Ozone Technology for Domestic Water Consumption Supply in Puri Sartika Housing, Gunungpati, Semarang, Indonesia

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Abstract: Data from Center for Statistics of Indonesia (BPS), Gunungpati Semarang become one of developed areas with 5,399,085 Ha and 70,901 total population or 20,605 households. The large number of population come up a problem especially on water supply for domestic needs. Preliminary research showed that the quality of water on this area is not suitable for consumption on in the other words the minimum standard of good quality water does not meet. The condition happened because of using water directly from underground that has contaminated by some sediments and dangerous compound, and it worried for long term, people will suffer from health problems from using the water. This research developed from the community engagement activities in Puri Sartika Housing, Gunungpati, Semarang, Indonesia. With the implementation of this research, it is expected to be able to provide knowledge about efforts to improve water quality in the area into consumption-worthy water. Thus, it is hoped that we can be able to apply the ozone technology to improve water quality in Puri Sartika Housing. From the results checked in PDAM Tirta Moedal Semarang, the physical and chemical water quality of the ozonated water has a reduction in the water content of the elements which are used as parameters for the feasibility of consumption water. Physically, the turbidity of the water after ozonation shows a very different color clarity. The color and turbidity of water before ozonation were 22 TCU and 5.05 NTU. Then, The color and turbidity of water after ozonation were 11 TCU and 2.92 NTU. From these results it can be concluded that, ozonated water is worthy of being water that is suitable for public consumption.

1 INTRODUCTION

Semarang City has an area of 373.70 km^2. Administratively City Semarang is divided into 16 sub-districts and 177 sub-districts. Of the 16 sub-districts that exist, there are 2 subdistricts that have the widest area, namely Mijen Subdistrict, with an area of 57.55 km^2 and Gunungpati Subdistrict. According to the 2016 Statistical Agency Data, geographically Gunung Pati has an area of 54.11 km^2. The topography of this area is in the form of medium and high plains, while the sub-districts with the smallest area are South Semarang Subdistrict, with an area of 5.93 km^2 followed by the District of Central Semarang, with an area of 6.14 km^2.

Puri Sartika Housing is one of the settlements located in the Gunung Pati Sub-district, Semarang City. Gunungpati Subdistrict is located in the southern part of Semarang City, directly adjacent to Ungaran. From the center of Semarang, the distance is around 17 km. Gunungpati Subdistrict is a city development area which has an area of 5,399,085 Ha. The Gunungpati region was occupied ihills with an altitude of 300 meters above sea level. One of them is Puri Sartika Housing. Population increase makes the need for drinking water even greater. Water supply is obtained from the Kretek Wesi river which is used for the daily needs of the Gunung Pati community, including Puri Sartika Housing. Distribution of the amount of water in Puri Sartika Housing is approximately $3m^3$/Neighborhood

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Table 1: Advantages and disadvantages of water purification methods.

Disinfecta	*Advantages*	*Disadvantages*	*Used*
Chlorine gas	It is very effective for removing almost all microbial pathogens and is appropriate as both pre-oxidant and disinfectant	It is a dangerous gas that is lethal at concentrations as low as 0.1 percent air by volume	Chlorine gas is employed as liquid solution
Chlorine dioxide	It is effective at low concentrations-dosages and is appropriate as both pre-oxidant and disinfectant	It is highly instable, thus, it requires to be produced *in situ*. It is characterized by a low redox potential	Chlorine dioxide is employed as liquid solution
Ozone	It requires shorter contact time and dosage than chlorine. It has the highest redox potential among all the disinfectants	Ozone gas is highly unstable and must be generated onsite. It does not guarantee adequate residual protection to water along the distribution system	Ozone is employed as gas
UV light	It effectively destroys bacteria and viruses, and requires short contact times	It may not inactivate *Giardia lamblia* or *Cryptosporidium* cysts. It does not guarantee adequate residual protection to water along the distribution system	Radiation

Association. Water drainage uses a rotating system at certain hours. Each neighborhood pillar will be drained from the storage reservoir, using pipes that flow to each house.

