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Cultivation of Artemia for Reducing BOD in Industrial Wastewater

N.C.Arun[1], S.Satheesh Kumar[2], M.Dhivakar Karthick[3]

[1,2,3]*Assistant Professor Civil Department, Kongunadu College of Engineering and Technology*

ABSTRACT

Tannery wastewaters are highly complex are characterized by high contents of organic, inorganic and nitrogenous compounds, chromium, sulphides, suspended solids and dissolved solids.All aerobic processes have a similar level of BOD removal, but highest BOD removal efficiency at a high organic loading rate was observed in aerobic reactors. Aerobic processes are employed for the treatment using artemia of tannery wastewater. Artemia were used in toxicity bioassays .Adult artemia was harvested at the age of 15 days after the inoculation of cyst in hatching tank.63.09 gm (wet weight) of artemia were collected from tank and the weight of each artemia was found 0.0036g. This review postulates the future role of artemia test in aquatic toxicology to be that of a reference or quality control in rapid screening tests as much as that of a predictor of chemical effects on species in marine environments.

Keywords: BOD, COD, Tannary wastewater, sulphides, chloride, artemia, biological treatment, dissolved oxygen

INTRODUCTION

Tanning is one of the oldest industries in the world. During ancient times, tanning activities were organized to meet the local demands of leather footwear, drums and musical instruments. With the growth of population, the increasing requirement of leather and its products led to the establishment of large commercial tanneries. Two methods are adopted for tanning of raw hide/skin viz., vegetable tanning and chrome tanning. The production processes in a tannery can be split into four main

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categories: (1) Hide and skin storage and beam house operations, (2) tanyard operations, (3) post-tanning operations and (4) finishing operations.

Tanneries are typically characterized as pollution intensive industrial complexes which generate widely varying, high-strength wastewaters. Variability of tannery wastewaters are not only from the fill and draw type operation associated with tanning processes, but also from the different procedures used for hide preparation, tanning and finishing. These procedures are dictated by the kind of raw hides employed and the required characteristics of the finished product. Tanning industry also has one of the highest toxic intensity per unit of output .During tanning process at least about 300 kg chemicals are added per ton of hides .Tannery effluent is among one of the hazardous pollutants of industry. Major problems are due to wastewater containing heavy metals, toxic chemicals, chloride, lime with high dissolved and suspended salts and other pollutants.Tanneries generate wastewater in the range of 30-35 L kg^{-1} skin/hide processed with variable pH and high concentrations of suspended solids, BOD, COD; tannins including chromium .The growth of industrialization has encroached even to small townships and villages along with all ills of pollution. In this review the characteristics of tannery wastewater are discussed and an effort has been made to give a brief idea of an approach to tannery wastewater treatment, particularly discussing and highlighting in brief the biological methods.

REVIEW OF LITERATURE

Islam.B.I et.all 2014 will be conducted studies on “Evaluation and Characterization of Tannary Wastewater” There is an enormous pressure from the various pollution control bodies to regulate and minimize the amount of pollution generated from the leather processing. The need for use of alternative to chemical methods to combat pollution problem have become necessary to protect the industry and to comply with the environmental norms. .The BOD5 /COD ratio of syntans was also lower than other compounds. The beam house operations soaking, liming and deliming lead to discharge of high amount of sulfides, lime, and ammonium salts, chlorides, sulphate, and protein in the effluent. Consequently, the wastewater is characterized with high amount of BOD and COD.

Alebel Alebe Belay 2010 conducted studies on “Impact s of chromium tannery effluent evaluation of alternative treatment process”. The paper has focused on the challenges/impacts of tannery effluent and

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evaluates the alternative treatment options used to treat, recover or recycle chromium from the waste water. The results of this review paper indicated that chromium is highly toxic and carcinogenic to human beings, animals, plants and the general environment (soil and water sediment). It is found out that chrome is the primary threat when ever tanning industry comes in to practice. Tan-nery effluents are ranked as the highest pollutants among all industrial wastes. They are especially large contributors of chromium pollution. In general chrome waste from leather processing poses a significant disposal problem to human health and the environment.Bruno S.Nunes et.all 2005 will be conducted studies on “Using of genus using artemia in ecotoxicity”the paper reviews information related to artemia that may be considered relevant for ecotoxicity testing. Aspects related to variability in results, adoptable toxicity end points, culture conditions, characteristics of species and strains, influence of geographical origins over physiological features and responses to chemical agents are considered. High salt concentrations can also be found in other habitats colonized by Artemia, such as temporal salt lakes, subjected to unpredictable floods. Artemia is one of the most valuable test organisms available for ecotoxicity testing and research done so far allows us to state that it is possible to sustain several options related to Artemia use in Toxicology and Ecotoxicology. As it was high-lighted in this review article, adaptability of Artemia genus to distinct environmental conditions may turn Artemia, in the future, into a crucial test organism for Ecotoxicology testing.

