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Chromium effects of tannery waste water and appraisal of toxicity strength reduction and alternative treatment

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Abstract

Tannery waste waters decrease the quality of water bodies into which they are discharged is of large scale environmental concern. Disposition of tanning effluents e.g. Chromium (Cr) into the environment creates inauspicious outcomes by modifying the normal physiochemical properties of soil and water. It is determined that Chromium is the principal threat whenever tanning industry derives in to practice. Cr is extremely venomous and carcinogenic to humankind, animals, vegetations and as well overall environment. The paper was executed solely on secondary information by conferring literature informants including scientific journals, conference articles document and internet site that focused on the effects of tannery waste water and assessment of alternative treatment options used to reduce, removal, retrieve or reprocess Cr from the waste water. Effective management of tannery effluent is the need of the hour. Although a lot of treatment alternatives were assessed to preclude its effect on the environment, neither of them forced out Cr completely. In some cases researchers however successful enough practicing biotechnological methods to reduce the strength and fatal state of Chromium (e.g., Cr(Vl)). Hence, treatment alternatives are either; complex, energy consuming, expensive or applicable to a indisputable portions of the world due to engineering science or proficient work force requirement. Consequently, to tackle these important challenge demanding environmental ordinance with jurisprudence implementation has to be practiced to apply improve treatment scheme which is widely applicatory. Defilers must acknowledge the environmental cost of their manufacture and treated according to polluter pay or precaution precepts. Furthermore, the general public has to be aware of it and all concerned organizations and authorities have to work hard to accomplish zero discharge level or leastwise to gain the standard limit of Chromium discharge defined/ accorded by Environmental Protection Agency.

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Introduction

Environment is getting flimsy and environmental pollution is one of the undesirable side effects of industrialization, urbanization, population growth and senseless attitude towards the environment. Industrial wastes are yielded from divergent processes and the amounts, features of discharged effluent vary from industry to industry depending upon the water consumption and average daily production (Shen, 1999). The common problems affiliated with unlawful management and disposal of wastes include diseases transmission, fire hazards, odor nuisance, soil and water pollution, aesthetic nuisance and economic losses (Nishanth *et al.*, 2010). Due to industrial expansion, large quantities of industrial wastes are accumulating in environment and cannot be disposed without prior special treatments. Due to industrial enlargement, massive quantities of industrial wastes are accumulating in environment and can't be disposed while not previous special treatments (Belay, 2010). In particular, waste products from the mining and metal refining industries, sewage sledges and residues from power station and waste incineration plants can contain heavy metals at high concentrations. Usually, these heavy metals can be leachated from the soil to the surface water system (Chang *et al.* 1984; Dowdy *et al.* 1991) at concentrations higher than they are allowed (CEC, 1986). Effluent disposal into the environment creates adverse effects by altering the normal physiochemical properties of soil and water (Kannan *et al.*, 2012). Though many conventional physicochemical methods are currently being practiced, biotechnological methods are becoming attractive alternatives, as they are economical and eco-friendly. Majority of manufactures are water based and a considerable volume of effluent is ejected to the environment either treated or inadequately treated leading to the problem of surface and ground water pollution. For this reason, they cannot be disposed into wastewaters plant and must be submitted to special treatment in order to reduce metals contents. Therefore, the management of waste sludge produced from the industrial activity becomes the most important issue of environmental protection. Naturally chromium exists in many oxidation states, but Cr(III) and Cr(VI) are of significant concern biologically. Chromium is an essential metal that is involved in the metabolism of glucose in humans and animals, but its hexavalent form is very toxic and carcinogenic (Rahmaty *et al.*, 2011). Demand for Cr(VI) is increasing day by day due to its extensive use in many industrial and chemical processes such as film and photography, galvanometric and electrical procedures, metal cleaning, plating and electroplating, leather, and mining (Unal *et al.*, 2010). These industrial processes generate toxic effluent in a large amount that contains hexavalent chromium with concentrations ranging from tens to hundreds of milligrams per liter along with other forms of chromium (Cheng *et al.*, 2010). Hexavalent chromium is often found in soil and ground water due to its wide spread industrial use in several process industries (Ganguly and Tripathi, 2002, Stern, 1982), such as tannery, electroplating, steel industries etc. Cr(VI) are highly toxic (Zhang *et al.*, 2001, Flores and Perez, 1999) pollutant even at very low concentration (Venitt and Levy, 1974, EPA, 1998, McLean and Beveridge, 2000). As many aerobic and anaerobic microorganisms are capable of reducing Cr(VI) to Cr(III), bioremediation may play an important role for the detoxification from Cr(VI) even at very low (ppm or ppb) level. It has already been reported that because of the presence of some enzymes called chromium reductases (Gu and Cheung, 2001), completely different microorganisms belonging particularly to the genus, *Pseudomonas* can reduce Cr(VI) to Cr(III). The reduction of transformation capacity of Cr(VI) by microorganisms at higher initial concentration of Cr(VI) has been observed by other researchers (Arellano *et al.*, 2004, Middleton *et al.*, 2003) and the phenomenon has been explained by the presence of inhibitory effect of Cr(VI) at high concentration level (Turick *et al*, 1997). A detailed literature search reveals that though a substantial quantum of investigation has been reported on bioremediation techniques, a substantive bioprocess study is still awaited.

