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Automatic Peat Water Treatment Method with Electrocoagulation and Salt Addition Techniques to Improve Chemical Quality to Drinking Water

Hari Rudijanto Indro Wardono[1],Tri Cahyono[2], Nur Hilal[3], Kalasta Ayunda Putri[4]

[1]Universitas Negeri Semarang, Indonesia

[2,3,4]Health Polytechnic of the Ministry of Health Semarang, Indonesia
*Corresponding Author: harirudijantoiw@students.unnes.ac.id

Abstrak. Good drinking water must meet the requirements of one of which is chemical parameters, namely iron. This research was conducted to support government programs in the development of the health sector and the achievement of MDGs targets, especially those related to improving drinking water treatment facilities and peat water treatment equipment that is easy to move. The study was conducted by a pre-experimental method, a one-group pretest-posttest approach. Sampling points are carried out in the initial reservoir and the final bath of the processing results. Replication is carried out three times at the use of voltages of 9 volts, 12 volts, and 15 volts. Manufacture of 4% saline solution as a coagulant material. Making artificial peat water with raw materials from Ngasinan village, Bawen District, Semarang Regency. Statistical analysis using the Anova test. Shows that used voltage of 9 volts on average can reduce iron levels by 100%, 12 volts by 90.80%, and at 15 volts by 90.57%. Complying with the requirements of the Minister of Health of the Republic of Indonesia Number 492 / Menkes / Per / IV / 2010 concerning Drinking Water Quality Requirements for iron content is 0.3 mg / lt. The difference in electrical voltage values does not have a significant effect on the decrease in iron content. It is necessary to make improvements to the research likes construction / position of the anode and cathode, the placement and protection of the sensor, tools used of the duration of sedimentation time (3 hours). using actual peat water, media cartridge for filtration.

Key words : Electrocoagulation, salt, iron

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INTRODUCTION

Water is a basic human need (Lavianiga et al., 2019), where seventy percent of the human body consists of water (Amalina, 2018). Water is also a type of resource needed to support the implementation of various household and industrial activities, both as production raw materials, cleaning materials, and coolers (Negara, 2004). Two of the eight Sustainable Development Goals (SDGs) state that by 2030 universal and equitable access to safe, quality and affordable drinking water for all can be achieved. The SDGs target goal Target 6.1 is 100% universal and equitable access to safe and affordable drinking water for all (Yekti, 2020).

To produce clean water, facilities are needed to produce clean water and also meet the requirements of the Indonesian Minister of Health Regulation No.492 / MENKES / PER / IV / 2010. The problem faced by humans to get clean water is the existence of clean water sources that are difficult to obtain and raw water sources are available but are not yet suitable for clean water, one of which is peat water. Peat water is a source of raw water that can be processed into clean water (Rasidah et al, 2017). In principle, peat water is groundwater or surface water that is found in many tidal, marshy and lowland areas, brownish-red in color, acidic pH and high organic content (Amalina, 2018). The characteristic of peat water is a pH below 7 (acid), high Fe content, color, high turbidity (Amalina, 2018).

Electrocoagulation is one of the alternative drinking water treatment techniques, especially to replace coagulation and flocculation techniques commonly used in conventional processing, to reduce the concentration of materials organic and an organic pollutant in water (Alaska Department of Environmental Conservation, 2015). There have been many studies conducted related to peat water treatment techniques into clean water and drinking water, especially those using electrocoagulation techniques, including research conducted by Flisia Elsa Lavianiga et al (2019) (Lavianiga et al., 2019), which gave results that peat water treatment with electrocoagulation techniques with the addition of salt 3 grams per 1 liter samples, at a pressure of 30 volts and a contact time of 240 minutes, can produce water that meets the requirements for clean water quality according to the Minister of Health of the Republic of Indonesia No. 32 of 2017, and research conducted by Adam Fadillah et al (2018) (Adam et al., 2018), which gives the result that peat water treatment with electrocoagulation techniques is continuously, with a voltage of 24 volts at a flow rate of 4 lpm, resulted in a decrease in Fe of 89 % from 2.909 mg / L to 0.322 mg / L and Mn of 92% from 0.232 mg / L to 0.019 mg / L.

The results of this study are in the form of peat water treatment equipment that can be moved from one location to another (*mobile*), so it is hoped that it will be used as a mini IPAM to meet the needs of households and the general public. It is also hoped that this research can support efforts to achieve sustainable development targets (SDGs), especially in the field of meeting the need for drinking water for the community, in Indonesia.