Geremew Liknaw Tadesse et.all 2017 will be conducted on studies on “impact effluent of tannary in environmental and human health” to remove the complex mixture of toxic organic chlorinated phenols, toxic pollutents such as sulphides ,phenolic compounds magnesium, sodium cobalt , copper lead grease and oil. Cr have different health effects and cause for acute toxicity, mutagenic, carcinogenic and high blood pressure for societies used untreated waste water contain large amount of Cr discharged from any tannery industries and also affect seed germination of the plants. The levels of Cr in the downstream river and spring water samples exceed from WHO permissible limit of total chromium in drinking waters (0.05 mg/L). The increased concentration of Cr in the water samples indicate the possible environmental pollution of downstream water bodies by the tannery effluent, soil and vegetable.

Selvaraj sujatha devi et.all 2013 will be conducted studies on “The effect of artemia franciscana on the removal of chromium by bioaccumulation”, the bioaccumulation of cr by artemia Franciscans was investigation metallothionein protein plays a key role in the uptake of cr by artemia and it was estimated by the silver

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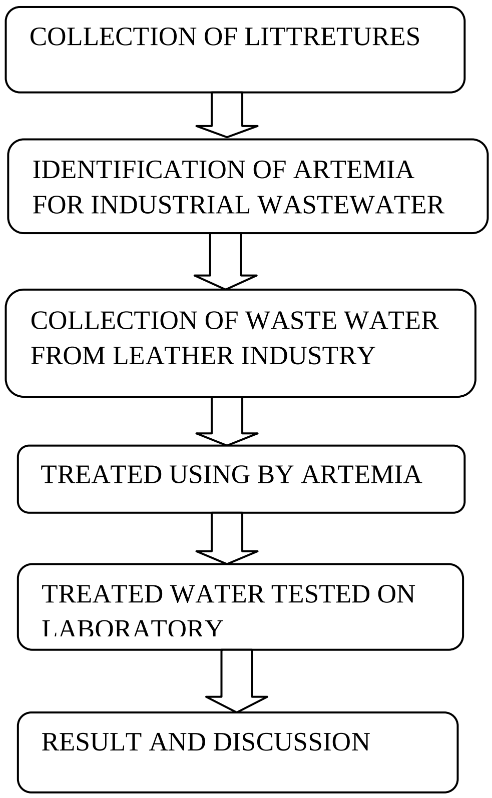
saturation method. Easy culturing of artemia proves this biological treatment to be an alternative for the various microbial treatments. The habitats in which the genus Artemia is found are characterized by the absence of predatory animal species. Therefore, in such environment the evolution of Artemia populations is favoured by the abundance of bacteria, protozoa and algae that are the basis of the Artemia diet.

METHODOLOGY



WASTEWATER TREATMENT PROCESSES

Many conventional processes were carried out to treat wastewater from tannery industry such as biological process, oxidation process and chemical process.

Biological treatmentmethods: Biological treatment of wastewater is evaluated as a good treatment method for industrial effluents. Treatment of wastes with bacteria involves the stabilization of waste by decomposing them into harmless inorganic solids either by aerobic or anaerobic process. In aerobic process, the decomposition rate is more rapid than the anaerobic process and it is not accompanied by unpleasant odours, whereas in anaerobic process, longer detention period is required and gives unpleasant odours.The processes used most frequently for biological treatment of tannery

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wastewater in CETPs in India are the Activated Sludge Process (ASP) and the Upflow Anaerobic Sludge Blanket (UASB) process. In general, ASP-based treatment is considered to be energy-intensive and expensive from an operation and maintenance point of view. On the other hand, anaerobic processes claim to offer several advantages, especially under tropical climatic conditions. However, a comprehensive comparison of the relative merits of tannery wastewater treatment by these two processes with field data has not yet been performed. As such, it is imperative that experience and knowledge gained through the operation of full-scale treatment plants treating tannery effluents employing both ASP and UASB processes is properly utilized.High variability in the organic content (reflected by COD concentration) and salinity (reflected by TDS concentration) of the soak liquor might make the proper operation of a biological treatment plant uneasy, causing important disturbance in the equilibrium of the microbial community. This choice resulted in frequent changes in the environmental conditions in the bioreactor.

