



ANALYSIS OF CHROMIUM (Cr) AND IRON (Fe) IN SEVERAL WELL WATER IN KAMPUNG BATIK KAUMAN SURAKARTA USING ATOMIC ABSORPTION SPECTROPHOTOMETRY (AAS)

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<p>Info Article</p> <p>Received : 02 Oktober 2025</p> <p>Revised : 01 November 2025</p> <p>Accepted : 02 Desember 2025</p> <p>Publication : 30 Desember 2025</p>	<p>Abstract: <i>Water is a fundamental necessity for life, as all living organisms depend on it for survival. Industrial wastewater such as that generated from leather, paper, textile, and batik industries may contain chromium and iron used as dyes, which can pose serious health risks if they enter the human body. The experiment was aimed to find out whether there were chromium and iron in well water at Batik Village Kauman Surakarta, and to know whether the contents of chromium and iron do not exceed the maximum limit. The experiment was done by Atomic Adsorption Spectrophotometry, because this method could analyze the elements precisely and accurately. The sample was acidified with HNO₃ concentrated before analyzed & then put into beaker glass & evaporated, & removed into volumetric flask & added with bi-distilled water up to the mark. The result of the experiment showed that all samples of well water did not contain chromium, but they contained iron. The iron content in sample A = (0.1821±0.0303) ppm; sample B = (0.1251 ± 0.0108) ppm, sample C = (0.6364 ±0.2394) ppm. The contents of iron in the three well water samples fulfill the requirements of Indonesian National Standard No. 01-0220-1987.</i></p>
<p>Keywords: Water, Chromium and iron contents, Atomic Adsorption Spectrophotometry.</p> <p>Kata Kunci: Air sumur, Kadar kromium dan besi, Spektrofotometri Serapan Atom</p>	
<p>Licensed Under a Creative Commons Attribution 4.0 International License</p> 	<p>Abstrak: Air merupakan kebutuhan pokok bagi kehidupan karena seluruh makhluk hidup memerlukannya untuk kelangsungan hidup. Limbah cair industry seperti dari industri kulit, kertas, tekstil, dan batik dapat mengandung kromium dan besi yang digunakan sebagai zat pewarna serta berpotensi berbahaya apabila masuk ke dalam tubuh. Penelitian ini bertujuan untuk mengetahui ada tidaknya kandungan kromium & besi dalam air sumur di Kampung Batik Kauman Surakarta, mengetahui kadar kromium dan besi sehingga dapat diketahui kadar tersebut tidak melebihi batas maksimum. Penelitian dilakukan dengan menggunakan metode spektrofotometri serapan atom, karena dapat menganalisis unsur dengan tepat dan akurat. Sampel di analisis di asamkan dengan HNO₃ pekat. Sampel yang telah di asamkan dimasukkan dalam beaker glass dan diuapkan, kemudian dipindahkan dalam labu takar & ditepatkan dengan aquabidestilata. Hasil penelitian menunjukkan bahwa semua sampel air sumur tidak mengandung logam kromium tetapi mengandung logam besi. Kadar besi sampel A = (0,1821 ±0,0303) ppm, sampel B =(0,1251 ± 0,0108) ppm, sampel C = (0,63364 ±0,2394). Kadar besi dalam tiga sampel air minum memenuhi persyaratan yang ditetapkan oleh Standar Nasional Indonesia No 01-0220-1987.</p>

INTRODUCTION

Water is an essential resource and a fundamental requirement for all living organisms. In recent years, water quality has become a critical issue that demands serious and comprehensive attention. Access to clean water that meets established quality standards has become increasingly limited and costly due to widespread contamination from various sources of waste generated by human activities, including domestic, industrial, and other anthropogenic processes (Wisnu, 2004). The number of industries discharging wastewater into surrounding water bodies continues to increase, contributing significantly to water pollution. Such discharges adversely affect aquatic ecosystems by disrupting the survival of fish, microorganisms, and other aquatic organisms. Furthermore, this contamination reduces the suitability of water for public uses, including recreational and commercial facilities, and renders it unfit as a source of potable water. In addition, polluted water is unsuitable for industrial applications (Mahida, 1984).

