

# Analysis Ground Water

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## ANALYSIS OF GROUNDWATER QUALITY IN MALAKA SARI VILLAGE ASSESSED FROM PHYSICAL, CHEMICAL AND MICROBIOLOGICAL PARAMETERS

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### ABSTRACT

The purpose of this study was to determine the value of groundwater quality in terms of physical, chemical and microbiological quality tests and to compare the test results with the quality of drinking water in the Republic of Indonesia Minister of Health Regulation No. 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitation Hygiene Needs. There were 12 samples of local groundwater taken. This test is carried out on physical parameters including color, smell, taste, turbidity and dissolved solids. Chemical parameters include iron content (Fe) with atomic absorption spectrophotometer (AAS) and hardness (Ca) methods, as well as microbiological parameters including total coliform and *Escherichia coli* using MPN (Most Probable Number) value calculations. The results of the study concluded that the results of the physical analysis contained one sample that did not meet the color and turbidity requirements according to the Permenkes, in chemical analysis there were two samples that did not meet the requirements for iron metal (Fe) according to the Permenkes. In the microbiological analysis, there were two samples that did not meet the requirements for total coliform and *Escherichia coli* which had been stipulated by the Minister of Health of the Republic of Indonesia No. 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitation Hygiene Needs. The results of the study can be concluded that the results of the physical analysis contained one sample that did not meet the color and turbidity requirements according to the Permenkes, in chemical analysis there were two samples that did not meet the requirements for iron metal (Fe) according to the Permenkes. In the microbiological analysis, there were two samples that did not meet the requirements for total coliform and *Escherichia coli* which had been stipulated by the Minister of Health of the Republic of Indonesia No. 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitation Hygiene Needs.

**Keywords:** Clean Water, Diarrhea, MPN (Most Probable Number), *Escherichia coli*

### INTRODUCTION

Water plays an important role to meet human needs, for example for drinking, cooking, washing, transportation, agriculture, industry and so on (Chuang et al., 2019). Water used for daily living needs must meet the requirements Health Quality Standards and Water Health Requirements for Sanitary Hygiene Needs (Chen et al., 2010). Clean water is water that is odorless, tasteless and colorless (Laftouhi et al., 2003).

An intense human activity of land resources has resulted in substantial changes in the land use and its impact on groundwater quality in temperate and developing world (Giuliano, 1995). Standard for water media for Purposes Hygiene Sanitation in physics, chemistry and microbiology (Nagarajan et al., 2010). So if there is only one parameter that does not meet the requirements, the water is not suitable for drinking (Andrade & Y., 2013). The use of drinking water that does not meet these quality standards can cause health problems, either directly and quickly or indirectly and slowly (Tomer et al., 2010).

Duren sawit is a place or village located in East Jakarta. The name Duren Sawit is a combination of the words Duren and Sawit, which used to be a plantation with lots of trees, especially duren and oil palm. Batavia territory during the Dutch colonial period was still in the form of swamps, gardens and forests (HM, 2012).

Malaka Sari Village is located in Duren Sawit sub-district, East Jakarta. This sub-district has a population of 32,553 people and an area of 1.38 km<sup>2</sup>. This sub-district is bordered by Penggilingan Kelurahan in the north, Kelurahan Duren Sawit and Klender in the west, Kelurahan Malaka Jaya and Pondok Kopi in the east and Kelurahan Pondok Kelapa in the south.

East Jakarta has the highest population distribution in DKI Jakarta, namely 28.04% of the entire population of DKI Jakarta. This data indicates that water demand for the East Jakarta region is also very high. However, the quality of groundwater for the East Jakarta area deteriorated with the parameter of the turbidity value of 65.30-985.00 mg / L exceeding the turbidity standard of 25 mg / L, manganese of 0.02-4.55 mg / L exceeding the standard. The quality of manganese is 0.5 mg / L, detergent and organic are 1.13-17.77 mg / L, exceeding the organic quality standard of 10 mg / L (Jakarta, 2009). Based on the 2018 RISKESDAS data, the number of diarrhea cases in East Jakarta reached 4,227 people because the ground water they consume may have been contaminated.

Based on the description above, the writer tries to further study the level of groundwater pollution in RT 15, 16, 17 RW 03 Malaka Sari Village, Duren Sawit District, East Jakarta. This area is considered very densely populated. With houses close together so that the distance is less than 10 m from the septic tank as a source of drinking water for residents of the area (Baig et al., 2010).