Aerobic biological treatment methods: Biodegradation of tannery wastewater using **activated sludge** process has been reported by many research workers. The performance of **activated sludge** process is affected by many factors. Various parameters of importance relating to growth of microorganisms and substrate utilization on which the operation of the reactor is based include mean cell residence time, Mixed Liquor Volatile Suspended Solids (MLVSS) concentration, hydraulic detention time, i.e., aeration time, food to microorganism (F:M) ratio and the **dissolved oxygen** the reactor. All these studies indicate a BOD_5 removal of 90 to 97% for the tannery effluent concluding **activated sludge** process as highly useful for the purpose.

An ASP was used for the treatment of tannery wastewater. It was operated continuously for 267 days. Settled tannery wastewater was used as influent to the aeration tank. A removal efficiency of above 90 and 80% for $BOD_5$and COD was obtained when the ASP is operated at an MLVSS concentration of 3500 mg L^{-1} keeping an aeration time of 12 h .A Common Effluent Treatment Plant (CETP) based on **activated sludge** process was employed for the treatment of tannery effluent. A significant reduction in COD and BOD levels were achieved during the course of treatment in CETP. It was observed that the chromium addition had less influence on the denitrification bacteria than on the nitrification bacteria.

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Combination of biological methods with physical/chemical methods: Due to the extremely changing quality of the raw wastewater, tan-yard wastewater, the biological pre-treatment could not be stabilized all the time and nitrification was sometimes inhibited.

Evaluation of the potential biological treatment was performed by the **activated sludge** system of suspended micro-organisms using seawater flocculated tannery wastewater. The pH adjustment of the influent wastewater and PO_4-P addition after seawater flocculation were the most important operational parameters to enhance the removal efficiency of COD in the **activated sludge** process. Removal efficiency of COD increases with increase in sludge retention time (SRT). With the pH adjustment and PO_4-P addition after seawater flocculation, 75% of COD was removed at the SRT of 15 days. Experimental results demonstrated that seawater flocculation was more effective than the comparable ferric salt flocculation in enhancing the biological treatment during the 110 days of operation (Ryu *et al.*, 2007).

Chromium removal: The tannery wastewater with increasing chromium concentrations, caused by poor waste**water management** with an average value in the influent was around 2.673±0.32 to 3.268±0.73 mg L^{-1} Cr. Investigations are focused on identification of the factors affecting the process performance (Banas *et al.*, 1999).

Chromium in tannery sludge causes serious environmental problems and is toxic to organisms and it was efficiently leached by the acidophilic sulfur-oxidizing Acidithiobacillus thiooxidans. A Gram-positive, chromium (Cr) resistant bacteria strain from effluent of tanneries, grown in media containing potassium dichromate concentration up to 80 mg mL^{-1} has the reducing capability Cr (VI).

RESULT AND DISSCUSION

1. **Determination of BOD**

S.NO	Samples	Weight of Sample(mg/l)	permissible limit
1.	Inlet	22 mg/l	30mg/l
2.	Outlet	16 mg/l	30mg/l

