5th ICRIEMS Proceedings
Published by Faculty Of Mathematics And Natural Sciences
Yogyakarta State University, ISBN 978-602-74529-3-0

Selokan Mataram Water Filtering Using Active Carbon of Coconut Shell, Indrayanti Sand and Zeolit Stone

Amar Amrullah[a)] Angga Fajar Setiawan Dedi Sastradika Arneta Dwi Safitri Suparno [b)]

Physics Education, Postgraduate Program, Yogyakarta State University

a)Corresponding author: amaramrullah16@gmail.com
b)suparno2000@yahoo.com

Abstract. This research aims at purifying water in Selokan Mataram Yogyakarta to be clear water by using such parameter as microbiology, chemical, and physics. The puryfying system used is clear water manufacturing system by utilizing media piece of coconut shell as active carbon, sand of Indrayanti beach, and zeolit stone. The parameter which is examined is Coliform total, iron content (Fe), acid degree (pH), radiance transmition, and Total Dissolved Solids (TDS). The instrument used comprises of four bottles which are arranged equally. The first bottle contains sand and pebble, the second bottle contains active carbon, the third bottle contains sand, zeloit stone, and cotton, then the forth bottle contains water which has been filtered. The result of research shows that Coliform total within filtered water getting decrease from 494 x 10^3 becomes 6,8 x 10^3 MPN/100ml, absorption eficiency of iron content (Fe) 97,9%, acid degree (pH) 7,5, there is decreasing of turbidity with eficiency indicator ray transmition as 78,95%, and total of dissolved solid substance (TDS) AS 178 PPM. Based on the requirement of Health Ministry Regulation for clean water, the last result variables of filtered water which is measured has fulfilled requirement except total degree of Coliform.

Keywords: Simple water filtering, active carbon, piece of coconut shell, indrayanti sand, zeolit stone.

INTRODUCTION

Water is an admittedly need of life. The quality of human life is clean on the very clean water quality in everyday life. Humans need clean water for survival [1]. Yogyakarta is an area in Indonesia that cares about the quality of water. One form of concern that is making the canal sitting during the reign of Sri Sultan Hamengku Buwana VIII in the form of selokan mataram canal [2]. Selokan mataram canal is an artificial river that extends in north of Yogyakarta connecting Progo River and Opak River. Selokan mataram canal has tremendous benefits for people around there. Sewerage Matter works as irrigation channels of rice fields and its recharge is useful for wells around Mataram ditch. Mataram ditch water is also used for fisheries [3].

Unfortunately, due to severe water erosion, it caused Mataram Gutters getting dirty. It is characterized by the color of the water which is light brown. This circumstance is exacerbated by the bad habits of people living along the canal. Many of them and agricultural waste into the canal. According to BAPPEDA Yogyakarta Year 2004, there is a decrease of water quality because of liquid waste discharge (lubricating oil and oil) accelerates sedimentation, as well as complicate the operation and maintenance of canal because there is no space for accumulating graving sediment and there is large amount of dump and garbage at the water gates. If the water of river is muddy, it can be ensured that the quality of water is low, because in it dissolved soil erosion from the upstream area. Soil erosion which soluble is liquid koloid that is stable, hence, it getsdi fficult to move stealthily. Consequently, the water of Mataram ditch cannot be clear without special treatment. The stability of soil erosion which is dissolved in the Mataram ditch can be caused by the large amount of mineral ions contained in the soil, therefore it contribute toward the electronic stability [4]. Contamination from the water of the Mataram ditch is very worrying. People working in rice cultivation and fishery

are equally distributed. Dirty scenery and bad smell Selokan mataram canal is a means for the tourism industry. In this case, smart and effective ways should be taken to save quality of water in the Selokan mataram canal. A research has been conducted by a group of researchers at Yogyakarta State University led by Suparno, Ph.D. looking for the best absorber for the Selokan mataram canal water filtration system. At this stage various types of sand and carbon have been investigated. Some of the results of the investigation are reported in this paper.

The quality of water can is able to see from several factors including water content, water turbidity, Coliform bacteria, total dissolved solids (TDS), and acidity (pH). The process of water quality improvement can be done by using chemical and physics method. However, in this research will only use physics method. Physical methods are performed by filtration using activated carbon, sand, gravel, and zeolite stones which are able to absorb. The activated carbon used in this research is coconut shell charcoal.

Most of coconut shells are only considered as industrial waste coconut processing, its abundant availability is considered as an environmental problem but renewable and cheap. Though coconut shell charcoal can still be processed again into products that have high economic value that is as activated carbon or activated charcoal [5].

