JURNAL PENDIDIKAN BIOLOGI INDONESIA
[Indonesian Journal of Biology Education]

Vol. 3 No. 3, 2017; pp. 202-207
p-ISSN: 2442-3750; e-ISSN: 2527-6204
http://ejournal.umm.ac.id/index.php/jpbi

Received: 14/10/2017
Revised: 25/11/2017
Accepted: 29/11/2017

THE USE OF SILICA SAND, ZEOLITE AND ACTIVE CHARCOAL TO REDUCE BOD, COD AND TSS OF LAUNDRY WASTE WATER AS A BIOLOGY LEARNING RESOURCES

Moch Assiddieq[1]*, Satya Darmayani[2], and Wirapati Kudonowarso[1]
[1] Environmental Engineering Study Program, University of Muhammadiyah Kendari
[2] Medical Laboratory Technology Department, Health Polytecnic of Kendari
*corresponding e-mail: moch.assiddieq@gmail.com

ABSTRACT

The aquatic environment contaminated with detergent waste in high concentrations can endanger the lives human and biota in the water. This study aimed to determine the decrease of BOD, COD and TSS content of laundry liquid waste by using filter media of silica sand, zeolite, and activated charcoal. Filter medium 1a can reduce BOD level from 98.6 mg/L to 58.80 mg/L (40.36%), while medium 1b can decrease BOD level to 21.20 mg/L (78.48%). It showed that media 1a had not fulfilled the quality standard of BOD of waste water that is 50 mg/L, while media 1b had fulfilled the standard of quality. Filter media 1a can decrease COD level from 210 mg/L to 78.80 mg/L (62.47%), whereas medium 1b can decrease COD to 25.60 mg/L (87.80%). This showed that media 1a and media 1b had met the quality standard of COD of waste water that is 100 mg/L. Filter media 1a can decrease TSS level from 465 mg/L to 122.5 mg/L (73.65%), whereas medium 1b can decrease TSS level to 52.3 mg/L (88.75%). This showed that media 1a and media 1b had met the quality standard of TSS of waste water that is 150 mg/L.

Keywords: *Silica sand, zeolite, activated charcoal, BOD, COD, TSS*

INTRODUCTION

Increasing population in urban areas brings changes to the lifestyle of society. With the high hours of work and activities carried out, the community can no longer meet the needs of households independently. This has led to an increase in public demand for household services, one of which is laundry. The emergence of this laundry business can provide benefits and it is a domestic work solution, as well as providing new jobs for the surrounding community. However, these benefits are inversely proportional to the resulting environmental quality.

The number of laundry services resulted in increased use of detergent, which will worsen the quality of the surrounding water because the business is not equipped with waste processing but it is discharged directly into the nearest sewer or water body. As a result, waste laundry is discharged into water bodies continuously without being processed, can cause problems of pollution.

The aquatic environment contaminated with detergent waste in high concentrations can endanger the lives of the biota of water and human that consumes the biota. The laundry waste needs to be handled more effectively because laundry waste contains chemicals with high concentrations including phosphates, surfactants, ammonia and nitrogen and dissolved solids (TSS), turbidity, biological oxygen deamnd (BOD), and high chemical oxygen demand (COD) (Ahmad and El-Dessouky, 2008). Each industry can produce liquid wastes with COD concentrations between 488-2847 mg/L and suspended solid (SS) between 38-857 mg/L (Seo, et al, 2001) but it all depends on the operational capacity of the laundry industry.

According to the Regulation of the State Minister of the Environment Number 03 in 2010 concerning the Quality Standards of Wastewater for Industrial Zones, industrial wastewater shall not contain COD, BOD and TSS in quantities beyond the specified quality standard. The quality standard for BOD parameters is 50 mg/L, COD 100 mg/L, and

Citation: Assiddieq, M., Darmayani, M. & Kudonowarso, W. (2017). The use of silica sand, zeolite and active charcoal to reduce BOD, COD and TSS of laundry waste water as a biology learning resources. *Jurnal Pendidikan Biologi Indonesia*, *3*(3), 202-207. https://doi.org/10.22219/jpbi.v3i3.4864

TSS 150 mg/L. BOD, COD, and TSS are part of physical-chemical parameters in waste water quality review (Alaerts and Santika, 1987).

