, Universitas Muhammadiyah Surakarta with number 189/KEPK-FIK/I/2024.

RESULTS

This research was conducted to reduce Fe levels in clean water in Jebugan Village, Klaten using egg shells and zeolite. Variations in the thickness of the egg shell and zeolite used were 5cm, 10cm and 15cm. Based on research carried out in February and after examining clean water samples from Jebugan Village, Klaten for Fe at Unit Pelaksana Teknis Laboratorium Kesehatan Daerah Kota Surakarta, univariate and bivariate analyzes were carried out. The results of the pH examination in the groups before and after treatment can be presented in Table 1.

Table 1 Results of pH Level Checks Before and After Processing Using Egg Shells and Zeolite in the Treatment and Control Groups

Repetition	Control		Treatment					
			5cm		10cm		15cm	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	6,8	6,8	6,8	7,0	6,8	6,8	6,8	6,9
2	6,8	6,8	6,8	7,0	6,8	7,0	6,8	7,0
3	6,8	6,8	6,8	6,9	6,8	6,9	6,8	6,8
4	6,8	6,8	6,8	6,8	6,8	6,8	6,8	6,8
5	6,8	6,8	6,8	6,8	6,8	6,8	6,8	6,8
6	6,8	6,8	6,8	6,8	6,8	6,8	6,8	6,8
Sum	40,8	40,8	40,8	41,3	40,8	41,1	40,8	41,1
Average	6,8	6,8	6,8	6,9	6,8	6,9	6,8	6,9

In Table 1. It can be seen that there was no decrease in pH levels in the control and treatment groups. The results of checking the temperature of the group before and after treatment can be presented in Table 2.

Table 2 Results of checking temperature levels before and after processing using egg shells and zeolite in the treatment and control groups

Repetition	Controls		Treatment					
			5cm		10cm		15cm	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	29	29	29	29	29	29	29	29
2	29	29	29	29	29	29	29	29
3	29	29	29	29	29	29	29	29
4	29	29	29	29	29	29	29	29
5	29	29	29	29	29	29	29	29
6	29	29	29	29	29	29	29	29
Sum	174	174	174	174	174	174	174	174
Average	29	29	29	29	29	29	29	29

In Table 2. There was no difference in temperature before and after in the control and treatment groups. Results of laboratory examination of Fe levels before and after treatment in the control group.

The results of laboratory examination of group Fe levels in the control group can be presented in Table 3.

Table 3 Results of Fe Level Examination Before and After Processing Without Using Egg Shells and Zeolite in the Treatment and Control Groups

Repetition	Control (mg/l)		Difference	Effectiveness
	Pre	Post	(mg/l)	(%)
1	1,446	1,398	0,048	3,320
2	1,446	1,397	0,049	3,389
3	1,446	1,399	0,047	3,250
4	1,446	1,394	0,052	3,596
5	1,446	1,396	0,050	3,458
6	1,446	1,393	0,053	3,665
Sum	8,676	8,377	0,299	20,678
Average	1,446	1,396	0,049	3,446

Based on table 3, it can be seen that there are differences in Fe levels before and after control. In this group, Jebugan Village clean water was treated without using egg shells and zeolite but soaking for 1 hour resulted in an average reduction of 3,446% with the highest percentage in the sixth repetition, namely from 1,446 mg/l to 1,393 mg/l (3,665%).

The results of laboratory examination of the Fe levels of the treatment groups before and after processing with a thickness variation of 5 cm can be presented in Table 4.

Table 4 Fe Content Examination Results Before and After Processing Using Egg Shells and Zeolite with a thickness variation of 5cm

Repetition	Treatment (mg/l)		Difference	Effectiveness
	Pre	Post	(mg/l)	(%)
1	1,446	0,889	0,557	38,520
2	1,446	0,887	0,559	38,658
3	1,446	0,885	0,561	38,797
4	1,446	0,888	0,558	38,589
5	1,446	0,884	0,562	38,866
6	1,446	0,886	0,560	38,728
Sum	8,676	5,319	3,357	232,158
Average	1,446	0,887	0,560	38,693

In Table 4, it can be seen that there are differences in Fe levels before and after treatment. The highest presentation in the Jebugan Village clean water treatment treatment using egg shells and zeolite with a thickness variation of 5 cm occurred in the fifth repetition, namely from 1,446 mg/l to 0,884 mg/l (38,866 %).

The results of laboratory examination of the Fe levels of the treatment groups before and after processing with a thickness variation of 10 cm can be presented in Table 5.

