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Durio Zibethinus Murr. Peel and Zeolite In Reducing the Hardness of Water

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ABSTRACT Hardness is water that contains metals or cations with two valences, especially calcium (Ca) and magnesium (Mg). Excessive hard water can cause detergents to not easily foam, be corrosive to household furniture and interfere with health such as kidney stone disease. This study aimed to test the filtration ability of a combination of Durio zibethinus Murr. peel activated charcoal with zeolite to reduce hardness in water. This study was a true experimental study with a pretest-posttest control group design using three variations of Durio zibethinus Murr. peel thickness 7 cm, 9 cm, 11 cm and zeolite 70 cm. The sampling method used was grappample with 9 replications and analyzed using the Anova statistical test. The results of the filtration hardness of the combination of Durio zibethinus Murr. peel activated charcoal) and zeolite 70 cm thickness with a thickness of 7 cm activated charcoal obtained an average of 107.18 mg/l. The thickness of activated charcoal 9 cm on average was 88.74 mg/l. The thickness of activated charcoal 11 cm on average was 71.40 mg/l. The result of One Way Anova statistical test (0.000) is smaller than (0.05), so the hypothesis is accepted. So there is a difference in the decrease in water hardness in variations in the thickness of the media for Durio zibethinus Murr. peel activated charcoal and zeolite. In future research, the thickness of Durio zibethinus Murr. peel activated charcoal (Durio zibethinus Murr.) and the thickness of zeolite which is more effective in reducing hardness can be determined, using Durio zibethinus Murr. peel activated charcoal and zeolite filtration by flowing water into the pipe for 5 minutes and performing further treatment of water to make it clear.

INDEX TERMS Hardness, Durio zibethinus Murr. Zeolite.

I. INTRODUCTION

Water is a natural resource that has an important role in human survival [1]. Water is an important component of the environment for the existence of humans, animals, plants, and other forms of life [2]. The first requirement for the implementation of good health is the availability of adequate water in terms of quantity and quality, which must meet the requirements of cleanliness and safety [3]. Water as based to in PERMENKES No. 416 of 1990 is water used for daily needs whose quality meets health requirements and can be consumed after cooking [4]. The majority of Indonesian people get drinking water from the ground. Groundwater contains a lot of Ca2+ and Mg2+ ions in the form of carbonate salts. Carbonate salts containing Ca2+ and Mg2+ ions are abundant in groundwater. The presence of metals or cations with two valences, such as Fe, Sr, Mn, Ca, and Mg, causes hard water. However, calcium (Ca) and magnesium (Mg) are the main sources of hardness [5]. Excessive hard water can interfere with health because it can cause kidney disease [6]. Another impact of hardness in water can increase the use of soap because the amount of foam produced is reduced so that it can pollute the environment and cause corrosion of household appliances [7]. From the results of a preliminary study in one of the well water houses of residents of Pragak Village, Parang District, it has a value that exceeds the threshold of 520 mg/l. Groundwater that has a high hardness content can be reduced by filtration. Filtration media include quartz sand, zeolite, and activated charcoal [8]. The durian fruit plant is native to Indonesia and ranks fourth in the national list of fruits, with an annual production of around 700 thousand tons. In order not to cause too much waste of Durio zibethinus Murr. peel, it can be used as a useful material. Durio zibethinus Murr. peel contains 60.45% cellulose,hemicellulose 13.09% and 15.45% lignin. With this high cellulose content, Durio zibethinus Murr. peel can be used as activated charcoal. Researching the combination of coconut shell activated charcoal and zeolite with a thickness of 30: 30 cm, the result is a decrease in hardness of 50.66% [9]. The decrease in the hardness of the combination of zeolite

and coconut shell activated charcoal with a thickness of 30: 30 obtained a result of 31.5% [10]. This study used a combination of activated charcoal with different ingredients, namely Durio zibethinus Murr. peel and zeolite with a thickness of activated charcoal. 7 cm, 9 cm, 11 cm and zeolite 0.5 mm in diameter with a thickness of 70 cm. The purpose of this study was to test the filtration ability of the combination of Durio zibethinus Murr. peel activated charcoal with zeolite to reduce hardness in water.

