THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

Analysis of Mechanical Water Filtration Systems for River Water Quality

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Abstract:
This research aims to know the role of mechanical water filtration tools in changing the river water that is still dirtyin to clean water and compare it with well water.
The research was conducted in Padang Village, Bulukumba Regency, and Indonesia. The material used in this research is water sourced from wells and river water. Other than that, other materials used are quartz sand, gravel, and charcoal and palm fiber. The research was conducted in two steps. The first step is to make a water treatment installation with a filtration system and the second steps of sample testing in the laboratory. Analysis of the data used is descriptive analysis. The results of the study show a physical analysis of water which includes water color still feasible and eligible for use, Total Suspended Solids still meet the requirements because it is below 50 ppm for all water sources, as well as Total Dissolved Solid still meet the requirements because it has a value below 1000 ppm, but in terms of odor, it has not fulfilled the requirements stipulated by the Government of the Republic of Indonesia, as well as Water turbidity in this research has not met the requirements because it exceeds 5 NTU both water sourced from wells and rivers. Water chemistry analysis results show hardness of water obtained in this research still meet the requirements set by the Minister of Health of the Republic of Indonesia where the maximum level of hardness allowed is 500 ppm. Water pH value in this research still meets the required pH value for clean water. The highest total organic matter in this research found in water that has undergone a screening process, both water sourced from wells and water sourced from the river.

Keywords: *System, filtering, mechanics, river water*

1. Introduction

Water in human life has a very vital function. The daily activities of humans are never separated from water. Starting from bathing, washing, cooking to human body elements, one of them also consists of water. Therefore, clean water that does not contain harmful chemical elements and disturbing the functions of the human body is very necessary (Ariyanto, 2007).

The problem of providing clean water this time special attention developed countries and developing countries. Indonesia as one of the developing countries cannot be separated from the problem of providing clean water for the community. One of the main problems faced is lack of available sources of clean water, not yet even distribution of services providing clean water especially in the countryside and clean water sources which is not yet utilized maximally (Ariyanto, 2007).Problems that are often found in water services that the quality of groundwater and river water used by the community does not meet the requirements as healthy clean water even in some places not even feasible to use (Astuti *et* al., 2015).

Human needs for water always increase from time to time, not only because of the increasing number of people who need the water, but also because of the increasing intensity and variety of the need for water (Silalahi, 2002).The need for water by humans is endless, especially decent clean water for household use such as: bathing, cooking, even the most important is to drink (Lubis and Affandy, 2014).

One source of water that is quite abundant but cannot be used directly for daily needs is river water. River water quality is affected by the quality of water supplies originating from the catchment area while the quality of the water supply from the catchment area is related to human activities in it (Wiwoho, 2005).Various human activities in fulfilling their life needs that come from industrial activities, households, and agriculture will produce waste which contributes to decreasing river water quality (Suriawiria, 2003).

There are various simple ways that can be used to get clean water, and the most commonly used way is to make water filters, and for us it might be the best to make a water purifier or simple water filters. Need to be considered, that water filtration is simple cannot completely remove the salt dissolved in the water. Because processing dirty water into clean water must be done carefully so that germs are in water completely gone (Susantoet al., 2014).

Based on these, then efforts are made to treat river water in to water that can be used for daily needs like mechanical water filtration. Through water filtration, it is expected to produce clearer river water to be used for everyday needs. Through water filtration, water quality can also be improved through mechanical filtration.

2. Research Purposes

This research aims to know the role of mechanical water filtration tools in changing the river water that is still dirty in to clean water and compare it with well water.

3. Method

The research was conducted in June-July 2017 in Padang Village, Bulukumba Regency, and Indonesia. The location of this research is because this location has abundant water potential but the abundant water cannot be utilized directly by the community because water conditions that are still cloudy are used for daily needs.

