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The Pulse Electromagnetic Fields Effect on pH and Heavy Metal of Water

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Abstract. Currently, the mining areas such as on the islands of Bangka Belitung, still using water from the lake former quarry. Water is a raw material in obtaining the local drinking water supply. The lake water is processed by chemistry and biology before being distributed to the public. In fact the former mining lake water has a heavy metal content are still relatively high. In the area of Bangka Belitung who is the producer of tin, river and lake water is still contaminated by heavy metals that are harmful to living creatures. It can not be parsed directly by microorganisms naturally and even requires a relatively long time to process them. Processing by using electromagnetic resonance is one of the alternative processing to eliminate the heavy metals. Electromagnetic resonance or in this research is called EWT (Electromagnetic Water Treatment) that is a cylindrical pipe on the outside of the coil windings consists of eight electromagnetic field strength of 9.1 mT. The advantage of this method has the high efficiency, has no lead to new compounds and has cleaner technologies. The use of electromagnetic resonance technology can be seen from the pH value in the test with the former quarry lake water. The testing resulted in a pH value of 4.54 becomes 5.31 at a flow rate of 16.2 l / m with a volume of 20 liters. It is circulated through the EWT for 20 hours. EWT is also able to reduce heavy metals by 42-91% with the largest reduction to the lowest copper and lead.

Keywords: pH, reduction, heavy metal, kolong water, mining, Electromagnetic.

1. Introduction

Availability of access to clean water is an important issue for developing countries, especially in Indonesia. Various life processes can not take place completely, without the availability of access to clean water, so the water supply for domestic, irrigation and industrial concern and priority. Indonesia has 2,838 km^3 surface water (renewable) and 455 km^3 groundwater. The using of water nationwide about 80 billion m^3 /year with the highest utilization rate in Java and Bali about 60%, with the purpose of its use, especially for drinking, domestic, municipal, industrial, agricultural, and others. From the data on water balance in 2003 can be seen that the need for water during the dry season in Java and Bali, which amounted to 38.4 billion cubic meters, only about 25.3 billion cubic fulfilled or only about 66 percent. This deficit is expected to be higher in 2020, where the number of population and economic activity increased significantly [1]. Indonesia was noted to have the water resources of 3.22 trillion cubic meters per year, equivalent to the per capita water availability of 16,800 cubic meters per year. When the rainy season comes, for example, water overflowing from far away. The problem, Indonesia is less clever in managing water. So do not be surprised if every year, in various media news emerged about the problems of drought [2].

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Bangka Belitung is a newly formed province in 2000. Bangka Belitung is the largest tin-producing region that is growing and much in demand by the mining industry and tourism in Indonesia. The mining industry is now given authority to explore the tin mines namely PT. Timah Tbk. The needs of the Bangka-Belitung Islands community for clean water that is free of heavy metals in accordance with the quality standards of clean water and drinking water are enormous, considering the source of their water comes mostly from the lake ex-mine. As well as in the industrial world the availability of clean water is also urgently needed, especially as feed water to the boiler. Unconventional tin mining activities in Bangka Island lately of growing concern. Along with the construction of the smelter (processing plant into a tin beam) also increased very sharply. Their smelter posed a great threat environmental pollution. This is because the new smelters are less consider side of the environment. Damage caused by illegal mining activities are easily found, such as in the Belinyu District. Mining activities also cause damage to river ecosystems and habitats in it [3]. The main objective of this research activity is to optimize the utilization of the former mining lake through the processing of the former mine water treatment with the use of Electromagnetic Resonance as the development of methods for water quality improvement in physical-chemical that can be used by industry and society. Optimizing were observed the increase on the pH value of the *kolong* water sample so that the solution is expected to boost economic growth based on the efficient use of water resources and energy, and reduce the waste due to the use of chemicals in the water treatment process.

