

Analysis of the Copper (Cu), Chromium (Cr), and Manganese (Mn) Levels from the Steel Industry Liquid Waste by Atomic Absorption Spectrophotometry Method

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Abstract. Liquid waste from the steel industry processing, washing machine, and kitchenware foundry that is disposed containing copper (Cu), chromium (Cr) and manganese (Mn) elements which is harmful to environmental. The levels of elemental copper (Cu), chromium (Cr), and manganese (Mn) were analyzed using Atomic Absorption Spectrophotometry (AAS) method. The effluent samples were destructed with the addition of concentrated HNO₃. Then determining of the concentration of the element copper (Cu), chromium (Cr) and manganese (Mn) using Atomic Absorption Spectrophotometer with a calibration curve. The obtained results for the levels of copper (Cu) on the inlet samples were 0.9714 mg/L - 0.9719 mg/L, the outlet samples were 3.9990 mg/L - 4.0002 mg/L. Hence, the levels of the element chromium (Cr) on inlet samples were 0.0295 mg/L - 0.0297 mg/L, the outlet samples were 0.0399 mg/L - 0.0400 mg/L and the levels of manganese (Mn) in the inlet samples were 0.1269 mg/L - 0.1271 mg/L in a outlet samples were 2.9699 mg/L - 2.9701 mg/L. Then the steel industry wastewater for elemental copper (Cu) and manganese (Mn) has exceeded the limits that have been instituted by the Minister of Environment Decree No. 51, 1995, about the Liquid Waste Quality Standard for Industrial Activity.

Keywords: Copper, Chromium, Manganase, Liquid Waste Steel Industry, Atomic Absorption Spectrophotometry..

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1 Introduction

Indonesia's economic development leads to industrialization. There are no less than 30,000 industries operating in Indonesia from year to year showing an increasing. This number increasing has the impact of the industrialization, namely the increase in pollution resulting from industrial production processes. The water, air, soil pollution and disposal of hazardous and toxic waste (B3) is a problem that must be faced by communities living around industrial

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areas (<http://ringkasan-hendynura.blogspot.com/2012/10/analisis-dampak-lingkungan-amdal.html>).environmental-amdal.html).

According to the Decree of the State Minister for the Environment Number: KEP-51/MENLH/10/1995 concerning Liquid Waste Quality Standards for Industrial Activities. Article 1 point 3 that is meant by liquid waste is waste in liquid which is produced by industrial activities and discharged into the environment and suspected of degrading the quality of the environment.

The metal industry for household purposes produces a small amount of pickling liquid which cannot be processed at the factory site and requires special processing. The toxic effects of heavy metals can block the work of enzymes thereby disrupting the body's metabolism, causing allergies, being mutagenic, teratogenic or carcinogenic to humans and animals. (Widowati, W, 2008).

The use of Atomic Absorption Spectrophotometer (AAS) analysis has the advantage of very sensitive analysis results (detection limit of less than 1 ppm), little interference, effective and efficient, selective, specific, relatively inexpensive analysis cost, can easily make matrices according to standard, the analysis time is very fast and easy to do. The process is relatively simple and there is no need to separate metal elements in its implementation. It is very appropriate for the analysis of substances at low concentrations (Khopkar, SM, 1990).

Copper (Cu) is pink and malleable; is also required by humans in small amounts. In contrast, it will be toxicity if the amount exceeds the limit (Widowati, W, 2008). Chromium (Cr) is a gray metal, an element found in everyday life and is an essential element for humans and animals at low concentrations. Chromium (II), chromium (III) and chromium (IV) or known as hexavalent chromium and toxic to humans. (Stoepler, M. 1992)

Manganese (Mn) and iron (Fe) which are oxidized in water are brownish and insoluble, causing limited use of water. The water cannot be used for household and industrial purposes because of both types of materials are derived from rock solutions containing Mn and Fe compounds. Water containing solid solution has the property of conducting electricity and this accelerates corrosion (<http://www.artikelbagus.com/2012/01/limbah-metal-berat.html>).

Based on the description above, the authors are interested to conduct research about Analysis of Copper (Cu), Chromium (Cr) and Manganese (Mn) Elements from Steel Industry Liquid Waste Using Atomic Absorption Spectrophotometry (AAS) Method.

2 Materials and Methods

2.1 Materials

In this study, the steel industry wastewater was collected from steel industry located in North Sumatra Province. The nitric acid (HNO₃) was purchased from Sigma-Aldrich, Germany.