The material used in this research is water from wells and water sourced from rivers a round Padang Village, Bulukumba Regency, and Indonesia. Other than that, Other materials used are 12 kg quartz sand, 10 kg gravel, 5 kg charcoal and 0.5 kg palm fiber. Sand is useful for holding down fine dirt deposits, gravel is useful for filtering large-sized materials, for example: leaves in rivers, mosses, algaeetc, palm fiber is useful for filtering particles that have escaped from the previous layer and flattening the flowing water, and charcoal is useful for filtering/ removing odors, color, pollutants in water, as a protector and exchange of resin in water distillation devices (Merdekawati, 2016).

This research is conducted in two steps. The first step is to make a water treatment installation with a filtration system and the second steps of sample testing done in the laboratory. The procedure of this research is that the initial sample water consisting of well water taken from around the research site was filtered, then compared to river water taken from the research location, both water sources were taken and immediately analyzed in the laboratory both before and after the screening process.

Screening installation arrangement that starts from the bottom consisting of gravel, quartz sand, charcoal and palm fiber. Furthermore, sample water is put into a water filtration container as much as 20 liters, then the filtered water is taken to be analyzed in the laboratory to compare water quality before and after processing both water from well water and from river water.

4. Results and Discussion

4.1. Water Physics Analysis

4.1.1. Color of Water

Water color can be influenced by the presence of organisms, colored materials that are suspended and organic compounds. The smell and taste can be caused by the presence of organisms in the water such as algae, and can also be caused by the presence of H_2S gases from anaerobic decomposition of organic compounds (Mukarromah, 2016).According to (Effendi, 2003) the color of the waters can also be caused due to the presence of organic materials (the presence of plankton or humus)and inorganic (such as iron metal ions and manganese).Therefore, the color of water can indicate the presence of dissolved substances in the water which greatly affect water quality.

Furthermore, Gabriel (2001) states that water color is generally caused by negatively charged colloidal particles, so that color purification in water is done by adding positively charged coagulant materials such as aluminum and iron.

The results of this research show the highest color of water obtained in water originating from river water of 0.078 TCU, but after going through the screening process the color value decreased to 0.056 TCU. According to Government Regulation No.82 of 2001 it was stated that the color of water for daily use must be worth 0 TCU. Thus, in this research only water sourced from wells fulfilled the requirements both before and after water filtration which was equal to 0.01 TCU.

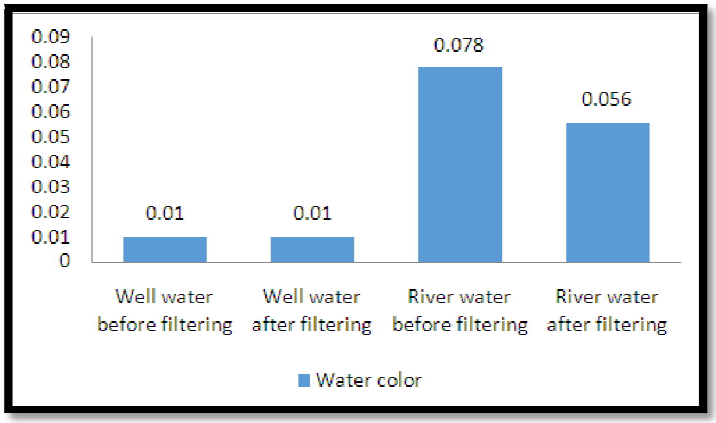

Figure 1: Water Color Before and after the Screening Process

4.1.2. Smell of Water

According to the Regulation of the Minister of Health of the Republic of Indonesia number492/MENKES/PER/IV/2010, the physical properties of drinking water are tasteless and odorless.As well asMinister of Health of the Republic of Indonesia number416/Menkes/Per/IX/1990states that drinking water must not

smell. Where as in this research shows that river water both before and after the screening process still smells of mud and the source of well water smells neutral.

4.1.3. Water Turbidity

Water turbidity in this research showed the highest turbidity occurred in river water of 14.55 NTU, but after screening for river turbidity, there has been a decrease to 10.12 NTU.

According to the Government Regulation of the Republic of Indonesia Number 82 of 2001regarding Water Quality Management and Water Pollution Control, turbidity of water to drink must be 0 (zero),while according to Regulation of the Minister of Health of the Republic of Indonesia number492/MENKES/PER/IV/2010, physical properties of drinking water, namely maximum turbidity is 5.Thus in this research, only water from wells met the requirements according to the Government Regulation of the Republic of Indonesia Number 82 of 2001 and the Minister of Health of the Republic of Indonesia number492/MENKES/PER/IV/2010.