METHODS

This type of research is a *pre-experimental* study, with *a one group pretest- posttest* approach. The population in this study is the entire peat water that will be treated or will not be treated with electrocoagulation devices, salt addition, flocculation, sedimentation, multi-media filtration and disinfection with automatic ultra violet light in this study. Sampling points are carried out in the initial reservoir and the final bath of the processing results. Replication is carried out three times at the use of voltages of 9 volts, 12 volts and 15 volts (Kurniawan et al, 2014). Manufacture of 4% saline solution as a coagulant material in the electrocoagulation process. Making artificial peat water with raw materials from Ngasinan village, Bawen District, Semarang Regency and dug wells in Piken Village, Kembaran District, Banyumas Regency with a Fe level of 4.87 mg / lt.

The free variables are peat water treatment devices, the free variables are Fe levels. The control variables are voltages of 9 volts, 12 volts and 15 volts, salt content of 4%, arrangement of dual filter media, flow discharge, continuous flow type. Intervening variables include coagulation-flocculation processes, sedimentation, filtration and automatic disinfection. The moderator variable in this study is the composition of pollutants in water.

In this study, the instrument or tool used The research instrument used is in the form of a peat water treatment tool consisting of an electrocoagulation bath, flocculation, sedimentation, multi-media filtration bath, disinfection tube with ultra violet light, system of edification and microcontrol. Components supporting the operation of the treatment equipment (NaCl) salt solution basins, water tanks, water pumps, electrical power sources and piping systems) (Alaska Department of Environmental Conservation, 2015). Data analysis was carried out descriptively analytically by comparing water quality data (iron content) of treated water with untreated water and statistical analysis was carried out using the ova test.

RESULTS AND DISCUSSION

Peat water treatment equipment into drinking water with electrocoagulation system, double media stimulation and UV light disinfection.

The tool consists of components

Raw water/peat water storage tank with a capacity of 1,000 liters

Electrocoagulation tank capacity 400 liters

Double media filtration tub

Ultra violet light disinfection tube

Product water storage tank capacity 400 liters

2 (two) water pumps

Piping system

Wiring system

pH and turbidity sensors

Mikrokontrol program

Figure 1. Peat water treatment equipment into drinking water with electrocoagulation system, double media fltration and UV light disinfection

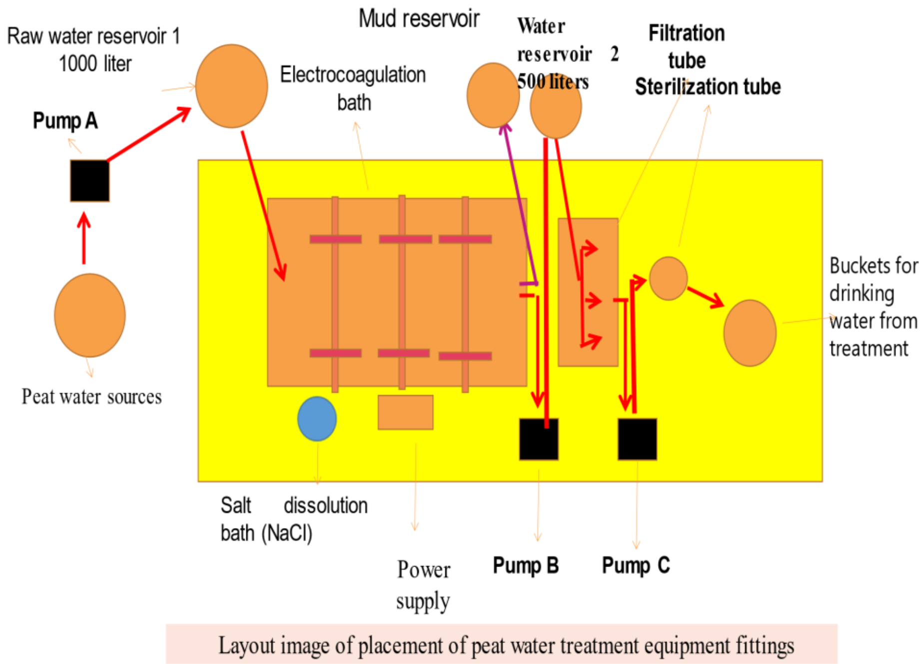

Figure 2. Layout Image of Placment of Peat Water Treatment Equipment Fitting

Fe (Iron Content)