#### RESEARCH METHODOLOGY

This type of research is descriptive, namely collecting data and recording total coliform and Escherichia coli data by calculating the MPN value, and testing for Fe using Atomic Absorption Spectrophotometer and hardness using complexometry. This sampling technique is purposive technique, by taking samples of groundwater residents who have dug well criteria. This research was conducted in the Laboratory Microbiology Study Program UHAMKA Pharmacy and Science and PAM JAYA Laboratory Jl. Pejompongan Raya No. 2 Central Jakarta (Yusuf et al., 2011)

#### PROCEDURE

**Location Survey** by means of residents' homes or locations that have data dug wells. The location plan is made for random or random sampling so that it is not too close to one house to another. (TU et al., 2014).

**Sterilization tool** made of glass and metal wrapped with paper and cotton, tied using a mattress strap, then put in an autoclave, then sterilized at 121 °C for 30 minutes with a pressure of 1 atm. (Y et al., 2017)

**Making LB medium (Lactose Broth):** Medium Lactose Broth weighed as much as 10.4 grams, then dissolved with 1000 ml of sterile aquadest into erlenmeyer and heated on a hot plate. The Lactosa Broth solution was put into a test tube equipped with a 5 ml durham tube, the tube was covered with aluminum paper, sterilized by autoclaving for 15-20 minutes at 121 °C, 1 atm pressure (Duan et al., 2015).

**Making BGLBB (Brilliant Green Lactose Bile Broth) media:** Medium Broth Green Lactose Bile Broth weighed 32 grams, then dissolved as much as 800 ml of sterile aquadest into erlenmeyer and heated on a hot plate until dissolved. Broth Green Lactose Bile Broth solution is put into a test tube equipped with a 5 ml durham tube, then the tube is covered with aluminum paper, sterilized by autoclave for 15-20 minutes at a temperature of 121 °C 1 atm pressure (Huang et al., 2014; Ren et al., 2016).

**Making EMBA (Eosin Methylene Blue Agar) media:** Eosin Methylene Blue Media In order to weigh as much as 36 grams, then dissolved in 1000 ml of distilled water into erlenmeyer then stirred until homogeneous. The dissolved medium is then put into a 10 ml petri dish. The medium was sterilized into an autoclave at 121 °C for 15 minutes. (TU et al., 2014).

**Sampling includes:** (a) Prepare a sterile sampling bottle. (b) Make sure the faucet is good. (c) The valve cover is opened and water is allowed to drain for 5 minutes before measuring and sampling is carried out. (d) The water sample is taken carefully, fill the sample bottle as much as 150 ml without touching the surface and the bottle cap is closed carefully. (e) The bottle is marked with a label. (f) The bottle is stored in an ice box. (g) Then proceed with a microbiological examination of the sample(Saleem et al., 2016; Vasin et al., 2016).

**Physical examination includes:** (a) Checking the color of the water can be done using the sense of sight, namely by inserting a water sample into a bottle and then observing the color. (b) Smell examination is carried out using the sense of smell, namely by smelling water. (c) Checking the taste of the water is carried out using the sense of taste, namely by tasting the taste of the water. (d) Inspection of water turbidity can be carried out using the sense of sight, namely by filtering the water with filter paper and then observing the color. (A. NF, 2017)

#### **Microbiological Examination**

Water / sample dilution stage: (a) take 1 ml of sample into a test tube, then add 10 ml of distilled water to obtain 10-1 concentrations, (b) take 1 ml of sample from 10-1 dilution into a test tube, then add 10 ml of aquadest ad to obtain 10-2 concentrations, (c) take 1 ml of sample from 10-1 dilution, put in a test tube, then add 10 ml of distilled water to obtain 10-3 concentrations(Gautam et al., 2013).

The prediction test procedure includes: (a) preparing 9 test tubes containing Lactose Broth medium, giving codes A1, A2, A3, B1, B2, B3, C1, C2, C3. Enter 1 ml of sample with a 10-1 dilution into tubes A1, A2, A3. Enter 1 ml of sample with a 10-1 dilution into tubes B1, B2, B3. Enter 1 ml of sample with a 10-1 dilution into tubes C1, C2, C3. (b) incubated all test tubes were incubated for 2 X 24 hours at 37 °C. If gas builds up in the durham tube at the bottom, perform a prediction test(Kumar et al., 2014).

