Original Article

Journal of Forensic Chemistry and Toxicology
Volume 9 Number 2, July-December 2023
DOI: http://dx.doi.org/10.21088/jfct.2454.9363.9223.1

Elimination of Chromium (Vl) from Industrial Effluent through the Utilization of Water Hyacinth weed

Anuradha Tiwari[1], Nand Lal[2], Ashish Kr Singh[3], Tamanna Begam[4], Neelam Pal[5]

How to cite this article:

Anuradha Tiwari, Nand Lal, Ashish Kr Singh *et al.* / Elimination of Chromium (Vl) from Industrial Effluent through the Utilization of Water Hyacinth weed/J Forensic Chemistry Toxicol. 2023;9(2):71–74.

Abstract

Biosorption is a physico-chemical binding of a substance to biological material. Water hyacinth has been successfully utilized for the removal of chromium (VI) from waste water samples. The plants were divided in to two part (i) root (ii) foliage. Each part was dried at 75^0C for 48 hours and then its weighed was taken. The tissue samples weight then ash in the muffle-furnace at 350^0C for 5 hours. Ash samples were digested with acids (HNO_3, HCl) and diluted with 100 ml of distilled water. The detection of chromium (VI) carried out by Atomic Adsorption Spectrophotometer (AAS). This method of removing chromium from water is cost-effective, eco-friendly and has been shown to be effective in laboratory studies.

Keywords: Chromium; Biosorption; Water Hyacinth; Effluent.

INTRODUCTION

India is a major contributor to the industrial[1] effluent problem[2] in the region, with many of these facilities releasing large amounts of waste water containing Cr (VI) into the surrounding environment. Two tanning methods are used in leather tannery. Vegetable tanning or chrome tanning. Approx 90% of tanneries around the world today use salts of trivalent chromium (chromium (III) hydroxide sulphate) for tanning. The main hazards related to chromium (III) can oxidized to chromium (VI) at very low pH values when oxygen is present. Chromium (VI) is a toxic metal[3] that can be harmful to both humans and the environment if released into the water sources in excessive amounts.

In Uttar Pradesh particularly in and around Kanpur upto 70-80 percent tanneries are located on the bank of river Ganga.[4] In Kanpur, tanneries generate large amount of waste water as a result of the leather processing operations[5], which can contain high levels of chromium (VI). Chromium (VI) is widely used in various industries, such as leather tanning, wood preservation and electroplating, which can lead to its release into the environment in the form of effluent. Tanneries must reduce chromium level in their effuents.[6] The ability of biological materials[7] to concentrate pollutants, often too many thousands of time the level in the

Author Affiliation: [1,5]Assistant Professor, [2]Professor, [3]Associate Professor, Department of Chemistry, Vikramajit Singh Sanatan Dharma College, Kanpur 208002, Uttar Pradesh, India, [4]Assistant Professor, Department of Chemistry, Dayanand Brajendra Swarup College, Kanpur 208006, Uttar Pradesh, India.

Corresponding Author: Nand Lal, Professor, Department of Chemistry, Vikramajit Singh Sanatan Dharma College, Kanpur 208002, Uttar Pradesh, India.

E-mail: drnandlal71@gmail.com

Received on: 08.04.2023 **Accepted on:** 31.05.2023

surrounding environment has long been known.[8] The use of water weeds, such as water hyacinth, to remove chromium from tannery effluent is a highly effective and sustainable solution.

To mitigate the negative impacts of chromium (VI)[9] on the environment, various methods have been developed for removing it from effluent. One such method is the use of water weeds, such as water hyacinth[10], to absorb chromium (VI) from the water. Water hyacinth is a highly efficient and low-cost method for removing chromium (VI) from effluent. This plant has the ability to absorb and accumulate heavy metals, including chromium (VI), from the water due to its high biomass[11] and extensive root system. The absorption process is a result of the interaction between the heavy metal ions and the organic compounds in the water hyacinth. Studies have shown that water hyacinth is highly effective in removing chromium (VI) from water, with removal efficiencies of upto 95%, observed in some cases. Further more, water hyacinth has a relatively fast removal rate, making it an ideal method for removing chromium (VI) from effluent in real-time. In addition to its removal efficiency, water hyacinth is also a sustainable method for removing chromium (VI) from effluent. The plant is non-toxic, renewable[12] and can be grown easily in a variety of water sources. More over, water hyacinth is a versatile plant that can be used for other purposes, such as for bio-fuel production[13] and as a source of food for livestock. So, water hyacinth is an effective, low-cost and sustainable method for removing chromium (VI) from effluent. By utilizing the absorbent properties of this water weed, industries[14] can reduce the release of chromium (VI) into the environment and help to protect both human health[15] and the environment.[16] The suitability of this method will be tested for industrial use. Biosorption of heavy metals will studies on water weed (water hyacinth) for removal of Chromium. The effect of pH and uptake time will be investigated to achieve maximum absorption.

