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RESEARCH ARTICLE

REMOVAL OF TOXIC METAL (CHROMIUM) BY USING LOW-COST ADSORBENT IN THE LEATHER PROCESSING AREA HAZARIBAGH, DHAKA, BANGLADESH

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ABSTRACT

Waste containing toxic elements has been found in the project area Hazaribagh in Dhaka. This paper aims to explain & mention the various types of toxic elements & their intensity in the study area. Pollution of living environment with inorganic and organic metallic species is one of the serious problems in the world. (Pollutants cycles in the environment (Environmental Chemistry, UNEP, 3rd edition, (1979), Pollution of the living environment with inorganic heavy metals is one of the serious concerns because of its non-degradable character. (World leather vol 13, no 7, November 2000) With the progress of Science and Technology today it is possible to detect and quantify heavy metals and metalloids in different matrices and explain their movements through various environmental compartments and trace their pathways. Through these routes, the toxic metals such as As, Pb, Cd, Hg, Cr etc. are incorporated into drinking water and various food chains through bio geochemical cycling. (HMSO, London, 1987) By using low-cost adsorbent, it is possible that near about 89% chromium can be removed.

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INTRODUCTION

The natural balance of the chemical elements in the environment is being altered by human activities and consequently, environmental changes are occurring. (FAO, 1999) When a set standard is exceeded by this change, pollution of the natural environment occurs. The margin between essentiality and toxicity in living systems is very narrow. So roughly, the chemical elements in biological nature can be divided into three well-known categories (Lenntech.com/periodic elements /cr htm) such as

- Mineral elements K, Ca, Mn and Fe
- Essential trace metals B, Cu, Zn, Co, Ni
- Toxic heavy metal such as As, Se, Cd, Pb, Cr, and Hg.

Any overburden or deficiency of essential trace metals (TMs) in living systems would lead to physiological disorders. (Kolomaznik, 2000) At the dawn of civilization, men used many chemicals in their daily life.

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But at present due to phenomenal industrialization and economic development, their use of chemicals has increased. The huge consumption of these chemical substances has resulted in widespread contamination of the global environment, i.e. the hydrosphere, geosphere, biosphere and the atmosphere. (http://www.dhakatribune.com/environment/2013/nov/06/hazaribagh-named-5th-most-polluted-place-earth). Three types of metals (lead, cadmium, chromium) were observed in the leather processing area Hazaribagh. Hazaribagh has 50 acres of the area & over 200 factories. (http://www.the daily sun/present condition of tannery, 28/01/14) We know that toxic element is harmful to human body as well as for environment. Diarrhoea, stomach pain, severe vomiting, bone fracture, reproductive failure, damage to the central nervous system, psychological disorder, DNA damage, cancer development etc can be caused by cadmium (Chamra Shilpa-Poribesh Dushan O Dushan Matra Kamanor Upaye). Again rise in blood pressure, kidney damage, brain damage and disruption of biosynthesis of haemoglobin & anaemia, subtle abortions, disruption of the nervous system can be caused by lead. (Adeel *et al*., 2012) Chromium (iii) is not harmful to the human body but its converted state chromium (VI) is very much harmful. (Abdul Mottalib et al.).

Allergic skin irritation, dermatitis, gastrointestinal ulcers, conjunctiva, bronchitis, lung cancer, liver & kidney necrosis, nephritis can be caused by chromium (VI) (Wang, 1986).

Index term: Atomic Absorption Spectroscopy, Heavy metal, Absorbent, Tannery, Toxic metal, Adsorbent.

Aim of this work

Chemical pollution of the agro-environment with inorganic species such as heavy metals (HMs) beyond permissible limits is a global concern because Metal pollutants are biologically non-degradable. (Topping, 1986) They tend to accumulate in various vital organs and therefore even exposure to trace concentrations of these toxic metals induces various toxic effects. The study area was being covered by Hazaribagh & its surrounding areas which are mostly polluted by the tannery wastes that contains a huge amount of toxic elements such as Chromium, Lead etc generated during leather processing. (probz blog.june 5/2015)

Chromium in most part is possible to recover from the waste water (Fabiani *et al*., 1997)

It has been attempted to perform the following tasks

- To determine the various types of toxic elements in tannery wastes.
- To determine the amounts & intensity of the toxic elements in tannery wastes.

Fig.1. Present condition of Hazaribagh canal

Fig.2. Discharging waste water from tannery

METHODOLOGY

Sample collection

Five samples were collected from different places of Hazaribagh. Primarily the aim of this project was the identification of toxic metals in the leather processing area Hazaribagh. So, samples were collected from relevant sources.

