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Research Article

An Analytical Study on Cr (VI) Ion Concentration in the Well Water of Citarum River Neighborhood Residents

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ABSTRACT

An alarming level of contamination of the water in the Citarum river has been caused by activities associated with the textile industry in Bandung. Despite the fact that the water from this river is the primary supply for the town. The presence of metals with a Cr (VI) content in industrial waste may have hazardous consequences on the community in the surrounding area. Because of the metal's high solubility, there is a concern that it will make its way into the well water of residents living in the area surrounding the river. The objective of this research is to ascertain the content of Cr (VI) that is present in the water of residents living in the area around the Citarum river basin. We collected several water samples from Pangauban Village RW 05 in Katapang, which is obtained in the Bandung Regency. The method that was utilised was a descriptive method that utilised Atomic Absorption Spectrophotometry (AAS) by taking 10 well water samples, specifically 4 well water samples that were located 10-30 metres away from the river body, 3 well water samples that were located 30-60 metres from the river body, 3 well water samples that were located 60-100 metres away from the river body. Based on the findings, it was determined that R1 showed a certain content of Cr(VI). The investigation showed that ten of the well water samples tested positive for the presence of Cr (VI), with four of the wells having levels of Cr (VI) that were higher than the maximum threshold and the other six wells having levels of Cr (VI) that were still below the maximum limit.

Keywords: Chromium (VI), Heavy Metals, River Pollution, Well Water

Introduction

Water is one of the most essential components of a healthy human life. Therefore, water sources are required to be able to support a life that is both abundant and of high quality. Surface water, ground water, rainfall are the three main categories that contribute to the overall water of potable water in Indonesia. River water and lake water are two types of surface water that may be found (Tumanggor, Dharma and Marsaulina, 2012; Andini, 2017). One of the most significant sources where water may be found is in the river. Rivers in certain underdeveloped nations, such as Indonesia, serve several purposes, including that of a garbage dump and a location to dispose of human waste. Additionally, these rivers are used for bathing, washing clothing, even washing cooking utensils (Sulistyorini, Edwin and Arung, 2013; Herlambang, 2006). The presence of rivers may also make it possible for humans to support out various tasks. Typically, communities that are located close to rivers have accelerated advancement in a variety of industries, including industry (Susana, 2003). The Citarum River, which flows through Bandung in West Java, is an example of a river in Indonesia that plays this role.

Bandung, Indonesia's textile industry is continuing to undergo extremely fast development in recent years. Regrettably, the development of this industry is not being supported by effective monitoring in any way. Industry participants have been encouraged to dump their waste into the Citarum River as a result of the high level of industrial activity and the inadequate waste treatment facilities in the area. Despite the fact that the river serves as the primary supply of drinking water for the people who reside in the watershed, The fact that the discarded waste turns out to contain substances that are extremely hazardous to human health and the environment is cause for waste (Irhamni, Pandia, Purba, Hasan, 2017; Kocasoy and Güvener, 2008). Toxic and hazardous waste (B3) is another name for waste that contains substances that are The disposal of industrial waste at facilities such as "refineries, fertilisers, pesticides, metallurgy, iron and steel, leather working, photography, manufacturing of electrical equipment, metal surface treatment, wastewater treatment plants" is a direct source of pollution. Other indirect sources include: (Olukanni, Agunwamba, dan Ugwu, 2014).

Waste products from the textile industry typically include the heavy metal chromium (VI), which plays an important role in the colouring of clothing. In addition to that, waste liquid from the textile industry may include high concentrations of the heavy metals zinc, lead, nickel, as well as organic halogen (Malik, Surakusumah, Surtikanti, 2016). Chromium compounds are both nephrotoxic and carcinogenic, so of course this presents a significant health risk (Abdi and Kazemi, 2015). There are two distinct forms of chromium ions, which are denoted as Cr (VI) and Cr (III). The distinctions between these two forms are rather glaring. The heavy metal chromium (VI) has a toxicity that is much higher than that of chromium (III) (Rudibyani et al, 2020). It is mentioned in the Decree of the State Minister of the Environment that has the number Kep 03 / MENKLH / 11/1991 that the maximum total chrome content that is permitted in waterways is 0.1 ppm, while the chrome content (VI) is 0.05 ppm. This information can be found in the document. This demonstrates that even a trace amount of chromium (VI) may have a negative impact on the surrounding environment. The solubility of Cr (VI) is quite high, much higher than that of Cr (III) (Rudibyani, et al, 2020). This raises worries about the potential for Cr (VI) to be present in the well water of residents who live in the area near the river.

