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Analysis of Physical and Chemical Quality of PDAM Water in Teluk Ambon Baguala Sub-District

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Abstract: A study has been carried out on the analysis of the physical and chemical quality of PDAM water in the Teluk Ambon Baguala sub-district. The purpose of this study was to analyze the physical and chemical quality of water from the Regional Drinking Water Company (PDAM) in Halong, Lateri, and Passo villages, including smell, taste, color, temperature, a total of dissolved solids (TDS), pH and hardness. The method used is the observation in the field at the time of sampling, then measurement and analysis in the laboratory. The results of the study indicate that the physical and chemical quality of PDAM water in the Teluk Ambon Baguala sub-district, which are smell, taste, color, total of dissolved solids (TDS), pH and hardness have met the drinking water quality standards according to the Regulation of the Minister of Health No. 492/Menkes/per/IV/2010.

Keywords: PDAM water quality; Physics; Chemistry

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Introduction

Water is a very vital need for human life and living things in general. The availability of water on earth is always constant, meaning that it does not increase or decrease because water undergoes a hydrological cycle. Although the amount of water on earth on earth is always constant, the quality of water changes along with the growth in population and human activities (Alihar, 2018). Good water quality includes physical, chemical, and biological quality tests so that when consumed it does not cause side effects for health (Rosyidah, 2017).

Isworo et al., (2017) stated that the water quality measurement are included physical, chemical and microbiological parameters that should meet standard of health and environment requirements. According to the Regulation of the Minister of Health No. 492/Menkes/per/IV/2010 regarding the requirements and supervision of water quality, in terms of physical and chemical parameters, good water has no taste, no smell and no color, and is not harmful to health (Sahrijanna & Sahabuddin, 2014). The pH of the water should be neither acidic nor alkaline but neutral to prevent the dissolution of heavy metals and corrosion of the distribution pipeline. The recommended pH for clean water is 6.5-8.5. Clean water is usually not aesthetically pleasing (Rohmawati et al., 2018). The smell of the water will give an indication of the quality of the water. Taste of clean water is usually tasteless or bland. Tasted water indicates the presence of various substances that can be danger to health (Ayuniar & Hidayat, 2018).

Water should be colorless for aesthetic reasons and to prevent contamination from various colored chemicals and microorganisms (Loan et al., 2013). For clean water standards, the dye is expected to be as high as 50 TCU and for drinking water standards, the maximum dye content is 15 TCU (Siburian et al., 2019).

For turbidity, water is said to be cloudy if it contains so many suspended particles of material that gives a

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muddy and dirty color or appearance. The level of turbidity of water can be known through laboratory examination using a Turbidimeter. For clean water standards, the maximum permissible turbidity is 25 NTU and 5 NTU for drinking water standards (Pratama et al., 2016). Temperature of water should be about 10-25 ˚C (in tropical climate) so that there is less dissolution of chemicals from the pipeline system that can be danger to health. The total of dissolved solids (TDS) usually consists of organic substances, inorganic salts, and dissolved gases. If the TDS increases, the hardness of water will also increase (Devesa & Dietrich, 2018). Furthermore, the effect of TDS or hardness on health depends on the chemical causing the problem (Islam et al., 2017).

The definition of drinking water in the Regulation of the Minister of Health No. 492/Menkes/per/IV/2010 concerning the requirements for monitoring the quality of drinking water is that it can go through a processing step or without any processing that still meets the applicable provisions and can be drunk directly (Ujianti et al., 2018). The availability of clean water is very much needed by the community to meet their daily needs (Yusal & Hasyim, 2022), that is why the existence of PDAM is important to help the community. PDAM is a regional drinking water company managed by government which aims to meet the needs of water in the community for their daily activities.

The previous research showed that based on the analysis of physical conditions (smell, color, taste, turbidity, TDS) were good, while the initial pH and water temperature did not meet the drinking water quality standards according to PERMENKES No.492/Menkes/per/IV/2010. If the acidic water is consumed continuously, it will cause stomach pain and indigestion (Gusril, 2010). Analyzing river water quality using a pollution index based on government regulations is important to give good information and better management. For example, Haeruddin et al., (2019) have conducted research on river quality in Central Java and showed that the heavy metal contamination had exceeded the Government Regulation standard meaning that the river is polluted so that better treatment for prevention and recovery can be taken. Therefore, the river must be managed comprehensively for sustainable use to create one river one management concept (Haeruddin et al., 2019).

