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Further study of ground water quality in industrial area of Bekasi and residential area of Depok, West Java, Indonesia

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Abstact. This research aims to analyze the quality of water in the industrial and residential areas. This research was conducted for two months. The parameters analyzed in this research are pH, TDS (Total Dissolved Solid), EC (Electrical Conductivity), and water temperature, using pH meter and TDS meter. The average results for industrial area (Bekasi) are pH 7.31, TDS 138.14 ppm, EC 205.63 µs, and temperature at 29.38º C. Meanwhile, the results for residential area (Depok) are pH 8.04, TDS 115.50 ppm, EC 190.40 µs, and temperature at 28.61ºC. From these data, it can be concluded that water in these two regions can be consumed, compared with the quality standard in Regulation of Minister of Health No. 32, 2017.

Keywords: industry, Bekasi, temperature, TDS, water quality

1. Introduction

Water covers around 70% of earth surface, with the volume of around 1,368 million km [1]. In the developing countries, such as Indonesia, the water contamination (in surface water and ground water) is the main cause of health problem in human being. Since the limitation of open space[2], the research shows the result that more than 14,000 people around the world die every day because of the diseases caused by water contamination [3]. Many data about water pollution in Indonesia are written in some journals [4-13].

Nowadays, the main problem of water resource covers the quantity of water which is not able to meet the increasing need and the decreasing quality of water for domestic need [14]. The quality of clean water affected by the domestic and industrial waste can be analyzed based on the physical parameters, such as odor, temperature, turbidity, taste, and colour, or with the biological parameters, such as the total coliform bacteria [15].

(a) (b)

Figure 1. (a) is Sewer in Depok City and (b) is Kalimalang River in Bekasi regency

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In order to see and compare the quality of ground water in the regions with different sources of contaminants (from industry and household), this research on the quality of ground water was conducted in two different regions, namely Depok City and Bekasi Regency. Depok, known as residential area, is located at West Java Province, Indonesia. The width of this city is 200.29 km^2, located at coordinate of 6º 23’ 24’ North Latitude 106º 49’ 48” East Longitude / 6.39º South Latitude 106.83º East Longitude.

(a) (b)

Figure 2. (a) is Depok city map and (b) is Bekasi regency map

Meanwhile, Bekasi with many industrial areas is also located at West Java Province, Indonesia. With a width of 1,484.37 km^2, this city is located at coordinate of 1060 48’ 28” East Longitude 1070 27’ 29” and 6 0 10’ 6” South Latitude.

This research aims to detect and measure the effect caused by a contaminant on the quality of environment (environmental surveillance), to know the description of water quality in these two regions in general (appraisal of resources) and to compare the quality of water with the quality standard based on the use, and to assess the feasibility of water resource for certain interest.

2. Research Methodology

The measured parameters in this research are pH, TDS (Total Dissolved Solid), EC (Electrical Conductivity), and temperature [16-18], They were measured with two instruments, namely pH meter to measure pH and TDS meter to measure TDS, EC, and water temperature.

The sample of water used in this analysis was taken from the faucet from ground water (not PDAM/Local Water Company) in office/industrial area in Bekasi Regency and residential area in Depok City.

This research was conducted for eight weeks, from 9 March 2018 to 11 May 2018. Once a week, 5 samples of water were taken and averaged, so the data from first to eighth week were obtained.

3. Result and Discussion

a. Conclusion

A summary of the study results is shown in Table 1. Based on the standard value of research, Figure 3, it can be concluded that the quality of groundwater at both the industrial and residential locations are unsafe for use because acidity values does not meet both the accepted standards of the government and international health organizations [26-29].

