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THE EFFECT OF ZEOLITE AND ACTIVATED CARBON ADDITION IN THE MAKING OF TEAPOT ON INCREASING ADSORPATION POWER

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ABSTRACT

The need for clean water is a demand to meet the need for proper and healthy food. However, many water sources are unhealthy due to various factors. Meanwhile, clean and healthy water processing equipment is still relatively expensive or quite large in size. The aim of our research was to determine the effect of adding zeolite and activated carbon in the manufacture of teapots so that they have adsorption capacity capable of processing dirty water that is not suitable for consumption into clean water that is suitable for consumption. Based on the literature, activated carbon and zeolite are effective for purifying water and restoring water quality. The method used in this research is descriptive quantitative. Data collection uses experiments, while data processing uses descriptive comparative analysis. In this research, teapots were made by combining clay with activated carbon and zeolite. Test results at the Cilacap Regency Regional Health Laboratory show that well water that is put into the teapot will undergo a hygienic process, both its physical, chemical and microbiological properties. Ability to reduce the number of bacteria up to 1,500 bacteria for 1 hour (60 minutes).

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Kata Kunci: Water, Activated Carbon, Clay, Teapot, Zeolite.

INTRODUCTION

The need for clean water is a demand to fulfill the need for proper and healthy food. However, many water sources are unhealthy due to various factors, ranging from land use change, lithology, weather, climate and human activities that contaminate surface water, both physics, chemistry and biology (Kartodihardjo et al., 2020). Likewise with conventional well water, which on average is polluted by domestic and industrial waste, which has an impact on human health (Widiyanto et al., 2015). The increase in population and standard of living in urban areas has increased the demand of water, but according to Sebayang et al. (2015) access to clean water is increasingly limited and expensive. Meanwhile clean and healthy water processing equipment is still relatively expensive or quite large in size. There is a need for innovations in clean water treatment media that are practical, effective, efficient and based on local wisdom.

Clean water treatment techniques commonly used according to Wicaksono et al. (2019) include coagulation techniques, redox techniques, bioremoval and bioremediation, reverse osmosis, and filtration techniques using filter media such as sand, mineral rock, biofilters or other filtration media. The manufacture of simple standard water treatment filtration equipment in rural areas is generally still on the scale of household needs. The filtration device according to Nainggolan

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et al. (2019) made with materials that are cheap and easy to obtain, easy to use and can be moved because the size is not too big. However, no one has yet developed traditional tools such as teapots, jugs and gooks to become filtration media with the principles of absorption and adsorption (Lestari et al., 2021). to treat healthy water quickly and effectively but cheaply and affordably.

The teapot is a traditional craft artwork made with clay (clay). Using a clay teapot as a medium for storing water is indeed healthier because according to Suranny (2015) the pores of the soil allow oxygen outside the teapot to penetrate in the teapot. This process caused the water in the clay pot to feel fresh and cool. The teapot according to Oentoro (2019) is an Indonesian cultural heritage in the form of a series of containers for serving drinks and is equipped with several cups. Since ancient times, Indonesian people, especially in rural areas, used to use clay teapots. However, now the existence of clay pots is being replaced by kettles made of metal such as aluminum and plastic. Therefore, an effort to preserve culture is needed by adding the function of the ability to treat clean water with the principles of absorption and adsorption. This research was conducted to prove whether or not there was an effect of adding zeolite powder and activated charcoal to the teapot formula in improving water quality and reducing the number of bacteria in water.

LITERATURE REVIEW

Based on the Regulation of the Minister of Health of the Republic of Indonesia No. 492/Menkes/Per/IV/2010 concerning Drinking Water Quality Requirements states that drinking water is water that goes through a processing process or without a processing process that meets health requirements and can be drunk directly. Drinking water is declared safe for health if it meets the physical, microbiological, chemical and radioactive requirements contained in the mandatory parameters and additional parameters stipulated by the Indonesian Ministry of Health.

Meanwhile, clay teapots or jugs are one of the craft arts in the form of traditional Indonesian earthenware objects. The shape of the teapot is unique and has many variants. However, in general, teapots are globular in shape with a cylindrical shape at the top which functions as a handle. The anatomy of a teapot consists of the mouth, neck, spout, body, and base (Winata, 2020). The main function of a clay teapot is as a container for drinking water, but a teapot can also function as a cultural ritual tool (Mustaqin & Wayuningsih, 2015).