In this research, the analysis of the physical and chemical quality of PDAM water in Teluk Ambon Baguala sub-district have been carried out, especially in the location of Halong, Lateri and Passo villages. This analysis includes physical properties (temperature, total of dissolved solids (TDS), odor, taste, and color) and chemistry properties (pH and hardness). And in the continuing research, the overall quality of PDAM drinking water will be tested in more location, cover chemical and biological properties.

Method

The research method used is sampling in the field and tested in the laboratory. The research will be carried out through the following stages: (1) Preparation and sampling of PDAM water at PDAM water sources in Halong, Lateri and Passo villages. (2) Determination of physical and chemical parameters of water samples: odor, taste, color, temperature, TDS, pH and hardness.

Materials and tools

The materials used in this research are: Water samples from PDAM Teluk Ambon Baguala, ammonium hydroxide (NH_4OH), p.a (E.Merck), magnesium EDTA p.a (E. Merck), eriochrome Black T (EBT) p.a (E.Merck), hydrochloric acid (HCl) p.a (E.Merck), calcium carbonate ($CaCO_3$) buffer solution p.a (E.Merck), isopropyl alcohol p.a (E.Merck), hydroxamine hydrochloride p.a (E.Merck). The tools used in the research are laboratory glassware (Pyrex), sample bottle, thermometer scale 100 ˚C, pH meter, TDS meter, analytical balance.

Procedures

1) Sample collection

Sampling is collected from three locations of water sources, namely Wainitu Ambon water, carried out at the suction point of the PDAM pipe with the basis of research only focusing on water used for PDAM, water taken at the PDAM water treatment installation is carried out directly from its sources. And samples collected from taps of PDAM customers' houses within some distance range.

2) Sample Preparation (Laboratory Test)

Research parameters. (1) Smell, taste, and color inspection. Physically, samples of PDAM drinking water at the three location points can be smelled, tasted, and seen the color of the sample directly. (2) Determination of Temperature (˚C). (3) The PDAM drinking water sample is poured into a sample bottle, then a thermometer was dipped into the water sample. After 2-3 minutes, read the thermometer scale and record the temperature. (4) Determination of TDS. PDAM drinking water samples taken at the three locations were put in sample bottles and brought to the laboratory. Then the sample in the sample bottle was poured out into a beaker. Dip the part of the TDS instrument that has the iron part into the sample to be measured. After the part of instrument was immersed in the sample, the TDS meter will automatically start calculating the dissolved solids content in the sample. Wait approximately 1

minute until the numbers on the screen do not change. The number shows the total of dissolved solids in the sample, and the results are recorded. (5) Determination of pH. PDAM drinking water samples taken at the three locations were put in sample bottles and brought to the laboratory. Then the sample in the sample bottle was poured out into a beaker. Turn instrument on by pressing the on button on the pH meter, then the pH meter is immersed in the sample. When electrode of the pH meter is immersed in water, the number scale will move randomly, wait until the number does not change, and record the result. (6) Determination of Hardness. A total of 0.25 g of anhydrous calcium carbonate ($CaCO_3$) powder was weighed in a 50 mL beaker. Diluted it little by little with distilled water and then put into a 250 mL beaker with a funnel. Add 200 mL of distilled water and HCl (1:1) little by little until all ($CaCO_3$) is dissolved. The solution was boiled for several minutes to expel CO_2, after cooling added a few drops of 3 N NH_4OH or HCl, until the solution turned orange. The solution was transferred to a 250 mL volumetric flask and diluted to exactly to 250 mL with distilled water. Meanwhile, dissolved disodium ethylene tetra acetate dihydrate (EDTA) in distilled water and diluted to a volume of 1000 mL. EBT Indicator preparation. A total of 0.5 g of EBT was dissolved in 4.5 g of hydroxyamine hydrochloride and mixed in 100 mL of 95% isopropyl alcohol. For hardness test (Sa'adah et al., 2021), a total of 50 mL of the sample was put into an Erlenmeyer flask and 1 mL of buffer solution was added. Furthermore, as a color reagent, add 2 drops of EBT indicator, then add the standard EDTA titrant slowly while shaking continuously until the purplish red color disappears. Then add a few drops of EDTA in 3-5 second intervals. At the end point of the titration a blue color will be formed in the solution. The calculation of hardness is determined using the following equation:

$$\text{mg/mL } CaCO_3 = \frac{\text{mL EDTA x M EDTA x BM } CaCO_3 \text{ x } 1000}{\text{mL sample}} \quad (1)$$

Where:

mL EDTA : volume of used EDTA
M EDTA : Molarity of EDTA
BM $CaCO_3$: 100.091 g/mol