Pari [6] argues that activated carbon is able to be used for various industries, such as, the pharmaceutical industry, food, beverages, water treatment (water purification) and others. Nearly 70% of activated carbon products are used for refining coconut oil, pharmaceutical, and chemical sectors. According to Subadra [7], the raw materials which can be made into activated carbon are all carbon-containing materials from plants, animals or minerals. These materials are various types of wood, rice husks, animal bones, coal, coconut shell, coffee bean shells. When the materials are compared, the coconut shell is the best material that can be made into activated carbon because the activated carbon made from coconut shell has a lot of micropore, low ash content, high water solubility and high reactivity. Making this activated carbon can be done by physics with activator and heating process in high temperature which aims to multiply pores and create new porosity, so that activated carbon has high absorption [8].

METHODS

This research consists of several stages, namely the preparation stage of tools and materials, the implementation of research, analysis of research data, discussion, and conclusions.

A. Preparation of tools and materials

This study aims to purify the water of Yogyakarta Mataram ditch into clean water using microbiological, chemical, and physical parameters. Minister of Health Regulation no. 416 of 1990 on the requirements and supervision of water quality, which means clean water is water that is used for daily purposes whose quality meets health requirements and can be drunk when it has been cooked. The water we use in this research comes from the water of selokan mataram canal located in front of the Faculty of Engineering UNY.

Purifying water using a water filter consisting of four plastic bottles of 1.5 L size arranged in series. Materials used in water filtration are Indrayanti beach sand, gravel, activated carbon from granule or 8 mesh (2.40 mm) coconut shell charcoal, zeolite stone and cotton filter.

Indrayanti Beach Sand is used as one of the filter material because it has good ability as sand water filter. This is in line with the opinion of Suparno [2] that Indrayanti Beach sand has a good porosity.

The activated carbon used comes from coconut shell charcoal because it can reduce turbidity, iron content, and NaCl content in water. According to [9] the chemical composition of coconut shell is Sellulosa 26,60%, Lignin 29,40%, Pentosan 27,70%, Solvent Extractive 4,20%, Uronat Anhidrid 3,50%, Ash 0,62%, Nitrogen 0 , 11%, and water 8.01%.

This study is using zeolite stone. Zeolite stone has a high capacity as an adsorbent (adsorbent). Possible adsorption mechanisms are physical adsorption (involving Van der Walls forces), chemical adsorption (involving electrostatic forces), hydrogen bonding and formation of coordination complexes. Zeolites can absorb electrolyte metal elements in solution. Because Zeolites have basic properties that include dehydration, adsorption, ion exchangers, catalysts, and PIP separators [10].

In addition, this study also uses gravel as a water filter material. The gravel used are derived from the eruption of Mount Merapi that has good quality. The content of silica on the gravel can be used as absorbent material, especially for final purification. Gravel is a rough aggregate that contains minerals such as stones, because of the hardening and the large amount of quartz. [11].

Activation in this research is physical activation by the way of heating. Physical activation is the process of breaking carbon chains from organic compounds with the aid of heat at temperatures of 800 ° C to 900 ° C. [12].

Warming aims to increase the absorption of the material because the pores on the surface of the material become open and larger [13]. Prior to activation, all ingredients are washed thoroughly. The activation process of coconut shell charcoal was heated for 2 hours with temperature 200°C, while for sand, gravel, and zeolite stone heated for 1 hour with temperature 200°C. According Suryani [14], the temperature used for physics process activation is not too high, because to avoid damage of the material structure. Design tool used is like the following picture 1:

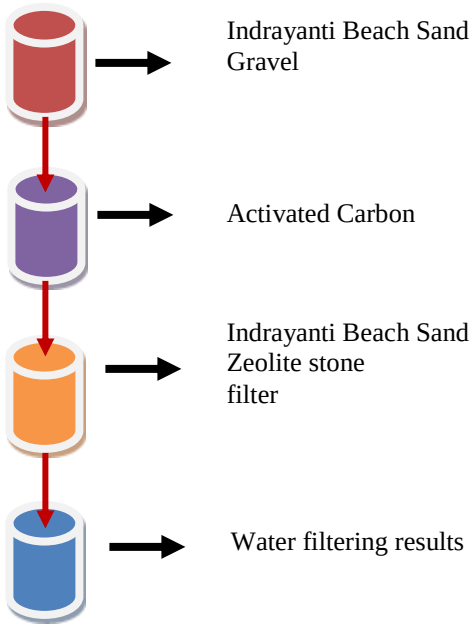

Figure 1. Design of Filtering Tool

IMPLEMENTATION OF RESEARCH

This study aims to purify the water of Selokan mataram canal into clean water using microbiological, chemical and physical parameters. The variables studied were coliform bacteria, iron content, acidity (pH), turbidity, and Total Dissolved Solids (TDS) or total solute.

a. Testing of Microbiology Parameters

Coliform bacteria testing is a test of microbiological parameters used. This test is carried out immediately after the screening takes place that is stored in a sterile bottle so as not to be contaminated with the environment. The test was conducted at Balai Laboratorium Kesehatan (BLK) Yogyakarta.

b. Chemical Parameter Test

Testing of chemical parameters tested in this research is Fe (iron) and acidity (pH). Fe content testing was performed at the UNY Physics Laboratory and pH testing using pH meter.

c. Physics Parameter Test

Physical parameters test used in this research is turbidity testing conducted in UNY laboratory and measurement of total content of substance in dissolved. To determine the level of turbidity of water, can be done by observing the intensity of light transmission using luxmeter. While the total measurement of substances on dissolved using TDS meter.