Table 1. Conclusion Result

Location	*Parameter Check*				Result
	pH	TDS	EC	ºC	
Work Industry	X	O	O	-	X
Home Residential	X	O	O	-	X

Note O Recommended
X Not Recommended
- Not Defined

b. Ph

	W1	W2	W3	W4	W5	W6	W7	W8
Office	8.19	7.61	7.12	8.22	7.02	6.79	6.76	6.74
Residential	8.33	8.21	8.10	8.46	7.90	7.78	7.78	7.72

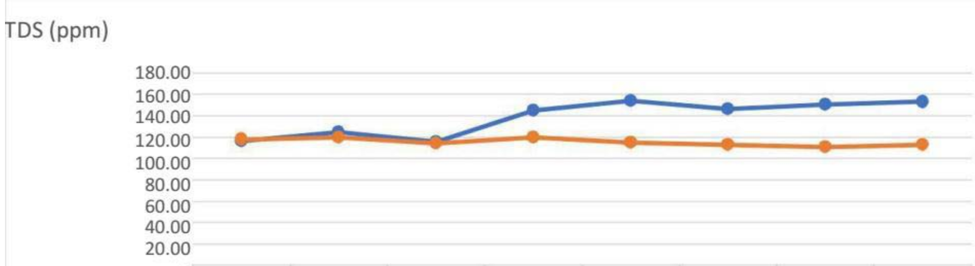
Figure 3. pH graphic

pH is a figure between 0 and 14 defining how acidic or alkaline a body of water is along a logarithmic scale. The lower the number, more acidic the water is. The higher the number, the more alkaline it is. pH 7 is considered neutral.

From pH graphic, it can be observed that the range of ground water pH in the industrial area of Bekasi Regency (office) is 6.74 - 8.22. Meanwhile, the range of ground water pH in residential area of Depok City (residential) is 7.72 - 8.46. These two regions have pH of ground water which tends to be alkaline. However, based on the data, pH of ground water in Depok as residential area has the average value which is higher or more alkaline compared with the ground water in Bekasi since the household waste is more alkaline, such as soap water which is previously used for washing or taking a bath.

In the regulation in Indonesia, it is stated that the quality standard of pH for hygiene and sanitation is 6.5 – 8.5 [19-22]. Based on the regulation, viewed from the parameter of pH, ground water in these two regions is feasible to be used or consumed.

c. TDS



	W1	W2	W3	W4	W5	W6	W7	W8
Office	116.00	124.60	115.60	145.00	153.80	146.40	150.68	153.00
Residential	118.00	120.00	114.00	120.00	115.00	113.00	111.00	113.00

Figure 4. TDS Graphic

TDS (Total Dissolved Solid) is the term used to describe the inorganic salt and a few organic substances dissolved in water. It usually consists of calcium, magnesium, sodium, potassium cation, carbonate, hydrogen carbonate, chloride anion, sulphate, and nitrate. TDS combine the sum of all ion particles that are smaller than 2 microns (0,0002 cm). In "clean" water, TDS approximately equal to salinity. In wastewater or polluted areas, TDS can include organic solutes (such as hydrocarbons and urea) in addition to the salt ions. According to the standard of WHO, TDS levels in the consumed water are as follows [23]:

Table 2. TDS level in the consumed water

Less than 300 ppm	Excellent
300 – 600 ppm	Good
600 – 900 ppm	Fair
900 – 1,200 ppm	Not good
Above 1,200 ppm	Unacceptable

Water with extremely low concentrations of TDS may also be unacceptable because of its flat, insipid taste. High TDS concentrations can also be measured gravimetrically, although volatile organic compounds are lost by this method.

Quality standard of TDS in Indonesia for clean water is up to 1,000 ppm [23, 24]. From the data of research in these two locations, it can be observed that the average TDS value of water in Bekasi is higher than in Depok. However, when compared with the quality standard of clean water in Indonesia, the TDS value in these two regions still meets the requirements; it even belongs to the category of excellent water according to the standard of WHO.