2. Literature Review

Presence of *kolong* water of the former tin mining in Bangka-Belitung remains an interesting phenomenon, especially as the region's largest tin producer in Indonesia. The *kolong* water is a source of raw water in Bangka Belitung. Bangka Belitung island communities currently use water taps are derived former mine as a source of clean water. Water under physically-chemically treated before being distributed to the public. The depth of the *kolong* water varied from one to 21 meters, but the depth is generally under more than five meters. Extensive mining under 2,488 hectares, compared with an area of 1,169,354 hectares of Bangka Island, then this has changed under 0.2% of the land into a water. As mines excavation, *kolong* water in the region has a degree of low acidity (pH) and the concentration of heavy metals, such as ferrum (Fe), aluminum (Al), plumbum (Pb) and manganese (Mn) is quite high [4].

Several studies have been conducted with regard to the influence of the mining area to the daily life of the community around them by [5]. Padmanabha et al has an analysis Provides evidence of the negative effects of mining activities on local communities in the Ib Valley coal mining region in the Jharsuguda district of Odisha. Reviews These activities have adversely affected agriculture and human health. Michael Hendryx [6] has observations and recommendation that the evidence on the public health impacts of surface coal mining. Environmental evidence has shown that surface waters and biota are harmed by mountaintop removal, while other studies have shown environmental water and air pollution exist in residential areas close to mining.

Water resources on the island of Bangka-Belitung emerging but has not been utilized properly due to low pH conditions and still contain hazardous heavy metals. Bangka-Belitung Islands community needs for clean water that is free of heavy metals and in accordance with the quality standards of clean water and drinking water are enormous, considering the source of their water comes mostly from the former mining lakes or also called *kolong* water. From the results of studies that have been carried out, *kolong* water on the island of Bangka-Belitung is divided into two, namely the young and the old *kolong*. In a study [7], the form of the targets under the dimensional aspect that is the determination of dimension to find out how much and how vast *kolong* contained in Bangka-Belitung post-mining activities as well as followup conditions affecting the availability of the *kolong*. The young *kolong* generally has a pH <5 and partially *kolong* has a pH <3 with an elevation of heavy metals such as Fe, Zn, Pb, Al and As above the drinking water quality standard or for class I (PPLH). Old *kolong* is under aged> 20 years and have better water quality than the young *kolong*, however, some old *kolong* studied previous research had poor water quality. This depends on the type of geologic material which predominates in the kolong area is also pollution caused by mining inconventional activities. *Kolong* containing pyrite (FeS), which has a high range of pH = 2.5 to young *kolong* and pH = 4.5 highest for the old *kolong*[8]. Whereas the old *kolong* contaminated TI activities in addition to having a low

pH, contain high solids also contain heavy metals. Under the former generally surrounded by land mines so very poor critical nutrients. Ecological *kolong* improvement require a very long time, while people continue to need a source of clean water for daily life. It will require a technology that can improve water quality physicochemical using Electromagnetic Resonance (EMR). The prototype for generating EMR called the EWT which consists of a cylindrical pipe which on the outside comprises 8 electromagnetic coil windings with a field strength of 9.1 mT.

Research on water quality improvement using Electromagnetic Resonance method has done a lot of them by [9]. In the study, Ran Cai et al explain that the use of magnetic fields can alter the properties of water and affect water molecules. In addition, the magnetization of water caused by the displacement of protons in hydrogen bonding chain closed can affect water molecules and change the energy of the molecule. While Lucyna Holysz, et al [10] explained that a magnetic field can also affect the amount of water that evaporates along with the conductivity of a solution of KCl, NaCl, Na_3PO_4, and $CaCl_2$.

3. Method

To perform the test made plans execution method as shown in Fig. 1.

