

## Introduction

Bangladesh suffering a severe chromium pollution crisis as tanneries at Hazaribagh uses a huge amounts of chromium salts during raw hides and skin processing that produces enormous untreated effluent into the river Buriganga. So, this study aims to find a plausible way to treat those effluents in a feasible way that uses cheap and low cost adsorbents and involves intensive environmental education potential to eradicate such chromium threat. Sugarcane bagasse (SCB), a prominent adsorbent for heavy metal treatment due to its good absorptive sites and feasibility was investigated in this project. This study finds an auspicious chromium treatment method where an encouraging amount of chromium was removed from a synthetic chromium wastewater solution using SCB biosorbent. As an impulsion on environmental education, this project also intends to provide a hands-on experiment for chromium treatment with SCB that clearly has the potential to be applied in science classes in local schools.

## Research Motivation

### Current Status

- In the last few decades, leather industries has been attracted a considerable attention concerning the environmental pollution. Bangladesh is suffering a serious crisis since most of the tanneries in Hazaribagh-Dhaka, directly discharges the chromium wastes into closely situated river Buriganga and the surrounding environments.
- Different types of chromium salts are used in tanning processes, of which 60-70% are used and rest 30-40% remains in solid or liquid wastes. It has been estimated that on an average 20,000 m<sup>3</sup> of tannery effluents are being generated in Hazaribagh area.
- When these chromium contents comes into air in the shape of fine dust particles, it accumulates at the bottom after remaining in the air for a certain time.
- A great amount of chromium gets dissolved in natural water and some cases certain amount of chromium gets composited in the soil while the rests of them enters into deep soil and ultimately gets diluted with groundwater and contaminates them.

### Pollution Extent

- Every season approximately 60,000 tons of leathers are processed in Hazaribagh area that generates nearly 95,000 liters of effluents without treatment along with 115 tons of solid wasted daily into the open environment. That results an excessively higher accumulation of chromium restricted to the topsoil in Hazaribagh area up to the depth of 1.5 m.
- Such practice turned Hazaribagh as one of the world's top 10 worst polluted place, at the same time lack of emphasis on tannery waste treatment posed an acute crisis threatening approximately 1.6 millions lives and a river directly.

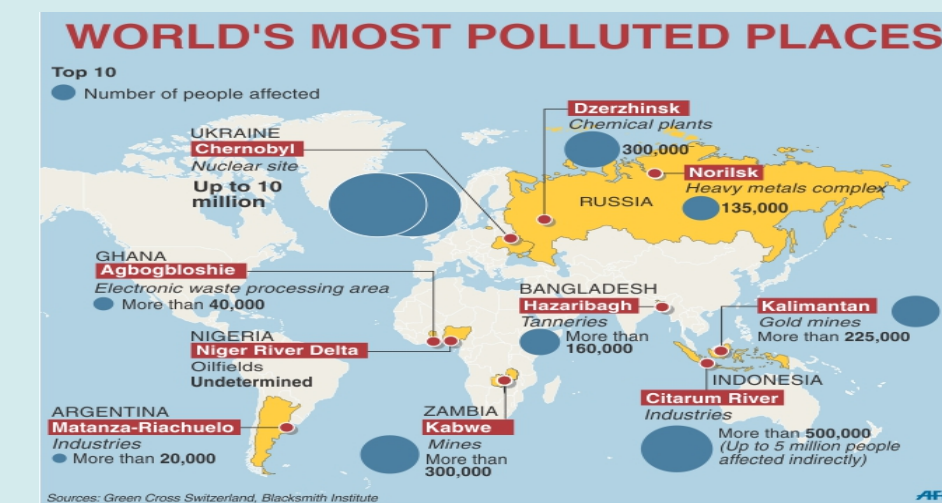


Fig: Chromium Pollution Threatening Lives & Destroying River Buriganga [3] [4]

### Impacts on Public Health

- Chromium occurs into the nature into trivalent Cr (III) and hexavalent form Cr (VI). Cr (III) is natural and Cr (VI) are formed through oxidation. These effects public health as people exposed through inhalation, ingestion and dermal contact.
- Although Cr (III) are less toxic, yet under certain ligand conditions it leads to cell death and structural modification of protein. On the other hand, Cr (VI) is a very well known carcinogen that causes cancer, respiratory system dysfunction, chronic skin diseases, bronchospasm, perforation of nasal septum, mucous membrane infection, ulceration and DNA replication.



Fig: Effect of long term chromium exposure on skins & lungs causes cancer [5] [6]

## Chromium Treatment & Education To Rescue

### Why SCB for Chromium Treatment

- Most of the conventional treatment approaches are highly energy intensive and moderately expensive that produces harmful end-products as well and causes secondary pollution. Considering all these pros and cons, potential application of Sugarcane bagasse (SCB) as bio-adsorbent to get rid of chromium has been recognized as one of the most promising alternative. In a nutshell, it's a simple method with effective results.