When present in high enough concentrations, this metal is known to cause problems for the kidneys, as well as the skin, blood vessels, respiratory system. Chromium increases the risk of developing lung cancer and persistent ulcers or perforations in the nasal septum in the respiratory system (Adhani and Husaini, 2017). Influence on the skin, namely in the form of persistent ulcers on the top surface of the skin. It is believed that the blood vessels increase the risk of plaque becoming thicker in the aortic vessels. On the other hand, renal tubular necrosis is a form of abnormality that may occur in the kidney (Adhani and Husaini, 2017). In humans, exposure to high levels of chromium compounds may cause inhibition of erythrocyte glutathione reductase, which in turn lowers the ability to eliminate methemoglobin with haemoglobin. This can have serious health consequences (Koutras et al, 1965; Adhani and Husaini, 2017). Chromate compounds can cause DNA damage in a variety of ways, including the formation of DNA adducts, chromosomal aberrations, chromatite exchange, changes in replication and transcription of DNA, according to the findings that were obtained from a number of different experiments that were conducted in vitro and in vivo (Adhani and Husaini, 2017).

Atomic Absorption Spectrophotometry, sometimes known as AAS, is a method that may be used to determine the content of chromium (VI) metal present in water. The method of quantitative elemental analysis known as atomic absorption spectrophotometry (AAS) bases its measurements on the free metal atoms' ability to absorb light of certain wavelengths (Aprilia, Rahayu and Ayu, 2015). In the method of metal analysis, the method known as atomic absorption spectrophotometry (AAS), which is sometimes known simply as AAS, is the most widely used method because, in analysis to its ease of use, it is also highly selective and very sensitive (Kumalawati, 2016; Rosita and Sosmira, 2017). In addition, this instrument has other benefits, like increased specificity, decreased detection limits, the capability to analyse additional components within the same solution (Aprilia, Rahayu and Ayu, 2015).

Research Method

A descriptive method is used in this kind of research that is carried out by researchers. A method known as descriptive research is one that depicts or provides a description of the thing that is going to be evaluated via sample data or population (Sugiyono, 2015; Notoatmojo, 2012; Yusuf, 2015). This research was carried out on a smaller scale in a laboratory using an experimental approach. Residents of Pangauban Village, which is obtained in West Bandung Regency and is known for having a high degree of river pollution, had their wells sampled in order to collect representative samples from the area. Purposive sampling was used as the method of sampling in this investigation.

The consideration of samples was determined by taking into account the distance of the well to the river body. In addition to this, one must also take into account the presence of industrial activities in the surrounding region. The number of samples collected is ten, they were taken from a variety of locations and then divided into three distinct regions. The ratio of the samples collected is four to three to three, with the intention that four of the wells are located between 10 and 30 metres away from the river, three of the wells are located between 30 and 60 metres away from the river, three of the wells are located between 60 and 100 metres away from the river. The research data were obtained from primary data, which were produced from the outcomes of measurements of chromium (VI) levels using Atomic Absorption Spectrophotometry (AAS) at a wavelength of 357.9 nm.

Preparation of the Test Solution

The sample of water from the well is put into a beaker that may hold up to 500 millilitres of liquid. After that, it goes through a filtration process so that it may be separated from the soil. The filtrate received an additional 10 millilitres of nitric acid.

Make a Standard Solution Curve

The standard solution is created by dissolving K2Cr2O7 crystals in order to form a standard series solution with a concentration of 2 mg/ L, 4 mg/ L, 6 mg/ L, 8 mg/ L, 10 mg /L. These concentrations are used to determine the value of the standard solution. After that, an atomic absorption spectrophotometry test was performed at a wavelength of 357.9 nm on this standard series solution. After plotting the absorbance and concentration values to form a standard curve, a straight line equation is obtained as a result of this process. With the use of this equation, one can calculate the concentration of Cr (VI) present in the given sample.

Result and Discussion

Standard Solution Curves

Before determining the amount of the heavy metal chromium(VI) that is present in the well water, one must first determine the absorbance value of the standard solution. This content is then provided in the form of a calibration curve. This measurement is based on research that determined the absorbance value and the standard curve of Chromium(VI) solution. At a wavelength of 357.9 nm, measurements of absorbance or concentration are done using atomic absorption spectrophotometry, also known as AAS. These measurements are based on a series of solutions. Table 1, demonstrates the presentation of absorbance findings that have been obtained from five rows of standard solutions with varied concentrations at a wavelength of 357.9 nm.

Table 1.Absorbance Value of Cr (VI) Standard Solution

Concentration (ppm)	Absorbance
0.0	0.0000
2.0	0.0371
4.0	0.0730
6.0	0.1188
8.0	0.1534
10	0.2020

Table 1, contains the absorbance data that was derived from the measurement results of five series of standard Chromium (VI) solutions with concentrations of 0.0, 2.0, 4.0, 6.0, 8.0, 10 ppm. These measurements were carried out using Atomic Absorption Spectrophotometry (AAS), the wavelength used was 357.9 nm. The absorbance results are higher when the value of the concentration of the standard solution is increased; the standard solution with a concentration of 10 ppm has the greatest absorbance value, which is 0.2020. The absorbance results are lower when the value of the concentration is decreased. From the measurements of the standard series, then poured into the calibration curve using the straight line equation y = ax + b (see Figure 1), where y is the absorbance value and x is the concentration.