Table 1. Percentage of decrease in Fe content from fe content of raw water to fe content of product water in experiments using voltages of 9 volts, 12 volts, and 15 volts

Voltage (Volts)	Replication	Level of Fe		Percentage of subduction of Fe levels (%)	Fulfillment of thd provisions of the Minister of Health of the Republic of Indonesia No.492/MENKES/PER/IV/2010
		raw water	product water		
9	1	0.91	0	100.00	Meet
	2	0.41	0,05	87.80	Meet
	3	1.36	0	100.00	Meet
	Average	1.135	0	100.00	Meet
12	1	0.25	0,06	76.00	Meet
	2	0.16	0,03	81.25	Meet

	3	0.62	0.02	96.77	Meet
	Average	0.435	0.04	90.80	Meet
15	1	0.58	0.05	91.38	Meet
	2	0.95	0.04	95.79	Meet
	3	0.48	0.05	89.58	Meet
	Average	0.53	0.05	90.57	Meet
Average				93.79	

Note : The standard fe level in drinking water according to the Minister of Health of the Republic of Indonesia No. 492 / MENKES / PER / IV / 2010 the maximum allowed is 0.3 mg / l.

Based on the data listed in table 1. the above can be seen that the use of an electrical voltage of 9 volts on average can reduce the fe content of water by 100%, in the use of 12 volts voltage by 90.80%, and at 15 volts voltage by 90.57%. This data can also be known that in the use of the lowest voltage (9 volts), it can reduce the Fe content in the highest percentage as well, which is 100% (Kristianto & Setiawan, 2012). Based on nine replication experiments, all of them (100%) were able to produce product water that met the standard provisions of the Minister of Health of the Republic of Indonesia No.492 / MENKES / PER / IV / 2010 for the fe content parameter of drinking water (Permenkes RI, 2010).

Effect of Voltage on Decreasing Fe Levels

Table 2. The results of the one-way Anova analysis influence voltage on the decrease in Fe levels

ANOVA

	Vo influence Sum of Squares	ltase against df	Fe Drop Mean Square	F	Itself.
Between Groups	200.667	2	100.333	1.685	.263
Within Groups	357.333	6	59.556		
Total	558.000	8			

Based on table 2. we can know the magnitude of the value of Sig. = 0.263 > 0.05 so that Ho is rejected, or in other words it can be concluded that there is no significant influence of the magnitude of the value of the electrical voltage used on the decrease in fe levels.

Statistical test analysis was not significant because the data on the results of the decrease in iron levels were not uniform in the sense that there was a decrease in the cadaver of iron in the product water showing figures of 0.0 mg / liter and 0.02 - 0.06 mg / liter, although it still met the iron content requirements.

The electrocoagulation method for the deposition process does not use coagulants, but uses an electrochemical process, in which in this process a redox reaction will occur, where the reduced metals are deposited at the negative electrode, while at the positive electrode there will be an oxidation reaction. The addition of salt (NaCl) is carried out to increase the efficiency of coagulation. Iron in water is ferrous and ferrous , some are dissolved and settle in water. Because the iron element in water is a metal, it will react in a redox system.

Ferro iron (fe^{++}) is a form of dissolved &invisible compound that can be in the well water at the reservoir water which is under anaerobic conditions. When in contact with air, this shape will turn into ferri iron (fe+++) yang insoluble and visible .

$$4\ Fe^{2+} + O_2 + 10\ H_2O \text{ ====> } 4\ Fe(OH)^3 + 8\ H^+$$

Insoluble dissolved

CONCLUSIONS AND SUGGESTIONS

Conclusion

Automatic peat water treatment equipment with electrocoagulation techniques and salt addition with electrical voltages of 9 volts, 12 volts, and 15 volts, in general is able to reducing the Fe content as high as 93.79%. The high value of electrical voltage does not have a significant effect on the the decrease in Fe content.

Suggestion

It is necessary to make improvements to the research tools used, especially in: (1) the construction / position of the anode and cathode used for electrocoagulation, (2) the piping system so that there is no leakage, (3) the placement and protection of the sensor, and (4) the increase in the number of UV light lamp units.

Needs to improve the setting of the duration of sedimentation time in the electrocoagulation tank after completion of the process electrocoagulation (3 hours). using actual peat water, media cartridge for filtration.

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