Tannery effluents and Chromium contamination

Tannery effluents are of large scale environmental concern because they color and diminish the quality of water bodies into which they are released. Among heavy metals presents in sludge, Chromium is one of the most common. This metal exists in two stable oxidation states, trivalent and hexavalent Chromium. The trivalent Chromium state is less toxic and mobile, while hexavalent Chromium is easily soluble and 100 fold more toxic than trivalent Chromium. So, the reduction of Chromium(VI) to Chromium(III) is an attractive and useful process for remediation of Chromium(VI) pollution, and the technologies focusing on transformation of Chromium(VI) to Chromium(III) have accordingly received much more concerns (Vijayanand *et al.,* 2012). Tannery waste-waters are stratified because the highest pollutants among all industrial wastes. They are particularly giant contributors of Chromium pollution.

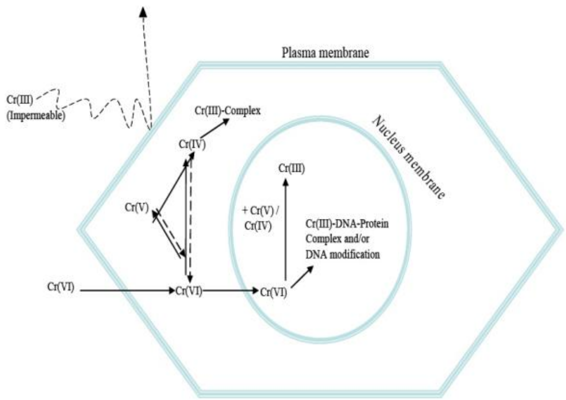

Fig. 1. Schematic diagram of the toxicity and mutagenicity of Cr(VI) (Cheung *et al.,* 2007)

Toxicity of Chromium and its accumulation

Industrial activities like electro plating, metallic cleansing and dyeing processing, cement, and leather tanning are the great sectors that play role in discharging Chromium into the environment. Cr in the hexavalent phase (Cr-Vl) comprises identical toxicant. It's rather challenging that polluted arena by industrial wastewater exhibit a mobilization ration of less than 5 (possibly poisonous) for selected plant species. The mobilization ratios for weeds become greater than 5 (Fig. 1), which has healthy morphology in the early flowering stage (Kisku *et al.,* 1999). A study done by Marchese *et al,* 2008 about the rate of accumulation of Chromium in four fresh water plant species, clams, crabs, and fishes showed that, all the four fresh water species and animals were found with high concentration of Chromium which is a denotation of its eminent assemblage potentiality.