d. EC

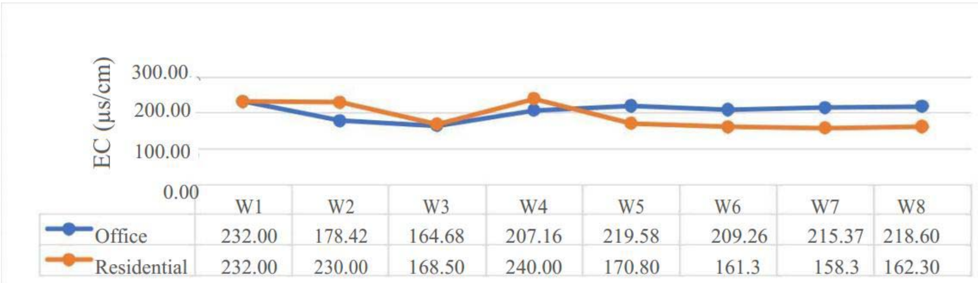


Figure 5. EC Graphic

Electrical Conductivity is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water. These conductive ions come from dissolved salts and inorganic materials such as alkalis, chlorides, sulphides, and carbonate compounds. Compounds that dissolve into ions are also known as electrolytes. The more ions that are present, the higher the conductivity of water.

The difference between TDS and EC is that TDS measures the particles dissolved in water and EC is the conductivity value of the dissolved particles.

From the data, it can be observed that the range of EC measurement data in Bekasi is 164 – 232 µs/cm, which is higher than Depok, 158 – 232 µs/cm. This is linier to TDS value, where TDS value in Bekasi is also higher than in Depok. There is no set standard for the conductivity of water. This is because conductivity can differ not only between oceans and fresh water, but even between neighboring streams. If the surrounding geology is different enough, or if one source has a separate inflow, conductivity values of neighboring waters bodies will not be the same.

e. Temperature

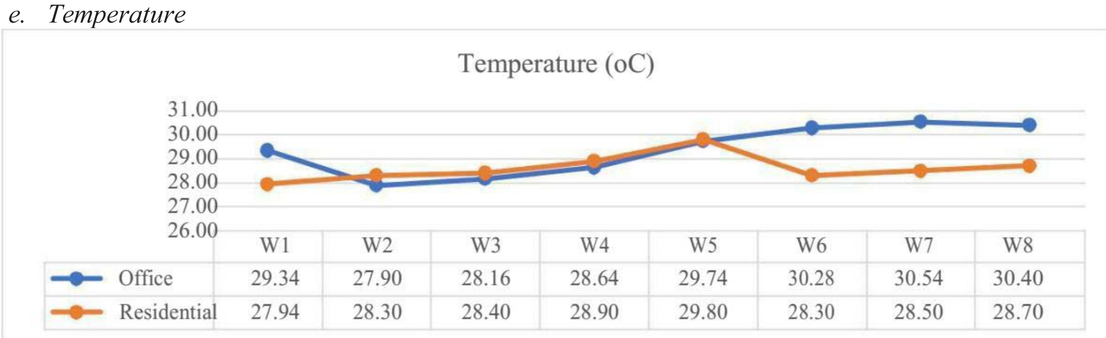


Figure 6. Temperature Graphic

Water temperature can be affected by many ambient conditions. These elements include sunlight/solar radiation, heat transfer from the atmosphere, stream confluence and turbidity. Shallow and surface waters are more easily influenced by these factors than deep water [23].

Based on the data shown in temperature graphic in Figure 6, the temperature of ground water in Bekasi tends to be higher than in Depok. The range of temperature in industrial area is 27.9^{o} C – 31.2^{o}C, while the range of water temperature in residential area is 27.9^{o} C – 29.8^{o} C.

Compared with the quality standard of clean water in which the requirement is ± 3ºC from the air temperature [25], the water temperature in these two regions still meets the requirements since air temperature is around 27-32º C [26-30].

4. Conclusion

1. The average results for industrial area (Bekasi) are pH 7.31, TDS 138.14 ppm, EC 205.63 µs, and temperature at 29.38º C.
2. The average results for residential area (Depok) are pH 8.04, TDS 115.50 ppm, EC 190.40 µs, and temperature at 28.61º C.
3. Based on the data of research result from parameters of pH, TDS, EC, and temperature in Bekasi and Depok, which are then compared with Regulation of Minister of Health No. 32 Year 2017 regarding Quality Standard of Environmental Health and Health Requirements of Water for Hygiene, Sanitation, Swimming Pool, Solus Per Aqua, and Public Bath, ground water in Depok and Bekasi is consumable.

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