II. RESEARCH METHODS

The research design used was a true experimental study with a pretest-posttest control group design [10]. This research was conducted at the Surabaya Industrial Research and Consulting Laboratory by taking samples in Pragak Village RT 11 RW 4, Parang District, Magetan Regency. The variables in this study were the decrease in hardness in water with variations in the thickness of the media for activated charcoal Durio zibethinus Murr. Peel 7 cm, 9 cm, 11 cm and zeolite diameter 0.5 mm thickness 70 cm with 9 repetitions in order to obtain a total of 27 samples [11]. The sample collection technique used is using Grab Samples [12]. The filtration process is carried out by entering the sample water into the sample holding reactor which is in a higher position than the filtration unit. Prior to filtration, water samples were taken to be checked for initial hardness. Then the water is flowed into the filtration unit until it is full and allowed to stand for 5 minutes for up to 9 repetitions. After the filtration process is complete, the water in the yield reactor is taken to check its hardness. In this study, the media used were gravel with a thickness of 7 cm, fine sand 5 cm, activated charcoal 7,9,11 cm, zeolite 70 cm, and palm fiber 3 cm. The filtration unit uses a 4 inch PVC pipe with a height of 1 meter. The sample holding reactor has a volume of 30 liters with a height of 38 cm [13]. The analysis in this study used the one-way ANOVA statistical test [14] to determine the difference in the decrease in clean water hardness on the thickness of the media for activated charcoal Durio zibethinus Murr. peel and zeolite.

III. RESULTS

If The results of decreasing water hardness in combination filtration treatment of Durio zibethinus Murr. peel activated charcoal and zeolite with variations in height and thickness of activated charcoal 7 cm and zeolite 70 cm are presented in TABLE 1.

Based on TABLE 1, it is known that the results of the examination of the hardness of clean water samples after filtration of Durio zibethinus Murr. peel activated charcoal with a thickness of 7 cm and zeolite with a thickness of 70 cm averaged 107.18 mg/L.

The results of decreasing water hardness in combination filtration treatment of Durio zibethinus Murr. peel activated charcoal and zeolite with variations in height and thickness of activated charcoal 9 cm and zeolite 70 cm are presented in TABLE 2.

TABLE 1
Hardness Examination Results with a Thickness of Durio zibethinus Murr. peel Activated Charcoal 7 cm and Zeolite 70 cm

Replication	Hardness (mg/L)	
	Before	After
1	518.80	115.20
2	518.80	109.50
3	518.80	122.05
4	518.80	110.80
5	518.80	105.85
6	518.80	99.90
7	518.80	98.95
8	518.80	101.50
9	518.80	100.95
Avarage	518.80	107.18

TABLE 2
Hardness Examination Results with Thickness of Durio zibethinus Murr. peel Activated Charcoal 9 cm and Zeolite 70 cm

Replication	Hardness (mg/L)	
	Before	After
1	518.80	85.15
2	518.80	90.80
3	518.80	88.90
4	518.80	85.94
5	518.80	87.55
6	518.80	91.80
7	518.80	90.52
8	518.80	89.06
9	518.80	88.96
Avarage	518.80	88.74

Based on TABLE 2, it is known that the results of the examination of the hardness of water samples after filtration of activated charcoal from Durio zibethinus Murr. peel with a thickness of 9 cm and zeolite thickness of 70 cm averaged 88.74 mg/l.

The results of decreasing water hardness in the combination of filtration treatment of Durio zibethinus Murr. peel activated charcoal and zeolite with variations height and thickness of activated charcoal 11 cm and zeolite 70 cm are presented in TABLE 3.

Based on TABLE 3 it is known that the results of the examination of the hardness of water samples after filtration of Durio zibethinus Murr. peel activated charcoal with a thickness of 11 cm and zeolite with a thickness of 70 cm averaged 71.40 mg/L.

The results of the one-way ANOVA statistical test to determine the difference in the decrease in hardness in clean water in various thicknesses of media for Durio zibethinus

Murr. peel activated charcoal and zeolite can be seen in TABLE 4.

TABLE 3
Examination Results with Thickness of Durio zibethinus Murr. peel Activated Charcoal 11cm and Zeolite 70 cm

Replication	Hardness (mg/L)	
	Before	After
1	518.80	71.50
2	518.80	70,95
3	518.80	74,10
4	518.80	72,84
5	518.80	69,88
6	518.80	70,05
7	518.80	72,10
8	518.80	71,14
9	518.80	70,09
Avarage	518.80	71,40

TABLE 4
ANOVA One Way Statistical Test Results

	Sum of squares	df	Mean square	F	Sig
Between Group	1252027.067	3	417342.356	2.417	.000
Within Group	552.557	32	17.268		
Total	1252579.645	35			

Based on TABLE 4 the results of the One Way Anova Statistical Test, the results obtained are the probability values (p.value) listed in the Sig column. is 0.000 < = 0.05, so the conclusion is H1 is accepted, so there are differences in the decrease in clean water hardness in various thicknesses of media for activated charcoal Durio zibethinus Murr. peel and zeolite.

