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Reducing of chromium intensity of tannery effluent by using low-cost adsorbents

Md. MOSHRUR RAIHAN[1]
Md. RAZIB HOSEN
Md. ASHIQUR RAHAMAN
Institute of Leather Engineering and Technology
University of Dhaka, Dhaka, Bangladesh
FARID AHMAD
Institute of Appropriate Technology
Bangladesh University of Engineering & Technology
Dhaka, Bangladesh

Abstract:

The tannery effluent containing chromium is discharged from tannery industries of Hazaribagh to the nearest river, Buriganga. So reducing of chromium content of tannery wastes is very important for the protection of the water of Buriganga river and the aquatic environment. This paper analyzes the process of reducing the intensity of chromium in tannery effluent by using low-cost adsorbents. Five types of adsorbent were used - rice husk, sawdust, banana peel, orange peel, sugar cane. Adsorption is more efficient & cost effective technique for the removal of heavy metals from waste water. [12]Not only the chrome tanning but also other operations leather processing is also responsible for high rate of chromium content in tannery effluent. But the higher amount of chromium near about 87% can be removed by using low-cost adsorbents.

Key words: Tannery effluents, Bio-adsorbent, Treatment, Chromium

[1] Corresponding author: Md. Moshrur Raihan

1. INTRODUCTION:

The natural balance of environment is changing rapidly by the human activates. In Bangladesh, tanning industry is one of the highest pollutant industries. Near about 95% tanneries in Bangladesh is situated at the Hazaribagh in Dhaka city. [16] They are converting raw hides & skin into leather, it is known as the tanning process. For this operation, a lot of organic & inorganic chemicals/compounds are used. Most of the chemicals are not fully consumed by the leather. In 90% tanneries of the world, chromium compounds are used as the tanning agent. [17] After completing the tanning process without further treatment of effluent they are discharged from the leather industry. Nearly 60-70% chromium compound are consumed by the hides & skin and the rest amount of chromium is discharge directly from industry. [14] This is the main cause of environment pollution.

Basic Chromium Sulphate ($[Cr(H_2O)_6]_2(SO_4)_3$)is one of the main chemicals which is used in the tanning process.[18] During tanning process, 60-70% of total chromium reacts with hides & skin and the rest of the chromium (40-30%) remains in wastes.[15]Leather industry consumes more than $50m^3$ of water for processing one ton raw hides.[19] Chromium is possible to recover from the waste water. Hexavalent chromium is carcinogenic at very low level & more toxic to the aquatic environment. [7] Chromium compounds in waste water have an unfavourable effect on the life & growth of the aquatic organism. [6] The huge consumption of chromium has resulted in widespread contamination of global environment i.e. hydrosphere, geosphere, biosphere & the atmosphere. Chromium (iii) is less harmful to our environment but its converted state chromium (VI) is very much harmful to human body. [13] Allergic skin irritation, dermatitis, intestine ulcers, bronchitis, lung cancer, kidney neurosis, nephritic, can be

caused. [1] Chromium is responsible for the water pollution of the river Buriganga. The main reason of environmental pollution is the unconsciousness of the human being. Discharging of chromium into river water is the main responsible for changing the aquatic environment. [3] So the reducing of chromium from tannery effluent is much needed.

2. METHOD AND MATERIALS:

2.1 Reagents and Chemicals

The essential reagents and chemicals for this study were Sulfuric acid, Hydrochloric acid, Nitric acid etc. All of them were of industrial grades.

2.2 Sample location

The sample was collected from the local canal of Hazaribagh area on 20th November 2015. Hazaribagh is located between $23^0$43.85'N to $23^0$44.05'N latitude and $90^0$21.85'E to $90^0$22.15'E longitude.

2.3 Adsorbent preparation

Five types of adsorbents were collected from different parts of Bangladesh. Adsorbents were ground well with the help of a grinding machine and average moisture content of all adsorbents was 18%.

2.4 Sample preparation

The sample was collected from the canal of Hazaribagh which flows to river Buriganga. Firstly sample was digested according to Society of Leather Chemist (SLC) 7. Then the sample was taken in the sampling High-Density Poly Ethylene (HDPE) bottle & was investigated by flame atomic absorption in Centre for Advanced Research in Sciences (CARS), University of Dhaka. The sample was kept in the refrigerator at a reasonable

temperature (below 4^0c) until the experiment was completed. Chromium content was 603 ppm.