2.2 Procedure

In this study, the destruction stage used is wet destruction which a total of 100 mL of sample was put into a beaker glass then 5 mL of HNO₃ was added and then heated until the solution was almost dry. After that, 50 mL of distilled water was added and then put into a 100 mL of volumetric flask through filter paper, then diluted with diluent solution up to the boundary line and stirred until homogeneous. Furthermore, the copper (Cu), chromium (Cr) and manganese (Mn) element levels was determined using an Atomic Absorption Spectrophotometer (AAS) (SNI 6989.16.2009).

3 RESULT AND DISCUSSION

The absorption measurements results of standard series solutions of elements copper (Cu), chromium (Cr) and manganese (Mn)

Tabel 1. Calculation results of elemental copper (Cu) levels from steel industry liquid waste

No	Week	Copper (Cu) Levels (mg/L)	
		Inlet	Outlet
1	I	0.9719	4.0010
2	II	0.9715	3.9993
3	III	0.9714	3.9990

Tabel 2. Calculation results of elemental chromium (Cr) levels from steel industry liquid waste

No	Week	Chromium (Cr) Levels (mg/L)	
		Inlet	Outlet
1	I	0.0295	0.0400
2	II	0.0297	0.0401
3	III	0.0297	0.0399

Tabel 3. Calculation results of elemental manganese (Mn) levels from steel industry liquid waste

No	Week	Manganese (Mn) Levels (mg/L)	
		Inlet	Outlet
1	I	0.1271	2.9701
2	II	0.1269	2.9699
3	III	0.1269	2.9700

Based on the table results, it can be seen that in the first week, the elemental copper (Cu) levels in the inlet sample was 0.9719 mg/L, the second week was 0.9720 mg/L and the third week was 0.9715 mg/L, while the chromium (Cr) in the inlet sample in the first week was 0.0295 mg/L, in the second week was 0.0297 mg/L and in the third week was 0.0297 mg/L, and the manganese (Mn) levels in the first week inlet sample was 0.1270 mg/L, the second week was 0.1269 mg/L and the third week was 0.1269 mg/L. Elemental copper (Cu) level in the first week's outlet sample was 4.0010 mg/L, the second week was 4.0011 mg/L and the third week was 3.9970 mg/L. Elemental chromium (Cr) level in the first week's outlet sample was 0.0403 mg/L, the second week was 0.0401 mg/L and the third week was 0.0403 mg/L. Meanwhile, the manganese (Mn) element in the first week outlet sample was 2.9700 mg/L, the second week was 2.9699 mg/L and the third week was 2.9702 mg/L.

Eka Putra (2002) reported that some steel industry wastewater in Medan obtained an average elemental content of copper (Cu) 0.01 mg/L – 0.35 mg/L and an average element of chromium (Cr) 0.16 mg/L – 0.01 mg/L. that the levels of copper (Cu) and chromium (Cr) have exceeded the predetermined threshold while the levels of manganese (Mn) have not exceeded the predetermined threshold value. This is because there are some factories that do not yet have a Wastewater Treatment Plant (IPAL).

Based on the results of observations of copper (Cu) and manganese (Mn) levels from the first, second and third weeks originating from the outlet wastewater, it was found that it had passed the Decree of the Minister of Environment No. 51 of 1995 concerning Liquid Waste Quality Standards for industrial activities, namely 2 mg/L for copper (Cu), 2 mg/L for manganese (Mn), while in the outlet sample the element chromium (Cr) did not exceed the threshold set by the Decree of the Minister of the Environment No. 51 of 1995 concerning Waste Quality Standards Liquid, namely 0.5 mg/L, because the chromium element used by industry is not too much needed in the steel industry production process.

4 Conclusion

In conclusions, it was found that the elemental levels of copper (Cu) in the inlet samples were 0.9714 mg/L - 0.9719 mg/L. Elemental copper (Cu) levels in the outlet sample were 3.9990 mg/L - 4.0002 mg/L. Elemental chromium (Cr) level in the inlet sample was 0.0295 mg/L- 0.0297 mg/L. The elemental chromium (Cr) level in the outlet sample was 0.0399 mg/L – 0.0401 mg/L, while Manganese (Mn) in the inlet sample was 0.1269 mg/L - 0.1271 mg/L. Elemental manganese (Mn) levels in the outlet samples were 2.9699 mg/L - 2.9699 mg/L. Then the elemental levels set by the Minister of the Environment Number: KEP-51/MENLH/10/1995 concerning Liquid Waste Quality Standards for Industrial Activities are 2 mg/L for copper (Cu), and 2 mg/L for manganese (Mn).

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