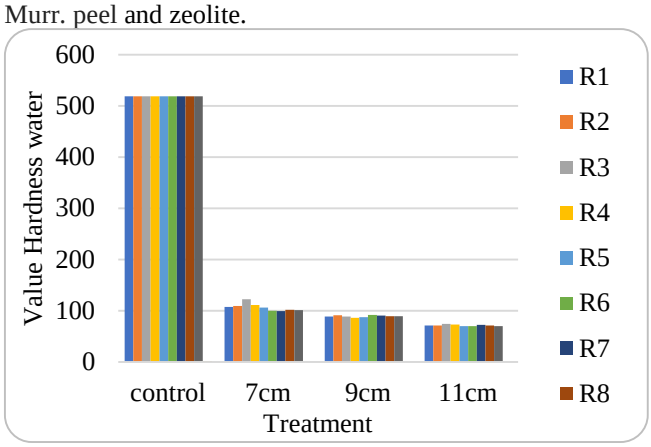

FIGURE 1 Graph of average decrease in hardness at various thicknesses of media for activated charcoal of Durio zibethinus Murr. peel and zeolite.

The picture of the average decrease in hardness on various thicknesses of media for activated charcoal Durio zibethinus Murr peel Durio zibethinus Murr. peel and zeolite can be seen in FIGURE 1. It can be seen from the graph above that the highest decrease in hardness is in variations in the thickness of the Durio zibethinus Murr. peel 11 cm and zeolite 70 cm. So, the more The thicker the filtration media, the higher the decrease that occurs. The process made Durio zibethinus Murr. peel activated charcoal and zeolite for filtration showed FIGURE 2 :

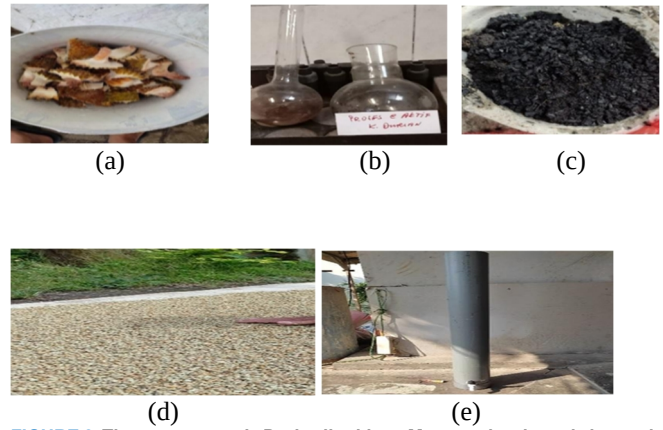

FIGURE 2. The process made Durio zibethinus Murr. peel activated charcoal and zeolite for filtration (a) Durio zibethinus Murr Peel , (b) Process of actived charcoal, (c) Durio zibethinus Murr. Peel active charcoal, (d), Zeolite (e) Filtration.

IV. DISCUSSION

1. BEFORE TREATMENT

The hardness of water in Pragak Village, Parang District, Magetan Regency before treatment was still above the quality standard with the results of the examination of water chemical parameters of 518.80 mg/L. According to the Regulation of the Minister of Health No. 416 of 1990 concerning Water Quality explains that clean water used every day is allowed to contain a hardness of 500 mg/L [15]. Water that contains excessive hardness can have a negative impact on life, such as increasing the use of soap because the amount of foam produced is reduced so that it can pollute the environment and corrode household appliances [3]. The long-term impact that occurs will be worse, such as triggering kidney stone disease [16].

2. AFTER TREATMENT

Hardness on the thickness of Durio zibethinus Murr. peel activated charcoal 7 cm and zeolite 70 cm is 107.18 mg/L, hardness on the thickness of Durio zibethinus Murr. peel activated charcoal 9 cm and zeolite 70 cm which is 88.74 mg/L hardness on the thickness of Durio zibethinus Murr. peel activated charcoal 11 cm and zeolite 70 cm which is 71.40 mg/L. This reduction has met the quality standard according to the Regulation of the Minister of Health no. 416 of 1990 concerning Water Quality, which is 500 mg/L. This happens is influenced by several factors. The first factor is that Durio zibethinus Murr. peel has a high cellulose content of 60.45% [17] which can be used as activated charcoal for filtration media to decrease hardness.

The polymers in cellulose form chemical bonds that have a uniform surface of the cellulose chain and form a porous layer [18]. This porous solid material is able to absorb dissolved substances in water as Ca and Mg ions [19]. The second factor is found in zeolites which have a negative charge which can release cations and replace them with other cations such as zeolites releasing Na and being replaced by binding Ca or Mg [20]. The third factor is the thickness of the Durio zibethinus Murr. peel activated charcoal because the thicker the activated charcoal used, the better the filtration process. Because the higher the thickness of the activated charcoal used, the wider the surface area of the activated charcoal and the more pores there are for the absorption process [21]. Meanwhile, according to [22], the higher the thickness of activated charcoal, the greater the distance traveled, so the longer the time required for contact between water and activated charcoal can improve the filtering process [23].