Table.1 Determination of BOD

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Concentration mg/l

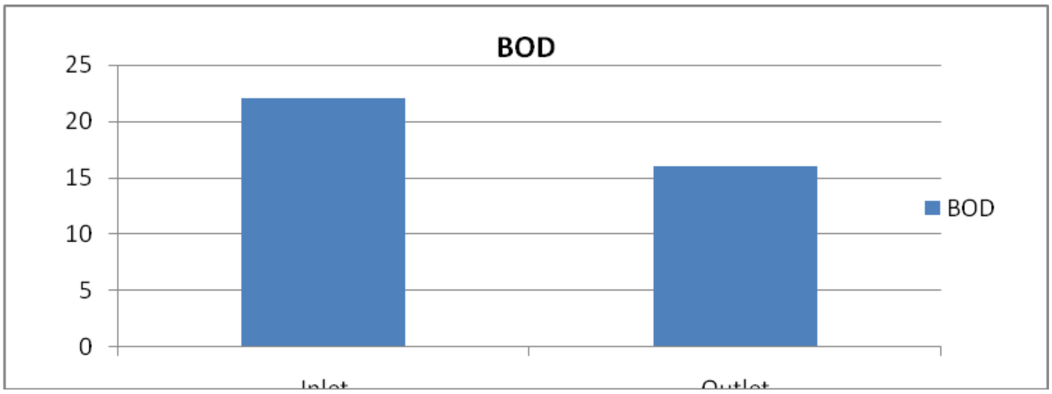

Fig on .1 BOD Value

The BOD content presented after treated tannary wastewater 16mg/l < 30mg/l (permissible limit) so it's safe. Sutitable for disposal in the nature water body. It‘s recommended to reuse.

2. Determination of COD

S.NO	Samples	Weight of sample (mg/l)	permissible limit
1.	Inlet	126 mg/l	250mg/l
2.	Outlet	92 mg/l	250mg/l

Table.2 determination of COD

Concentration mg/l

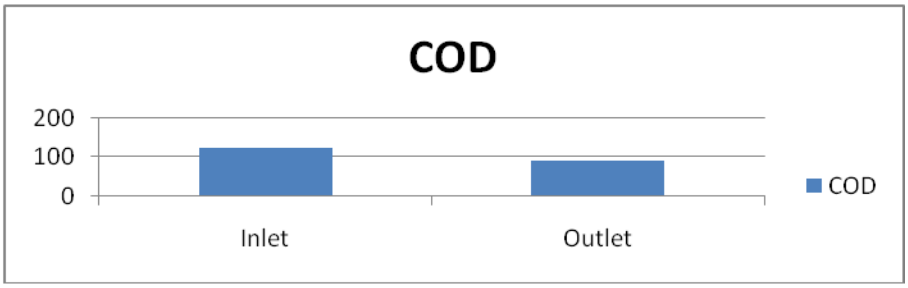

Fig on .2 COD value

The COD content presented after treated tannary wastewater 92mg/l < 250mg/l (permissible limit) so it's safe. Suitable for disposal in the nature water body. It‘s recommended to reuse.

3. Determination of PH

- Sample1=8.67

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❖ Sample 2 =8.12

Concentration mg/l

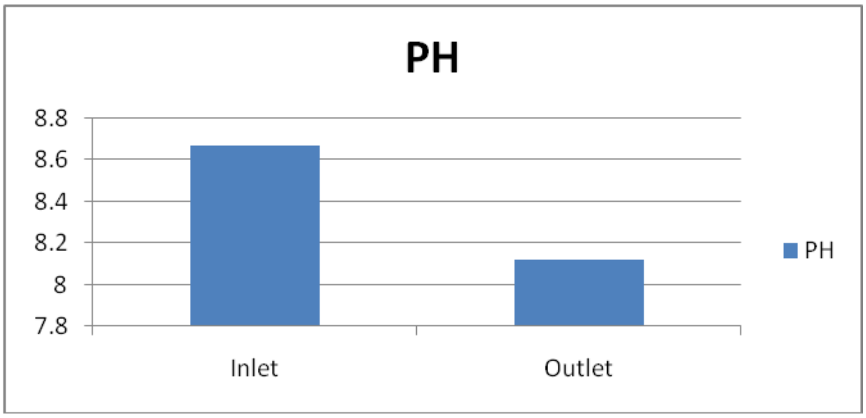

Fig on .3. PH value

The PH value presented after treated tannary wastewater 8.12 < 9 (permissible limit) so it's safe. Suitable for disposal in the nature water body. It‘s recommended to reuse.

4. Determination of Total solid

S.NO	Sample	Weight of sample (mg/l)	permissible limit
1.	Inlet	450.5 mg/l	700mg/l
2.	Outlet	274 mg/l	700mg/l

