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Original Article

BIOCHEMICAL ANALYSIS OF TANNERY EFFLUENT

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ABSTRACT

Objective: The objective of the present investigation is to assess the biochemical analysis in the effluent sample collected from the nearby runoff of common effluent treatment plant (CETP) at Valayampet, Vaniyambadi, Tamilnadu, India,

Methods: Biochemical characteristics of the effluent were determined as per the protocol derived by American public health association (APHA).

Results: The results indicated that effluent sample was found toxic in nature, having high BOD, COD, TDS and Cr (VI) content (3.13 mg/L).

Conclusion: As per the results obtained it was concluded that leather industry should make all attempts to reduce its impact on environment by making every effort to reuse and recycle chemical compounds.

Keywords: Tannery, Vaniyambadi, effluent, CETP, chromium.

INTRODUCTION

Tanneries are such industries which contributes a major part in water usage. Obviously the waste water from this unit contains considerable amounts of hazardous compounds and where heavy metals are very common. Today 70% of available water in India has been polluted and two thirds of illness in India is related to water-borne diseases. Effluents from the tanneries contain high concentrations of inorganic and organic chemicals and are characterized with residual COD and high TDS. Chromium salts (particularly chromium sulphate) are the most widely used tanning substances today. Hides tanned with chromium salts have a good mechanical resistance, an extraordinary dyeing suitability and a better hydrothermic resistance in comparison with hides treated with vegetable substances. Unfortunately only a fraction of the chromium salts used in the tanning process react with the skins. The rest of the salts remain in the tanning exhaust bath and are subsequently sent to a depuration plant where the chromium salts end up in the sludge [1-3]. At high concentration, Cr^{3+} salts used in tanning process exhibit toxic and carcinogenic behavior to the flora and fauna of the aquatic system [4-5]. One of the major emerging environmental problems in the tanning industry is the disposal of chromium contaminated sludge produced as a by-product of waste water treatment.

At high concentrations chromium is toxic, mutagenic, carcinogenic and teratogenic. chromium exists in oxidation states of +2, +3 and +6. The trivalent oxidation state is the most stable form of chromium and is essential to mammals in trace concentration and relatively immobile in the aquatic system due to its low water solubility. The hexavalent chromium is much more toxic to many plants, animals and bacteria inhabiting aquatic environments [6-7].

There are more than 10 nos of CETP(s) in operation in the Vellore district, Vaniyambadi CETP is tied up with more than 100 tanneries, handling industrial effluents and discharging treated effluents in Palar river basin. There is no water flow in River Palar at present due to construction of many water reservoirs across the tributaries in Andhra Pradesh and Karnataka. Due to high permeability of riverbed, the treated effluents infiltrate into the soil and almost little (or no) discharge is visible in the river. Generally there are three types of wastewater from tanneries i.e soaking effluent, chromium effluent and other wastewater. Soaking wastewater containing high TDS is commonly allowed for solar evaporation either in the premises or at CETPs. The effluents are generally high TDS, BOD and CETP(s) also receives chromium in significant concentrations.

Only a few CETPs are meeting the standards in terms of BOD and none of the CETPs are meeting the standard in terms of TDS as stipulated by Tamil Nadu pollution control board. None of the CETPs have been issued either consent order or direction by TNPCB [8]. The objective of the present investigation is to assess the biochemical analysis in the effluent sample collected from nearby runoff of common effluent treatment plant (CETP) at Vaniyambadi, Tamilnadu, India,

MATERIALS AND METHODS

Materials

Potassium dichromate ($K_2Cr_2O_7$) (Analytical grade) used for the preparation of Cr (VI) stock solution and 1, 5-diphenylcarbazide (1, 5 DPC) required for colorimetric estimation of Cr (VI) was purchased from Sigma -Aldrich Chemical Co., USA. All other reagents used were of analytical grade.

Methods

Effluent sample collection

The effluent sample from nearby runoff of common effluent treatment plant (CETP) at Valayampet, Vaniyambadi, Tamilnadu, India, was collected in sterile glass bottles, transported on ice to the laboratory for biochemical analysis.

Biochemical Analysis

Biochemical characteristics of the effluent were determined following standard methods described by American public health association (APHA) [9]. The amount of Cr (VI) in the effluent sample was determined using diphenylcarbazide (DPC) colorimetric methods with a UV-Vis spectrophotometer (Model No. 1240 – Shimadzu Japan) with 1.0 cm quartz cuvettes. Stock solution (1g/ L) of Cr (VI) was prepared by dissolving required quantity of $K_2Cr_2O_7$ in deionised water. This solution was further diluted to prepare different working concentrations. The pH of the solution was adjusted with 0.1 N HNO_3 and 0.1 N NaOH solutions.

RESULTS

The effluent sample collected from nearby runoff of common effluent treatment plant (CETP) at Valayampet, Vaniyambadi was analyzed for biochemical properties and results showed in Table 1. The effluent was highly acidic (pH 6.3) having high biochemical oxygen demand (983 mg/L), chemical oxygen demand (1873 mg/L), total dissolved solids (9984 mg/L) and Cr content (3.13mg/L).

Table - 1: Biochemical properties of the tannery effluent, CETP, Valayampet, Vaniyambadi.