Chemical contaminants present in water pose serious health risks to communities consuming contaminated water. These substances may accumulate in the human body over prolonged periods and induce adverse physiological effects. Due to their cumulative and persistent nature, such contaminants are often not readily metabolized or eliminated, thereby acting as cumulative toxins (Sunu, 2001). Consequently, systematic monitoring and control of liquid waste discharges are necessary to minimize potential health and environmental impacts. In the textile industry, chromium and iron are commonly used as coloring agents. However, exposure to these metals may have harmful biological effects. Chromium and its compounds can interact with various biological components within the body, potentially disrupting metabolic functions. Iron toxicity may increase capillary permeability, leading to plasma leakage, reduced blood volume, tissue hypoxia, and, ultimately, metabolic acidosis. According to the Indonesian National Standard (SNI) No. 01-0220-1987 for drinking water quality, the maximum permissible concentration of chromium is 0.05 ppm. For iron, the recommended concentration is 0.1 ppm, while the maximum allowable concentration is 1.0 ppm. Therefore, reliable analytical methods are required to monitor the presence and quantify the levels of chromium and iron contamination in well water sources. This study aims to determine the presence of chromium and iron in well water samples collected from Kampung Batik Kauman, Surakarta, and to quantify their concentrations to ensure compliance with the established maximum permissible limits.

METHOD

The study was conducted using Atomic Absorption Spectrophotometry (AAS), which provides precise and accurate elemental analysis. Before analysis, the samples were acidified with concentrated nitric acid (HNO₃) to preserve the metals and ensure complete dissolution. The acidified samples were then transferred into a glass beaker and evaporate duce the volume. Subsequently, the residues were quantitatively transferred into a volumetric flask and diluted to the mark with distilled water to obtain the final solution for analysis.

RESULT AND DISCUSSION

Results

Qualitative Sample Analysis

Qualitative analysis was performed using Atomic Absorption Spectrophotometry (AAS) by employing hollow cathode lamps specific to each target element. Each lamp was operated sequentially according to the suspected element present in the sample. The presence of a particular element was confirmed when the sample exhibited absorbance at the characteristic wavelength emitted by the corresponding hollow cathode lamp. Iron (Fe) was detected at its specific analytical wavelength of 248.3 nm, indicating the presence of iron in the sample.

Quantitative Sample Analysis

1. Preparation of the Chromium (Cr) Calibration Curve

Quantitative analysis of chromium was carried out using the calibration curve method. Standard solutions were prepared from a 1000 ppm chromium stock solution, followed by a series of dilutions to obtain working standards at various concentrations. Each standard solution was then measured for its absorbance using Atomic Absorption Spectrophotometry (AAS) under the specified analytical conditions. The corresponding concentrations and absorbance values were used to construct the calibration curve, as presented in Table 1.

Table 1. Absorbance of chromium (Cr) standard solution by atomic absorption spectrophotometry

No	Concentration (ppm)	Absorbance
1.	1,25	0,039
2.	2,50	0,078
3.	5,00	0,145
4.	7,50	0,211
5.	10,00	0,268

The calibration curve calculations yielded the following data:

$$a = 0,079953658$$

$$b = 0,003810731707$$

$$r = 0,176430024$$

$$Y = a + bx$$

$$Y = 0,079953658 + 0,003810731707.X$$

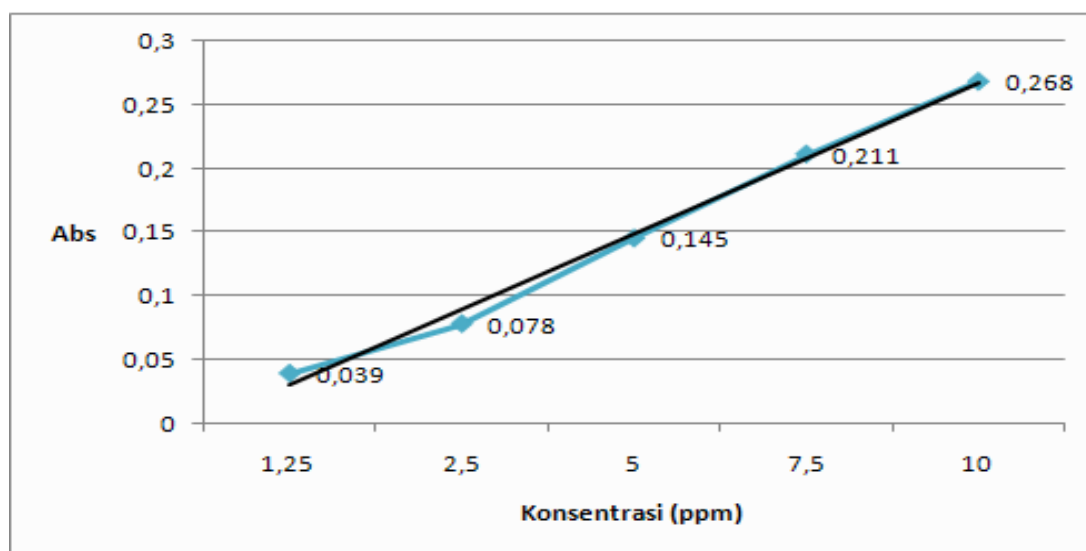


Figure 1. Chromium (Cr) calibration curve

2. Preparation of the Iron (Fe) calibration curve

Standard solutions were prepared from a 1000 ppm stock solution, then a series of standard solutions was prepared for the iron (Fe) to be studied, with concentrations and absorbances as shown in Table 2 below.