Table .4. Determination of Total solids

Concentration mg/l

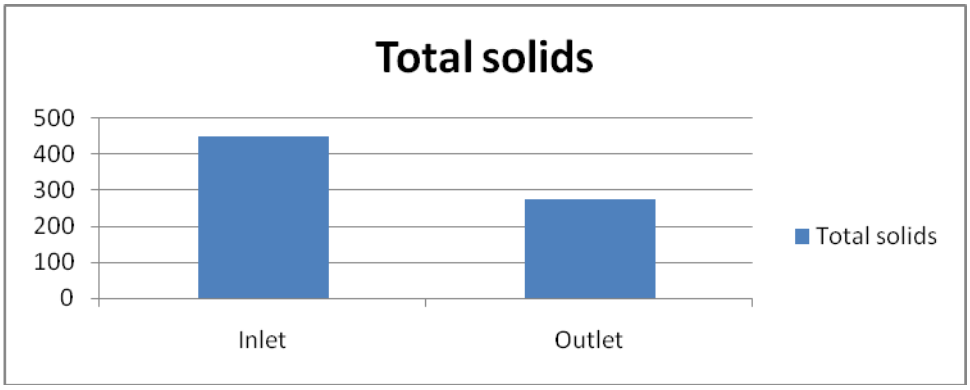

Fig on .4. Total solids

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The total solids presented after treated tannary wastewater 274mg/l < 700mg/l (permissible limit) so it's safe. Sutitable for disposal in the nature water body. It's recommended to reuse.

5. Determination of Dissolved Solids

S.NO	Samples	Weight of sample (mg/l)	permissible limit
1.	Inlet	33460 mg/l	2100mg/l
2.	Outlet	18660 mg/l	2100mg/l

Table .5. Determination of Dissolved Solids

Concentration mg/l

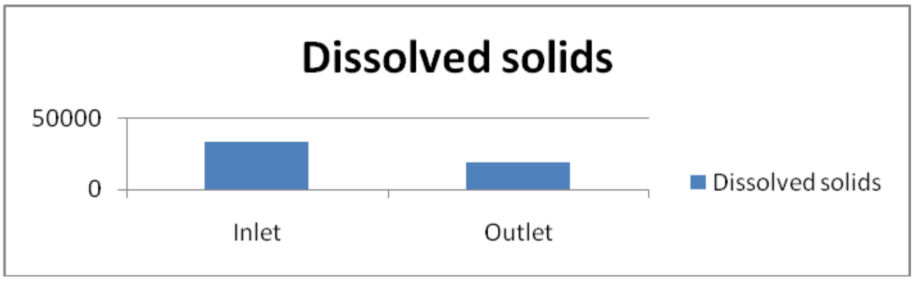

Fig on .5. Dissolved Solids

The dissolved solids presented after treated tannary wastewater 18660mg/l >2100mg/l (permissible limit) so it's not safe. Sutitable for disposal in the nature water body. It's recommended to reuse. The most commonly occurring cation in fresh water is calcium. Changes in TDS concentrations in natural waters often result from industrial effluent, changes to the water balance or by salt-water intrusion.

6. Determination of Suspended solids

S.NO	Samples	Weight of samples(mg/l)	permissible limit
1	Inlet	76.52 mg/l	100mg/l
2	Outlet	42.8 mg/l	100mg/l

Table .6. Determination of Suspended solids

Concentration mg/l

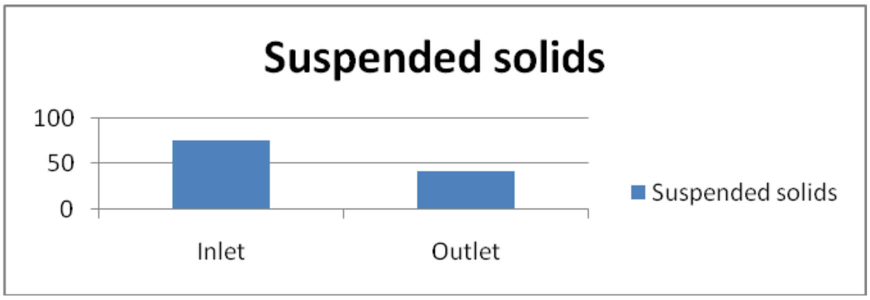

Fig on .6. Suspended solids

The suspended solids presented after treated tannary wastewater 42.8mg/l < 100mg/l (permissible limit) so it's safe. Suitable for disposal in the nature water body. It‘s recommended to reuse.

