Chrome treatment of wastewater from tanneries

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Abstract: The research focuses on the challenges/impacts of tannery effluent and explores alternate treatment techniques for treating, recovering, or recycling chromium from waste water. The work was entirely based on secondary data obtained from secondary sources such as scientific publications, book chapters, conference report papers, and websites.

According to the findings of this review study, chromium is highly hazardous and carcinogenic to humans, animals, plants, and the general environment (soil and water sediment). Chrome has been identified as the principal hazard when the tanning industry is used. Despite the fact that several treatment approaches were considered to mitigate its environmental impact, none of them were able to completely cure or recover chromium.

Keywords: Chromium Toxicity, Environmental Impact, Chromium Recovery and Recycling, Chromium Treatment Option, Tannery Effluent.

Introduction

Waste is produced by all sectors of our society, including industry, agriculture, mining, energy, transportation, construction, and consumers. Pollutants in waste include wasted materials, process products, and chemicals. These contaminants may generate pollution if they are discharged beyond the environment's ability to absorb them. Industrial wastes are created by many processes, and the volume and toxicity of waste emitted vary according to the individual industrial process. Tannery effluents are among the most polluting of all industrial wastes. They contribute significantly to chromium contamination. For example, around 2000-3000 tonnes of chromium escape into the environment each year from tannery businesses in India, with chromium concentrations ranging between 2000 and 5000 mg/l in the aqueous effluent compared to the suggested permitted discharge limits of 2 mg/l.

Vegetable tanning, which does not include chromium, and chrome tanning are the two types of tanning methods. Traditional vegetable tanning, on the other hand, cannot be deemed more ecologically beneficial than chrome tanning due to the high pollutant load and minimal treatability. Moreover, vegetable tanned leathers have various physical qualities and uses, but they are biodegradable. Nowadays, chrome tanning accounts for more than 90% of worldwide leather output (18 billion sq. ft.). The most often utilised tanning ingredients nowadays are chromium salts (especially chromium sulphate). In comparison to hides treated with vegetable compounds, hides tanned with chromium salts offer greater mechanical resistance, exceptional dyeing adaptability, and better hydrothermic resistance. However, only a small percentage of the chromium salts used in tanning react with the skins. The remaining salts are left in the tanning exhaust bath before being transferred to a depuration facility, where the chromium salts end up in the sludge. The disposal of chromium-contaminated sludge produced as a byproduct of wastewater treatment is one of the key rising environmental issues in the tanning industry. Tannery effluents have a negative impact on the mitotic process and impair seed germination in widely grown pulse crops. Chromium is poisonous, mutagenic, carcinogenic, and teratogenic at high amounts. Chromium has three oxidation states: +2, +3, and +6. The trivalent oxidation state is the most stable form of chromium and is vital to mammals at trace concentrations. Nevertheless, due to its poor water solubility, it is largely immobile in the aquatic system. Many

plants, animals, and microbes in water habitats are substantially more hazardous to hexavalent chromium.

Most microorganisms are vulnerable to Cr (VI) toxicity, however others have resistance mechanisms that allow them to survive high amounts. A link was discovered between soil total chromium level and the occurrence of metal tolerant/resistant microorganisms. Two stable oxidation states of Cr (III and VI) occur in natural waters, with differing toxicities, motilities, and bioavailability. Cr (VI) is a very toxic, soluble in water, motile oxidising chemical that causes severe damage to cell membranes.

The usual practise of land-based disposal of tannery wastes with the premise that the dominating species in the tannery waste would be the thermodynamically stable Cr (III) species has resulted in widespread chromium contamination of soils. Yet, recent detections of dangerous Cr (VI) in surface water and groundwater in several parts of the world raise serious concerns about the existing disposal of Cr-containing wastes. Despite Cr (III's) thermodynamic stability, the presence of certain naturally occurring minerals, particularly MnO2 oxides, can promote Cr (III) to Cr (VI) oxidation in the soil environment. This issue is of public importance because Cr (VI) is bioavailable at high pH, and this form is extremely mobile and so offers the highest danger of groundwater pollution.

Cleaner approaches for reducing chromium in waste water, such as high exhaustion processes and direct or indirect chromium recycling, cannot totally eradicate chromium from post tanning effluent. In answer to this issue, chromium was replaced with combinations of metallic cat ions such as titanium, magnesium, aluminium, and zirconium, but the results produced so far are not totally satisfactory for all types of leather. Synthetic organic tanning agents, alone or in combination with a metallic cat ion, can be used to replace chromium in various types of leather, provided that environmental and worker health requirements are followed.