The release of heavy metal poses significant threat to the environment and public health because of their toxicity, bio-accumulation within the organic phenomenon and persistence in nature together with bio accumulation effect (Ceribasi and yetis, 2001). In the tanning industry leather processing involves changeover of put quick-tempered conceal or skin into leather. Tanning factors could help stabilization of the skin matrix against biodegradation. This industry has gained an unfavorable image in society with regard to its contamination potentiality and consequently is confronting a critical challenge. Basic Chromium sulfate is a tanning agent, which is employed by 90% of the tanning industry. Conventional Cr tanning consequences in effluent containing as high as 1500–3000 ppm (parts per million) of Chromium; nevertheless, high-exhaust Chromium tanning techniques lead to a effluent containing 500–1000 ppm of Chromium (Aravindhan *et al.*, 2004). Merely, the expelling limits for trivalent Chromium vary broadly ranging from 1 to 5 mg/l in the case of blunt release into water system and 1 to 20 mg/l in the case of expel into the public sewer system. Consequently, the treatment plant used by the tanning industry demands to address the influent by 200 fold to send to water body, which is not pragmatic in most of the cases (Tadesse *et al.*, 2011).

Chromium impacts on the environment

Cr(VI) negatively affects the environment due to its eminent solubility, mobility and responsiveness. Soils and groundwater surrounds are the most fictile to Cr(VI) pollution from spills, unlawful disposition and unguarded stock piles of new techniques chromium products. Though Cr(III) is an important nutrient for human beings, there is no uncertainty that Cr(VI) compounds are both acutely and inveterately poisonous. The dose threshold result for this component hasn't yet been checked accurately adequate to allow ordinances to be specified. Nevertheless a few risk appraisal analyses are presently being attempted. The direct discharge of wastewaters from tanneries in to water bodies has become an arising environmental trouble in these days. Most of these effluents are exceedingly complex mixtures containing inorganic and organic compounds that make the tanning industry possibly a pollution-intensive sphere (Akan *et al.*, 2007). At large, Chromium waste from leather treating sets a substantial disposition trouble to human wellness and the environment. Awan *et al.*, (2009) analyzed the aggregation of alloys in the economically substantial crops and vegetables watered with tannery effluent. They've accounted that the aggregation of metal from soil to plant structure will not comply any specific model and diverged with relation to metal, species and plant structure. The contamination troubles are aggravated by the under mentioned attributes of Cr(VI):

- Cr(VI) is highly dissolvable and mobile in water. These consequences in eminent consumption rate in animal and plant cells.
- Cr(VI) is extremely accessible to live organisms through multiple paths of entrance such as consumption, epidermal adjoin, breathing in, and absorption (in the case of plants and rootages).
- Cr(VI) shortens seed sprouting of plants (Anon, 1974; Towill *et al.*, 1978). This is suspected to be due to root dalliances.
- Other analysis suggested retardation of development photosynthesis and enzyme actions in algae due to the bearing of Cr(VI) at concentration as low as 10 ppm (Rosko *et al.,* 1977, Silverberg. *et al.*, 1977; Sharma, 2002).