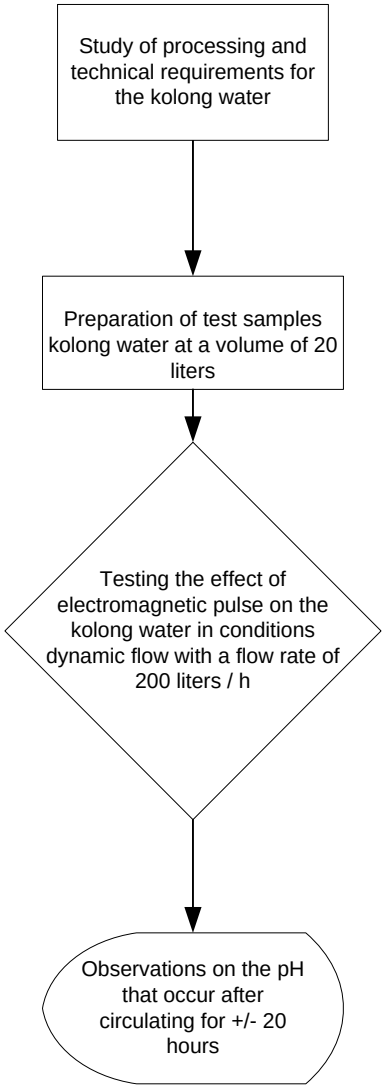


Fig. 1: The test method.

This experiment is to observe changes in the pH value of the *kolong* water sampling with a volume of 20 liters. Sampling of *kolong* water performed at *Kolong* Menjelang 2 in District Munthok Bangka Barat.

Kolong water Menjelang 2 is used as a raw water PDAM Tirta Dharma to meet the water needs of 45,000 ± population. Because the sampling pH is highly acidic, then the water pH adjustment to pH of ± 4.5 before testing. Testing is circulated in the EWT which generates a pulse electromagnetic field of 9.1 mT for

20 hours. The testing process is within the dynamic flow at a flow rate of 16.2 liters / h and observed using a pH meter. Prototype testing is shown in Figure 2.

Fig. 2: EWT Prototype.

4. Discussion

Towards the second pit water is under the medium, which is used for the source of water for PDAM Tirta Dharma after water under Towards this vault 1. Water is mixed with water coming from the mountains Menumbing with a certain ratio in order to achieve the desired characteristics of the raw water by PDAM Tirta Dharma. PDAM's raw water is treated physically-chemical through coarse filters, coagulation, flocculation, sedimentation, filtration and chlorination eventually.

Results of testing the effect of pulse electromagnetic field on the pH value of the water used mine a volume of 20 liters with a flow rate of 16.2 l / m are shown in Table I.

Table I: The test result of the effect of pH value of the water used mines against the electromagnetic field pulses using EWT

pH of water vol. 20 liters with a flow rate of 16.2 l/m for 20 hours	
t (hour)	**pH**
1	4,84
2	5,04
3	5,06
4	5,06
5	5,06
6	5,06
7	5,06
8	5,07
9	5,09
10	5,11
11	5,12
12	5,14
13	5,16
14	5,17
15	5,18
16	5,19

17	5,20
18	5,22
19	5,23
20	5,25

While the data graph is shown in Fig. 3 as follows

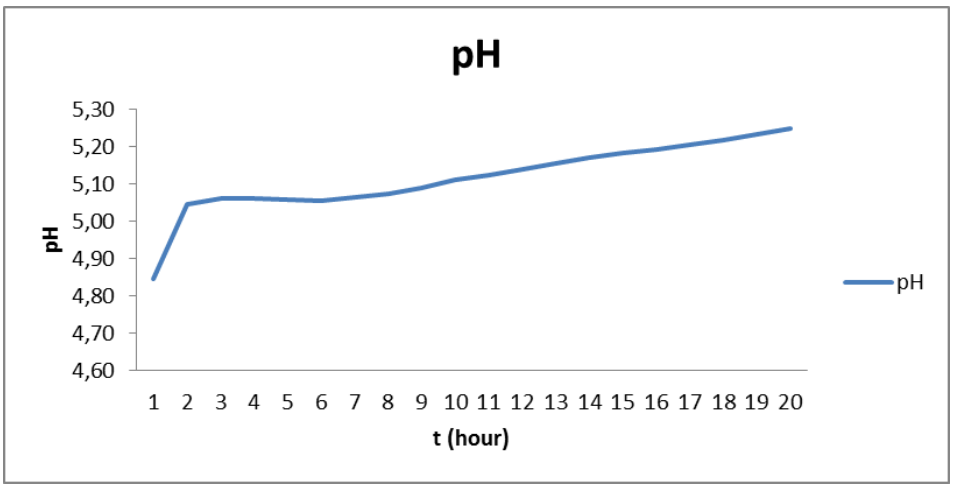
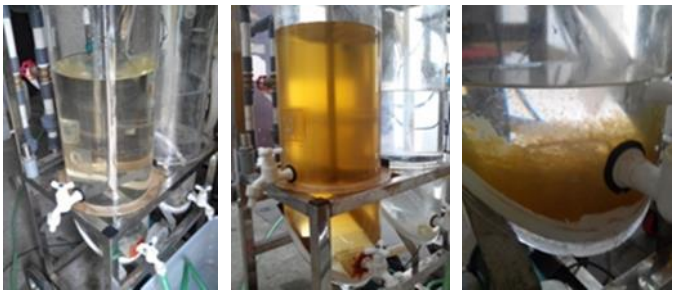