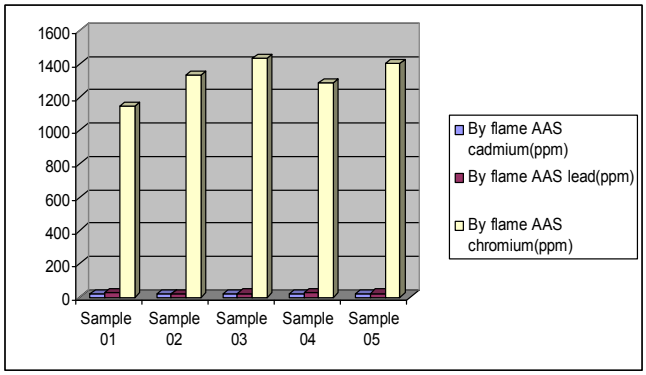
Sample preparation & procedure

Samples were collected by the plastic bottle & preserved below a temperature of 4°c. Samples were digested according to SLC 7 (acid digestion) method. Then samples were taken to the sampling bottle (HDPE) & were investigated by flame atomic absorption in CARS, University of Dhaka. All samples were kept in the refrigerator at the reasonable temperature until the experiment was completed.

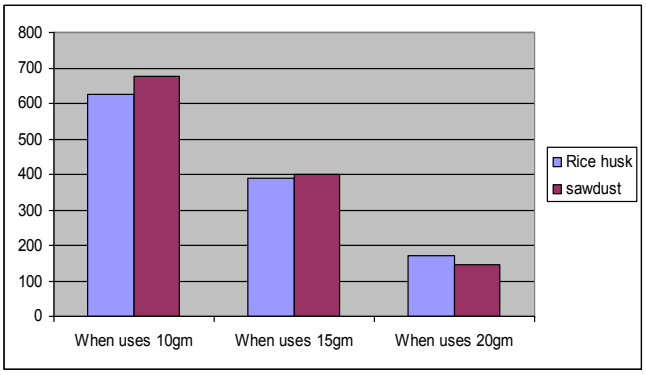
RESULTS AND DISCUSSION

In the leather processing area Hazaribagh, cadmium & lead were found in a small amount. For the tanning process, these two metals are not used regularly. For preparing the most of the leather, chromium is used in a larger extent. So the chromium level is very high.

Sample identity	By flame AAS cadmium (ppm)	By flame AAS Lead (ppm)	By flame AAS Chromium(ppm)
Sample 01	17.425	24.99	1143.25
Sample 02	18.56	21.30	1334.56
Sample 03	16.39	23.45	1430.98
Sample 04	16.67	24.64	1287.26
Sample 05	19.11	23.01	1401.57



Adsorbent	When used 10gm	When used 15gm	When used 20gm
Rice husk	626.39	388.58	169.25
sawdust	676.78	401.27	146.19



As per the toxicity level, chromium is one of the highest toxic metals. Various types of statistics show that chromium compound is found in the tannery waste water in an amount of 2500-8000ppm (Chandra *et al*., 1997), 2000-5000ppm (Hafez *et al*., 2002). But in this work 1100-1500ppm was found, because the samples were combined wastes. Five samples were mixed. Mixed sample was taken which had 1319.52ppm of chromium. 100ml of the mixed sample was taken. Two types of adsorbents rice husk & sawdust were used. But different quantities of adsorbents were used. At first, 10gm adsorbent was used. Nearly 50% chromium was reduced. Then, 15gm & 20gm adsorbents of rice husk & sawdust were used respectively. The reducing rate was 86.87% & 88.66% for rice husk & sawdust respectively. It was observed that as adsorbent sawdust is better than rice husk. If the use of adsorbent is more the reducing rate will be higher.

Conclusion

In the tannery wastes especially Chromium was found relatively in a higher amount than that of lead & cadmium. Cadmium & Lead were found in a smaller amount. The highest concentration of chromium in wastes was 1430.98 ppm. But in the tannery area, it should not exceed the amount of 50-200 ppm. (Datta, 1979) More or less than 30% of chromium (Md. Abul Hashem et al.) remains in the spent liquor, which finally falls on the river, Buriganga through the drain. The annual discharge amount of chrome is about 1000 to 1200 Tons. (http://news.priyo.com/topic/central-effluent-tretment plant 23/ 5/15) But by setting up of a chromium recovery plant, this chromium could be recovered and could be reused in the tanning process. In the view of the hazardous level at Hazaribagh area, toxic elements lead and cadmium are less responsible for pollution. In tanning operation liming is the worst operation & more responsible for the hazardous level of Hazaribagh. And all of the pre-tanning operations are responsible for environmental pollution. So, by using low-cost adsorbents we can reduce chromium near up to 89%. Establishing a Chrome Recovery Unit (CRU) should be Compulsory for all running Tanning Units in Bangladesh. Clean technology should be followed in every tannery. To stop the burning of trimmings of wet-blue or leather for cooking or glue production, public awareness should be increased as more as possible in Hazaribagh by close contact with those who are related to this activity.

Acronyms

CARS	Centre for Advanced Research in Sciences.
CRU	Chrome Recover Unit
HDPE	High Density Poly Ethylene
PPM	Parts Per Million
SLC	Society of Leather Chemist

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