Chromium tanning and its treatment controversy

Tanneries are a great generator of chromium contamination and discharge Chromium(VI) effluent in a large volume. Newly, it has been ascertained that their metabolism could be applied in the technology of desulphurication of fuels and industrial gasolines (Halfmeier *et al.*, 1993). The efficiency of these procedures comprises competitory with the conventional processes of desulphurization and the side productions are sulphur, sulphuric acid or gypsum. Two types of tanning systems are used in tanning where vegetable tanning and Chromium tanning, where vegetable tanning doesn't comprise Chromium. However, due to the higher contamination load and low treatability, conventional vegetable tanning cannot be conceived further environmentally congenial than Chromium tanning. Furthermore, vegetable tanned leathers induce distinct physiological attributes and particular applications, merely is perishable (Ceribasi and yetis, 2001). Chromium salts (especially Chromium sulphate) are the most widely applied tanning contents but solely a divide of the Chromium salts applied in the tanning action respond with the skins. The residual of the salts persist in the tanning evacuate and are afterwards transmitted to a depuration plant wherever the Chromium salts finish in the waste-slime (Wionczyk *et al.*, 2006). Among the leading emergent environmental troubles in the tanning industry comprises the disposition of Chromium infected slime developed as a byproduct of effluent discourse. Tannery wastewaters seriously strike the mitotic procedure and shorten germ sprouting in extensively cultured pulse crops (Moore and Ramamoorthy, 2001). At high immersions Chromium is noxious, mutagenic, carcinogenic, and teratogenic and it is a metallic contaminant that, in nature subsists mainly as the dissolvable, extremely poisonous Cr(Vl) anion and the less solvable lower poisonous Cr(III), the trivalent cation. Reduction or oxidation reactions betwixt the two conditions is thermodynamically conceivable below physiological state (Arias and Tebo, 2003), thence chromate and Cr(III) are both biologically crucial ions. Chromate is more toxic than Cr(III); therefore salutary purposes of Cr could just be executed by Cr(III). Chromium survives inch oxidation states of +2, +3, and +6. The trivalent oxidation state comprises the most static constitute of Chromium and comprises necessary to mammals in trace density and comparatively fixed in the marine system attributable its scummy water solubility. A lot of researches have described that hexavalent chromium could be reduced into trivalent chromium by chemical techniques (Erdem, 2006). Though these physiologic and chemical treatment methods have followed extensively went for in exercise, they demonstrate few limitations specified low efficiency and eminent price (Rulkens *et al.,* 1995). In general, bioengineering personifies an effective and skilled alternative to chemical and physiological techniques for resolving a lot of troubles of environmental pollution as of low requirement of energy and materials, and low generation of waste product and discharges. Recently, biological hexavalent chromium simplification has been modernized with a few vantages due to the lowly prices and the substantial lower numbers of the developed ooze (Sisti *et al.,* 1996 and Konovalova *et al.,* 2003). Chromium is applied in distinct industrial operations and discharged into the surroundings. Leather processing industries (LPI) practice chromium material for tanning of leather. Remainder chromium thence is ejected in solid or watery wastewaters which are exceedingly noxious and depicts mutagenic and carcinogenic results with biological organisms due to its accented oxidating qualify (McLean and Beveridge, 2001). Chromium(III) promptly builds insolvable oxides and hydroxides preceding pH scale 5, therefore it is inferior poisonous and bioavailable than Chromium(VI) (Rai et al., 1987). Application of Chromium resistant bacteria for detoxification of Chromium(VI) has been conceived because a frugal, efficient and secure operation across formal physical and chemical techniques (Ganguli and Tripathi, 2002). Due to high correlativity between Chromium tanning and its environmental impact, ascertaining of the efficiency of treating functioning and discourse plant takes on premier importance. Consequently, the target of this report is to draw prospective impact of tannery discarded, assess the different Chromium treatment techniques, strength reducing techniques and to discuss the challenges faced to Chromium removal methods.

Chromium(VI) Reduction Microbiology

Chromium(VI) is virulent to biological systems attributable to its strong oxidizing potential that can harm cells (Kotas and Stasicka, 2000). However, some microorganisms within the presence or absence of oxygen will reduce the toxic form of Cr(VI) to its trivalent form (Francisco *et al.,* 2002). These microorganisms are known as chromium reducing bacteria (CRB). It was demonstrated that among CRB, gram-positive CRB are significantly tolerant to Cr(VI) toxicity at relatively high concentration, whereas gram-negative CRB are more sensitive to Cr(VI) (Coleman, 1988). Initially, researchers targeted on facultative microorganisms such as, *Pseudomonas dechromaticans, Aeromonas dechromotica*. A series of other diverse microorganisms were later isolated including sulphate-reducing bacteria (SRB) such as *Desulfovibrio vulgaris* (Lovley and Philips. 1994) and Fe(III) reducing bacteria such as and *Thiobocillus ferrooxidan* (Quillitana *et al.,* 2001).

Aerobic Cultures

Different studies conducted using various species of microorganisms have shown that some species isolated from Cr(VI) contaminated environments are capable of reducing Cr(VI) to Cr(III). Most of those microorganisms show outstanding resistance to Cr(VI) toxicity through cellular level mutations and different community level survival mechanisms. The Cr(VI) reduction activity under aerobic condition is generally associated with soluble proteins that use Nicotinamide adenine dinucleotide (NADH) as an electron donor either as a requirement for growth (Ishibashi *et al.*, 1990) or for enhanced activity (Horitsu *et al.,* 1987) as shown in following equation:

$$2 \cdot CrO_4^{2-} + 13 \cdot H^+ + 3 \cdot NADH \rightarrow 2 \cdot Cr^{3+} + 3 \cdot NAD^+ + 8 \cdot H_2O \quad \Delta G^{o'} = -917.71\ kJ/mol$$