Effendi (2003), states that the high value of turbidity can make it difficult to filter and reduce the effectiveness of disinfection in the water purification process. Turbidity is closely related to the value of TDS in water. The higher the TDS value in water, the higher the turbidity value in water.

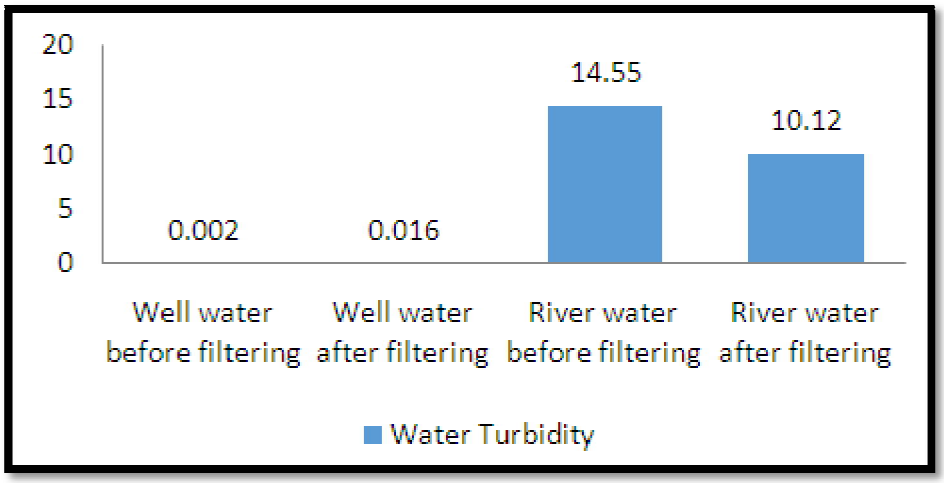

Figure 2: Water Turbidity before and after the Screening Process

4.1.4. Total Suspended Solid

Total Suspend Solid (TSS) is suspended material (diameter> 1 μm) which is retained in the Millipore sieve with a 0.45 μm pore diameter.TSS consists of mud and fine sand and microorganisms, which are mainly caused by soil erosion or soil erosion that is carried into the water body.

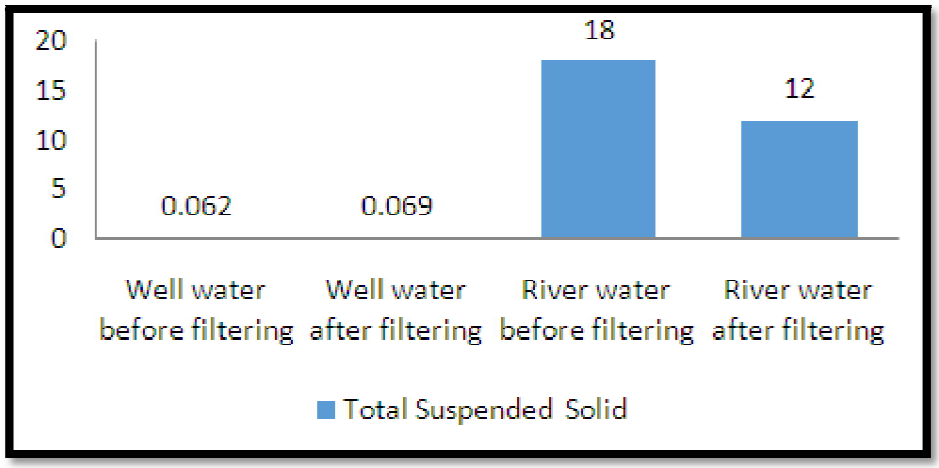

Figure 3: Total Suspended Solid Water before and after the Screening Process

In Figure 3 shows the highest Total Suspended Solids in this study occurred in water sources originating from the river and not yet done filtering process at 18 ppm, but has undergone a process of decline after the screening process to 12 ppm. While water comes from the well both before and after the screening process containing Total Suspended Solid of 0.062 and 0.069 ppm. According to the Government Regulation of the Republic of Indonesia Number 82 of 2001the maximum limit of Total Suspended Solid is 50 ppm, thus all water sources in this research both from the well and from the river are still within the permissible limits because it is still below 50 ppm.

