Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author:	Bernadeta Wuri Harini
Assignment title:	Quick Submit
Submission title:	The Application of Spectrophotometry Method for Measurin...
File name:	g_Iron_Content_of_Groundwater_after_Merapi_Mountain_Eru...
File size:	286.92K
Page count:	5
Word count:	2,137
Character count:	10,496
Submission date:	03-May-2021 02:13PM (UTC+0700)
Submission ID:	1576588797

The Application of Spectrophotometry Method for Measuring Iron Content of Groundwater after Merapi Mountain Eruption

Bernadeta Wuri Harini
Electrical Engineering
Sanata Dharma University
Yogyakarta, Indonesia
wuribernard@usd.ac.id

Sri Agustini Sulandari
Physic Education
Sanata Dharma University
Yogyakarta, Indonesia
agustfis@usd.ac.id

***Abstract*— The eruption of Merapi Mountain in Yogyakarta in November 2010 spewed a lot of material to the surface of the earth. These conditions could affect the chemical content in ground water, such as iron content. Therefore, in this research will be made an iron content measuring instrument that is used to measure iron content in ground water of Turi, Klangkapan, Kali Kuning and Umbul Pajangan after the eruption of Merapi Mountain.**

The measuring iron content in the groundwater in this research is using spectrophotometric method. Because iron is measured at wavelengths between 495-570 nm, so this system will work by using a green laser light source. The results of the data processing will be displayed on the LCD (Liquid Cell Display) in mg/l.

The iron content instrument can measure the iron content 1 – 5 mg/l as well. The iron content instrument still needs improvement because it can not measure iron content below 1 mg/l in accordance with the results should be. The iron content of four springs are increasing with the rate between 19.17 – 305.7%. However, the iron content in the water in the four areas is safe for consumption because it is on the allowed threshold by the Ministry of Health (less than 0.3 mg/l).

Keywords—groundwater, Merapi Mountain, eruption, iron content, green laser

I. INTRODUCTION

Ground water is a strategic resource, because it involves the basic necessities lives of many people in various community activities. In November 2010 had occurred eruption of Merapi Mountain in Yogyakarta which spewed a lot of material to the surface of the earth. These conditions could affect the chemical content in ground water, such as iron content. The maximum allowed by the Ministry of Health No.. 416/MENKES/PER/IX/1990 for Fe content in the water not more than 0.3 mg/l [1].

The measuring iron content in the groundwater in this research is using spectrophotometric method. This method is considered a fairly simple method. The analysis is done relatively quickly, and the samples were analyzed in small quantities. Today, the spectrophotometers on the market are very expensive and only certain people that could use a spectrophotometer, so many people are less able to take advantage of these tools. Therefore, we intend to make the iron content in the water measuring instrument more simple, inexpensive, and easy to use with the spectrophotometric method. Some researcher has been utilizing a spectrophotometer for testing content of iron in the water. One of the existing research conducted by Nia Faricha, in a research entitled "*Pembuatan Alat Ukur Kadar Besi dalam Air dengan Metode Absorbsi Spektrofotometri* ". This research used polychromatic light source i.e. a halogen lamp and a light sensor i.e. LDR (Light Dependent Resistor). The results are displayed in units of percent. [2]. Another researcher is Ram Murat Singh et al that developed instrument for measuring iron content in water [3]. The instrument uses RGB-LED (Red Green Blue - Light Dependent Resistor) as light source and LDR receiver. The method of convertion Fe to the red complex solution is done by adding the solution with KSCN.

In this research, an iron content in water measuring instrument will be designed using laser light source. Because the iron is measured at wavelengths between 495-570 nm, so this system will work by using a green laser light. The instrument of iron content that is made will be used to measure iron content in ground water of Turi, Klangkapan, Kali Kuning and Umbul Pajangan to assess changes in the content of iron in groundwater after the eruption of Merapi Mountain. These four areas are located at the edge of Mount Merapi. The results of the data processing will be displayed on the LCD (Liquid Cell Display) in mg/l unit. The iron content measurement tool is equipped with a battery that can be recharged so that it can be brought to a place where there is no power source.