Table 5 Results of Fe Content Examination Before and After Processing Using Eggshells and Zeolite with a thickness variation of 10cm

Repetition	Treatment (mg/l)		Difference	Effectiveness
	Pre	Post	(mg/l)	(%)

1	1,446	0,415	1,031	71,300
2	1,446	0,417	1,029	71,162
3	1,446	0,416	1,030	71,231
4	1,446	0,412	1,034	71,508
5	1,446	0,414	1,032	71,369
6	1,446	0,413	1,033	71,438
Sum	8,676	2,487	6,189	428,008
Average	1,446	0,415	1,032	71,335

In Table 5, it can be seen that there are differences in Fe levels before and after treatment. The highest presentation in the Jebugan Village clean water treatment treatment using egg shells and zeolite with a thickness variation of 10 cm occurred in the fourth repetition, namely from 1,446 mg/l to 0,412 (71,508 %).

The results of laboratory examination of the Fe levels of the treatment groups before and after processing with a thickness variation of 5 cm can be presented in Table 6.

Table 6 Fe Content Examination Results Before and After Processing Using Eggshells and Zeolite with a thickness variation of 15cm

Repetition	Treatment (mg/l)		Difference (mg/l)	Effectiveness (%)
	Pre	Post		
1	1,446	0,078	1,368	94,606
2	1,446	0,079	1,367	94,537
3	1,446	0,075	1,371	94,813
4	1,446	0,076	1,370	94,744
5	1,446	0,074	1,372	94,882
6	1,446	0,073	1,373	94,952
Sum	8,676	0,455	8,221	568,534
Average	1,446	0,076	1,370	94,756

In Table 6, it can be seen that there are differences in Fe levels before and after treatment. The highest presentation in the Jebugan Village clean water treatment treatment using egg shells and zeolite with a thickness variation of 15 cm occurred in the sixth repetition, namely from 1,446 mg/l to 0,073 mg/l (94,952 %).

The results of the normality test and difference test in the groups before and after treatment can be presented in table 7.

Table 7 Results of the Normality Test and Difference Test in the Before and After Groups Treatment

Test	p-value	information
Shapiro Wilk	>0,05	Hα is accepted
One Way ANOVA	<0,01	Hα is accepted

The initial stage in statistical testing is to determine whether the distribution of the data to be analyzed is normally distributed or not by carrying out a data normality test. The data normality test used is the Shapiro-Wilk test. After the Shapiro-Wilk normality test, the p-value or probability value > 0,05 was obtained, so it can be concluded that the data distribution is normally distributed. Then proceed with the One Way Anova test. The results of the One Way Anova test show that for various variations in eggshell and zeolite thicknesses of 5cm, 10cm

and 15cm, a significant value of 0,001 (p-value<0,01) is obtained, so Ho is rejected and Hα is accepted, namely There is an influence of variations in the thickness of egg shells and zeolite on decreasing Fe levels between before and after administration of egg shells and zeolite with thickness variations of 5cm, 10cm and 15cm in clean water in Jebugan Village, Klaten .

The results obtained from examining iron levels in drilled wells in Jebugan Village, Klaten before and after treatment in the treatment group were then entered into a table and analyzed descriptively and analytically. The following are the results of the univariate test in this study.

Table 8 Descriptive Statistics

Treatment	N	Mean	Std. Deviation	Minimum	maximum
0cm	6	1,396	0,0023	1,4	1,4
5cm	6	0,887	0,0019	0,9	0,9
10cm	6	0,415	0,0019	0,4	0,4
15cm	6	0,076	0,0023	0,1	0,1
Total	24	2,774	0,0084	2,8	2,8

Based on Table 8, it can be seen that the highest mean value of the 6 treatments is 1,396. The highest standard deviation value is 0,0023. Then the lowest minimum value in this study is 0,1. Meanwhile, the highest maximum value in this study was 1,4.

A Multiple Comparisons test was carried out to determine the most effective thickness of filtration media to be used. The following are the results of the Multiple Comparisons test. The results of the Multiple Comparisons test can be presented in table 9.

Table 9 Multiple Comparisons Test

(I) Treatment	(J) Treatment	Mean Difference (IJ)	Std. Error	Sig.
0 cm	5 cm	0,5097	0,0011	0,000
	10cm	0,9817	0,0011	0,000
	15cm	1,3203	0,0011	0,000
5 cm	0 cm	-0,5097	0,0011	0,000
	10cm	0,4720	0,0011	0,000
	15cm	0,8170	0,0011	0,000
10cm	0 cm	-0,9817	0,0011	0,000
	5 cm	-0,4720	0,0011	0,000
	15cm	0,3387	0,0011	0,000
15cm	0 cm	-1,3203	0,0011	0,000
	5 cm	-0,8107	0,0011	0,000
	10cm	-0,3387	0,0011	0,000

Based on Table 9. The results of the Multiple Comparisons test in this study obtained a significance value of 0,000 in all samples. 0,000 < 0,05 so there is a significant average effect between each treatment. The value for measuring effectiveness is seen from the mean difference column where the effective thickness for filtration is 15cm because 15cm has a value of 1,3203, which is the highest value compared to the other sample values.