7. Determination of chloride content

S.NO	Samples	Weight of samples (mg/l)	permissible limit
1.	Inlet	5240 mg/l	1000mg/l
2.	Outlet	3080 mg/l	1000mg/l

Table 7. Determination of chloride content

Concentration mg/l

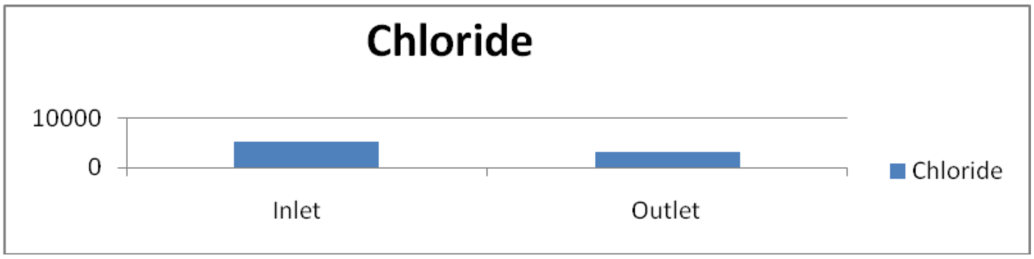

Fig on 7. Chloride content

The chloride content presented after treated tannary wastewater 3080mg/l < 1000mg/l (permissible limit) so it's not safe. Suitable for disposal in the nature water body. It‘s recommended to reuse. Chloride is toxic to aquatic life and impacts vegetation and wildlife. There is no natural process by which chlorides are broken down, metabolized, taken up, or removed from the environment.

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8. Determination of Nitrates content

S.NO	Samples	Weight of samples (mg/l)	permissible limit
1.	Inlet	256 mg/l	1000mg/l
2.	Outlet	184 mg/l	1000mg/l

Table 8. Determination of Nitrates content

Concentration mg/l

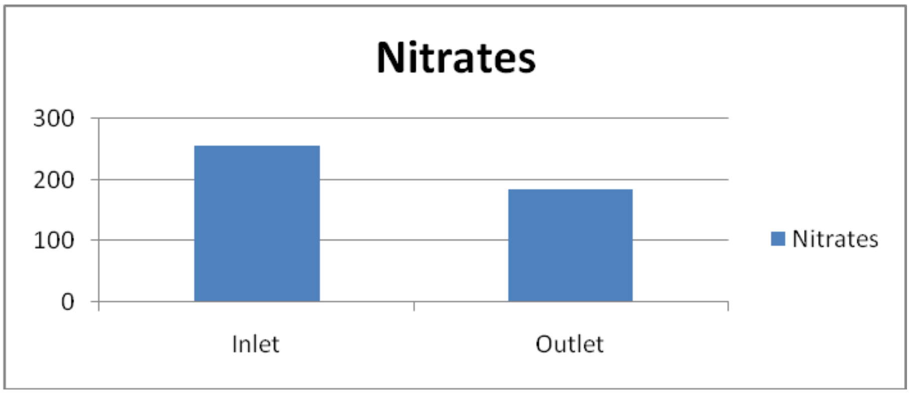

Fig on 8. Nitrates content

The Nitrates content presented after treated tannary wastewater 184mg/l < 1000mg/l (permissible limit) so it's not safe. Sutitable for disposal in the nature water body. It's recommended to reuse. Excess nitrogen in water can harm people. Too much nitrogen, as nitrate, in drinking water can be harmful to young infants or young livestock. Excessive nitrate can result in restriction of oxygen transport in the bloodstream.

9. Determination of Chromium content

S.NO	Samples	Weight of samples (mg/l)	permissible limit
1.	Inlet	22.8 mg/l	2mg/l
2.	Outlet	18.6 mg/l	2mg/l

Table .9. Determination of Chromium content

Concentration mg/l

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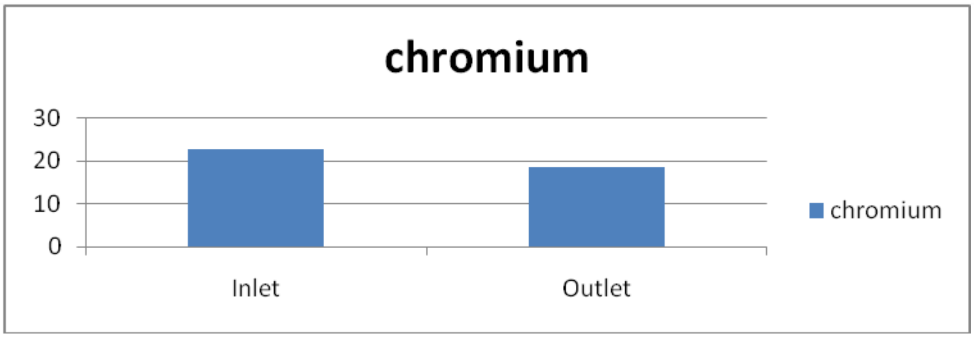

Fig on 9. Chromium content

The chromium content presented after treated tannary wastewater 18.6mg/l > 2mg/l (permissible limit) so it's not safe. Sutitable for disposal in the nature water body. It's recommended to reuse. Suitable for disposal in the nature water body. It's recommended to reuse. Crops contain systems that arrange the chromium-uptake to be low enough not to cause any harm. But when the amount of chromium in the soil rises, this can still lead to higher concentrations in crops.