II. MATERIALS AND METHODS

The stages of this research are as follows:

1. Taking samples of ground water in Turi, Klangkapan, Kali Kuning and Umbul Pajangan
2. Manufacturing iron content instrument

   The principle of the measurement of the sample shown in Figure 1. Light with intensity *Io* passes through the

The Application of Spectrophotometry Method for Measuring Iron Content of Groundwater after Merapi Mountain Eruption

by Harini Bernadeta Wuri

Submission date: 03-May-2021 02:13PM (UTC+0700)
Submission ID: 1576588797
File name: g_Iron_Content_of_Groundwater_after_Merapi_Mountain_Eruption.pdf (286.92K)
Word count: 2137
Character count: 10496

The Application of Spectrophotometry Method for Measuring Iron Content of Groundwater after Merapi Mountain Eruption

Bernadeta Wuri Harini
Electrical Engineering
Sanata Dharma University
Yogyakarta, Indonesia
wuribernard@usd.ac.id

Sri Agustini Sulandari
Physic Education
Sanata Dharma University
Yogyakarta, Indonesia
agustfis@usd.ac.id

***Abstract*— The eruption of Merapi Mountain in Yogyakarta in November 2010 spewed a lot of material to the surface of the earth. These conditions could affect the chemical content in ground water, such as iron content. Therefore, in this research will be made an iron content measuring instrument that is used to measure iron content in ground water of Turi, Klangkapan, Kali Kuning and Umbul Pajangan after the eruption of Merapi Mountain.**

The measuring iron content in the groundwater in this research is using spectrophotometric method. Because iron is measured at wavelengths between 495-570 nm, so this system will work by using a green laser light source. The results of the data processing will be displayed on the LCD (Liquid Cell Display) in mg/l.

The iron content instrument can measure the iron content 1 – 5 mg/l as well. The iron content instrument still needs improvement because it can not measure iron content below 1 mg/l in accordance with the results should be. The iron content of four springs are increasing with the rate between 19.17 – 305.7%. However, the iron content in the water in the four areas is safe for consumption because it is on the allowed threshold by the Ministry of Health (less than 0.3 mg/l).

Keywords—groundwater, Merapi Mountain, eruption, iron content, green laser

I. INTRODUCTION

Ground water is a strategic resource, because it involves the basic necessities lives of many people in various community activities. In November 2010 had occurred eruption of Merapi Mountain in Yogyakarta which spewed a lot of material to the surface of the earth. These conditions could affect the chemical content in ground water, such as iron content. The maximum allowed by the Ministry of Health No.. 416/MENKES/PER/IX/1990 for Fe content in the water not more than 0.3 mg/l [1].

The measuring iron content in the groundwater in this research is using spectrophotometric method. This method is considered a fairly simple method. The analysis is done relatively quickly, and the samples were analyzed in small quantities. Today, the spectrophotometers on the market are very expensive and only certain people that could use a spectrophotometer, so many people are less able to take advantage of these tools. Therefore, we intend to make the iron content in the water measuring instrument more simple, inexpensive, and easy to use with the spectrophotometric method. Some researcher has been utilizing a spectrophotometer for testing content of iron in the water. One of the existing research conducted by Nia Faricha, in a research entitled "*Pembuatan Alat Ukur Kadar Besi dalam Air dengan Metode Absorbsi Spektrofotometri* ". This research used polychromatic light source i.e. a halogen lamp and a light sensor i.e. LDR (Light Dependent Resistor). The results are displayed in units of percent. [2]. Another researcher is Ram Murat Singh et al that developed instrument for measuring iron content in water [3]. The instrument uses RGB-LED (Red Green Blue - Light Dependent Resistor) as light source and LDR receiver. The method of convertion Fe to the red complex solution is done by adding the solution with KSCN.

In this research, an iron content in water measuring instrument will be designed using laser light source. Because the iron is measured at wavelengths between 495-570 nm, so this system will work by using a green laser light. The instrument of iron content that is made will be used to measure iron content in ground water of Turi, Klangkapan, Kali Kuning and Umbul Pajangan to assess changes in the content of iron in groundwater after the eruption of Merapi Mountain. These four areas are located at the edge of Mount Merapi. The results of the data processing will be displayed on the LCD (Liquid Cell Display) in mg/l unit. The iron content measurement tool is equipped with a battery that can be recharged so that it can be brought to a place where there is no power source.