Media commonly used for water purification according to Sunarsih et al. (2013) silica sand, zeolite and activated charcoal. In a study by Rahmayanti & Hamidah (2019), a brackish water filter with a composition of activated charcoal, zeolite, silica sand, and gravel was effective in reducing Coliform bacteria by up to 100% and total bacteria by up to 97%, but less effective in reducing salinity and TDS. Zeolite is a mineral rock formed from hydrothermal processes in alkaline igneous rocks. Based on its chemical, physical and structural characteristics, zeolite obtained from nature can be applied to various fields. Among the uniqueness of Zeolite is its ability to absorb organic and inorganic substances, exchange cations, catalysts and filter fine-sized molecules (Oktaviani et al., 2018). There are several types of materials that are similar in function and use to natural zeolite, namely silica gel, activated charcoal, and artificial zeolite. The ability of activated charcoal and silica gel as adsorbents does not exceed that of natural zeolite. Also, artificial zeolite has a purer content and broader capabilities as a catalyst than natural zeolite (Juniansyah et al., 2017).

Activated charcoal according to Dewi (2020) is a porous solid with a carbon element content of 85-95% which results from heating at high temperatures but is not oxidized. According to Lempang (2014) the raw material for activated charcoal must contain a lot of carbon and have lots of pores. Production of activated charcoal can be done through physical and chemical activation processes. Differences in the raw materials used and the method of activation cause the properties and quality of activated charcoal to differ. Activated charcoal is generally used in the

industrial, health, environmental and agricultural sectors. Among the forms of its application are as an absorbent for heavy metals in liquid waste, an absorber for pesticide residues, an absorber for toxic gas emissions, an increase in the total amount of soil organic carbon, and a decrease in microbial biomass.

A simple water filtration device commonly used by rural communities according to Arief et al. (2020) used a circuit system combining cotton, andesite and charcoal to filter cloudy and dirty water to turn it into clear water. The principle of water purification that is often used is absorption and adsorption. According to Lestari et al. (2021) absorption is the process of absorbing pollutant materials which are then bound by absorbents. Absorption generally uses activated charcoal. While adsorption is the binding of free ions in water which is suspected as a pollutant by the adsorbent. Adsorption generally uses zeolite.

METHOD

The method used is descriptive with a quantitative approach. Teapots are made with the help of traditional craftsmen in Brani Village, Sampang District, Cilacap Regency. The materials used are clay (clay), activated charcoal powder and zeolite powder. Data collection used experiments with organoleptic and pH testing at the Chemistry Laboratory of SMA Negeri 1 Sampang, Cilacap Regency and water quality testing at the Regional Health Laboratory (Labkesda) Cilacap Regency. The parameters used are physical properties which include odor, TDS, turbidity, taste, temperature and color; chemical properties including iron content, fluoride, hardness, chloride, 6 valence chromium, manganese, nitrate, nitrite, pH, cyanide and sulfate; as well as bacteorology which includes total coliform. Data analysis used descriptive comparative by comparing the quality of water that has been treated in the teapot with raw water taken from polluted water sources.

RESULT AND DISCUSSION

Making clay teapots is done by mixing zeolite powder and activated charcoal into clay (clay) with a certain composition according to the results of trial and error so that good quality teapots are obtained, namely according to standards set based on consumer desires and market demand (Hadiwijaya et al. , 2022).

Figure 1. Making teapots with the addition of zeolite and activated charcoal (a) Ingredients formulation (b), Forming a clay pot, (c) Burning clay teapot

Then tested using sea water with parameters of pH levels and water organoleptic properties, namely taste, smell and color.

Figure 2. Trial of the teapot using sea water Trial of the teapot using sea water (a) Water clarity test and (b) pH testing

The test results can be seen in the following table 1.

Table 1. Teapot Test with Seawater

Raw Water	Times (hours)						Information
	0,25	0,5	0,75	1	12	24	
pH 7,0	pH 7,1	pH 7,0	pH 7,0	pH 7,0	pH 7,0	pH 7,0	Water
murky	semi	clear	clear	clear	clear	clear	quality
salty	salty	salty	salty	salty	semi	semi	good

Based on the table above, it is known that the ability of the teapot to purify and improve water quality with the water pH indicator being 7.0 or neutral and the water getting clearer and less salty. According to Wardani & Arifiyana (2020) water is acidic if it has a pH of less than seven (<7), alkaline if the pH is more than seven (>7) and neutral if the pH is equal to seven (=7). In Regulation of the Minister of Health of the Republic of Indonesia No. 31 of 2017 states that water clarity is an important parameter to determine water quality.