DISCUSSION

One source of clean water utilized by humans is groundwater using dug wells. Groundwater or dug wells are often contained by components both organic and inorganic among the various harmful metals that are usually often contained in it such as iron (Fe) (Pradana et al., 2018).

The content of Fe (II) ions contained in clean water can cause changes in the color of water to yellow-brown and after contact with air for a while will cause an unpleasant smell, yellow spots on clothes and impact health problems or disorders in people who consume continuously (Amalia et al., 2022). If the environment is out of balance, the human condition will be out of balance too. This imbalance can cause various problems for humans, especially health problems (Asyfiradayati et al., 2023). If the human body is overloaded with iron (Fe), it can damage important organs in the body such as the pancreas, heart muscle and kidneys (Pradana et al., 2018).

Iron (Fe) levels can be reduced in several ways such as oxidation, ion exchange, filtration or adsorption. Adsorption is able to reduce concentrations caused by heavy metal pollution. Adsorption is also more economical, does not cause toxic effects and is able to remove organic matter. The adsorption process is the transfer of particles in solution to the pore surface of the adsorbent granules. There are two adsorption methods, batch and continuous systems (Misfadhila et al., 2018). Research Amalia et al., (2022), that adsorbents from chicken eggshells are able to absorb iron metal (Fe) in wastewater by -4.31% - 99.65%, the optimal ability to absorb iron metal (Fe) using adsorbents from chicken eggshells occurs when the contact time is 60 minutes with an adsorbent mass of 1.5 grams, which is 99.65%.

In the research that was carried out, the pH of water was measured before and after filtration by carrying out six repetitions, the results were still relatively the same, namely 6,9. Based on these results, the pH of the water is not influenced by the filtration method and the decrease in Fe levels is actually influenced by the treatment carried out using zeolite media and activated carbon. If the water contains a pH<7, it is acidic. If the pH measurement results are compared with the standards issued by Regulation of the Minister of Health of the Republic of Indonesia number 2 of 2023 concerning Environmental Health, the permissible pH is 6.5-8.5, so the pH of water 6.9 is still within the standard. allowed for consumption but with the condition that it must go through the treatment process first (Husaini et al., 2020).

Zeolite itself has the ability to function as an ion exchanger, adsorption, and catalyst. Zeolites are crystalline silicates that have a highly ordered structure and high porosity. To use

synthetic zeolites as effective sorbents, they must first be activated with a strong acid, such as HCl (Yunita et al., 2019). Natural zeolite that is activated using HCl has a greater capacity than natural zeolite without activation which is used to remove rhodamine B from water solution (Astuti et al., 2019). The use of zeolite as a well water filtration media. As a well water filtration media, zeolite decreased by 65.06% (Utari et al., 2022).

The water temperature measurement results of 29°C based on the results before treatment and after going through the filtration method with repetition six times did not change. Based on these results, the filtration method does not affect the water temperature based on the Regulation of the Minister of Health of the Republic of Indonesia number 2 of 2023 concerning Environmental Health, the permitted temperature is ± 3 air temperature. Thus the temperature of 29°C is still within the permissible standards.

Iron (Fe) content, pH and temperature of well water in Jebugan Village, Klaten measured by the filtration method using zeolite media and egg shells with a thickness of 5, 10 and 15 cm. Measurement of the iron (Fe) content of well water was carried out at the Surakarta City Health Service Laboratory.

The physical characteristics of the well water used as a sample are that it has an odor and a brownish yellow color. The presence of iron (Fe) in this water causes this to happen. The well owner knows that the physical condition of the well water is poor, so the water is only used for sanitation hygiene.

Iron levels that do not match or exceed quality standards can cause many problems, such as corrosive pipes, tubs, sinks, toilets, changing color, smell and taste, as well as irritation to the eyes, skin and damage to the intestinal walls (Yusmidiarti et al., 2021). Because water components can cause health problems, which if not treated immediately can cause poisoning.