Despite the fact that Cr III is a necessary nutrient for humans, Cr (VI) compounds are both immediately and chronically harmful. This element's dosage threshold impact has not yet been characterised precisely enough to allow rules to be created. Nonetheless, some risk assessment study is being conducted right now.

Cr III complexes have likewise extremely limited mobility in soils, making them comparatively inaccessible to plants [ibid]. The direct release of tannery effluents into water bodies has been a significant environmental concern in recent years. The majority of these waste liquids are extraordinarily complex combinations of inorganic and organic substances, making the tanning business potentially a polluting industry.

In general, the disposal of chrome waste from leather production poses a major risk to human health and the environment. All tanneries must now properly inspect their waste streams. One of the components that must be closely managed is the discharge of chrome into those streams. The environmental effect of tannery chrome waste has been the topic of much scientific and technical debate. . Since then, statutory limitations for chrome discharge and disposal have been established, and appropriate recommendations have been developed across the world. Because of the strong relationship between chrome tanning and its environmental impact, evaluating the efficiency of processing activities and treatment plants is critical.

As a result, the goal of this study is to outline the possible impact of tannery waste, evaluate the various chrome treatment methods, and analyse the issues that chrome removal technologies confront.

Only roughly 55-60% of chromium is taken up in commercial traditional chrome tanning (average). As a result, ongoing inventive process changes for cleaner technologies have been critical in the leather-processing industry to protect our environment.

The leather processing business uses a procedure that involves treating hides and skins with a range of chemicals and passing them through several unit activities. All of this takes a long time and contributes to a rise in chromium, COD, chlorides, sulphates, and other mineral salts in effluent. Yet, perhaps more concerning, the process consumes large amounts of water in locations where ground water is rapidly depleting. Mukherjee, 2006, delivered a thought-provoking research study at the International Union of Leather Technologies and Chemist Societies (IULTCS) Conference in order to address this enormous obstacle. This study looked into a method for reducing water use in deliming, pickling, and basification-free chrome tanning.

This results in a 20% reduction in chemical use for chrome tanning alone. Water consumption can be reduced by 37-40%. It is also a low-energy technology. This outstanding technique is highly tempting to tanning firms, environmentalists, and it also inspires other researchers to perform some work for probable enhancement or it directs in some way to a new route.

Scientists regularly employ important phrases such as pollution avoidance, waste reduction, product empowerment, and process innovation.

These options, however, are very much limited to recycling wastewater to a maximum number of cycles before discharging or using ecologically beneficial chemicals.To entirely prevent pollution, the discharge of low pollution loads or a zero-discharge concept should be the theme of the day.

Based on this extensive study of the literature, it is clear that chromium is very hazardous to human health, animals, and the environment.

There are several methods for removing chromium from tannery effluent, and some treatment processes removed approximately 99% of the chromium from wasted spirits. Often, these technologies are difficult, expensive, energy heavy, limited to a certain location, need experienced workers, and some are not yet commercialised. Yet, because to its low cost, technologies such as electro coagulation might provide very high chromium removal (98%) and repeatability to impoverished nations. Despite these scientific efforts, the tanning industry remains a major polluter of the environment globally. To prevent the public health and environmental impact of tannery waste in general, and chromium in particular, environmental regulations such as effluent discharge limits must be stringent, and organisations must be strong enough to take action by applying the polluter principle or the precautionary principle to avoid the effects of toxicity and bioaccumulation.

References:

1. T. T. Shen, “Industrial pollution prevention,” 2nd Edition, Springer, pp. 40, 1999.
2. M. M. Altaf, F. Masood, and A. Malik, “Impact of long-term application of treated tannery effluents on the emergence of resistance traits in rhizobium sp. isolated from trifolium alexandrinum,” Turkish Journal of Biology, Vol. 32, pp. 1–8, 2008.
3. Moore and Ramamoorthy, “IUE assessment for chromium containing waste forms the leather industry,” 2001. http:// www.ctc.fr/faq/docs/CTC_recommendations_IUE_3.pdf
4. V. J. Sundar, J. R. Rao, and C. Muralidharan, “Cleaner chrome tanning—emerging options,” Journal of cleaner production, Vol. 10, pp. 69–74, 2002.

5. B. Wionczyk, W. Apostoluk, and W. A. Charewicz, “Solvent extraction of chromium (III) from spent tanning liquors with Aliquat 336,” Journal of Hydrometallurgy, Vol. 82, No. 1–2, pp. 83–92, 2006