RESULTS AND DISCUSSION

1. Total Coliform Content

Coliform measurements were taken from data with the composition of sand material indrayanti, gravel, carbon coconut shell, zeolite stone, cotton filter. Testing of Coliform bacteria was conducted by Balai Laboratorium Kesehatan (BLK) Yogyakarta with result as follows:

Table 6. Total Coliform Bacteria

Sample	Total Coliform (MPN/100ml)
Water Sewers	494×10^3
Filtering Water 1	89×10^3
Filtering Water 2	$6{,}8 \times 10^3$

In testing of bacteria Coliform performed 2 times treatment. Total Coliform Selokan mataram canal water before filtration is at 494 x 103 MPN / 100ml. The first treatment without using zeolite stone decreased by 405 MPN / 100ml. These results are still relatively high so that the second treatment by adding zeolite stone. In this second treatment obtained the result of the reduction of 82.2 MPN / 100ml from the first treatment. So the total results of the last bacterium Coliform of 6.8 x 103 MPN / 100ml. Based on Permenkes No. 492 of 2010 on drinking water and clean water, the minimum allowable threshold for drinking water is 0 MPN / 100mL and clean water is not piped 50 MPN / mL. Thus, the filtered water can not be used for drinking yet as drinking water or used as clean water. The decrease of Coliform bacteria is relatively small because the coconut shell activated carbon used has reached the saturation point. The saturated point of activated carbon coconut shell is relatively faster because the small size of particles in the Mataram ditch fill the pores of the coconut shell activated carbon.

2. Efficiency of Iron Absorption (Fe)

Measurement of Iron Level (Fe) is done by measuring the initial iron content in water before treatment, and Final iron content in the treated water using UV-Vis Spectrophotometry.

Table 5. Total Metals Fe

Sample	Total Fe (mg/L)
Water gutter	2,7990
Final Result Filtering	0,0585

Analysis of iron absorption efficiency was obtained by 97.9%. Absorption of iron content is quite significant by using coconut shell activated carbon. The final result of filtration of iron content contained 0.05 mg / l. These results are eligible for Permenkes No. 492 of 2010 which applies to drinking water where the threshold limit of Fe metal is 0.3 mg / l.

3. Degree of acidity (pH)

All three samples were measured with pH meter to determine their acidity level. The results of the measurement of the similarity of the three samples are presented in the following:

Table 4. Results of pH Measurements

Sample	pH
Water Sewer Mataram	7,5
Screening Water	7,5
Mineral Water	7,7

Based on the above table, it seems that there is no change in the level of acidity between sewerage water with filtered water results. This is because the materials used in filtration are neutral, no alkaline or acidic. These results are eligible for Permenkes No. 492 of 2010 for applicable drinking water quality where the pH threshold limit of 6.8-8.5.

4. Light Transmission Efficiency

The measurement of light intensity is done by using a series of light transmission devices with the principle of passing a beam of light through a glass container already filled with water then light passing through a glass container received by luxmeter. The tool is made in such a way, so that no outside light enters the circuit. To determine the maximum intensity that can be captured luxmeter, the initial measurement is done by not entering the water into the glass container. After the maximum intensity is known, then measuring the filtered water samples, water of selokan mataram canal, and mineral water with the same steps. The results of light intensity measurements of the above three samples are presented in the table below:

Table 5.1. Results of Light Intensity Measurement

Sample	Light Intensity (Lux)
Back intensity	2
Maximum Intensity	19
Water Sewers	0
Filtering Water	15
Mineral Water	19

Analysis of light transmission efficiency (ET) can be calculated by the following equation:

$$E_T = I_t / I_{max} \times 100\%$$

The results of the light transmission efficiency of the three samples are presented in the following table:

Table 5.2. Efficiency of Light Transmission

Sample	Light Efficiency Transmission (%)
Water Sewers	0
Filtering Water	78.95
Mineral Water	100

Based on the above table, it can be seen that the filtered water approaches the clarity of mineral water with the light transmission eifisience of 78.95%. The quality of filtering tools and materials used is quite effective when compared with the original state that is water of selokan mataram canal which has a 0% light transmission.