3. DIFFERENCES IN DECREASING WATER HARDNESS IN VARIOUS THICKNESSES OF DURIO ZIBETHINUS MURR. PEEL AND ZEOLITE PEEL ACTIVATED CHARCOAL MEDIA.

The results of the one-way ANOVA test analysis obtained a probability value (0.000) which means it is smaller than the value of (0.05), then the hypothesis is accepted. So there is a difference in the decrease in water hardness in variations in the thickness of the media for Durio zibethinus Murr. peel activated charcoal and zeolite. The best treatment in reducing hardness was the thickness of Durio zibethinus Murr. peel activated charcoal 11 cm with an average decrease of 447.39 mg/L. This is because the higher The thickness of the activated charcoal used, the wider the surface area of the activated charcoal and the more pores there are for the absorption process [23]. Based on the results of the decrease in hardness in water, there was a decrease in each additional height of the thickness of Durio zibethinus Murr. peel activated charcoal [24]. The decrease in hardness at the thickness of activated charcoal 7 cm to 9 cm increased by 18.44 mg/l, at the thickness of activated charcoal 9 cm to 11 cm increased by 17.34 mg/l.

4. TEMPERATURE AND PH

In this study the temperature before treatment was 29ºC, then the temperature after treatment ranged from 30.5ºC to 30.9ºC. While the pH in this study before treatment was nine while after treatment was eight.pH and temperature good to treatment reducing hardness water [25].

V. CONCLUSION

The water hardness before the combination treatment of Durio zibethinus Murr. peel activated charcoal filtration and zeolite was 518.80 mg/l so it was categorized as not meeting the quality standard according to Minister of Health Regulation No. 416 of 1990. The results of water hardness after the combination treatment of Durio zibethinus Murr. peel activated charcoal filtration of with high variation Durio zibethinus Murr. peel activated charcoal thickness is 7 cm and zeolite with a diameter of 0.5 mm and a thickness of 70 cm through a contact time of 5 minutes obtained an average result of 107.18 mg/l so that it is categorized as having met the quality standard according to Permenkes No. 416 of 1990. The results of water hardness after a combination of filtration treatment of Durio zibethinus Murr. peel activated charcoal with variations in height of 9 cm thickness of durian shell activated charcoal and zeolite with a diameter of 0.5 mm and a thickness of 70 cm through a contact time of 5 minutes obtained average results an average of 88.74 mg/l so that it is categorized as having met the quality standard according to Permenkes No. 416 of 1990. The results of water hardness after a combination of filtration treatment of Durio zibethinus Murr. peel activated charcoal with variations in height of 11 cm thickness of Durio zibethinus Murr. peel activated charcoal and zeolite with a diameter of 0.5 mm and a thickness of 70 cm through a contact time of 5 minutes obtained average results an average of 71.40 mg/l so that it is categorized as having met the quality standard according to Permenkes No. 416 of 1990. The results of differences in the decrease in the hardness of water in various thicknesses of media for Durio zibethinus Murr. peel activated charcoal and zeolite values obtained F = 2.417 (p = 0.000) then hypothesis is accepted. So there is a difference in the decrease in clean water hardness in variations in the thickness of the media for Durio zibethinus Murr. pee activated charcoal and zeolite. The results of the highest decrease in hardness in water filtration are variations in height of 11 cm Durio zibethinus Murr. peel activated charcoal and zeolite with a diameter of 0.5 mm and a thickness of 70 cm, which is 447.39 mg/l with a percentage of 86.23%. The results of the most effective and efficient treatment are variations in height of Durio zibethinus Murr. peel activated charcoal thickness 7 cm and zeolite with a diameter of 0.5 mm and a thickness of 70 cm because they have met the quality standards according to the Minister of Health Regulation No. 416 of 1990 with a lower manufacturing value.

VI. RECOMMENDATION

For further research; Finding the most effective thickness of Durio zibethinus Murr. peel activated charcoal by increasing the thickness of Durio zibethinus Murr. peel activated charcoal. Looking for the thickness of the zeolite which is more effective in reducing the hardness by varying the thickness of the zeolite for the filtration media to decrease the hardness [26]. Using Durio zibethinus Murr. peel activated charcoal filtration and zeolite by flowing water into the pipe for 5 minutes [27]. The presence of cloudy water color in this study, further research was carried out to treat the water to be clear [28]. For the Community;Can utilize Durio zibethinus Murr. peel waste as activated charcoal as filtration media in reducing hardness effectively and efficiently with a thickness of 7 cm activated charcoal and 0.5 mm diameter zeolite and 70 cm thickness.

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