10. Determination of Total Alkalinity

S.NO	Samples	Weight of sample(mg/l)	permissible limit
1	Inlet	8970mg/l	600mg/l
2	Outlet	5100mg/l	600mg/l

Table 10 Determination of Total Alkalinity

Concentration mg/l

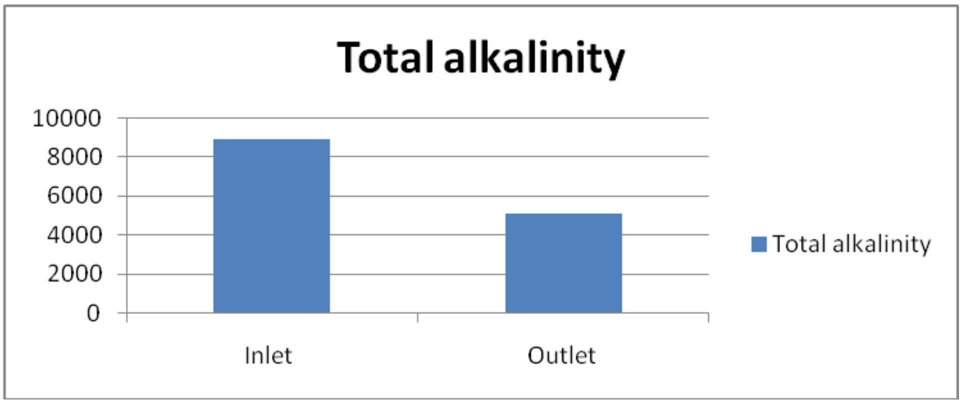

Fig on 10 Total Alkalinity

The Total Alkalinity content presented after treated tannary wastewater 5100mg/l >600mg/l (permissible limit) so it's not safe. Suitable for disposal in the nature water body. It's recommended to reuse. Suitable for disposal

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in the nature water body. It‘s recommended to reuse. High Alkalinity Effects on Plant Nutrition. Potential adverse effects. In most cases irrigating with water having a causes no problems as long as the alkalinity is low. This water will probably have little effect on growing medium pH because it has little ability to neutralize acidity.

11. Determinations on Hardness

S.NO	Samples	Weight of samples (mg/l)	permissible limit
1	Inlet	15670mg/l	600mg/l
2	Outlet	9850mg/l	600mg/l

Table 11. Determination Total Hardness

Concentration mg/l

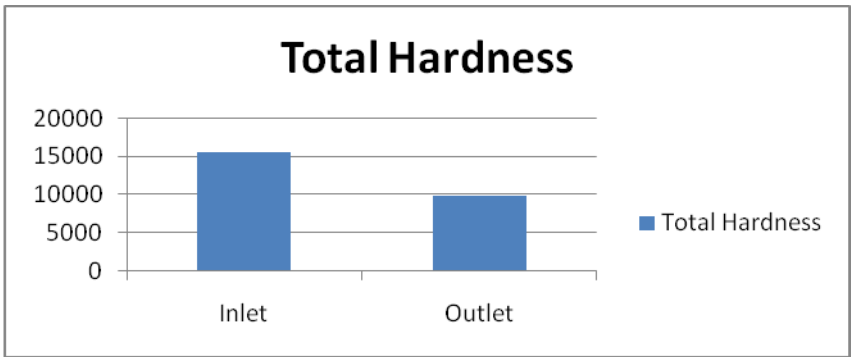

Fig on 11 Total Hardness

The Total Hardness content presented after treated tannary wastewater 9850mg/l >600mg/l (permissible limit) so it’s not safe. Suitable for disposal in the nature water body. It‘s recommended to reuse. Suitable for disposal in the nature water body. It‘s recommended to reuse. The most important impact of hardness on fish and other aquatic life appears to be the affect the presence of these ions has on the other more toxic metals such as lead, cadmium, chromium and zinc. Generally, the harder the water, the lower the toxicity of other metals to aquatic life.

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