Some wastewater treatment techniques, especially laundry water which is commonly used include using water hyacinth, alum coagulant and zeolite media, and using sand and activated charcoal. According to Sulpryan (2014), the effectiveness of water hyacinth in lowering the concentration of BOD waste water is 46.66% and COD 64.28%.

According to Sisyanreswari et al (2014) the effectiveness of alum coagulant and zeolite media in reducing the concentration of COD waste water is 69.44% and TSS is 66.18%, whereas according to Setyobudiarso and Yuwono (2014) the effectiveness of sand and charcoal is active in reducing the concentration of COD waste water by 55.33% and TSS of 50.57%. According Kasam (2005), reduced ability of activated carbon caused pores on the carbon surface covered by molecules that have been absorbed. This also occurs in biosand filter reactors 2 activated carbon 30 and 60.

Based on observations on various types of media used to treat laundry water, the authors take a slow sand filter media with filter material in the form of zeolite, active charcoal and silica sand as a method to treat laundry waste water. Method retrieval is based on the efficient timing of waste treatment and does not require large areas of land.

Silica sand filter media serves to filter the solids present in the water in the filtration tube, activated carbon serves to remove micro-pollutants such as organic matter, detergent, and odor, while for zeolite is used for molecular filters, ion exchangers, material absorbers and catalysts (Setyobudiarso and Yuwono, 2014).

This problem is related to the biology concept that is taught in High School, grade X in the 2nd semester, about the material of environmental change and waste recycling at KD 4.10 "Solving Environmental Problems by Designing Waste Recycling Products and Environmental Conservation Efforts", by using indicators of achievement of competence "Conducting Experiments on the Effect of Water Pollution on the Survival of the Organism".

Observations conducted on teachers of biology subjects found several problems that occur such as lack of resources of competent teaching materials as a medium for students. Based on the problems that have been described above, it is necessary the use of learning media and good learning resources in order to help the process of biology learning effectively and efficiently (Siswandari, et al, 2016). The development of creativity in teaching is one important factor in the ongoing learning process. Learning resources are everything that can facilitate the learners in obtaining some information, knowledge, experience, and skills in teaching and learning process (Retno, 2016).

Based on the early observations of the researchers, most laundry businesses do not have liquid waste treatment. Therefore, the waste water treatment system is required to clean water by making filter media like slow sand filter combination of activated charcoal, silica sand, and zeolite.

Based on the above background, we get the problem formulation whether by using filter media of silica sand, zeolite, and activated charcoal can fulfill the standard of quality of BOD, COD and TSS of laundry wastewater? And how is the utilization of the results of research on the utilization of silica sand, zeolite, and activated charcoal to reduce BOD, COD and TSS laundry waste water can be a source of biology learning?.

METHOD

This research was conducted on 17 June-19 August 2017 at Basic Laboratory of Environmental Engineering Department of Muhammadiyah University of Kendari. The type of research used in this research was quantitative descriptive to know how far the effectiveness of silica sand filter media, zeolite and activated charcoal in lowering BOD, COD and TSS laundry waste water.

The population in this research was residual wastewater of laundering of garments in all home laundry business around Kendari Barat Subdistrict, and taken as sample that was waste of washing process in Laundry B chosen by purposive sampling based on criteria that have been determined by the researchers, the criteria are waste generated dumped into the river, the physical character of the turbid waste and smells nice.

The data in this study were collected from the beginning of the research, ie data obtained by researchers through interviews, discussions and direct observation in the field. The primary data was obtained directly by the researchers from the research sources and data obtained

from experimental results and laboratory analysis. Then the data have been analyzed presented in the form of tables and narration to discuss the research results.

Tools and Materials

The tools used in this research are PVC Pipe 6 ", PVC Pipe 3", Elbow ¾", Dop 6", Dop 3 ", Stop Faucet ¾", gauge (meter), Jerry can.The materials used in this research are zeolite, sand silica, activated charcoal, laundry liquid waste.

Tool Design

COD, and TSS levels after treatment of 1a filter media with zeolite, silica, and activated charcoal respectively 2 kg, and 1b filter media with zeolite mass, carbon active and silica sand of 4 kg.