4.1.5. Total Dissolved Solids

Effendi (2003) states that the main cause of Total Dissolved Solids is inorganic material in the form of ions commonly found in waters. The total suspended solids consist of mudand fine sand and microorganisms, especially those caused by soil erosion or erosion carried into the body water (Sugiharto, 1987).This solid consists of inorganic and organic compounds dissolved in water, minerals and salts (Bassett, 1994).

According to Retnosari and Shovitri (2013), Total Dissolved Solids is the amount of dissolved solids measuring ≤ 1 μm, where the greater the increase in the value of Total Dissolved Solids indicates that the organic material has not been completely degenerated from waste into gas. Decreasing the value of Total Dissolved Solids content due to dissolved particles has been converted into gas which is released as a byproduct of the biodegradation process by microorganisms. Smaller particles dissolved in wastewater will go through the methanogenic phase, so that the particles dissolved in the waste will be converted into gas.

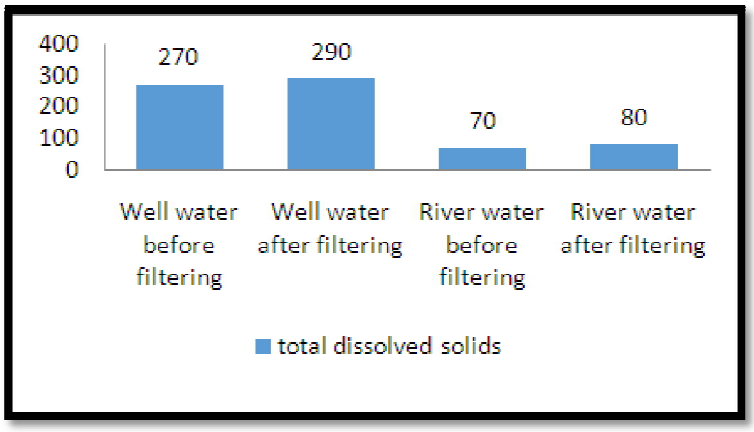

Figure 4: Total Dissolved Solids of Water Before and after the Screening Process

In this study the highest total dissolved solids in well water which has been carried out by screening process is 290 ppm, followed by the source of well water before the screening process at 270 ppm, the source of river water after the screening process is 80 ppm and the lowest is for water from the river before the water filtration process is carried out. However, Total Dissolved Solids content is still lower than required by the Government Regulation of the Republic of Indonesia Number 82 of 2001which states that Total Dissolved Solids must be <1000 ppm, or according to Regulation of the Minister of Health of the Republic of Indonesia No. 416/ Menkes/Per/IX/1990which states a maximum Total Dissolved Solids at 1500 ppm. Furthermore, the value of Total Dissolved Solids like this according to Leonore et al. (1998) falls into the category of fresh water.

4.2. Water Chemistry Analysis

4.2.1. Hardness

The water hardness content obtained in this research is highest in well water sources that have been carried out by a screening process at 67.5 ppm, followed by a water source before a filtration process at 52.5 ppm, source of river water that has been done filtering processat 35 ppm and the lowest at river water sources before it is done filtering process at 27.5 ppm. According to the Regulation of the Minister of Health of the Republic of Indonesia No. 416/MENKES/PER/IX/1990 concerning requirements for quality of clean water, the maximum level of hardness allowed is 500 ppm. Therefore, the content of hardness of water originating from wells and rivers, both before and after the screening process is still below the required hardness threshold.

