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EC PHARMACOLOGY AND TOXICOLOGY
Research Article

Chromium III in Gezira Tannery Corporation Wastewater (Wad Medani, Sudan)

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Received: January 30, 2019; **Published:** February 27, 2019

Abstract

This study was initiated to investigate the level of chromium III in Gezira Tannery Wastewater and compare with the permissible limit stander for chromium III. Samples of Gezira Tannery Corporation (GTC) wastewater (WW) were collected from both the mouth and the tail of the drainage stream. These samples were analyzed to determine the concentrations of Cr using atomic absorption spectrometric (AAS) method. Results of AAS method showed high quantities of Cr III (1.85%), i.e. above the WHO permissible limit (0.0001%).

Keywords: *Chromium III; Gezira Tannery Corporation (GTC); Absorption Spectrometric (AAS)*

Introduction

The leather tanning industry is a well-known for its severe negative impact on the environment. In this industry animal hides are transformed into leather in a succession of several complex stages, consuming high quantities of water and using large amounts of chemicals such as lime, sodium sulfide, ammonium sulfate, sodium chloride, bactericides, vegetable tannins, and chrome salts, etc. Tanneries wastewaters (WW) are mainly characterized by high salinity, high organic loading, and specific pollutants, such as sulfide and chromium [1]. The tanning processes are the most contaminating to the environment mainly because of its high organic load and sulfide-content, as well as its content of inorganic salts of chloride, ammonia, chromium, and sulfate [2]. Pollution by tanneries did not receive enough attention in the Sudan. Large amount un-reacted (untreated) WW from Gezira Tannery Corporation (GTC), Wad Medani, Central Sudan, is discharged into the nearby areas, viz. the natural forest east of the tannery, which lies between the tannery and the blue Nile and Atra village. Such WW contains a percentage of chromium which this practice has resulted in a total destruction of the forest surrounding the tannery. Moreover, some of these effluents are suspected to run/drain to the Blue Nile, which is very close to the premises of the tannery.

Objective of the Study

The objective of the present work is to determine the level of chromium III in GTC wastewater and compare with the [3] WHO permissible limits.

Materials and Methods

The experiments were conducted in the Environment and Natural Resources Research Institute (ENNRI), the National Center for Research (NCR), Khartoum, the Sudan.

Sampling

Samples of WW were collected from two locations: the outlet of the stream of WW and the bond inside the previous forest which is used as an evaporation site. Samples from both locations were tested to determine the concentration of chromium.

Figure 1: *The outlet of the WW stream (Location A).*

Figure 2: *The forest (Location B).*

The collected samples were acidified at the time of collection with nitric acid (2 ml of 69 - 72% concentration) to minimize precipitation and adsorption of the chromium cat ion on the walls of the container (100 ml). Time between collection of samples and analysis was about 24 hr.

Wastewater (WW)

The determination of chromium-content in the WW was achieved by using the atomic absorption spectroscopic (AAS) method. It is widely used in water analysis field [4].

Procedure

To a 100 ml sample, 2 ml nitric acid (HNO_3; 69 - 72%) and 5 ml HCl were added; this solution was heated for 15 minutes on a hot plate, cooled slightly and filtered with suction through a sintered-glass into a clean flask. The filtrate was transferred to a 100 ml-volumetric flask. The solution was diluted to the 100 ml mark, mixed thoroughly and used directly for determination of chromium by atomic AAS model: 3110 (Perkin- Elmer Type). Data were taken directly from AAS.

Analysis of the data

The data were subjected to ANOVA analysis.

Results and Discussions

The results of chemical analysis of the WW collected from the two locations, i.e. LA and LB for the determination of the concentrations of chromium are presented in table 1. The concentration (g of Cr/100 ml; i.e. %) obtained from location (LA) at the beginning of the stream (1.85%, i.e. 18500 ppm) was higher than that detected at location (LB), i.e. the forest (0.25% = 2500 ppm; tail of stream). Both values are higher than the WHO permissible limits (i.e. 0.0001%).

Analysis	Location A (Mouth of stream; %)	Location B (Tail of stream; %)
Mean ± SE	1.85 ± 0.04	0.25 ± 0.25
C.V.%	3.61	17.44

Table 1: *Concentration of chromium III (g/ml or %) in the WW of GTC, Wad Medani, Determined by AAS method.*

Conclusion

The tanning industry uses some compounds that are known to be toxic. Therefore the waste/effluents of GTC are expected to be toxic, too. The indicator for such toxicity was the death of almost all trees of the forest closer to the GTC, where this WW is released for a very long period of time. GTC used to have water treatment unit during the 1970s, which is not functioning now for one reason or another.

Chemical analysis for GTC wastewater using AAS demonstrated the presence of high quantities of chromium (1.85%). Their concentrations were more than the WHO permissible limits (0.0001).

Recommendations

1. Wastewater from GTC and the other tanneries must be treated to remove all toxicants, and never allowed to be released untreated to bare land or a forest.
2. Currently, since the water treatment unit is not working, WW must be released into specially designed evaporation ponds; the remaining residues must be collected for final proper disposal.
3. Chromium must be substituted by another input because of its high toxicity and accumulation.

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Volume 7 Issue 3 March 2019