II. MATERIALS AND METHODS

The stages of this research are as follows:

1. Taking samples of ground water in Turi, Klangkapan, Kali Kuning and Umbul Pajangan
2. Manufacturing iron content instrument

   The principle of the measurement of the sample shown in Figure 1. Light with intensity *Io* passes through the sample containing molecules along b, some light will be absorbed by the molecule. This resulted in the intensity drops to *I*. Both the value of the light intensity (*Io* and *I*) were measured by photodetector. Light with intensity *Io*, after passing through the absorber with concentration c, along b, the intensity will drop to *I* follow the relationship

$$\log(I_0 / I) = \varepsilon\, b\, c \qquad (1)$$

where ε is the molar absorptivity [4],[5]

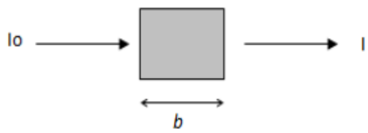


Figure 1 Absorption of light by the sample

Molar absorptivity is a constant that depends on the type of molecule and the wavelength. Equation 1 can be expressed in the form

$$\log(I_0 / I) = A \qquad (2)$$

where A: absorbance, then equation 1 becomes

$$A = \varepsilon\, b\, c \qquad (3)$$

Where ε and b is constant and A is measured, the iron level c can be obtained. The block diagram of this instrument is shown at Figure 2. The circuit of laser source and photodiode are shown at Figure 3. The flowchart of the measurement process is shown at Figure 4.

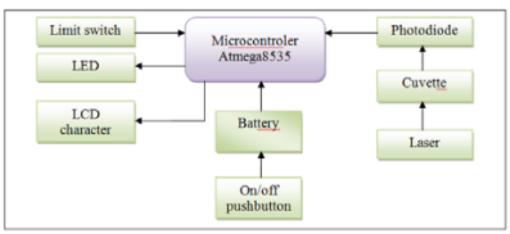
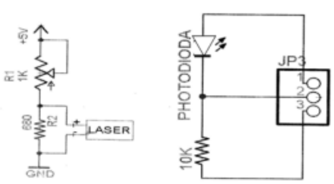


Figure 2. Block diagram



a. Laser source circuit b. Photodiode circuit

Figure 3. The circuit of laser source and photodiode

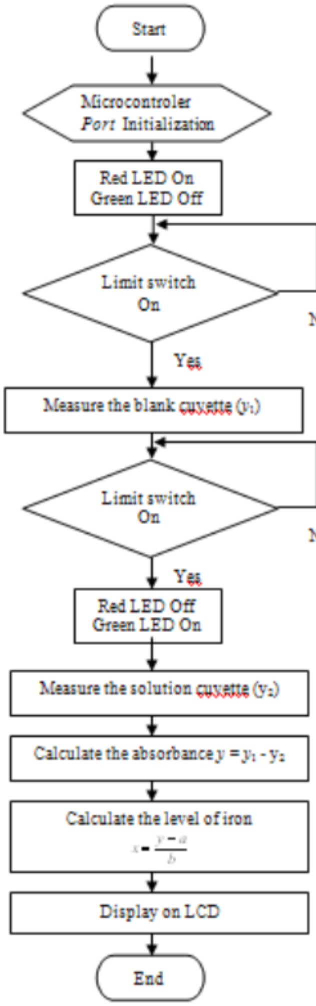


Figure 4. Fowchart of the measurement process

3. Preparation of Fe standard curve

   a. 1 ml of standard solution of standard Fe 100 ppm pipetted and put in a 100 ml flask. one drop of 0.2 M Na-acetate, 5 ml solution hidroksilaminklorida 10%, and 5 ml of 0.25% o-phenantrolin added into the flask. Then the solution in the flask is diluted to mark boundaries.

   b. In the same way, the solution to the volume of iron solution 0, 2, 3, and 4 ml were made. The number of drops of a solution of Na-acetate adjusted to the volume pipetted iron, then, 5 ml solution of o-phenantrolin 0.25%, 5 ml solution hidroksilaminklorida added to the flask and the mixture was diluted to mark boundaries.

4. Measurement of Fe standart series:

   - measure the blank cuvette (y_1) and iron solution cuvette (y_2) for sixth solution above at a wavelength of maximum absorbance
   - calculate the absorbance for sixth solution above with formula

$$y = y_1 - y_2 \quad (4)$$

   - draw the graph of the absorbance for sixth solution above to obtain a linear equation of Fe standart curve:

$$y = bx + a \quad (5)$$

where y = absorbance

x = iron content

b, a = constant

5. Calibration of the Fe standart curve measurement between the instrument and standart spectrophotometer

6. Preparation of the sample solution

   25 ml water sample is pipetted into a 100 ml measuring flask. One drop of 0.2 M Na-acetate, 5 ml of 10% hidroksilaminklorida solution and 5 ml of 0.25% o-phenantrolin added to the flask and then the solution was diluted to mark boundaries.