5. Total Dissolved Solids (TDS)

Indicator of clean water is one of solute solid (TDS). All three samples were each measured using a TDS meter to determine the total dissolved solid. The use of this tool is quite simple by directly dipping the measuring instrument into the three water samples. The result of measurement of total dissolved solids from the three samples is presented in the following table:

Table 6. Results of TDS Measurements

Sampel	TDS (ppm)
Water Sewerage Mataram	100
Screening Water	178
Mineral Water	131

Based on the above table the total dissolved solid (TDS) of filtered water has increased by 78 ppm from its original state. The total increase of dissolved solids is probably due to the particles of filter material being dissolved into the filtration water. The water of Selokan mataram canal does have a relatively small amount of dissolved solids. Despite the increase with the final result of 178 ppm, it is still below the threshold of drinking water quality requirements according to Minister of Health Decree no. 492 Year 2010 of 500 ppm.

CONCLUSION

Based on qualitative and quantitative research and discussion, it can be concluded that water filtration done in this research can decrease Total Coliform contained in filtered water from 494 x 103 to 6,8x103 MPN / 100ml, efficiency of iron absorption 97,9%, degree of acidity (pH) 7.5, there was a decrease of turbidity level with indicator of light transmission efficiency equal to 78,95%, and total soluble solid (TDS) 178 ppm. Based on the Permenkes requirement for clean water, the measured water filter final variables are eligible except the total amount of Coliform.

REFERENCES

1. Rhagunath, H.M., *Groundwater Second Edition*. New Delhi: Wiley Eastern Limited (1987)
2. Theresiana A.L. *Fungsi Selokan Mataram bagi Daerah Istimewa Yogyakarta*. Yogyakarta. BPAD Yogyakarta (2014)
3. Suparno. *The Use of Indrayanti Beach Sand and Coconut Shell Carbon as Absorbents in Selokan Mataram Canal Water Filtration System*. International Journal of Basic & Applied Sciences IJBAS-IJENS. 12[6]: (2012), pp. 125-128.
4. Suparno and F.M. Besty, *Coconut Shell Activated Carbon as An Alternative Sedimentation Agent In Water Purification System*. International Journal of Art and Science Conference. (2012)
5. Dhidan, K. Samar. *Removal of Phenolic Compounds from Aqueous Solution by Adsorption on to Activated Carbons Prepared from Date Stones by Chemical Activation with FeCl3*. Chemical Engineering Department-College Of Engineering-University Of Baghdad-Iraq. (2012)
6. Pari, G. dan Sailah, I. *Pembuatan Arang Aktif Dari Sabut Kelapa Sawit Dengan Bahan Pengaktif NH4HCO3 Dan (NH4)2CO3 Dosis Rendah.* Bogor (2001).
7. Subadra, I. Setiaji, B. dan Tahir, I. *Activated Carbon Production From Coconut Shell With (NH4)HCO3 Activator As An Adsorbent In Virgin Coconut Oil Purification.* Yogyakarta: Universitas Gadjah Mada (2005)
8. Sembiring, M. dan Sinaga, T. *Arang Aktif (Pengenalan dan Proses Pembuatannya).* Medan: Universitas Sumatera Utara (2003).
9. Cheremisinoff & Morresi, A.C., *Carbon Adsorption Applications*, Carbon Adsorption Handbook, Ann Arbor Science Publishers, Inc, Michigan, . (1978) pp. 7-8.
10. Supraptiningsih. *Adsorpsi dan Desorpsi Krom pada Zeolit untuk Pengolahan Limbah Cair Industri Penyamakan.* Prosiding, Seminar Nasional Kimia. Surakarta: FMIPA UNS (2011)
11. Usman Bapa Jenti dan Indah Nurhayati, *Pengaruh Penggunaan Media Filtrasi Terhadap Kualitas Air Sumur Gali Di Kelurahan Tambak Rejo Waru Kabupaten Sidoarjo.* Jurnal Teknik WAKTU Volume 12 Nomor 02 Juli (2014).
12. Kim, I.K. Hong, I.S. Choi and C.H. Kim, Journal Of Ind. And Eng. Chemistry, 2 (2) 1996
13. Peraturan Menteri Kesehatan No. 416 Tahun 1990 tentang syarat-syarat dan pengawasan kualitas air
14. Ajayi O.A., and Olawale A.S., *A Comparative Study of Thermal and Chemical Activation of Canarium Schweinfurthii Nutshell*. Journal of Appl. sci. Res. New York. 5(12): (2009) pp. 2148-2152.
15. Suryani, M. S., *Pengaruh Zeolit Aktif untuk Mengabsorbsi Unsur-unsur dalam Limbah Pabrik Spiritus Madukismo,* Journal of Biosciences, (2010)