Volume 6, Issue 4 (2019) 1-6 ISSN 2347 - 3258
International Journal of Advance Research and Innovation

Experimental Investigations on Treatment of Tannery Effluent by Senna Auriculata and Cactaceae for Agricultural Purpose

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Article Info
Article history:
Received 25 January 2019
Received in revised form
20 February 2019
Accepted 28 February 2019
Available online 15 March 2019

KEYWORDS
Tannery waste water, Senna auriculata, cactus, biosorbent, toxic effects.

ABSTRACT
Tannery effluent contains more and more toxic substances. Tannery effluent literally affects the quality of water bodies from where it is discharged.Tannery effluent are highly complex and it is chracterized by high conent of organic, inorganic, suspended solids and dissolved solids, sulphides, chromium, turbidity, hardness, sulphate, chloride, dissolved oxygen, BOD, COD. The treatment of tannery effluent is crried out by physical, chemical, biological treatment or combination of these treatment. Also the treatment also carried out by using the filter media step procedure.This research paper mainly deals with reducing the properties of turbidity,hardness, sulphates, chlorides, sulphides. Senna auriculata and cactus powder are used as adsorbent for the treatment of tannery water. The leaves of senna auriculata is anti-biotic and it removes more impurities from the waste water. Finally this treatment process is economic and it consumes very low cost. Around 80-90% of impurities are eliminated by this treatment.

1. INTRODUCTION

Tanning is one of the oldest industries in the world. As a world continues to grow commercial agriculture consumes more and more water. This technique aims to remove suspended particles. Major problems are due to wastewater containing heavy metals, toxic chemicals, chloride dissolved and suspended solids and other pollutants. As this water is consumed both waste water and streams and regulated requirements increases. Effective waste water has become one of the corner stone's of running a successful agriculture business. Ecosphere's patented ozone waste water treatment technology provides a cost-effective, chemical free solution for treatment and reuse of the large amounts of waste water generated from agricultural processing operations. The use of waste water for crop irrigation is becoming increasingly common, especially in arid and semi-arid areas. Crop yields are higher as the waste water contains not only water for crop growth, but also plant nutrients [N2 & P].

Industrial effluents are one of the important pollution sources in the pollution of the water environment. It is any waste water generated by industrial activities. The treated waste water may be reused or released to a sanitary sewer or surface water in the environment.

2. STUDY AREA

In Tamil Nadu (India) there are large number of leather tannin industries are available. Even discharge of tannery effluents into natural water bodies without proper treatment are prohibited by the government and also enforced by law, some industries removes only colour from the effluent using lime process and discharging it into the water bodies without any treatment process for removal of pollutants from the wastewater. Due to these reasons the natural water bodies which are being used as drinking water source are contaminated. The reason behind discharging the wastewater without treatment is because of the cost of treatment process.Tannery effluents were collected from a leather tanning industry using a 40 litres can, which is pre-washed using diluted acid for removal of any pathogens present in it.

2.1. OBJECTIVES

- To prepare the treatment process with Senna auriculate and Cactus.
- To measure the treated water by following the procedure.
- To convert the waste effluent into useful.

2.2. SCOPE

- Removal of toxic components like **pH, Turbidity, Hardness, DO, TDS, COD, BOD, Sulphate and Chloride** which affects the human health and environmental impacts.
- To convert the waste effluent into useful for the purpose of agricultural.