Table 2. Absorbance of iron (Fe) standard solution by atomic absorption spectrophotometry

No	Concentration (ppm)	Absorbance
1.	1,25	0,030
2.	2,50	0,066
3.	5,00	0,152

The calibration curve calculations yielded the following data:

$$a = -0,013$$

$$b = 0,0328$$

$$r = 0,999108866$$

$$Y = a + bx$$

$$Y = -0,013 + 0,0328 X$$

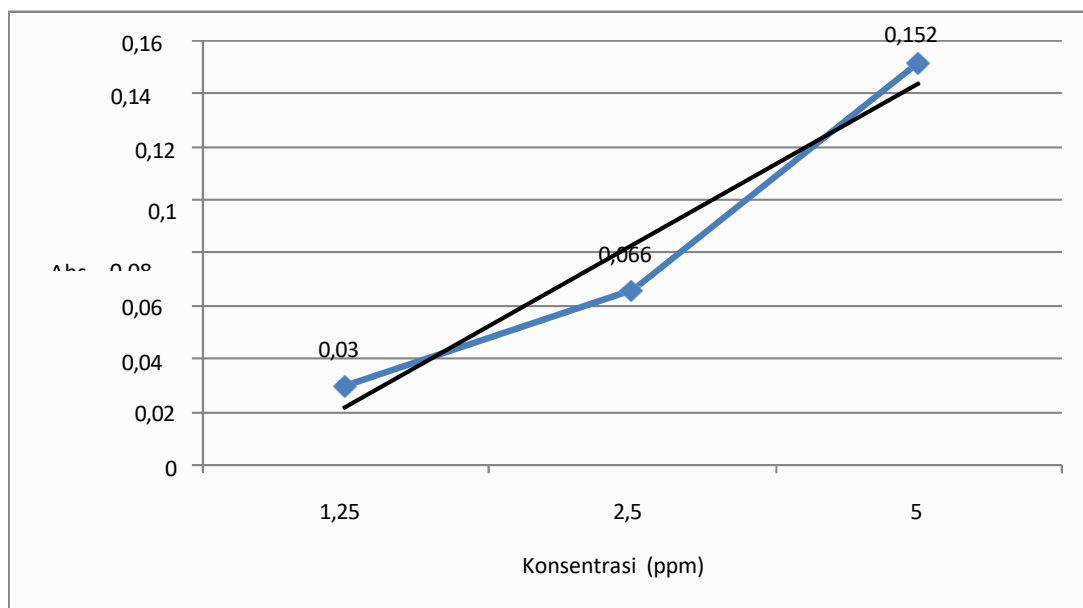


Figure 2. Iron (Fe) calibration curve

Based on the analysis that has been carried out, the levels obtained for each measured absorption are shown in Figure 3.

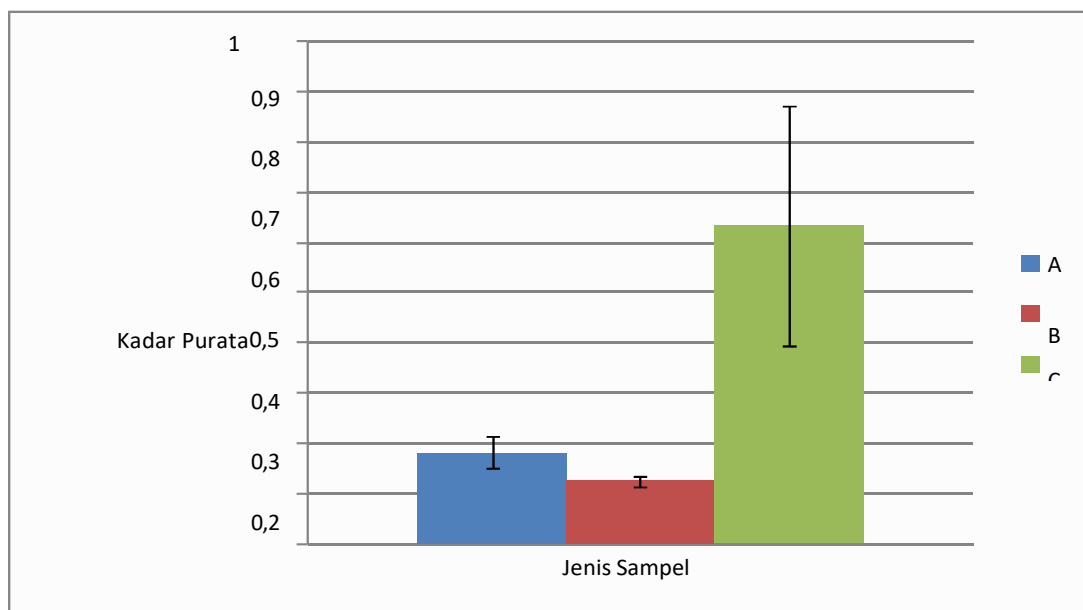


Figure 3. Curve of average iron content (Fe)