Estimation tests include: (a) Prepare a loop needle and heat it using a bunsen fire. Each test tube for the positive prediction test was taken 1-2 ose, then transferred into a test tube containing 3 ml each of Broth Green Lactose Bile Broth medium. All test tubes were put into the incubator at 37 °C for 1 x 24 hours. If there is gas at the bottom of the Durham tube, it means that the water sample contains faecal coliform bacteria (Srinivasamoorthy, K., Nanthakumar, C., Vasanthavigar et al., 2011).

The Complete Test Procedure includes: (a) Preparing a petri dish that already contains Eosin Methylene Blue Agar media. Prepare an ose needle heated with Bunsen fire. Each test tube positive confirmation test was taken 1-2 ose of each dilution level 10-1, 10-2, 10-3(Singh et al., 2015). On the Eosin Methylene Blue agar medium, the ose was scratched and then incubated for 24 hours at 37 °C. Bacterial colonies that grow are observed on the surface of the media, if they are metallic green, it means that the presence of Escherichia coli is positive in the water sample(R. NF et al., 2016).

**Chemical Examination includes:** (a) pH measurement can be made using pH universal indicator paper. (b) Measurement of ferrous metal is carried out by means of an Atomic Absorption Spectrophotometer. (c) Hardness measurement is carried out by complexometric titration.

#### **DISCUSSION**

The results of the research from 12 samples taken from the environment in RT 15, 16, 17 RW 03 Malaka Sari Village, Duren Sawit District, East Jakarta, which can be seen in the following table

No.	RT	Sample Code	Physical Test			
			Color	Smell	Taste	Turbidity
1	15	S1	Colorless	No smell	Tasteless	0.47 NTU
2		S2	Colorless	No smell	Tasteless	0.20 NTU

3		S3	Colorless	No smell	Tasteless	0.34 NTU
4		S4	Colorless	No smell	Tasteless	0.23 NTU
5		S5	Cloudy *	No smell	Tasteless	36.7 NTU *
6	16	S6	Colorless	No smell	Tasteless	0.27 NTU
7		S7	Colorless	No smell	Tasteless	0.94 NTU
8		S8	Colorless	No smell	Tasteless	0.35 NTU
9		S9	Colorless	No smell	Tasteless	0.51 NTU
10	17	S10	Colorless	No smell	Tasteless	0.20 NTU
11		S11	Colorless	No smell	Tasteless	8.77 NTU
12		S12	Colorless	No smell	Tasteless	0.96 NTU

**Table 1.** Physical Test Results

From Table 1 it can be seen that of the 12 samples analyzed, there was 1 sample whose parameters did not meet the predetermined standard requirements, namely there was a cloudy color and the turbidity value reached 36.25 NTU in the groundwater sample with sample code S4 from RT 15. According to Permenkes RI No 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitation Hygiene Purposes The standard value for turbidity is 25 NTU.

**Table 2.** Chemical Test Results

No.	RT	Sample Code	Chemical test				
			pH	Hardness	Iron (Fe)	Organic Substances as KMnO <sub>4</sub>	Chrome IV
1		S1	5.5 *	96.20	<0.155	0.85	<0.027
2	15	S2	6 *	69.20	<0.155	0.68	<0.027
3		S3	6.5	106.40	<0.155	0.85	<0.027
4		S4	6.5	86.00	<0.155	0.38	<0.027
5		S5	6 *	235.20	0.315	0.57	<0.027
6	16	S6	6 *	147.40	<0.155	0.38	<0.027
7		S7	6.5	164.60	<0.155	0.68	<0.027
8		S8	5.5 *	173.60	1,528 *	2.06	<0.027
9		S9	6.5	119.60	<0.155	0.85	<0.027
10	17	S10	6.5	105.20	<0.155	0.35	<0.027
11		S11	5.5 *	143.00	1,530 *	0.52	<0.027
12		S12	6.5	148.20	<0.155	0.57	<0.027

Information:

\* Does not meet the requirements in accordance with Permenkes RI No. 32 of 2017 on Environmental Health Quality Standards and Water Health Requirements for Sanitation Hygiene Purposes

From Table 2, there are 6 samples that show the pH value is less than the requirements and there are 2 samples from 10 samples that show the iron (Fe) value does not meet the requirements of the groundwater sample code S8 from RT 16 and groundwater sample code S11 from RT 17 while 10 other samples meet the requirements that have been set. According to Permenkes RI No. 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitation Hygiene Purposes, the standard value for ferrous metal (Fe) is 1 mg / l. In the pH test, there were 6 samples which had a value of the degree of acidity which was not in accordance with the Republic of Indonesia Minister of Health Regulation No. 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitary Hygiene Purposes with a pH range value of 6.5-8.5.