Anaerobic Cultures

In subsurface conditions at the contaminated site may be severely oxygen depleted clue to lack aeration in laminar flow groundwater systems. Under anaerobic conditions different microorganisms *Escherichia coli, Ochrobactrum sp., Providencia sp., Pseudomonas aeruginosa, Pseudomonas spp*, etc. reduce Cr(VI) via the mediation of either a soluble reductase, a membrane-bound reductase or both (Wang and Shen, 1995; Miller *et al.*,1999; McLean and Beveridge, 2001).

Remediation options: Physical and Chemical Treatment

Physio-chemical remediation processes such as ion exchange, precipitation and reverse osmosis have been used to remove Cr(VI) from effluents mainly as end of the pipe solutions (Patterson, 1985). For contaminated surfaces, most commonly applied technologies include excavation and removal of contaminated material which be sent to a landfill while the site is subjected to a pump-and-treat process to limit the spread of pollutant. The treated water is pumped back into the aquifer dilute or flushes the pollutant. Unfortunately, this technique presents the pollutant (Nyer, 1992; Watts, 1998). The above method does not address the final waste disposal problem and is generally expensive due to high operational costs (Patterson *et al.*, 1985; Zahir, 1996).

Recovery and Recycling of Chromium

Conventional leather production Chromium tanning spent liquors containing significant amounts of Chromium along with different polluting (both organic and inorganic) substances. Only 60% to 70% of Chromium is utilized from the total used for tanning, while the rest 30 to 40% remains in the spent tanning liquor, which is normally sent to a wastewater treatment plant. This inefficient use of Cr and its release to the environment has to be remunerated by designing a decent recovery and recycling scheme. The recovery of Cr from spent tanning and re-tanning baths provides a significant economic advantage in terms of both its reuse and also the simplification of the processing of global wastewaters (Cassano *et al.*, 2007). Several recovery techniques such as chemical precipitation, membrane processes, adsorption, redox adsorption, and ion exchange have been proposed for this purpose. Among these membranes process offer very interesting opportunities for the recovery and recycling of primary resources from spent liquors of unit operations such as soaking, unharing, pickling, degreasing, dyeing, and Chromium tannage. Studies showed that the application of nanofiltration (NF) and reverse osmosis (RO) in combination can provide better recovery of unreacted Chromium from high concentrated spent tanning effluent. In practice, direct and indirect recycling are widely practiced Chromium recycling methods where the direct form entails spent float being recycled direct to the Chromium tanning processing for re-use. While, the indirect form entails precipitating and separating the Chromium from the float containing residual Chromium, and then re-dissolving it in acid for re-use. The efficiency of both methods can be very high (more than 90%); it depends on the effectiveness of the float collection process and the recycling/reusing technique. However, it is obligatory to adopt and practice the new technologies that are more efficient in recovering this chemical, that may be a massive challenge to tanning industry (Ludvik *et al.*, 2000). The recovery of Chromium could help in reducing the possibility of oxidizing Cr III to Cr VI (carcinogenic) compound and helps to rescue the financial and environmental cost occurred as a result of its proper discharge (Awan *et al.*, 2003). In fact experimental conditions like, temperature, P^H, time, need to be controlled to have more efficient recovery.

Treatment Media Used for Chromium

Biological Treatment (Bioremediation) of Chromium

The term "bioremediation" leas been used to describe the process of using microorganisms to degrade or remove hazardous pollutants from the environment (Glazer and Nikaido, 1995). Even though Cr(VI) can be reduced by algae or plants, in soil microorganism has been demonstrated to be most efficient (Cervantes *et al.*, 2001, Basu *et al.,* 1997; Ganguli and Tripathi, 2002; Francisco *et al.,* 2002). Microbial applications have been tested directly for Cr(VI) removal in industrial effluents and groundwater using bioreactors but has not been fully tested. The toxicity of Chromium(VI) is effectively remediated by microorganisms such as *Thiobacillus ferrooxidans*.