S.No	Parameters	Inference/ Concentration
1	Colour	Dark brown
2	Odour	Foul smell
3	pH	6.3±0.2
4	Cr (VI)	3.13±0.4
5	Turbidity (NTU)	245±2.1
6	TDS (mg/L)	6434±13.3
7	TSS (mg/L)	3985±6.5
8	Phosphates (mg/L)	0.29±0.02
9	BOD (mg/L)	983±3.0
10	COD (mg/L)	1873±4.0
11	Calcium (mg/L)	1231±3.0
12	Magnesium (mg/L)	234±2.5
13	Sodium (mg/L)	5786±4.6
14	Potassium (mg/L)	1324±4.2
15	Total solids (mg/L)	9984±5.4
16	Total hardness (mg/L)	2423±2.3
17	Chlorides (mg/L)	3123±2.8
18	Sulphates (mg/L)	756±2.1
19	Nitrates (mg/L)	8.7±0.2

Values are expressed as X±S.D

It is worth mentioning that the Cr concentration in the treated effluent was much higher than the prescribed limits in Indian standards [10]. The level of Cr (VI) concentration was found to be 3.13 mg/L, but the industrial effluent permissible discharge level of Cr(VI) into inland water is 0.1 mg/L. In addition the level of phosphates, calcium and magnesium was found to be relatively high in comparison with standard value and the results were 0.29 mg/L in the case of phosphate and calcium depicts more than 1g/L followed by magnesium shows 234 mg/L.

In the environment, hexavalent Cr salts do not readily precipitate or become bound to components of soil and therefore, Cr (VI) can move throughout aquifers to contaminate groundwater and other sources of drinking water thus representing a toxic hazard to livestock and wildlife [11].

DISCUSSION

Worldwide chromium contamination of ground water and soil has arisen predominantly from the common practice of land-based disposal of tannery wastes under the assumption that the dominant species in the tannery waste would be the thermodynamically stable Cr (III) species. However, recent detection of significant levels of toxic Cr (VI) in the effluent sample collected from the nearby runoff of common effluent treatment plant raise critical questions relating to current disposal of Cr-containing wastes. Although Cr III is an essential nutrient for human beings, there is no doubt that Cr (VI) compounds are both acutely and chronically toxic. Cr III is less toxic than some other elements (Hg, Cd, Pb, Ni and Zn) to mammalian and aquatic organism, probably due to the low solubility of this element in its trivalent form. Cr III compounds also have a very low mobility in soils and are thus relatively unavailable to plants. The direct discharge of effluents from tanneries in to water bodies has become a growing environmental problem in these days. Most of these waste waters are extremely complex mixtures containing inorganic and organic compounds that make the tanning industry potentially a pollution-intensive sector. Despite the thermodynamic stability of Cr (III), the presence of certain naturally occurring minerals, especially MnO_2, can enhance oxidation of Cr (III) to Cr (VI) in the soil environment. This factor is of public concern because at high pH, Cr (VI) is bioavailable and it is this form that is highly mobile and therefore poses the greatest risk of groundwater contamination. Technologies used to reduce chromium in waste water such as high exhaustion process, direct or indirect chromium recycling to be practiced.

CONCLUSION

It is concluded that effluent sample collected from the nearby runoff of common effluent treatment plant (CETP) at Valayampet, Vaniyambadi, showed much higher values of biochemical parameters than the prescribed limits in Indian standards. The level of Cr (VI) concentration was found to be 3.13 mg/L, but the industrial effluent permissible discharge level of Cr (VI) into inland water is 0.1 mg/L.

The above study shows the statistical values of numerous biochemical generated by the leather industry and present in the effluent. Chemical recovery and reuse is an economically feasible alternative for the leather sector. With their short payback period chemical recovery plants are financially attractive options. Leather industry should make all attempts to reduce its impact on environment by making every effort to reuse and recycle chemical compounds.

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REFERENCES

1. Ros M, Ganter A. Possibilities of reduction of recipient loading of tannery waste Slovenia. J Water Sci Tech 1998; 37: 145-52.
2. Song Z, Williams CJ, Edyvean RJ. Sedimentation of tannery wastewater. J Water Res 2000; 34: 2171-6.
3. Kotas J, Stasicka Z. Chromium occurrence in the environment and methods of its speciation. J Environ Pollu 2000; 107: 263-83.
4. Bartlett R, B James. Behaviour of chromium in soils - III oxidation. J Environ Qual 1979; 8(1): 31.
5. Dessi M B, H Kozlowski, G Micera and M.V. Serra. *In vitro* interaction of mutagenic chromium (VI) with red blood cells. J FEBS Lett 1989; 257: 52.
6. Ajmal M, AA Nomani, A Ahmad. Acute toxicity of chrome electroplating wastes to microorganisms: adsorption of chromate and chromium (VI) on mixture of clay and sand. J Water Air Soil Pollut 1984; 23: 119-27.
7. Tsou T S, RJ Lin, JL Yang. Mutational spectrum induced by chromium (III) in shuttle vectors replicated in human cells: Relationship to Cr (III) -DNA interaction. J Chem Res Toxicol 1997; 10:692.
8. Performance status of common effluent treatment plants in India. J Central Pollution Control Board 2005.
9. APHA. Standard methods for the examination of water and wastewater, 18th Edn. American public health association. American water works association: Water environmental federation; Washington DC 1992.
10. General standards for discharge of environmental pollutants part-A: Effluents. J Environment (Protection) Rules 1986.
11. Losi E, Amrhein C, Frankenberger WTJ. Environmental biochemistry of chromium. J Rev of Environmental Contamination & Toxicology 1994; 136: 91-131.