2.5 Procedure:

100ml sample was taken in a beaker. 10 gm of each adsorbent was added & the beaker was kept 24 hours at room temperature. Then the contents of the beaker were filtered with Whitman filter paper and analyzed by Atomic Absorption Spectrometer (Perkin-Elmer, Model-b A analyst 200, llionis USA). 15gm & 20 gm of each adsorbent were also used as similar way.

3. RESULT & DISCUSSION:

Various types of statistics show that when the untreated tannery effluent is directly discharged from leather industry, then the chromium compound is found in the tannery waste water in an amount of 2500-8000 ppm [2] & 2000-5000 ppm [9]. But the sample was taken from canal of Hazaribagh i.e. combined liquor, so the chromium compound was 603 ppm. Many treatment processes such as precipitation, ion exchange, filtration, membrane filtration, electrothermal treatment, and reverse osmosis are available. [5] But these conventional techniques have many disadvantages such as less efficiency, complicated treatment process & disposal salt. [8]

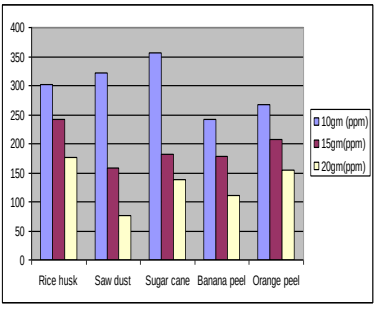
Adsorbent name	When 10gm used, the remaining Cr(ppm)	When 15gm used, the remaining Cr(ppm)	When 20gm used, the remaining Cr (ppm)
Rice husk	302	242	176
Sawdust	322	158	77
Sugar cane	356	181	138
Banana peel	241	178	110
Orange peel	267	207	154

Firstly, when 10gm of adsorbents was used; the reducing rate of chromium was the highest for the banana peel. Then, 15gm & 20gm of adsorbents were used. But finally, the reducing rate of chromium was highest for sawdust & lowest for rice husk.

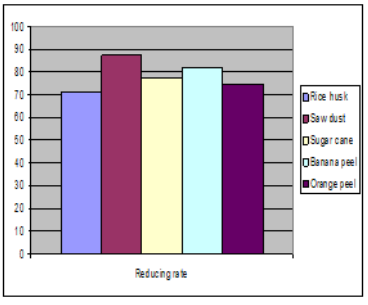
When 10 gm of adsorbents was used then the reducing rate of chromium was in the order of Banana peel > Orange peel > Rice husk > Sawdust > Sugarcane.

After using 15 gm of adsorbents the reducing rate was highest for sawdust. The reducing rate order was Sawdust > Banana peel > Sugarcane> Orange peel > Rice husk.

Finally, 20 gm of adsorbents was used and the reducing rate of chromium was the highest for sawdust. And the reducing rate follows the same order as shown in the following figure Sawdust > Banana peel > Sugarcane > Orange peel > Rice husk.



The reducing rate of different adsorbents is presented in the following figure-



The reducing rate of sawdust is the highest. Sawdust is available in Bangladesh & price is also comparatively lower than that of other adsorbents.

4. CONCLUSION:

All the adsorbents used are available at very low cost. [11] But in Bangladesh rice husk, sawdust & sugarcane are very much available. The capacity of chromium removing of five adsorbents is nearly same. But from the experiment, it is observed that saw dust is the best adsorbent. The reducing rate of saw dust is relatively higher than the other adsorbents (87.24%).

In Bangladesh, these chromium reducing techniques may be used easily. The environment pollution is a burning question of present time. [4] The owner of tannery industries should have proper initiatives to control the environmental pollution. The pollution level of Hazaribagh is higher than that of the other areas in Bangladesh. [10] So reducing of chromium intensity is badly needed. It is essential to use the low-cost adsorbents to reduce chromium from tannery effluent thereby protecting aquatic environment. Government should have more concern to protect the discharging tannery effluent without prior treatment. Untreated tannery effluent discharge must be banned. Law enforcement is needed for preserving the world livable.

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