Given that the number of various diseases caused by water to humans when humans use it, this microbiological examination is to determine the level of microbial pollution in groundwater. This test can also be used as an indicator of sanitation and an indicator of food and beverage safety. Coliform bacteria are known as bacteria that cause diarrhea and digestive tract disorders. Coliform bacteria have enteropathogenic properties or cause dangerous diseases for humans such as diarrhea (Supardan 2018).

**Table 3.** MPN Value Estimation Test

N o.	RT	Sample Code	Dilution						Positive Tube Combination			
			10-1		10-2		10-3					
1	15	S1	+	+	-	-	+	-	-	-	2-1-0	
2		S2	-	+	-	-	-	-	-	+	1-0-2	
3		S3	+	-	+	-	-	-	-	-	2-0-0	
4		S4	-	+	+	-	+	-	+	+	-	2-1-2
5	16	S5	+	+	+	-	-	-	-	+	-	3-0-1
6		S6	+	+	-	-	+	+	-	-	-	2-2-0
7		S7	-	+	+	+	+	-	-	+	-	2-2-1
8		S8	+	+	+	+	+	+	+	+	+	3-3-3 *
9	17	S9	-	+	+	+	+	-	-	-	-	2-2-0
10		S10	+	+	+	+	-	+	-	-	-	3-2-0 *
11		S11	+	+	+	+	+	+	+	+	+	3-3-3 *
12		S12	+	+	-	+	-	-	+	+	-	2-1-2

Information :

(-) = Not growing

(+) = Grow to Form Gas

(\*) = Not meeting the requirements

Based on the table 3 of the 12 test samples inoculated on the lactose broth media, the results obtained are as follows in the S1 sample code at 10-1 dilution, there are 2 tubes of 3 inoculated tubes showing the presence of gas, at 10-2 dilution there is 1 tube out of 3 inoculated tubes indicates the presence of gas and at 10-3 dilution of the 3 tubes inoculated there is no indication of gas so it cannot be said to be positive for the presence of coliforms. Of the 12 samples that have been tested, there are 3 samples that do not meet the requirements according to the purposes with standard values <50/100 ml.

Then u doji affirmation to confirm the presence of coliforms because in the predictor test positive results are not always caused by the presence of coliform bacteria (Basavarajappa H,

2015). Based on Table 4 below, of the 12 test samples inoculated on the brilliant green lactose bile broth media, the results obtained are as follows in the S1 sample code at 10-1 dilution, there is 1 tube out of 3 inoculated tubes showing the presence of gas, at 10-2 dilution and 10-3 dilution does not indicate the presence of gas so it cannot be said to be positive for the presence of coliforms.

**Table 4.** MPN Value Assertion Test

N o.	RT	Sample Code	Positive Tube Combination	MPN Coliform / 100ml	Information
1		S1	1-0-0	4	Fulfill the requirements
2		S2	0-0-1	3.0	Fulfill the requirements
3	15	S3	0-0-0	0	Fulfill the requirements
4		S4	1-0-1	7	Fulfill the requirements
5		S5	1-0-0	4	Fulfill the requirements
6		S6	1-2-0	11	Fulfill the requirements
7	16	S7	2-2-1	28	Fulfill the requirements
8		S8	3-3-1	460 *	Does not meet the requirements
9		S9	1-1-0	7	Fulfill the requirements
10		S10	2-1-0	15	Fulfill the requirements
11	17	S11	3-2-2	210 *	Does not meet the requirements
12		S12	1-0-1	7	Fulfill the requirements

Then a complementary test was carried out, from the results in Table 5 below, after observing the Escherichia coli colony on EMBA (Eosin Methylen Blue Agar) media from the 12 samples tested, there were 2 positive samples with Escherichia coli. This complete test was carried out to isolate and detect the Escherichia coli group of bacteria (A & AP., 2019). From the results of the affirmation test which showed positive results continued to the complementary test, namely by inoculating 1 ose sample that had been implanted in the confirmatory test medium into the EMBA (Eosin Methylene Blue Agar) medium in a zig zag manner then incubated at 37 ° C for 1 x 24 hours. Colony growth was observed in this medium, the colony that showed a metallic luster was Escherichia coli colony (H & M., 2015)