METHODOLOGY

The tannery effluent obtained from the tanneries at Jajmau in Kanpur bank of Ganga River. Plant weighed approx 5 to 7 Kg allow growing in 5 plastic containers, which have 20 litres capacity.

AR grade chemicals use in acids digestion (HNO3, HCl). The ratio of water and effluents are given in the table 1. pH of tannery effluents was in between 7 to 8 approx.

Table 1: Preparation of Sample

Sample	Water (%)	Effluent (%)
1	0	100
2	50	50
3	80	20
4	90	10
5	100	0

After 15 days observation the plant were divided in root and foliage (bunch of leaves). Root and foliage both are dried for 48 hours at 75°C. Dried plant tissue were grounded with a mill tissue sample weighed approx. 0.3 gm were ash in a muffle furnace at 350 °C for 5 hours.

These ash samples were digested with acids (HNO_3, HCl) and diluted with 100ml of distilled water digested plant samples and water were analyzed for chromium by atomic absorption spectrophotometer. The pH of the effluents which was taken from tanneries is near to neutral or basic in nature.

RESULT AND DISCUSSION

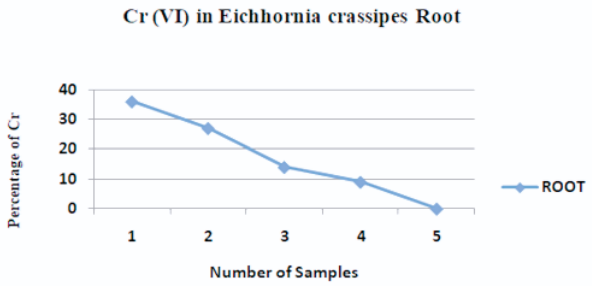

Fig. 1: Presence of Chromium in different samples of EC plant root

Fig. 1. Shows that in sample no. 1 (100% effluent) absorb 36 %, sample no. 2 (50% effluent) absorb 27%, sample no. 3 (20% effluent) absorb 14% and sample no. 4 (10% effluent) absorb 7% Cr (VI).

It means that the samples which have higher

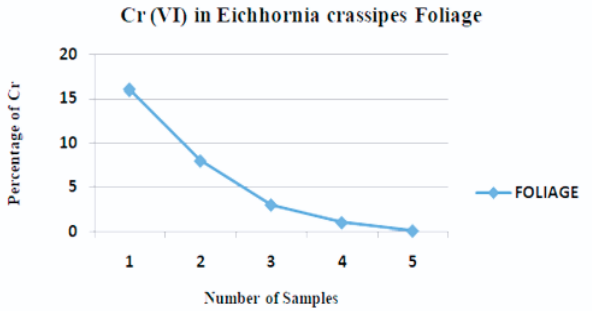

Fig. 2: Presence of Chromium in different samples of EC plant foliage

concentration show higher percentage of Cr (VI) absorption. This indicates that the Cr (VI) is absorbed by root of waterweed Eichhornia crassipes (EC).

Similarly, in *Fig. 2* absorption of Cr (VI) also observed by foliage of water weed Eichhornia crassipes (EC). Presence of Cr (VI) in sample no. 1 (100% effluent) absorb 16%, sample no. 2 (50% effluent) absorb 8%, sample no. 3 (20% effluent) absorb 3%, sample no. 4 (10% effluent) absorb 1% Cr (VI).

It reveals that maximum Cr (VI) absorbed by roots than the foliage. The mechanism of biosorption in hydrosphere plant are same as lithosphere. The oxygen released by photosynthesis of water hycinth gets dissolved into water. This dissolved oxygen is used by water hycinth plants for respiration. This water hyacinth can tolerate heavy metals in the substrate up to a threshold concentration. In addition to the ability to tolerate high concentrations of Chromium these plants can actively take them up and accumulate them in their parts. The removal of Cr (VI) metal by water hyacinth (EC) plant root are maximum absorption then the foliage. Thus with the help of this scientific work we can use the water weed EC in removing of Cr (VI) from tannery effluent.