7. Measurement of iron content:

   - measure the blank cuvette (y_1) and iron solution cuvette (y_2)
   - calculate the absorbance ($y = y_1 - y_2$)
   - calculate the content of iron: $x = \frac{y-a}{b}$ with a and b are obtained from linear equation of Fe standart curve

III. RESULT AND DISCUSSION

Figure 2 shows the iron content instrument that is made up. This figure shows the outside and inside of the iron content instrument. Table 1 shows the results of the voltage measurement of fifth Fe standard solution according to equation 4, which is further illustrated in Figure 3. The figure shows that the standart solution has 0.989 linearity level. The standart equation is

$$y = 0.003x + 0.002 \quad (6)$$

Table 2 shows the absorbance measurement using standart spectrophotometer, which is further illustrated in Figure 4. The figure shows that the standart solution has 0.994 linearity level. The standart equation is

$$y = 0.1889x - 0.0169 \quad (7)$$

From the two graphs above it is clear that the linearity of the iron content instrument is smaller than the standard spectrophotometer. It means that the iron content instrument still needs improvement.

Table 3 shows the content of Fe in mg/l in groundwater of four region after Merapi Mountain eruption using iron content instrument (in accordance with the equation 6) and standart spectrophotometer (in accordance with the equation 7). Table 4 shows the content of Fe in mg/l at before and after Merapi Mountain eruption that is tested at Balai Besar Teknik Kesehatan Lingkungan dan Pemberantasan Penyakit Menular (BBTKL PPM) Yogyakarta. If Table 3 compared with Table 4, it can be seen that the measured Fe content in groundwater using a standard spectrophotometer is similar to BBTKL PPM measurement result. It means that the method of preparation of the solution is correct. However, the iron content instrument can not measure iron content in accordance with the results should be. This is because the iron content in the water sample is too small. The iron content instruments can not detect iron content that is too small. For further improvement, the sensitivity of iron content instrument will be upgraded so that it can measure the small iron content as well. From table 4, we can know that the iron content after the eruption of Mount Merapi is higher than before the eruption. The greatest change occurred in the springs in the area Kali Kuning, i.e. 305.7%. However, the content of iron in the four springs is still below the threshold required by the Ministry of Health, which is less than 0.3 mg / l, so it is safe for consumption.

Table 1. Absorbance measurement of the iron content instrument.

Solution	Voltage (V)	Absorbance
0 mg/l	4.81	-
1 mg/l	4.805	0.005
2 mg/l	4.801	0.009
3 mg/l	4.797	0.013
4 mg/l	4.795	0.015
5 mg/l	4.791	0.019

Figure 2. Iron content instrument

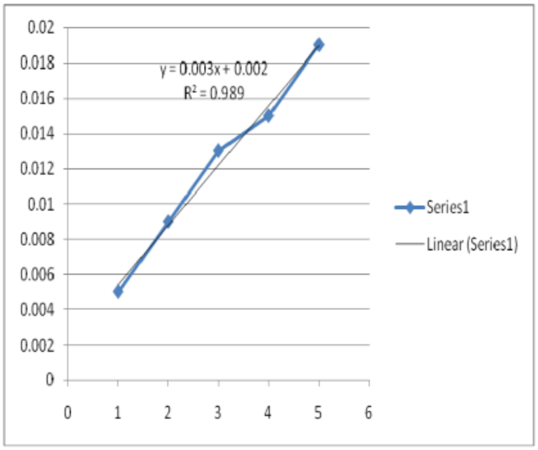


Figure 3. Series solution measurement result of the iron content instrument.