The biological processes are highly specific with culture requirements and at time are difficult to extrapolate the results from lab to field. It also often takes longer time than other treatment such as excavation and removal of soil. There are numerous factors affecting the method of bioremediation such as depletion of preferential substrates, lack of nutrients, toxicity and solubility of contaminants, chemical reaction or reduction potential and microbial interaction (Fig. 2).

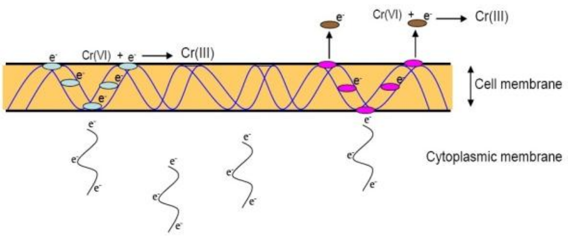

Fig. 2. Cr(VI) reduction in respiratory chain involving trans membrane protein (Myers *et al.,* 2000).

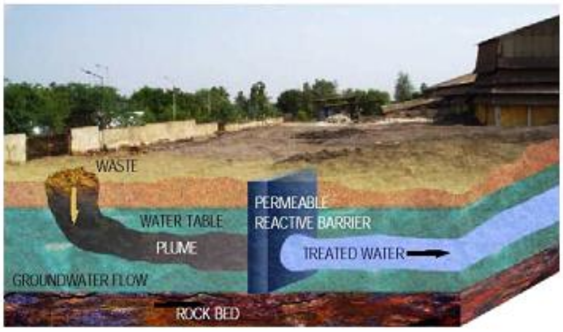

Fig. 3. Design of typical PRB (Sovani, 2005)

Unaltered bioremediation consists of placing a permanent, semi-permanent or exchangeable treatment unit down-gradient of the contaminated source as shown in Fig. 3. The barrier is placed across the groundwater flow path of a contaminant plume and it acts as a treatment wall. The intercepted contaminant material is either immobilized or transformed to a less virulent compound within the permeable reactive barriers (PRB) while permitting the groundwater to continue to flow naturally. These biological barriers square measure designed to intercept and treat contamination plumes however future action is needed to get rid of the contaminant sources. Microbial reactive barriers have been only applied on the experimental scale for the treatment of toxic metals such as Cr(VI). For example, a biological reactive barrier was studied for Cr(VI) decontamination using the yeast *Saccaromyces cerevisiae* by Krauter *et al.* (1996).

The outcome of each degradation process depends on microbes (biomass concentration, population diversity and enzyme activities), substrate (physicochemical characteristics, molecular structure and concentration), and a range of environmental factors (pH, temperature, moisture content, availability of electron acceptors, and carbon and energy sources) (Vijayanand *et al*., 2012). Rai *et al.*, 2005 did a study on seasonal variation of algal growth in tannery effluent and metal accumulation potential for Chromium removal scheme. It has been noticed that different algal species found with accumulated Chromium in their tissue, which could be used in developing bioremediation strategy for pollution abatement. Of course, factors like population density, volume of effluent, the nature of mixing with effluent and optimum algal biomass should be considered and well examined before promoting for wide application (Rai *et al.,* 2005).