In this study, researchers carried out four treatments with six replications for each treatment. After carrying out the first, second, third and fourth treatments with six replications, the samples were immediately examined at the Surakarta City Health Service Laboratory and obtained average effectiveness results of 1,396 mg/l (3,45%), 0,887 mg/l (38,69%), 0,415 mg/l (71,34%) and 0,076 mg/l (94,76%). Apart from that, from the Anova test, a value of 0,000<0,05 was obtained, which means that each treatment or thickness of the filtration media has a significant influence.

The use of eggshells as filtration media will also reduce the amount of waste in households and restaurants (Hasibuan et al., 2021). The results of this study are in line with research Marwanto et al., (2022), that chicken eggshells as a well water filtration media, powder from chicken eggshell waste has decreased, where Fe levels after giving 10 mg, 20 mg,

30 mg, 40 mg eggshell biocoagulants have decreased with an average decrease of 75, 68%; 84.68%; 88.29% and 85.59%. Chicken eggshells have a functional group (O-H) that functions to bind metal ions so that the absorption and ion exchange process occurs, the following is the alleged ion exchange process that occurs in chicken eggshell adsorbents and Fe 2+ metal ions. This study is in line with research Fatma et al., (2022), states that it can be concluded that the provision of eggshell powder of 5 grams, 7 grams and 9 grams in well water can reduce the number of iron (Fe) levels.

Judging from the effectiveness of the four treatments carried out, the most effective treatment in reducing iron (Fe) levels is between 0 cm, 5 cm, 10 cm and 15 cm using the Multiple Comparisons table where based on the results of the analysis it is found that a thickness of 15 cm is an effective thickness for reducing iron levels in well water in Jebugan Village, Klaten. This can be seen from the mean difference value where the effective thickness for filtration is 15 cm because 15 cm has a value of 1,3203 which is the highest value compared to other sample values. Judging from the results that meet clean water quality standards, the third treatment has results that are in accordance with clean water quality standards, but the results are at the threshold of 15 cm with an average result of 0,076 which according to the Regulation of the Minister of Health of the Republic of Indonesia number 2 of 2023 the iron (Fe) content in water for sanitary hygiene purposes is a maximum of 0.2 mg/l.

The first treatment, namely with a thickness of 0cm or no treatment, had results with an average of 1,396 mg/l, which is still above the standard. Meanwhile, the second treatment with a thickness of 5cm and 10cm is still considered less effective in reducing iron (Fe) levels because this figure is still above the standard iron (Fe) content in water for sanitation hygiene purposes, namely 0,2 mg/l.

Meanwhile, several research titles in Indonesia have also investigated the use of zeolite as a filtration media. As a filtration medium, zeolite can reduce Fe levels by an average of 0,16 mg/l (Trianah & Sani, 2023). Increasing the thickness of the zeolite filter media can help reduce iron levels in the waterBy increasing the thickness of the zeolite filter media, it can increase the ability of the media to reduce the Fe content contained in the water. This is because the more media added, the more surface area of pores that can bind cations in the water so that Fe levels in the water are reduced (Ilyas et al., 2021).

In this study, the iron (Fe) content in water had results below the maximum limit for iron (Fe) content, namely at a thickness of 15cm with a result of 0,076. Based on these results, the iron (Fe) content resulting from this research is below the clean water quality standard, which according to Peraturan Menteri Kesehatan Republik Indonesia number 2 of 2023, the

maximum iron (Fe) content in water for sanitary hygiene purposes is 0,2 mg/l (Ministry of Health Republic of Indonesia, 2023).

The thickness of the filtration media using egg shells and zeolite which is effective in reducing iron (Fe) levels so that it is below health quality standards is 15cm. There is a limitation in this research, namely that there was an error in sampling by providing a distance between the water outlet and the water container.

CONCLUSION

Based on the results of the study, it can be concluded that there are differences between the thickness of eggshells 5 cm and zeolite 5 cm, eggshells 10 cm and zeolite 10 cm, and eggshells 15 cm and zeolite 15 cm on the decrease in iron (Fe) levels in well water. the combination of eggshell and zeolite filter media is effective in reducing Fe levels in well water, Fe levels before treatment are 1. 446 mg/l, Fe levels after treatment with eggshell filter media and zeolite with a thickness of 0cm; 5cm; 10cm; and 15cm obtained results with an average of 1.396 mg/l (3.45%); 0.887 mg/l (38.69%); 0.415 mg/l (71.34%); and 0.076 mg/l (94.76%), the most effective filter media thickness in reducing Fe levels is with a thickness of 15cm.

It is recommended for the community to be able to carry out water treatment by filtering using zeolite and eggshells with a thickness of 15cm in the shelter before being used for daily purposes to be safe to use because iron (Fe) levels in water meet health quality standards.

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