Table 2. Absorbance measurement using standart spectrophotometer

Solution	Absorbance
1 mg/l	0.186
2 mg/l	0.362
3 mg/l	0.535
4 mg/l	0.709
5 mg/l	0.957

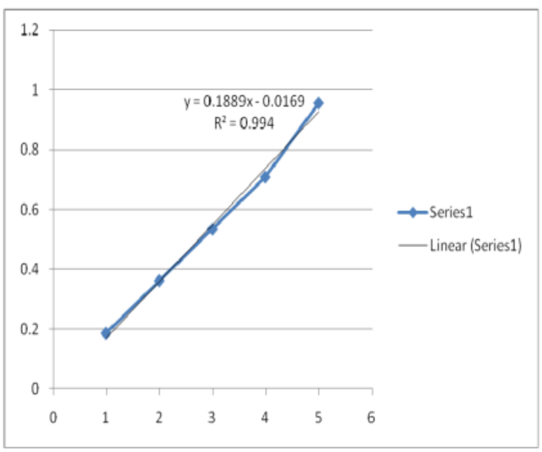


Figure 4. Series solution measurement result of standart spectrophotometer.

Table 3. Fe content of groundwater measurement using the iron content instrument and Standart spectrophotometer

Region	Absorbance Measurement		Fe content (mg/l)	
	Using the iron content instrument	Using Standart spectro-photometer	Using the iron content instrument	Calculating from absorbance using standart spectro-photometer
Klangkapan	0.001	-0.011	-0.333	0.031
Turi	0.001	-0.013	-0.333	0.020
Kali Kuning	0.001	-0.007	-0.333	0.052
Umbul Pajangan	0.001	-0.012	-0.333	0.026

Table 4. Fe content of groundwater measurement (tested at Balai Besar Teknik Kesehatan Lingkungan dan Pemberantasan Penyakit Menular Yogyakarta)

Region	Fe content (mg/l)		Increase (%)
	Before eruption	After eruption	
Klangkapan	0.0193	0.0230	19.17
Turi	0.0193	0.0230	19.17
Kali Kuning	0.0193	0.0783	305.70
Umbul Pajangan	0.0193	0.0230	19.17

IV. CONCLUSION

From the explanation above, it can be concluded below:

a. The iron content instrument can measure the iron content 1 – 5 mg/l as well

b. The iron content instrument still needs improvement because it can not measure iron content below 1 mg/l in accordance with the results should be

c. The iron content of four springs are increasing with the rate between 19.17 – 305.7%. However, the iron content in the water in the four areas (Turi, Klangkapan, Kali Kuning and Umbul Pajangan) is safe for consumption because it is on the allowed threshold by the Ministry of Health (less than 0.3 mg/l).

ACKNOWLEDGMENT

Thanks to Karolus Catur Setyo Noviyanto who helped this research.

REFERENCES

[1]. http://dinkes-sulsel.go.id/new/images/pdf/Peraturan/kmk%20syarat%20dan%20pengawasan%20kualitas%20air%20minum%20907-2002.pdf, was accessed on Dec 4th, 2012.

[2]. http://lib.uin-malang.ac.id/thesis/fullchapter/03540019-nia-faricha.pdf, was accessed on Nov 1st, 2012, unpublished

[3]. Singh, R.M., Mustafa, R., Ahemad, R., "Development of Microcontroler Based Instrument for Measuring Iron Content in Water", International Journal of Engineering and Innovative Technology (IJEIT), Volume 2, Issue 4, October 2012

[4]. Skoog, D.A., Leary, J.L. 1992. Principles of Instrumental Analysis. Fort Worth: Saunders College Publishing.

[5]. Harris, D.C. 1999. Quantitative Chemical Analysis. New York: W.H. Freeman and Company.

The Application of Spectrophotometry Method for Measuring Iron Content of Groundwater after Merapi Mountain Eruption

ORIGINALITY REPORT

7%	6%	5%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	repository.usd.ac.id Internet Source	1%
2	archive.org Internet Source	1%
3	btkljogja.or.id Internet Source	1%
4	toc.proceedings.com Internet Source	1%
5	Sumarno, Linggo. "Handwritten word segmentation using Kaiser window", 2013 International Conference on QiR, 2013. Publication	1%
6	www.neliti.com Internet Source	1%
7	es.scribd.com Internet Source	<1%
8	Agustinus Rudatyo Himamunanto, Anastasia Rita Widiarti. "Javanese character image	<1%

segmentation of document image of Hamong Tani", 2013 Digital Heritage International Congress (DigitalHeritage), 2013
Publication

9	catatanmahasiswakupukupu.blogspot.com Internet Source	<1%
10	M. C. García-Parrilla, A. B. Cerezo, W. Tesfaye, A. M. Troncoso. "Phenolic Compounds as Markers for the Authentication of Sherry Vinegars: A Foresight for High Quality Vinegars Characterization", American Chemical Society (ACS), 2011 Publication	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	Off		