CONCLUSION

The toxic metals pollution is global issues. The toxic metals are most frequently identifying problems in the aquatic ecosystem. Excellent removal capabilities of the water hycinth (EC) for several metals of environmental concern were known. These result indicated the possibility of using water weed to removal of chromium in tannery effluents which pose an environmental problem. Water hyacinth has been used successfully to remove heavy metal. This proves removal of chromium for industrial effluent is very effective, rapid and cheap.

ACKNOWLEDGMENT

The authors are grateful to Prof. Arvind Kumar Dixit, Head, Department of Chemistry V.S.S.D College, Kanpur, (U.P) for his valuable support.

REFERENCES

1. Amitrajeet A Batabyal, Tanneries in Kanpur and pollution in the Ganga: A theoretical analysis, Regio Sci Poli & Practi, 2022.
2. Satyendra Kumar Garg, Manikant Tripathi & Thiruneela Kantam Srinath, Strategies for chromium bioremediation of tannery effluent; Review of environmental contamination and toxicology, 2012;217:75-140.
3. A Singh, S Porwal, A Verma, Hexavalent chromium :toxic and genotoxic effects and its bioremediation strategies, Biomed J Sci & Tech Res 2021;35:27637-27642.
4. Anupama kumari, Samirkumarsinha, Nipunika rani & Ravinder kr. Sinha Assessment of heavy metal pollution in water rediment, and fish of the river Ganga atvaranasi India, Aratrian J. of Geosci; 2021; 14; 2346.
5. Oluwasegiomoloso, Kathlein Mortimer william R. wise, Luai Jransit Sustainability research in the lecture industry; A critical review of. progrex and opportunities for future research, J of cleaner prod., 2021; 285 1—11.
6. Saikia D.K., Mathur R.P., Srivastava S.R., Heavy metal in water sediment of upper ganga, Ind J Environ Health, 1988; 31:11-17.
7. Lazarids K.N., Charalanbous Ch., Removal of trivalent and hexavalent chromium from binary aqueous solution by composite alginate-goethite beads, Water Res 2005; 39:4385-4396.
8. Wilson M.W., Edyneam R.G., Biosorption for the removal of heavy metals from industrial waste water, ICHEME Symposium series No. 132,185-196.
9. M.E. Losi, C. Amrhein & W.T. Franken berger Jr., Environmental biochemistry of chromium, Reviews of Environ Contaminanf Toxico, ;136:99-121.
10. Ernie D., Tombado, Orlean G., Dela Cruz, Ernesto J., Guades, Evalution of water hyacinth ash, extract and fiber in concrete: Aliteratue review, Advan in civil engin mater, 2023;57:55-62.
11. M.A. Bote, V.R. Naik, K.B. Jagadeesh gouda, Review on water hyacinth weed as a potential biofuel crop to meet collective energy needs, Materi Sci for energy tech, 2020;3:397-406.
12. Md. Arman Arefin, Fazlur Rashid Amirul Islam, A review of biofuel production from floating aquatic plants: an emerging source of bio renewable energy, Biofpr, 2021;15:574-591.
13. Akshay Jain, Bhasker Jyoti Bora, Rakesh Kumar, Abdulrajak Buradi, Recent Advan. In thermofluids and manufaengin, 2022;106:377-388.
14. Weiping Su, Qingping Sun, Meisheng Xia, Zhengshun Wen and Zhiteng Yao, The resource utilization of water hyacinth (Eichhornia crassipes [Mart.]solms) and its challenges, Resources, 2018;46:2-9.
15. Hooshyar Hossini, Behna Shafie, Amir Dengham Niri, Manbouben Nazari, Aylin Jahanban Esfahlan, Mohammad Ahmadpour, Zazmara, Mannaz

Ahmadimanesh, Pouran Makndoumi, Nazam Mirzaei & Edris Hoseinzaden, A comprehensive review on human health effects of chromium: insights on indused toxicity, Environ Sci and pollu rese, 2022;29:70686-70705.

16. Ammar Malik, Messaoad Hachemi, Villemin Didier, New approach of depollution of solid chromium leather waste by the use of organic chelates: Economical and environmental impacts, J of Hazar Mater, 2009;170:156-162.