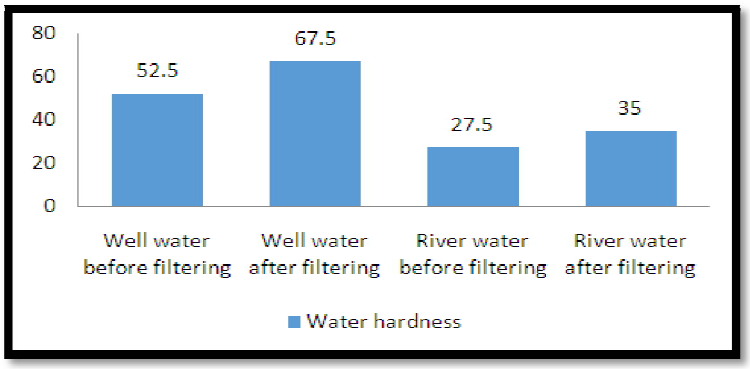

Figure 5: Water Hardness before and After the Screening Process

4.2.2. pH of Water

In general, pH values describe how much acidity or basicity of water. Waters with a pH value = 7 are neutral, pH <7 is said to be acidic, while pH> 7 is said to be an alkaline water condition (Effendi, 2003).Mahida (1986) states that industrial and household waste can affect water pH values.

The highest water pH value in this research was obtained at a water source before the screening process both water sourced from wells and water sourced from river water respectively 6.54 and 6.49 (Figure 6).According to the Ministry of Health of the Republic of Indonesia in 2010, the physical properties of drinking water are pH 6.5-8.5.Therefore,only the pH of well water before the screening process which fulfills the requirements the lowest pH value at 6.5,while the other water sources are well water after the screening process, river water both before and after the screening process all below the lowest pH threshold.

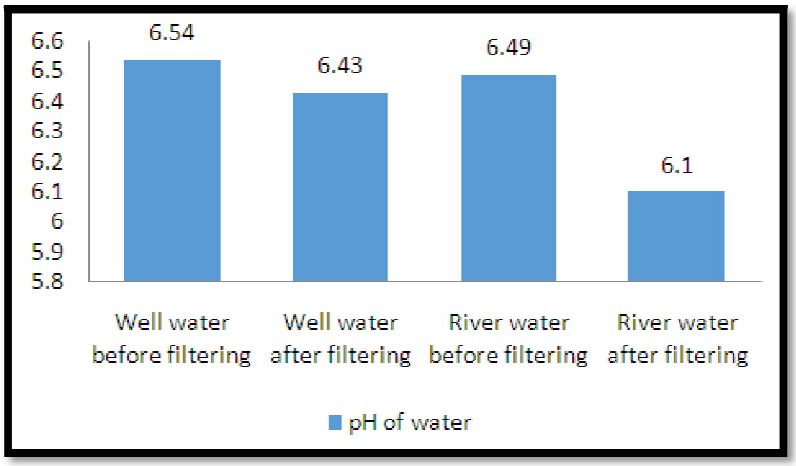

Figure 6: Ph of Water Before and after the Screening Process

The pH value of water obtained in this research is still lower than the results of research conducted by Sumiharni and Susilo (2009)who conducted research on the water quality of the Way Belau Kuripan river in Bandar Lampung through filtering water twice and find the initial pH filtering water of 6.8, the first filter and second filtration 6.67 pH value of 5.23.However,in this research have similarities to the research conducted by Sumiharni and Susilo (2009)that is, after the screening process the pH value has decreased.

4.2.3. Dissolved Organic Ingredients

Organic matter is a collection of various complex organic compounds that are or have undergone a decomposition process, both in the form of humus and mineralized inorganic compounds including heterotrophic and muscrophic microbes that are involved and are in it (Hardjowigeno, 2003; Supriyantini et al., 2017).

Organic materials in sediments are composed of deposited products which are influenced by conditions during the sedimentation process. Conditions in the presence of oxygen will reduce the amount of organic compounds which settles due to further degradation of organic matter in the water column. The amount of organic material that will be deposited is also closely related to primary productivity, waves, currents, and the presence of predators and decomposers (Killops and Killops, 1993).