Removal of Cr with other techniques

A wide range of physical and chemical processes are available for the removal of Cr(VI) from effluents. A major drawback with those treatment systems is sludge production and high operational cost and some of them are complicated for management. This actually makes the application of these technologies to be limited only in developed countries. In response to this challenge a different attempt were undertaken to produce a media which was feasible and cost effective to use by the majority. A comparison study conducted by leaching raw tannery effluent through mono and mixed columns (different grades) of vermiculite to evaluate their removal efficiency of Chromium. The mixed column of vermiculite has the highest Chromium removal (74.6%) while the mono vermiculite achieved 63.6%. This improvement in Chromium removal efficiency is brought by the use of combined media which increase its adsorption capacity. It was also found out that, it could remove cat ions like Ca, Na, Mg and K. of course high cat ion exchange helps to make the system more efficient (Jayabalakrishnan and D. Aselvaseelan, 2007). Recently different studies are concentrating use of combined media under the control of laboratory environment and the results seem promising. A research has been done by Tadesse *et al.*, 2006 to check the removal efficiency of Chromium from tannery effluent in a horizontal settling tanks and subsequent advanced integrated wastewater pond system (AIWPS) reactors. The raw combined effluent from the tannery had a different P^H and its removal efficiency was measured in detention time and P^H to come up with the best Chromium removal efficacy. After a one day detention time 58-95% of trivalent Chromium has been removed in the primary settling tank when the P^H is approached to 8, which is the optimum precipitation P^H for trivalent Chromium. A significant amount of Chromium has also removed in the secondary facultative pond and maturation pond. The presence of sulphide plays a role in the overall removal of Chromium which has some coagulating effect besides maintaining a conducive p^H for the formation of $Cr(OH)_3$ precipitate. However, since Chromium doesn't make any stable precipitate with sulphide, it has no any effect in the Chromium removal chemically. This study is prominent in finding ways to achieve the maximum removal of Chromium and producing an effluent that meet the standard criteria to discharge to water bodies. This technique needs get attention to be considered and applied in the conventional tannery treatment system to improve its efficiency and prevent the alleged environmental consequence due to the toxic effluent discharge (Tadesse *et al.,* 2006). Wastewater characterization is an important step in designing effective treatment facilities for industrial wastewaters. This is especially true for tanneries which exhibit significant differences in their production processes that generate effluents of unique and complex nature. Most pollutants in wastewaters appear to exist either in particulate form or are associated with particulates. This understanding led to the wastewater treatment strategy of removing particulate and colloidal matter in the primary step using suitable coagulants. Alum has been found to be the suitable coagulant for tannery wastewater in a dose range of 200–240 mg/L as $Al_2(SO_4)_3$ and it has removed 98.7–99.8% of Chromium. However other COD content needs secondary treatment for the tannery effluent. Therefore, chemically enhanced primary treatment (CEPT) technique offers almost complete removal of Chromium and produces an effluent that will no more affect the receiving water bodies (Haydar and Aziz, 2007).

Process alteration

There are several alternatives of addressing Chromium from tannery wastewater and a few treatment methods brought off almost 99% of removal of Chromium. Generally, these sort of methods are perplexed, overpriced, energy intensive, can be utilized on a particular area, others necessitate expert personnel and technologies. Even so, technology alike electro coagulation gave the sack Chromium (98%) and duplicability to modernizing states deserved to its low-cost. In spite of all these technological efforts tanning industry is nevertheless among the great polluter of the environment worldwide. Commercial conventional tanning has poor Cr uptake, about 55-60% (average). Therefore, constant innovative process adjustments for cleaner technology have been of the farthermost importance in the leather-processing sector to safeguard our environment (Belay, 2010). The method employed in the leather processing industry subjects the hides and skins to treatment with a wide variety of chemicals and passing through versatile unit operations. All this postulates a tremendous amount of time and they contribute to an increase in Cr, COD, chlorides, sulfates and other mineral salts, which end up as wastewater. Merely, perhaps more alarmingly, the process uses abundant quantities of water in areas where there is rapid depletion of ground water. Nevertheless, these approaches are very much confined within recycling of wastewater to a maximum number of cycles followed by expelling or use of environmentally-friendly chemicals. In principle discharge of minimal contamination loads or a zero-discharge concept should be the topic of the present time to foreclose pollution entirely (Mukherjee, 2006).

Conclusion

The ever increasing concern about the deterioration of the environmental condition could be a driving force to assess and remediate pollutant from the ecosystem. From this intensive review of literature it is patent that Chromium is very virulent to human wellness, beasts and the environment (land, water system, deposits plants and so on). Nowadays, all tanneries should thoroughly ascertain their waste watercourses. Chromium expelling into those streams is among the constituents that need to be rigorously ascertained. Consequently, to foreclose the general public wellness and environmental affect of tannery discarded and chromium notably the environmental ordinance suchlike wastewater expelling limit has to be rigorous and administration had higher omnipotent to the extent to postulate measure by implementing defiler precept or pre-caution rule to obviate the burden of perniciousness and bioaccumulation.

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