Well water in Kauman Batik Village, Surakarta, does not contain chromium (Cr) but does contain iron (Fe). The iron content in the well water samples was: Sample A: Iron content 0.1821 ± 0.0303 ppm; Sample B: Iron content 0.1251 ± 0.0108 ppm; Sample C: Iron content 0.63364 ± 0.2394 ppm. The chromium and iron levels in several well water samples in Kauman Batik Village meet the requirements set by Indonesian National Standard No. 01-0220-1987.

CONCLUSION

Based on the research results, it can be concluded that well water in Kauman Batik Village, Surakarta, does not contain chromium (Cr) but does contain iron (Fe). The iron content in the well water samples was: Sample A: Iron content 0.1821 ± 0.0303 ppm; Sample B: Iron content 0.1251 ± 0.0108 ppm; Sample C: Iron content 0.63364 ± 0.2394 ppm. The chromium and iron levels in several well water samples in Kauman Batik Village meet the requirements set by Indonesian National Standard No. 01-0220-1987.

REFERENCES

- Alaerts, G., & Santika, S. S. (1987). METODA PENELITIAN AIR. Usaha Nasional.
- Bambang, T. (2007). LIMBAH CAIR INDUSTRI SERTA DAMPAKNYA TERHADAP KUALITAS AIR TANAH DANGKAL DI DESA GUMPANG KECAMATAN KARTASURA [Skripsi, Universitas Sebelas Maret].
- Darmono. (1995). LOGAM DALAM SISTEM BIOLOGI MAKHLUK HIDUP. Universitas Indonesia Press.
- Darmono. (2001). LINGKUNGAN HIDUP DAN PENCEMARAN HUBUNGANNYA DENGAN TOKSIKOLOGI SENYAWA LOGAM. Universitas Indonesia Press.
- Gandjar, I. G. (1991). KIMIA ANALISIS INSTRUMENTAL. Universitas Gadjah Mada Press.
- Harmita. (2006). ANALISA KUANTITATIF BAHAN BAKU DAN SEDIAAN FARMASI. Universitas Indonesia Press.
- Khopkar, S. M. (1990). KONSEP DASAR KIMIA ANALITIK (A. Saptorahardjo, Trans.). Universitas Indonesia Press.
- Mahida, U. N. (1984). PENCEMARAN AIR DAN PEMANFAATAN LIMBAH INDUSTRI. Prima.
- Mukono, H. J. (2000). PRINSIP DASAR KESEHATAN LINGKUNGAN. Airlangga University Press.
- Palar, H. (1994). PENCEMARAN DAN TOKSIKOLOGI LOGAM BERAT. Rineka Cipta.
- Pujiastuti, P. (2003). HUBUNGAN ANTARA KUALITAS AIR LIMBAH INDUSTRI BATIK DENGAN KUALITAS AIR TANAH DANGKAL PADA

KAWASAN SENTRA INDUSTRI BATIK SURAKARTA [Tesis, Universitas Sebelas Maret].

- Purwaningsih, I. (2008). PENGOLAHAN LIMBAH CAIR INDUSTRI BATIK CV. BATIK INDAH RARADJONGGRANG YOGYAKARTA DENGAN METODE ELEKTROKOAGULASI DITINJAU DARI PARAMETER CHEMICAL OXYGEN DEMAND (COD) DAN WARNA [Skripsi, Universitas Islam Indonesia].
- Sartono. (2002). RACUN DAN KERACUNAN. Widya Medika.
- Slamet, J. S. (2002). KESEHATAN LINGKUNGAN. Universitas Gadjah Mada Press.
- Sudjono, S., Mauludin, D., Mulya, B. N., Sujarwo, Rofik, A., Mahfud, & Hayatman. (1994). PELAJARAN GEOGRAFI 1 UNTUK KELAS 1 SMU. Yudhistira.
- Sumardi. (1988). KURSUS METODA ANALISA KIMIA INSTRUMENTAL DAN APLIKASINYA. Puslitbang Kimia Terapan.
- Sunu, P. (2001). MELINDUNGI LINGKUNGAN DENGAN MENERAPKAN ISO 14001. Grasindo.
- Wardiyatmoko. (1994). GEOGRAFI SMU JILID 1. Erlangga.
- Wisnu, A. P. (2004). DAMPAK PENCEMARAN LINGKUNGAN. Universitas Gadjah Mada Press.