Result and Discussion

Sampling Site Conditions

PDAM is a regional company as a means of providing clean water which is supervised and monitored by regional executive and legislative officials. The source of water managed by PDAM Ambon comes from ground surface water that has been accommodated in a reservoir as well as from deep wells. Then the water is channeled in the installation to be distributed to the community as customers. In this study, there were three sampling locations, namely: water sources in Halong, Lateri, and Passo villages, where the three locations were in Teluk Ambon Baguala sub-district. The water at the three locations is used for daily needs by the surrounding community, either for drinking or for other needs. The definition of drinking water in the Regulation of the Minister of Health No. 492/Menkes/per/IV/2010 concerning the requirements for monitoring the quality of drinking water is that it can go through a processing step or without any processing should meets the applicable provisions and can be drunk directly.

Determination of Physical and Chemical Parameters of PDAM Water in Teluk Ambon Baguala Sub-District

Water quality generally indicates the quality or condition of water associated with a particular activity or need, while quantity concerns is the amount of water needed by humans in certain activities. Water is essential in life, there is not a single living thing in this world that does not need water. Most of the human body itself consists of water. The average human body contains water as much as 75% of its body weight. Adult has about 55-60% of body weight consists of water, for children about 65% and for babies about 80% (Popkin et al., 2010).

Clean water is needed to fulfill human needs to carry out all their activities. So, it is necessary to know how water is said to be clean in terms of quality and can be used in adequate quantities in human daily activities. In terms of quality, there are several requirements that must be met, including physical quality consisting of odor, taste, color, total of dissolved substances and chemical quality consisting of pH, hardness, and biological quality where the water is free from disease-causing microorganisms. For human to survive through many years, clean water must also be available in adequate quantities according to human activities in a certain place and a certain period of time (Zamaruddin, 2018).

Water as an essential material in life can be seen from the need for water for daily needs in the household, which is different in every place, every level of life or every nation and country. The higher a person's standard of living, the higher the human need for water (Suriawiria, 2005).

Water is an important factor in meeting the vital needs of living things such as drinking water or other household needs. The water used must be free from germs and do not contain toxic materials. The number of drinking water sources that meet the requirement as raw drinking water is decreasing as a result of human activities, either intentionally or unintentionally (Ningrum, 2018).

However, the water used is not always in accordance with health requirements, because it is often found that the water contains certain substances that can cause diseases that danger to human survival (Jannah & Itratip, 2017). The need for drinking water for humans must meet both in quality and quantity so that humans are able to live and carry out all activities in their lives.

In terms of water quality, directly or indirectly, pollution will affect water quality. In accordance with the basic considerations for determining the quality of drinking water, the management of water used by humans as drinking water is guided by water quality standards, especially in the assessment of the drinking water products it produces, as well as in planning the systems and processes that will be carried out on water resources. And based on the Regulation of the Minister of Health Number 492/Menkes/per/IV/2010 dated April 19, concerning the requirements and supervision of the quality of clear water, colorless, tasteless, odorless, does not contain pathogenic germs, does not contain other creatures that are harmful to health. human, does not contain chemicals and meets quality standards (Ayuniar & Hidayat, 2018).

The water quality parameters of PDAM Teluk Ambon Baguala Sub-district as the research sample used for the daily needs of the community are shown in Table 1.

Table 1. Water Quality Parameters of PDAM in Teluk Ambon Baguala Sub-District

Parameters	Locations of samples collection			Description
	L1 (Halong)	L2 (Lateri)	L3 (Passo)	
Odor	Odorless	Odorless	Odorless	Compliance to standard
Taste	Tasteless	Tasteless	Tasteless	Compliance to standard
Color	Colorless	Colorless	Colorless	Compliance to standard
Temperature (˚C)	28.00	28.00	29.00	Compliance to standard
TDS (mg/L)	163.00	299.00	281.00	Compliance to standard
pH	7.20	8.20	7.70	Compliance to standard
Hardness (mg/L)	114.10	210.19	162.15	Compliance to standard

Odor

The PDAM water at the three sampling locations did not smell, this indicates that PDAM water of Teluk Ambon Baguala sub-district met the odorless requirements for drinking water. Good water has a characteristic odorless when smelled from afar or up close. Foul-smelling water contains organic matter that is being decomposed by water microorganisms (Setyowati, 2015). Based on guidelines from the World Health Organization (WHO) in the book of treatment and water quality standards, water that is suitable for consumption is water that does not smell (Alihar, 2018). In accordance with the standards set by the Minister of Health No.492/Menkes/per/IV/2010 dated April 19, the working mechanism to examine the smell of water is carried out at the sampling location. By taking water from the PDAM water center area using a bottle and then examining it with the senses (nose).