The highest total organic matter in this research occurs in water that has undergone a screening process, both water sourced from wells and water sourced from rivers (Figure 7).According to Suparjo (2009) and Wattayakorn (1988) organic matter naturally originates from the waters themselves through decomposition processes, weathering or decomposition of waste from landfill waste such as domestic, industrial, agricultural and livestock waste or leftover feed which in the presence of bacteria decomposes into nutrients. The high total organic content can cause low dissolved oxygen content in waters (Susana (2009).

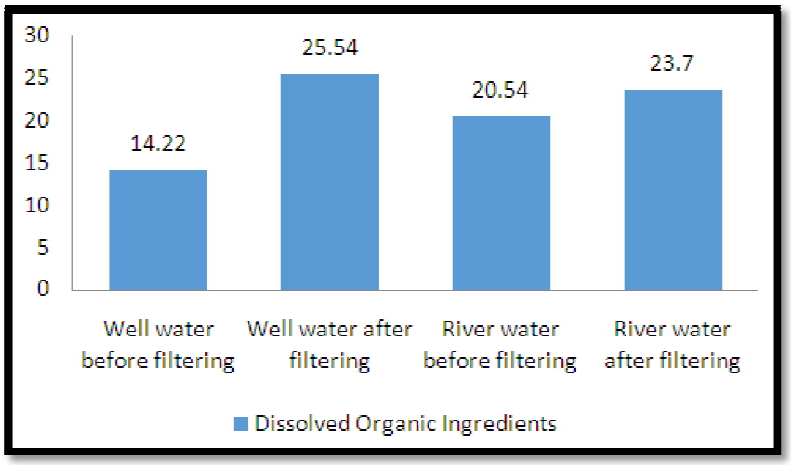

Figure 7: Organic Matter Dissolved in Water before and after the Screening Process

5. Conclusion

Results of water physics analysis in this research shows that the color of water in this study is still as recommended by the Government Regulation of the Republic of Indonesia Number 82 of 2001which states that the color of water for daily use must be 0 TCU. In terms of the smell of water, then the water in this study has not met the requirements set by Regulation of the Minister of Health of the Republic of Indonesia Number 492/MENKES /PER/IV/2010,that drinking water is non-taste and odorless. As well as Regulation of the Minister of Health of the Republic of Indonesia No. 416 / Menkes / per / IX / 1990states that drinking water must not smell. The turbidity of water in this study has not fulfilled the requirements because it exceeds 5 NTU in both water from wells and rivers. The highest total suspended solids in this study still meet the requirements because it is below 50 ppm for all water sources. Total Dissolved Solids in this research still meet the requirements because they have a value below 1000 ppm.

Water chemistry analysis results show the water hardness content obtained in this research still meets the requirements from the Regulation of the Minister of Health of the Republic of Indonesia No. 416/MENKES/PER/IX/1990 about clean water quality requirements the maximum level of hardness allowed is 500 ppm. The pH value of water in this study still meets the pH value required for clean water. The highest total organic matter in this study occurs in water that has undergone a screening process, both water sourced from wells and water sourced from the river.