**Table 5.** Escherichia coli test results

No.	RT	Sample Code	<i>Escherichia coli</i> (+/-)
1		S1	-
2		S2	-
3	15	S3	-
4		S4	-
5		S5	-
6		S6	-
7	16	S7	-
8		S8	+
9		S9	-
10	17	S10	-
11		S11	+
12		S12	-

**Information :**

(-) = No *Escherichia coli*

(+) = There is *Escherichia coli*

Pollution sources such as septic tanks must be at least 10 meters away. The minimum distance of 10 meters is intended so that the water source is protected from various kinds of pollution that may leak. Well spacing that does not meet health requirements is very likely to breed pathogenic bacteria caused by water-borne diseases (Aher & Deshmukh, 2019).

Based on the results of the *Escherichia coli* analysis, the samples that meet the requirements are more than the samples that do not meet the groundwater requirements cannot be said to be suitable for direct consumption because they are said to contain even a little bacteria, so they need to be cooked before drinking. Heating at 70 ° C for 3.5 seconds is effective for decontamination of *Escherichia coli* bacteria (Saimah et al., 2016)

**CONCLUSION**

Based on the results of the study, it can be concluded that from the entire physical, chemical and microbiological examination of 12 samples of groundwater residents in RT 15, 16 and 17 RW 03 Malaka Sari Village, Duren Sawit District, the results of the physical analysis were that there was one sample that did not meet the color requirements and turbidity according to Permenkes, in chemical analysis there are two samples that do not meet the requirements for iron metal (Fe) according to Permenkes. In the microbiological analysis, there were two samples that did not meet the requirements for total coliform and *Escherichia coli*.

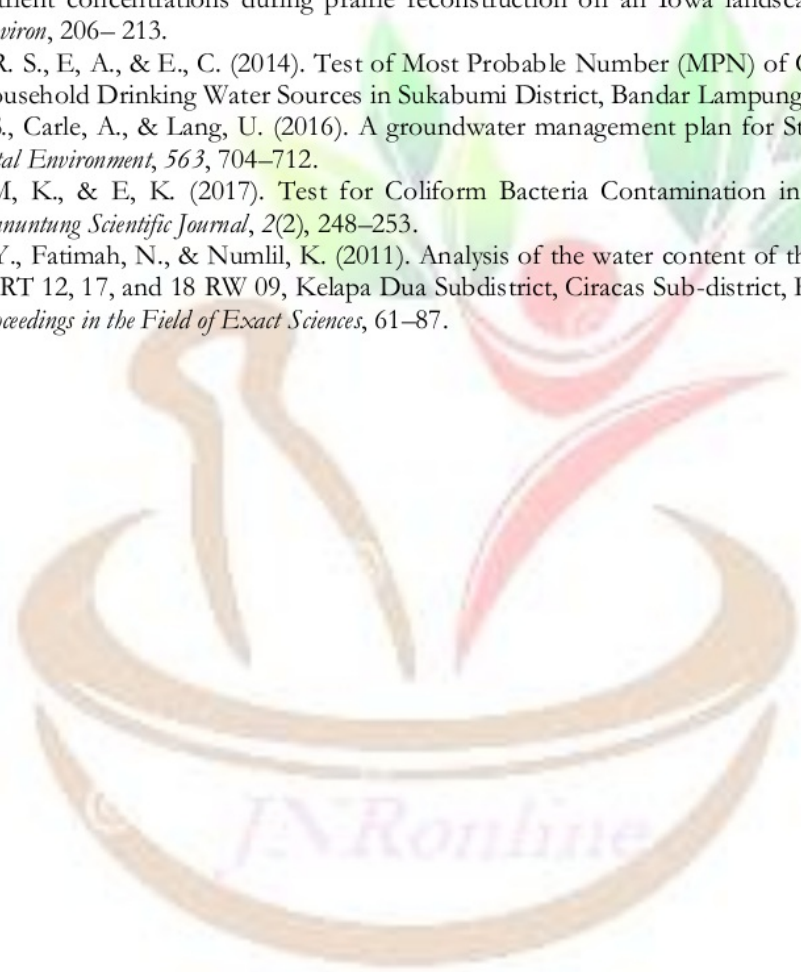
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