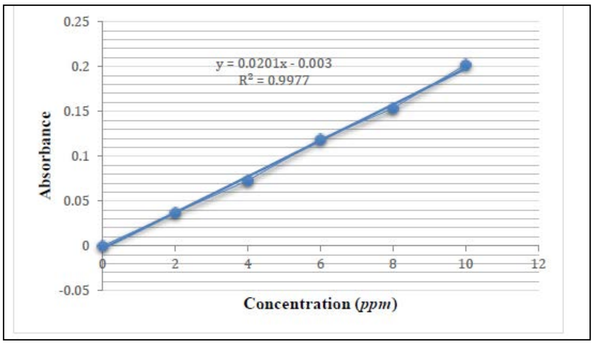

Figure 1.Standard Curve of Chromium Solution (VI)

The linearity test involves the determination of regression R2 from the calibration curve standard, which is where the correlation coefficient is obtained. By channelling the absorbance value of the standard Chromium (VI) solution and the concentration of the Chromium (VI) standard series, we were able to derive the line equation that is obtained in Figure 1. The values of the correlation coefficient point to the existence of a robust connection between the concentration of the solution (located on the x-axis) and absorbance (y-axis). The value of the regression coefficient R_2 was obtained to be 0.9977, which indicates that the value of R_2 is very close to ideal, the equation that was produced as a result is suitable for use in the determination of Chromium

(VI) levels in community well water samples taken near the Citarum River in Pangauban Village RW 05, Katapang, Bandung Regency. Atomic absorption spectrophotometry (AAS) was used as the method for chromium (VI) level inspection procedures in community well water samples located all around the Citarum River in Pangauban Village RW 05, Katapang, Bandung Regency. The equation of the line that may be obtained on the standard solution curve is y = 0.016x - 0.0003.

Levels of Cr (VI) in Well Water

At a wavelength of 357.9 nm, the levels of Cr (VI) in the samples were measured. These measurements were carried out. In order to calculate the concentration of Cr (VI), the obtained value of absorbance is first replaced into the equation y = 0.016x - 0.0003, which may be obtained here (see Table 2). In most cases, the given concentration values do not follow any discernible pattern. It is possible for Cr (VI) to be absorbed into well water when the site of the well is adjacent to a river since Cr (VI) has a high solubility (Rudibyani et al, 2020). With regard to the concentration of Cr (VI), a pattern of interaction should be developed between the wells and the rivers. On the other hand, the data shown in Table 2 shows the inconsistent lifting concentration. This shows that the capability of filtering dirt varies depending on the situation.

Table 2.Data from the Measurement of Concentration of Chromium (VI) in Well Water

No	Sample	Distance (m)	Concentration (ppm)
1	R1	10-30	0.101
2	R2	10-30	0.090
3	R3	10-30	0.023
4	R4	10-30	0.021
5	R5	30-60	0.022
6	R6	30-60	0.145
7	R7	30-60	0.008
8	R8	60-100	-0.027
9	R9	60-100	0.176
10	R10	60-100	-0.024

The level of Cr (VI) in the well water of the community located near the Citarum River was measured to be 0.101 ppm, 0.090 ppm, 0.023 ppm, 0.021 ppm. These results were obtained from four samples taken between 10 and 30 metres away from the river. There is a possibility that the range of sample values R1 and R2 will be higher than this threshold because of the presence of chromium (VI) metal contamination, which is thought to have come from the citarum river. The close proximity of the community's well water and the citarum river, both potential sources of chromium (VI), may influence a role in the elevation of chromium levels. There were a total of three well water samples taken between 30 and 60 metres away from the river, the results were 0.022 ppm, 0.145 ppm, 0.008 ppm. The threshold is not met by the range of sample values represented by R6. Because the R6 well is situated in location to a textile industry facility, the overall level of pollution is greater. Then, a total of three samples of well water were taken at a distance of sixty to one hundred metres from the river, the results obtained were -0.027 ppm, 0.176 ppm, -0.024 ppm, respectively, with a range of sample values R9 that above the threshold. The near vicinity to the textile industry, which is likely to promptly dispose of waste without first having it treated, is the probable cause of the high level of R9 in the area, which is 0.176 parts per million. As a result, the area's inhabitants' well water is instantly polluted. In the meanwhile, the fact that the value of R8 and R10 obtained was less than the results indicates that there is no Cr (VI). It is said that this is due to the fact that the residents' well water has a healthy soil structure, which allows it to influence the process of chromium (VI) metal absorption and so reduces the amount of water contamination. The typical return from tests that assess chromium (VI) levels is 0.0316 chromium (VI) levels that are higher than the threshold level. According to the Decree of the State Minister of the Environment No Kep 03 / MENKLH / 11/1991, the maximum level of total chromium that is permitted to be present in water is 0.1 ppm, while the content of chromium (VI) is 0.05 ppm. This information may be found in the document. Chromium (VI) levels may be affected by a number of factors, including the presence of turbid water in the citarum river and the fact that the river is receding, as well as the positioning of residential neighborhoods in close location to the textile industry.

Conclusion

According to the data of some research, part of the community well water in Pangauban Village is unfit for human consumption. This is due to the fact that the concentration of Cr (VI) is still higher than the value that constitutes the threshold. There were ten samples taken from well water that included Cr (VI), four of which were over the maximum threshold, while the other six wells were still below the maximum level.

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