Fig. 3: The observations under the water pH using EWT with circulation for ±20 hours

Testing with observations on parameters showed that pH using EWT EWT able to raise the pH value. Based on the understanding of acid-base according to Arrhenius along with its properties, an acidic compound in water because of the H + ions. As an alkaline compound in the water if there OH- ions. pH stands for hydrogen rank or power of hydrogen. pH express the concentration of H + ions in solution. An acidic substances in put in the water will result in an increase in hydrogen ions (H +) in water and fewer hydroxide ions (OH-). While at the base, the opposite will happen. Alkaline substances are put in the water will result in increase of hydroxide ions (OH-) and reduction of hydrogen ions (H +). The number of H + and OH- ions in the water can be used to determine the degree of acidity or alkalinity of a substance. The more acidic a substance, the more H + ions and the less OH- ions in the water. Instead more alkaline a substance is, the fewer the number of H + ions and the more OH- ions in the water so EWT is able to reduce the number of H + ions in water through electromagnetic properties. Figure 4 shows the sample under the water that has been processed using EWT. Sample initially clear, it looks dark and after settling for 15 precipitates a brown colored. The precipitate is then separated and the filtrate was analyzed with the results as presented in Table II. From the 7 parameters of heavy metal mixed with EWT compared with the characterization of water visible all parameters of contamination is reduced and only Pb concentrations will be seen rising. A decrease in the concentration of these pollutants varies from 42-91% with the greatest reduction to the lowest copper and lead contamination.

Table II. Results of Analysis of Water Quality Kolong after being processed through EWT

NO	PARAMETER	UNIT	RESULT	QUALITY STANDARDS
1	Barium (Ba)	mg/l	< 0,005	1
2	Ferrum (Fe)	mg/l	2,9	0,3
3	Mangan (Mn)	mg/l	0,11	0,1
4	Zink (Zn)	mg/l	22,76	5
5	Cuprum (Cu)	mg/l	0,21	1,0
6	Cadmium (Cd)	mg/l	<0,004	0,005
7	Plumbum (Pb)	mg/l	2,92	0,05



(a) (b)

Fig. 4: Kolong water before processed by the EWT (a) and after (b)

Although there has been a reduction of heavy metal concentrations, but some contamination is still above the parameters of quality standards set, such as iron, zinc, and lead. Metal beratterdapat naturally at any place on earth, in all the geological layers and all bodies of water. Presence of heavy metals also come from human activities. Heavy metals are rarely encountered in a free state, but rather in a state of the compound. The presence of heavy metals in a certain amount is needed by the body such as Zn, Cu, Fe and Mn, while the heavy metals Pb are highly toxic.

5. Conclusion

The conclusion that can be drawn from this paper is the electromagnetic properties EWT able to influence the acidity of the water used underneath becomes alkaline. This can be seen in changes in the acidity of the former mine water from the pH value of 4.84 to 5.25. The observation was made by the former mine water circulating through the EWT with a flow rate of 16.2 l / m. The changes are due to the interaction of H + ions to the electromagnetic force causing loss of balance and cause the H- ion was dominant. While the reduction of heavy metals in the water used to mine for 42 – 91% with the largest reduction to the lowest copper and lead. After processing, seen many colloidal still afloat and thus require another operation unit to help precipitate the colloids.

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