Then the research continued by taking water samples from Cibebek Hamlet, Karangtengah Village, Sampang District, Cilacap Regency. The water from the teapot is taken for 60 minutes by Labkesda Officers, then testing the water quality is carried out. The test results can be seen in the following table:

Table 2. Test results after the well water is put into the teapot

Num.	Parameter	Allow Limit	Raw Water	Result
Physics Parameters				
1.	Smell	No smell	No smell	No smell
2.	Dissolved solids (TDS)	1500 mg/l	285 mg/l	252 mg/l
3.	Turbidity	25 NTU Scale	2,36 NTU Scale	1,68 NTU Scale
4.	Flavor	Tasteless	Tasteless	Tasteless
5.	Temperature	$\pm$ 3^{o}C	28,3^{o}C	26,7^{o}C
6.	Color	50 TCU Scale	31 TCU Scale	15 TCU Scale
Chemical Parameters				
1.	Iron	1 mg/l	0,04 mg/l	0,02 mg/l
2.	Flourida	1,5 mg/l	0,33 mg/l	0,15 mg/l
3.	Hardness ($CaCO_3$)	500 mg/l	298,06 mg/l	269,22 mg/l
4.	Chloride	600 mg/l	101,92 mg/l	101,92 mg/l
5.	Cromium, Valensi 6	0,05 mg/l	0,015 mg/l	0,014 mg/l
6.	Manganese	0,5 mg/l	0,075 mg/l	0,052 mg/l
7.	Nitrate	10 mg/l	0,05 mg/l	0,03 mg/l
8.	Nitrite	1 mg/l	0,021 mg/l	0,011 mg/l
9.	pH	6,5 – 9,0	8,09	7,68
10.	Cyanide	0,1 mg/l	0,002 mg/l	0,002 mg/l
11.	Sulfate	400 mg/l	1 mg/l	1 mg/l
Bacteriological				
1.	Total Coliform	< 50/100 ml spl	< 2/100 ml spl	0/100 ml spl

The table above shows the improvement in water conditions after processing by adding it to the teapot. To determine the ability to reduce activity and the number of bacteria, a bacteorological test was carried out at the Cilacap District Health Lab with raw water taken from a well in Cibebek Hamlet, Karangtengah Village, Sampang District, Cilacap Regency which was indicated to be contaminated with bacteria due to its unpleasant odor and causing itching. when in contact with skin. The water is put into the teapot for 60 minutes (1 hour) then taken by the Cilacap Regency Labkesda staff to carry out a

bacteorological test with the results shown in the following table:

Table 3. Bacteriological Test Results

Bacteria	Raw Water	1 hour	3 hours	6 hours	12 hours	24 hours
Total	>2.400/100 ml spl	1.100/100 ml spl	1.100 /100 ml spl	1.100 ml spl	1.100 /100 ml spl	1.100/100 ml spl

Based on the table above, it is known that the teapot is able to suppress bacterial growth from >2,400 coliforms to 1,100 coliforms within 1 hour, and no new bacterial development appears for up to 24 hours. The test results show that to restore water quality and hygiene, it is enough to put water in a teapot whose raw materials have been formulated with zeolite powder and activated charcoal until the color of the water becomes clear, odorless and tastes fresh. Meanwhile, to reduce the number of bacteria, it takes 60 minutes to clean water from 1,500 coliforms. The average resident's well contains less than 1,000 coliform bacteria. If the residents' wells are put into the teapot, of course the quality will be better and the number of bacteria will be less so that it is more suitable for consumption.

Clay teapots, even though they seem traditional, can be made into a product that effectively filters dirty water so that it becomes fit for consumption with the principles of absorption and adsorption. This is in line with research by Arief et al. (2020). Making teapots is done by combining clay (clay) with zeolite powder and activated charcoal. The absorption activity of activated charcoal and the adsorption of zeolite mixed with clay in the form of a teapot are proven to be able to improve water quality and reduce the number of bacteria to a safe limit for use. This is in line with research by Lestari et al. (2021). If the teapot has reached the saturation limit, it can be activated by heating, as explained by Dewi et al. (2020). This teapot research proves that washing with boiling water followed by direct drying under the hot sun can activate the performance of the teapot when it reaches the saturation limit.

CONCLUSION

Making by combining clay (clay) with activated charcoal and zeolite affects the ability of the teapot to improve water quality and reduce the amount of bacterial contamination. The treatment process to restore water quality and hygiene is to put water in a kettle for about 60 minutes or more depending on the degree of contamination. Ability to reduce the number of bacteria up to 1,500 coliforms for 60 minutes. Thus this pot has the effect of improving water quality and reducing the number of bacteria in water.

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