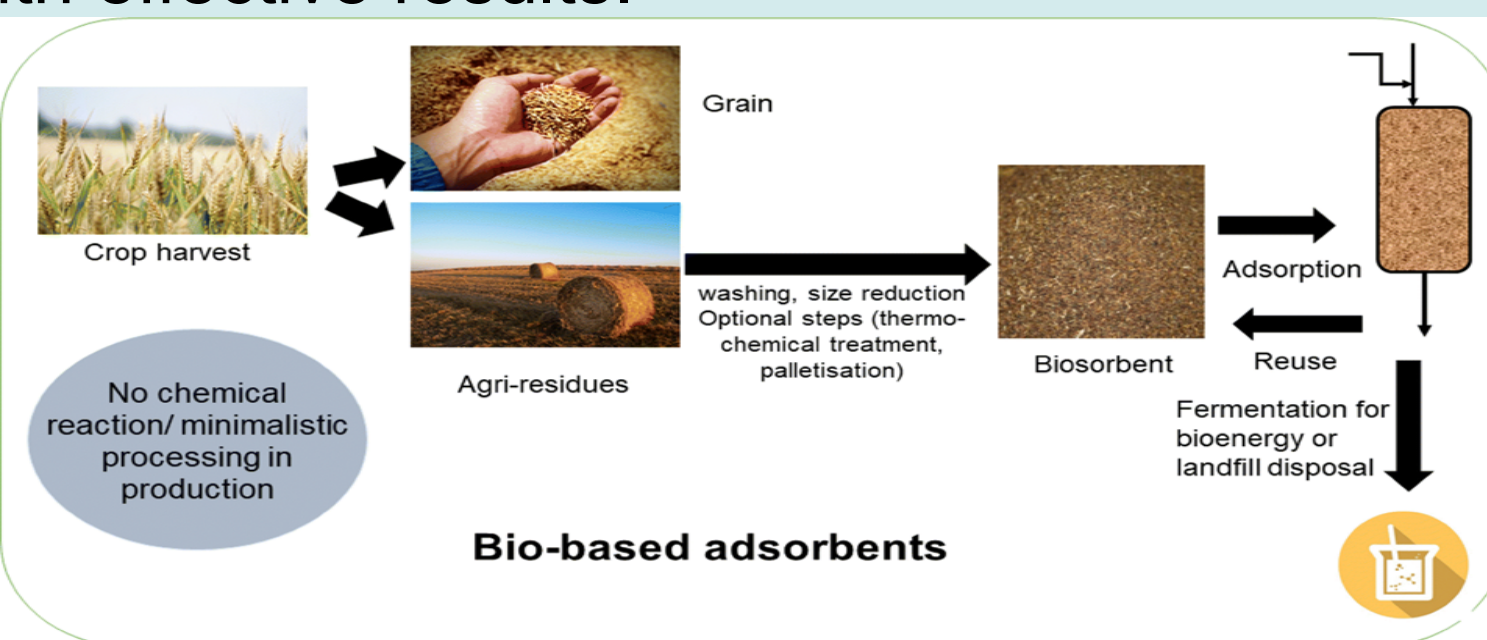


Fig: Advent of Sugarcane Bagasse Biosorbent [7]

### Chromium Treatment Method & Percentage Removal

- In this research, a laboratory based synthetic chromium containing waste has been prepared. Then the waste solution was treated with SCB biosorbent for the purpose of chromium absorption.
- An influence of pH, initial concentration, dosage and contact time on chromium removal was also investigated. Low pH was found effective in chromium removal since higher [H<sup>+</sup>] create hindrance to chromium diffusion. Lower initial concentration showed a better absorption as adsorbent amount was higher. Adsorbent dosage also influenced adsorption as higher the dosage, higher the removal. Lastly, Contact time between adsorbent and chromium solution showed a foreseeable variation in percentage removal as removal was higher along with the contact time.
- Percentage removal was determined using "Beer- Lambert's law" once the spectrophotometric absorbance values of chromium waste solutions were measured immediately after treatment. An outcome of maximum 85% of chromium removal was achieved while adjustment of different factors showed different removal.

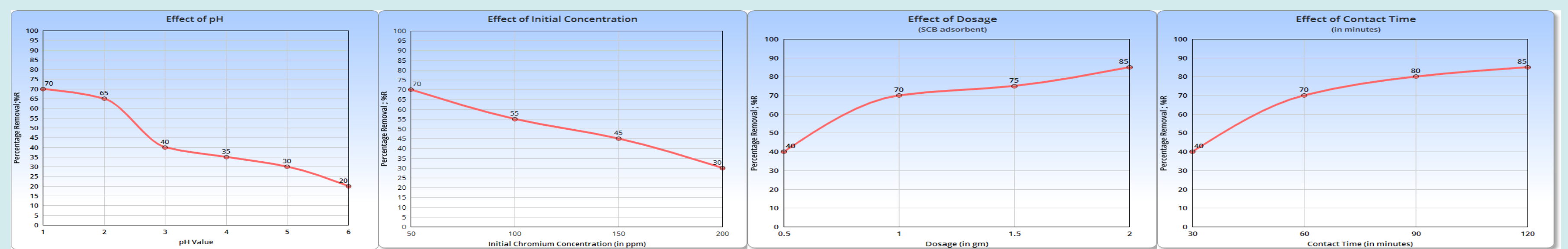


Fig: Changes of percentage removal of Cr along with the adjustment of different factors