6. References

i. Agustira, R., K.S. Lubis and Jamilah. 2013. Study of Water Chemical Characteristics, Water Physics and River Discharge in the Region DAS PadangDue to Tapioca Waste Disposal. Jurnal Online Agroekoteknologi., 1(3) : 615 – 625
ii. Ariyanto, D. 2007. Analysis of Clean Water Needs and Water Availability at IPA Sumur Dalam Banjarsari PDAM Surakarta City forNumber of Customers. Thesis. D-IIIUrban Infrastructure Civil Engineering. Civil Engineering Department.Faculty of Engineering, Sebelas Maret University, Surakarta.
iii. Astuti, D. W., M. Rahayu, and D. S. Rahayu. 2015. Total hardness determination (CaCO3) Well water in the hamlet of Cekelan Kemusu, Boyolali with Complexometry Method. KESMAS Journal. Vol.9, No.2, September 2015, pp. 119-124
iv. Bassett, J. 1994. Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis. Longman Group UK Limited: London.
v. Effendi. 2003. Review of Water Quality for Resource and Environmental Management.
vi. Gabriel, J. F. 2001. Environmental Physics. Hippocrates Publishers: Jakarta.
vii. Regulation of the Minister of Health of the Republic of Indonesia Number 416/MENKES/PER/IX/1990 About Clean Water Quality Requirements, Jakarta, 1990.
viii. Regulation of the Minister of Health of the Republic of Indonesia Number 492/MENKES/PER/IV/2010 About drinking water quality requirements. RI Ministry of Health: Jakarta.
ix. Hardjowigeno, S. 2003.Soil Science.. Akademika Presindo, Jakarta, 233 pp.
x. Killops, S.D., and V.J. Killops. 1993. Introduction to Organic Geochemistry. Logman Scientific Technical, Essex, 265 p.
xi. Leonore, S.C, Egreenberg, A., and D.E. Andrew. 1998. Standart Methods For The Examination of Water and Wastewater. Edisi 20 th. USA : APHA AWWAWEF.
xii. Lubis, Z., N. A. Affandy. 2014. Clean Water Needs in Glagah District, Lamongan Regency. TeknikA JournalA Vol. 6 No. September 2, 2014
xiii. Mahida, U. N. 1986.Pollution and Industrial Waste Utilization. Rajawali Press: Jakarta.
xiv. Merdekawati, G. I. 2016. Water Purification Using Simple Tools. Gunadarma University students.
xv. Mukarromah, R. 2016. Analysis of Physical Properties in Water Quality Studies in Springs Sumber Asem Kalijeruk Hamlet, Siwuran Village, Garung District, Wonosobo Regency.Essay. Department of Physics, Faculty of Mathematics and Natural Sciences, Semarang State University

xvi. Government Regulation Number 82 Tahun 2001 About Water Quality Management and Water Pollution Control.Jakarta, Sekretariat Negara.

xvii. Retnosari, A and M. Shovitri. 2013. Capability Isolates of Bacillus sp.in Degradating Septic Tank Waste. Sains dan Seni Pomits Journal. 2(1) : 7-1.

xviii. Silalahi, M. D. 2002, Optimizing Juridical Facilities as an Effort to Grow Urgency Awareness Society Sumber Daya Air (SDA), Air MinumMagazine, issue No. 97 / th. XXIII December 2002

xix. Sugiharto, O. 1987. Ecology, Environment and Development, Djambatan Publisher: Yogyakarta

xx. Sumiharni, G. and E. Susilo. 2009. Low Quality Water Treatment Becoming Non Domestic Water Consumption (Case Study:River water of Way Belau River water of Kuripan - Bandar Lampung). Rekayasa Journal Vol. 13 No.3, Desember 2009

xxi. Suparjo, M.N. 2009. Pollution Conditions for the Babon River in Semarang. Saintek Perikanan Journal. 4(2) : 38 – 45.

xxii. Suprihatin and Suparno, 2013. Water Treatment Process Technology, For Students and Industrial Practitioners.PT Publisher IPB Press,Bogor.

xxiii. Supriyantini, E., R. Azizah., T. Nuraini., and A. P. Fadmawati. 2017. Study of Organic Ingredients At Some River Estuaries in the Mangrove Ecosystem,In the Coastal AreaNorth Coast of Semarang City,Central Java. Marina Oceanographic Bulletin April 2017 Vol 6 No 1: 29–38.

xxiv. Suriawiria, U. 2003. Water in a Healthy Life and Environment. Alumni Publisher. Bandung

xxv. Susana, T. 2009. Acidity level (pH) and Dissolved Oxygen as an Indicator of Water Quality around the Cisadane River Estuary. Teknologi Lingkungan Journal. 5(2) : 33-39

xxvi. Susanto, D.,T. U. Kalsum,andY. H. Suzantri. 2014. Dirty Water Filtration Tool To Clean Water Using the Atmega 32 Microcontroller.MediaInfotamaJournal. Vol.10No.2, September2014.

xxvii. Wiwoho. 2005. Model Identification of River Containment Capacity with QUAL2E. Thesis. Diponegoro University. Semarang

xxviii. Wattayakorn, G. 1988. Nutrient cycling in estuarine. Paper presented in the Project on Research and its Application to Management of the Mangrove of Asia and Pasific, Ranong., Thailand, 17 pp