The problems that exist in this region are the condition of well water that is not clear, and is not suitable for consumption. In the Figure 1. can be seen the water in Puri Sartike Housing. The water was so dirty. This can be seen from the turbid color of the water and containing brown mud and high lime content. With the condition of the water contained a lot of mud that settles in the bottom of a tub like this, people can only use it for bathing and washing purposes. Therefore, we need a technology that can be used to improve the water quality chemically physically to be consumed.

Figure 1: Water Resources in Puri Sartika Housing.

There were several technology used for water treatment or water purification. Those technology were ozone (Wulansarie, 2015; Coward, et.al., 2018), UV light (Wulansarie, 2015; Coward, et.al., 2018), chlorine (Sorlini, et.al, 2015). Each technology has advantages and disadvantage. Those can be seen in Table 1. (Sorlini, et.al, 2015).

Based on Table 1, water purification technology applied in this research was ozone technology. There were several research about ozone. Ozone was applied in treatment of Vibrio sp. Bacteria (Wulansarie, 2018). Ozone is a gas molecule consisting of three oxygen atoms which can be produced by UV Light and Corona Discharge (Wulansarie, 2015). So, in this research ozone technology applied in water purification of Puri Sartika Housing.

2 METHODOLOGY

In this research ozone technology was applied in water purification. The sample was water from Puri Sartika Housing. Ozone generator used in this research had 0.0325 g/hour concentration. The research was carried out in pH=7.41 and room temperature. The flow rate of sample used in this research was 2 L/minute. The ozonation process was performed in continuous system. The system for this research can be seen in this Figure 2. below.

Figure 2: Ozone technology system in water purification.

In the system in Figure 2., the water entered in to filter 1, filter 2, ozone generator, and the last in to clean water tank. The gas from ozone generator passed to the flow for the water purification and then was recycled to the tank and the process run continuously. The sample was taken in 30th minutes base on the optimum time disinfection of ozone (Wulansarie, 2018). The output from clean water tank was analyzed in Clean Water Company (PDAM) Tirta Moedal Semarang.

3 RESULTS AND DISCUSSION

The result of this research can be seen in Figure 3. In Figure 3 can be seen the effect of ozone technology in water purification of Puri Sartika Housing. Physically, the difference between sample a (before purification) and sample (after purification) was very clearly. The sample a was rather muddy and the sample b was clear or transparent. Physically, we could say that the sample b (after purification process) was better than sample a (before purification process).

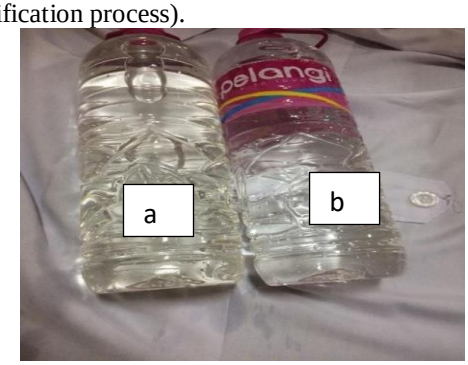

Figure 3: a. Water sample before purification, b. Water sample after purification.

The physical and chemical data for sample before and after purification process could be seen in Table 2 below. From Table 2 could be seen difference in physical and chemical properties between sample before and after purification.

Table 2: Physical and Chemical Properties of sample (before and after water purification process).

No	Properties	Unit	Before Purification	After Purification
Physical				
1	Color	TCU	22	11
2	Turbidity	NTU	5.05	2.92
Chemical				
3	Hardness	mg/L	167.04	134.56
4	Alkalinity	mg/L	171	191

From Table 2. could be seen that the sample after purification process was better than the sample before purification process. In this research, ozone was carried in neutral condition (pH=7.41). According Peratitus (2003) there are three ozonation; direct ozonation (in acid condition/pH<4), ozonation by ozone and OH radical (in pH= 4 – 9), and ozonation by OH radical (p>9). So, in this research was direct and indirect ozonation. According to Manley and Niegowski (1967), ozonation by OH radical is more powerfull rather than ozonation by ozone. Ozone could act as a disinfectant against pathogens, reducing taste and odor and the ability to oxidize compounds (Suslow, 2004) which suitable with the research.

4 CONCLUSION

Base on this research could be concluded that ozone technology can be applied in Puri Sartika Housing water purification process.

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