### Environmental Education

- Education can help these chromium threat situation and improve the perception towards the chromium waste treatment as long as the treatment process is easily affordable and simple to conduct. Most of the labors and employers involved in tannery industries are not aware of the environmental issues caused by tanning activities and lack of education and literacy appears to be the prime reason for that.
- Therefore, a series of educational workshop and consultations in those tannery industries in Bangladesh from time to time will be an effective and faster way to circulate educational information to raise awareness.



Fig: Conferences & Manifestations to raise public awareness [8] [9]

### Conclusion & Outlook

- Leather industries are export oriented indigenous raw materials based billion dollar sector of Bangladesh that involves great numbers of labor and plays a undeniably vital role of Bangladesh's economy. Therefore, it is almost unmanageable to think without tannery industries.
- In summary, this study develops a low cost SCB biosorbent as a key tool to tackle on going chromium crisis. Now, a proper utilization of this idea is a prime intention of this study.
- Fund attainment to provide "Hand-on materials along with treatment demonstration" in all the local educational institute are the next step of this study.
- Besides, necessary consultations and workshops among the tannery managements, teachers, local environmental activists and pressure group are enlisted into the blueprint of the study.

### References for Images

- <https://www.thedailystar.net/news-detail-35624>
- <https://www.theguardian.com/global-development-professionals-network/gallery/2015/oct/23/the-river-runs-black-pollution-from-bangladeshs-tanneries-in-pictures>
- <https://imgbd.net/2016/09/hazaribagh-most-polluted-zone-in-the-world/>
- <https://www.dhakatribune.com/uncategorized/2014/01/21/buriganga-waters-unable-to-support-living-organisms>
- <https://www.ecoopwhoop.com/This-11-Year-Old-Suffers-From-A-Rare-Skin-Condition-Which-Renders-Him-Unable-To-Walk-Or-Talk>
- <http://aboutlungcancer3000.blogspot.com/2012/12/stage-4-lung-cancer.html>
- <https://link.springer.com/article/10.1186/s40643-018-0223-7>
- <http://sanemnet.org/assessment-of-hazaribagh-tanneries/>
- <http://www.newagebd.net/article/28599/article/articleid/323/article/35972>

### References for Texts

- Chowdhury, M. et al. (2015) 'Characterization of the Effluents from Leather Processing Industries', *Environmental Processes*, 2(1), pp. 173–187. doi: 10.1007/s40710-015-0065-7.
- SCHER (2008) *Scientific Committee on Health and Environmental Risks: Opinion on phthalates in school supplies*, October. doi: 10.2772/41993
- Rajasulochana, P. and Preethy, V. (2016) 'Comparison on efficiency of various techniques in treatment of waste and sewage water – A comprehensive review', *Resource-Efficient Technologies*. Elsevier B.V., 2(4), pp. 175–184. doi: 10.1016/j.reffit.2016.09.004
- M. A. Halim, Ratan Kumar Majumder, S. M. Sumayed, N. A. (2011) 'STUDY ON GROUNDWATER, RIVERWATER AND TANNERY EFFLUENT QUALITY IN SOUTHWESTERN DHAKA, BANGLADESH: INSIGHTS FROM MULTIVARIATE STATISTICAL ANALYSIS', *Southeast Asian J Trop Med Public Health*, 40(1), pp. 187–192. Available at: [https://www.researchgate.net/publication/236009461\\_STUDY\\_ON\\_GROUNDWATER\\_RIVERWATER\\_AND\\_TANNERY\\_EFFLUENT\\_QUALITY\\_IN\\_SOUTHWESTERN\\_DHAKA\\_BANGLADESH\\_INSIGHTS\\_FROM\\_MULTIVARIATE\\_STATISTICAL\\_ANALYSIS](https://www.researchgate.net/publication/236009461_STUDY_ON_GROUNDWATER_RIVERWATER_AND_TANNERY_EFFLUENT_QUALITY_IN_SOUTHWESTERN_DHAKA_BANGLADESH_INSIGHTS_FROM_MULTIVARIATE_STATISTICAL_ANALYSIS).
- Kabir, M.M. Fakhruddin, A.N.M. Chowdhury, M.A.Z. Fardous, Z. and Islam, R. (2017) 'Characterization of tannery effluents of Hazaribagh area, Dhaka, Bangladesh', *Pollution*, 3(3), pp. 417–428. doi: 10.7508/pj.2017.03.
- Ahsan, A. (2016) 'Chromium Removal From the Tannery Wastewater Using', (iii). Available at: <https://pdfs.semanticscholar.org/2e70/651fe1542bf13c5f532d2834b0c234c4dd6a.pdf>.