Table 1. Result of Laundry Waste Analysis

Test Parameter	Unit	Sampel Code Size			Quality Standard (PP No. 03, 2010)
		Initial Sample	Tool 1a	Tool 1b	
BOD	mg/L	98.6	58.80	21.20	50
COD	mg/L	210	78.80	25.60	100
TSS	mg/L	465	122.5	52.3	150

(Source: Primary Data, 2017)

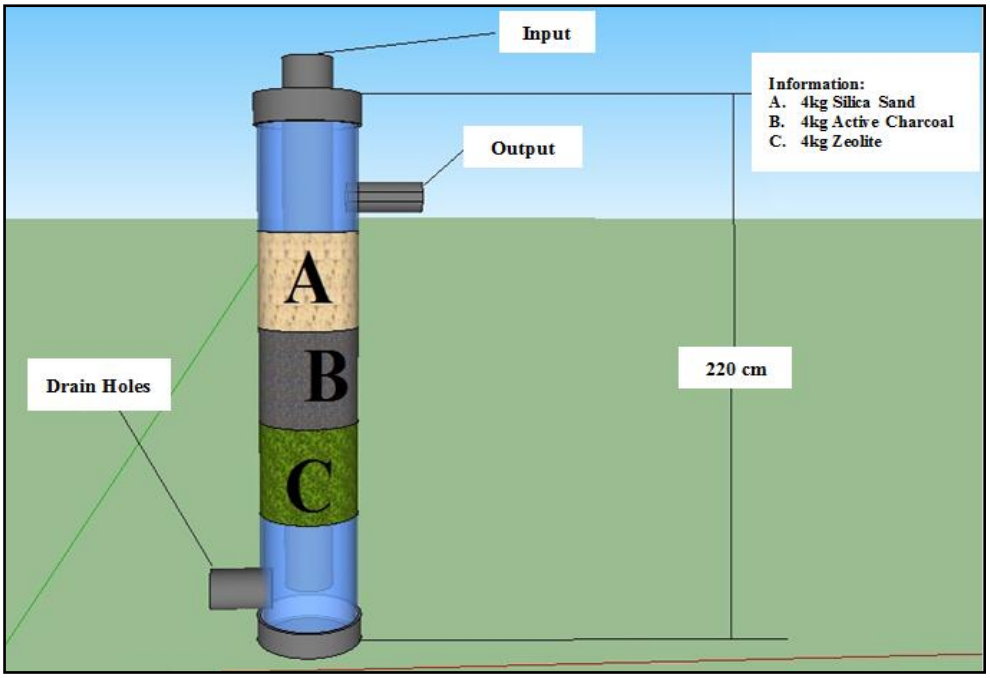

Figure 1. Design of Filter Tube Media (Source: Primary Data, 2017)

RESULTS AND DISCUSSION

This research used silica sand filtering media, active charcoal, and zeolite. In the filter media is treated, namely the mass number variation for filter media 1a with the mass of each 2 kg while for filter media 1b with each mass 4 kg. This showed that mass variation of filter media 1a and 1b was very influential to know the effectiveness of a filtration in lowering BOD, COD, and TSS in accordance with the established environmental quality standard. From the mass variation of media 1a and media 1b then obtained the results of the analysis described in table 1.

From the laundry waste analysis above, it was found that there was a decrease of BOD,

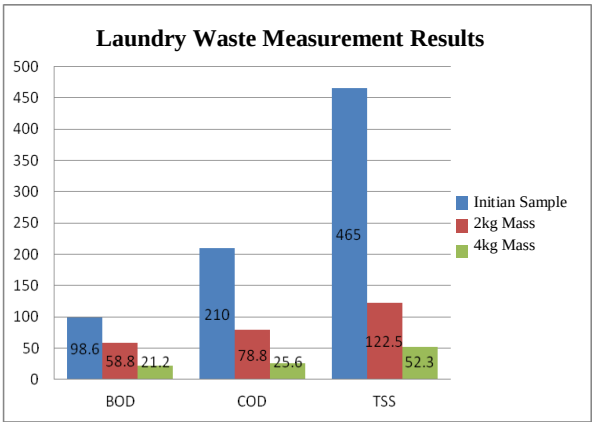

Figure 2. Results of Laundry Wastes Measurement (Source: Primary Data, 2017)

BOD (Biochemical Oxygen Demand)

From table 1, it can be explained that the change of BOD content in laundry waste sample decrease after treatment on media 1a and media 1b. Before treatment, BOD content of 98.6 mg/L, then after treatment on medium 1a with the mass of 2 kg filter material obtained BOD level of 58.80 mg/L and on treatment medium 1b with the mass of 4 kg filter material obtained BOD content of 21.20 mg/L.