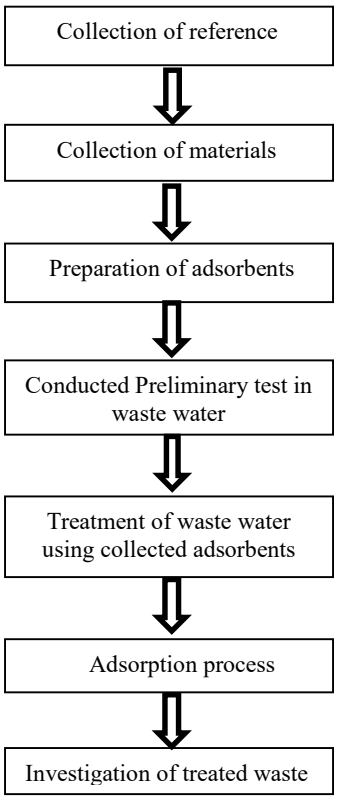
Table 1: Initial characteristics of tannery water

S.NO	Parameter	Concentration
1	pH	9.0
2	Turbidity	444 NTU
3	TDS	880 mg/l
4	Hardness	183.21mg/l
5	Sulphate	1135.19mg/l
6	Chloride	1730 mg/l
7	DO	0 mg/l
8	COD	1150mg/l
9	BOD	1023 mg/l

Table 2 : Standard values for the irrigation water

S.NO	Parameter	Permissible limits
1	pH	6.5-8.4
2	Turbidity	0.2-35 NTU
3	TDS	5-35 ppm
4	Hardness	100-150 mg/l
5	Sulphate	200-400 mg/l
6	Chloride	250-1000 mg/l
7	DO	0-5 mg/l
8	BOD	5-45 mg/l
9	COD	20-200 mg/l

3. METHODOLOGY



4. ADVERSE EFFECTS OF EFFLUENTS

According to the world health organisation board, about 80- 90% of all occurence of disease in the world are due to the release of untreated water to the society. Since those disease are directly related with human beings.

- The consequence of water pollution of the present and future generation should be within the people knowledge.
- The presence of high amount of BOD value can reults in the fast depletion of dissolved oxygen, if suppose it is directly discharged into the water bodies.
- The sample water with high amount of COD value may cause more toxic to the biological life.
- The appearence of colour indicate the water it is unsuitable for the use.
- The high amount of dissoloved oxygen will results in establishment of mosquito in the surrounding area.

5. MATERIALS AND METHODS

The waste samples of tannery waters are collected from the industry of leather. The flower extract of senna auriculate and cactus were collected and transported to the laboratory for the application of test. They are cleaned by removing the throns and brown spots from the flower, then they are cut into small pieces,allowed to dried in the sunlight and then the dried materials are converted into the fine powder which is comfortable for the treatment. In the middle of the process we obtained the viscous liquid with green colour with the pH of range of (3-4), using cactus aid for the removal of turbidity, COD,heavy metal. The effluent from leather industry are characterized by high properties of BOD, COD, suspended solides, sulphates, chlorides, turbidity are treated under the process of filter media procedure by using cactus and senna auriculate powder. Senna auriculate is a branched perennial shrub and it is grows well even in dry regions. The flowers, leaves, seed of Senna auriculata have more medicinal values. Senna auriculata was collected from the region of thiruvarur and cactus from the region of salem. The collected plant materials were washed thoroughly in distilled water and allowed them to dried and powdered into fine powder. Further, the plant materials were burnt to ashes which were employed in this work.

5.1. Preparation of cactus

The leaves and flowers of cactus were collected from the region of salem. The collected materials were cut into small pieces, then allowed them to dried in the heavy sunlight, the dried leaves were powdered into the fine powder.

Figure 1:Cactus powder

5.2. Preparation of Senna auriculate

Sample of Senna auriculate is collected and washed several times with distilled water and then sun dried for 48 hours to remove the moisture content and they were grinded and used as a absorbent in the experimental investigation.

Figure 2:Senna auriculata powder

6. EXPERIMENTAL METHODS

6.1. Determination of pH

pH is defined as the negative logerithimic of hydrogen ion concentration. pH= -log[H+]. The acidic or basic property of the sample is measured in terms of pH. pH is the measurement of the hydrogen ion concentration. If the value of hydrogen ion concentration is become very high then the pH value will become low. The actual pH of normal pure drinking water is 7. The pH value is determined also by using litmus paper and it is found by dipping the litmus paper in the sample and allowed them to dry for 2 minutes. This method may used to find the obsolute value of the sample. This litmus paper may show the changes of colour variation when the paper dipped in the acidic or basic samples. For the determination of pH value the litmus paper is immersed in the sample and allowed to dried the paper and obtained colour variation is compared with the limus colour chart and obsolute value of the pH can be determined. The obtained pH value of raw tannery effluent is 9 it shows the greenish blue colour appearence.