Taste

The taste of PDAM water at the three sampling sites was tasteless. The tasteless water meets the water standard according to the Minister of Health. Physically, water can be felt by the tongue. Water that tastes sour, sweet, bitter, or salty indicates the water is not good (Burlingame et al., 2007). The salty taste is caused by the presence of certain salts that are soluble in water, while the sour taste is caused by the presence of organic acids and inorganic acids. By taking water from the research location of the PDAM water center using bottle and then examining it with the senses (tongue). The results of the direct analysis of PDAM water samples in the research area are tasteless. The working mechanism for researching the taste of water is carried out in the field. Meanwhile, the standard set by the Minister of Health is that drinking water should be tasteless. The odor and taste parameters were tested by observing through the sense of smell and taste using the organoleptic method. Organoleptic/sensory testing is testing using the human senses as the main tool to assess the quality of a food/beverage product. Assessment using these senses includes specifications for the quality of appearance, smell, taste, and consistency/texture as well as several other factors needed to assess the product (SNI 01-2346-2006) (Badan Standarisasi Nasional, 2006).

Color

The color of PDAM water at the three sampling locations shows that the water is colorless (clear) so that it can meet the requirements for drinking water. Water for domestic use must be clear. Colored water means it contains other ingredients that may be harmful to health. In accordance with the standards set by the Minister of Health that drinking water should be colorless. The color of water can be caused by the result of contact between water and decaying organisms or from sludge particles infiltrated into PDAM water pipes (Jannah & Itratip, 2017).

Temperature

The water temperature allowed by Minister of Health Regulation is ± 30 ˚C. According to the results of this research, the temperature of the water samples from PDAM meets the requirements for clean water quality, which is in the range of 28-29 ˚C (Candra, 2018). The water temperature can change due to weather or climate and the transfer of water from the one location to another location as it exposed to sunlight. The method of measuring temperature is to insert a thermometer into the water sample that has just been taken, wait 2-3 minutes then read the scale on the thermometer. The temperature of the samples water should be cool or not hot, especially so that there is less dissolution of chemicals in the pipes, which can endanger health and could inhibit the growth of microorganisms (Kencanawati & Mustakim, 2017).

TDS

TDS (Total Dissolved Solid) in water allowed by the Minister of Health Regulation is a maximum of 500 mg/L. To determine the total of dissolved solids in the sample, an instrument called TDS meter is used. From the results of TDS measurements carried out in the laboratory, it shows that the TDS at the three research sites fulfills the requirements for clean water quality. From the first to the third location, respectively, is 163, 299, and 281 ppm or mg/L. The TDS in water allowed by the Minister of Health Regulation is 500 mg/L (Ningrum, 2018).

pH

The pH of water that is allowed by the Minister of Health Regulation is 6.5-8.5. The results of pH measurements carried out in the laboratory showed that the pH at the three research locations met the requirements for drinking. The pH = 7.2; 8.2 and 7.7 for Halong, Lateri, and Passo villages, respectively. pH is important in determining water quality because the acidity of water is generally caused by oxide gases that dissolve in water, especially carbon dioxide (Gafur et al., 2017). Influences concerning health aspects from drinking water quality standards in terms of pH smaller than 6.5 and greater than 9.2 can cause some chemical compounds to turn into toxins that are very detrimental to health (Kulthanan et al., 2013).

Hardness

Hardness is the amount of mineral content in water. In general, hardness is caused by the presence of two valent metal cations such as iron (Fe), manganese (Mn), calcium (Ca) and magnesium (Mg), but the main causes of hardness are Ca and Mg (Sa'adah et al., 2021).

The hardness obtained at the three research sites from the first to the third were: 114.10 mg/L; 210.19 mg/L and 162.15 mg/L, respectively. Based on the results obtained and refers to the permissible hardness in drinking water according to the standard of the Minister of Health Regulation which is 500 mg/L. If we compare the hardness of water at the three sampling sites with the Regulation of the Minister of Health, it can be said that the water from PDAM Teluk Ambon Baguala met drinking water standards.

Conclusion

Based on the results of the study it can be concluded that the analysis of the physical and chemical quality of the water from PDAM Teluk Ambon Baguala, in three locations which are Halong, Lateri and Passo villages, includes odor, taste, color, temperature, total of dissolved solids (TDS), pH, and hardness have met the Standard Requirements of Drinking Water based on the Regulation of the Minister of Health number 492 of 2010.

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