Based on figure 2, it can be explained that the difference of BOD value of laundry waste treatment on filter media 1a with zeolite mass, silica sand, and active charcoal are 2 kg above the standard of quality of waste water for industrial area, this means using filter media 1a, BOD has not fulfilled the standard quality requirement, while using filter media 1b with zeolite, silica, and activated charcoal respectively 4 kg, the result of its BOD content is below the quality standard, so that it meets the specified requirements.

From the above data can be seen that the filter media with zeolite, activated charcoal, silica sand with a mass of 2 kg can reduce BOD content up to 40.36%, while with filter media with zeolite, activated charcoal, silica sand with a mass of 4 kg has the greatest ability in lowering BOD content up to 78.49%. This is influenced by the mass of zeolite and activated charcoal. The larger the adsorbent mass in the filter media, the more organic substances from the waste water trapped in the pores of the adsorbent, thereby reducing the BOD content of waste water (Setyobudiarso & Yuwono, 2014).

COD (Chemical Oxygen Demand)

Based on table 1, it can be explained that the change of COD content in laundry waste sample decrease after treatment on media 1a and media 1b. Before treatment, COD content of 210 mg/L, then after treatment on medium 1a with the mass of filter material 2 kg obtained COD level of 78.80 mg/L and on treatment medium 1b with the mass of 4 kg filter material obtained COD level of 25.60 mg/L. Both media have met the quality standards so that the laundry water is safe to be disposed to the body water.

From the above data can be seen that the filter media with zeolite, activated charcoal, silica sand with a mass of 2 kg can reduce the level of COD to 62.47%, while with filter media with a mass of 4 kg has the greatest ability in lowering COD levels up to 87.80%. It is influenced by adsorption of organic substances by zeolite as well as activated charcoal. Organic compounds in the laundry waste will be reduced so that the oxygen needed to oxidize the organic substances becomes less, thereby decreasing the COD content to the maximum, while the silica sand is used as a filter media in the treatment of laundry liquid waste so as to reduce the content of organic materials in such waste (Ahmad & El-Dessouky, 2008).

TSS (Total Suspended Solid)

From table 1, it can be explained that the change of TSS content in laundry waste sample decreased after treatment on media 1a and media 1b. Before treatment, TSS content of 465 mg/L, then after treatment on medium 1a with the mass of 2 kg filter material obtained TSS level of 122.5 mg/L and on treatment medium 1b with the mass of 4 kg filter material obtained TSS level of 52.3 mg/L. So the level of TSS on both media has fulfilled the standard of quality so that the laundry water is safe to be discharged into water bodies.

From the above data can be seen that the filter media with zeolite, activated charcoal, silica sand with a mass of 2 kg can reduce TSS levels up to 73.65%, whereas with media with a mass of 4 kg can reduce TSS levels up to 88.75%. The decrease of TSS content in laundry waste occurring in each filter media due to zeolite and activated carbon can absorb the organic and inorganic substances contained in the laundry waste, while using silica sand, TSS content decreased because the adsorption power of silica sand is able to absorb solids - suspended density in water (Ahmad and El-Dessouky, 2008).

Utilization of Research Result as Learning Source

AECT (1977) defined the source of learning includes all the good sources of data, people or objects that can be used to provide facilities (ease) for learners learn. Therefore, the learning source is all the components of the instructional system both specifically designed and that can be used or utilized in learning activities.

The tendency of utilization of various learning resources in educational unit is influenced by two main factors namely internal factors and external factors (environment). Internal factors that influence the dominant is the awareness, passion, interest, ability, and

comfort in the user. While the influential external factors are the availability of varied learning resources, the source of learning a lot, the ease of access to learning resources, learning process, space, human resources, and prevailing traditions and systems in schools/educational institutions (Abdullah, 2012).

The results of this research are used as a learning resource that is as a research journal. Research journal is a research report about the results of research that has been done scientifically. Basically, most research journals can be held accountable for their scholarship depending on the method used in preparing reports of research journals (Rosita *et al.*, 2016).

Journal of this research can also be used as a source of student learning in class X of the 2nd semester on Biology subject on environmental change material and waste recycling. In accordance with the competency standard is to carry out experiments on the effect of water pollution on the survival of organisms with KD 4.10 ie solve environmental problems by making waste product recycling design and environmental conservation efforts.

CONCLUSION

Filter media, a combination of silica sand, zeolite and activated charcoal can decrease BOD, COD, and TSS. The value of BOD content from the processing of filter media 1a of 58.80 mg/L has not met the quality standard that is 50 mg/L while using the filter media 1b BOD content of 21.20 mg/L has met the quality standard. The value of COD in filter media 1a of 78.80 mg/L and on filter media 1b of 25.60 mg/L has met the quality standard of 100 mg/L. The value of TSS both on filter media 1a and filter media 1b of 122.5 mg/L and 52.3 mg/L has met the quality standard of 150 mg/L.

Implementation of research as a source of biology learning that is in the form of research journal with competency standard is carrying out experiments influence water pollution on the survival of organisms with KD 4.10 ie solve environmental problems by making waste product recycling design and environmental conservation efforts.

REFERENCES

Abdullah, R., (2012). Learning based use learning resources. *Didaktika,* 12*(2),* 216-231.

AECT, (1977). *The definition of educational technology.* Washington: Association for Educational Communication and Technology.

Ahmad & El-Desauky. (2008). Design of a modified low cost treatmeant system for the recycling and reuse of laundry waste water. *Journal of Resources, Conservation and Recycling, 52*(7), 973–978. Retrieved from www.elsevier.com/locate/resconrec.

Alaerts, S., & Smestri, S. (1987). *Metode penelitian air*. Surabaya: Usaha Nasional.

Kasam, Y., Andik, & Sukma, T. (2005). Decreasing chemical oxygen demand in liquid waste laboratory using coconut shell activated coconut activated carbon filter. *Jurnal Logika, 2*(2), 3-17.

Retno R. S., & Yuhanna W .L. (2016). The learning of science basic concept by using scientifiq inquiry to improve student's thinking, working, and scientific attitude abilities. *Jurnal Pendidikan Biologi Indonesia, 2*(1), 1-9. Retrieved from http://ejournal.umm.ac.id/index.php/jpbi/.

Rosita, D, Zaenab. S, & Budiyanto M.A.K. (2016). The analysis on the chlorine contents in rice circulation in pasar besar of Malang as the biological learning resource. *Jurnal Pendidikan Biologi Indonesia, 2*(1), 88-93. Retrieved from http://ejournal.umm.ac.id /index.php/jpbi/.

Seo T. G., Lee, T. S., Moon, B. H. & Lim. J. H. (2001). *Ultrafiltration combined with ozone for domestic laundry wastewater reclamation and reuse*. Retrieved from ws.iwaponline.com/content/ppiwawstws/1/5-6/387.full.pdf.

Siswandari A. M, Hindun. I, & Sukarsono. (2016). Phytoremediation of phosphate content in liquid laundry waste by using echinodorus paleafolius and equisetum hyemale used as biology learning resource. *Jurnal Pendidikan Biologi Indonesia, 2*(3), 222-230. Retrieved from http://ejournal. umm.ac.id/index.php/jpbi/.

Sulpryan, R. (2014). *Pengaruh treatment air limbah laundry dengan menggunakan eceng gondok (eichornia crassipes)* (Unpublisheed thesis). Kendari: Teknik Lingkungan Universitas Muhammadiyah Kendari.

Setyobudiarso, H, &Yuwono, E. (2014). Rancang bangun alat penjernih air limbah cair laundry dengan menggunakan media penyaring kombinasi pasir-arang aktif. *Jurnal Neutrino, 6*(2) 84-90.

Sisyareswari, H; Wiharyanto, O. & Rezagama, A. (2014). *Penurunan TSS, COD, dan fosfat pada limbah laundry menggunakan koagulan tawas dan media zeolit.* Retrieves from http://ejournal-s1.undip.ac.id/index.php /tlingkungan/article/view/7133/6900.