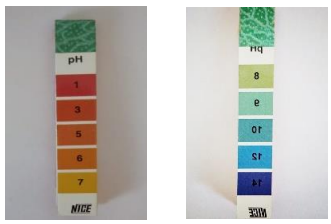


Figure 3:Litmus chart

6.2. Determination of turbidity

The turbidity value of the tannery effluent is determined by using nephelometer in NTU. If the properties of intensity of scattered light is higher then the turbidity value may also increased. The turbidity of the sample is the special from the amount of light is scattered by the sample taking a reference with standard turbidity suspension.

Figure 4:Turbidity meter

6.3. Determination of hardness

Hardness is considered to be the one of the important factor that determine the quality of the water. Hardness is defined as the characteriation of heavy metals present in the sample or the presence of calcium and magnesim ion content in water. Hardness is generally expressed as per million (ppm). The procedure for finding total hardness is based on the reaction of Ca^{++} and Mg^{++} ion with ethylenediamine tetra acitic acid and its disodium salt. Ethylenediamine tetra acetic acid(EDTA) and sodium salt form a soluble complex when added to a solution of certain metal cations Erichrome black T is added to an aqueous solution containing Ca^{++} and Mg^{++} ion has been complexed and when all of Ca^{++} and Mg^{++} ion has been complexed, the solution changes from wine red to steel blue obtained in the end point of titration. 50ml of standard hardwater is taken in a conical flask, 2ml of buffer solution and 2 drops of Erichrome black T are added. This titration against EDTA solution until wine red changes to steel blue colour.

6.4. Determination of total dissolved solids

Procedure

In the initial stage of the process is to taken the dry weight of the crucible which is available in the labarotory, then filter the sample by using the filter paper and then take the 20ml of the sample in the crucible, it should be kept it in muffle furnace (103 to 105°C) temperature after that kept the sample in the dessicator for cooling, finally measure the final weight of the dish.

Calculation

Total dissolved solid (mg/l) =

(final weight of dish – initial weight of the dish)× 1000×1000 /volume of the sample taken

6.5. Determination of solids

The difference between the total solids and total dissolved solids is suspended solids.

Total suspended solids = total solids – total disssolved solids

6.6. Determination of BOD

Biological oxygen demand of the waste water is the milligram amount of oxygen needed to biologically stabilize the one litre amount of water of that sample waste water (by process of bio degradation of organi contents with the help of micro organisms) in 5 days at 20°C. If suppose the value of biological oxygen demand is high, then it is found that the sample of waste water contains more amount of bio degradable organic compounds which is unnecessary for the requirement of water.finally it will may cause more pollution to the water bodies.

Procedure

Take the sample then it is dilute it with dilution water. Take the diluted sample in two biological oxygen demand bottles. Immediately find dissolved oxygen of the diluted effluent and dilution water. Incubate the two BOD bottles for 5 days. To prevent from the entry of air into the BOD bottles it should be properly stopper it well and measure the dissolved oxygen content in the BOD bottles at the end of 5 days.

Calculation

BOD in 5 days = (blank value – titrated value of the sample)×300/volume of the sample taken

6.7. Determination of COD

The chemical oxygen demand of that sample refers the amount of oxygen content in the water, expressed in milligram, is needed to stabilize the oxidizable chemicals occurred in one litre of sample water under some specific conditions. Initially take 2.5 ml of that sample in the particular tube material, then 1.5 ml of 0.25 N pottassium dichromate, spatula of mercuric sulphate HgSO4 and 3.5ml of COD acid were added and then it is kept in the COD incubator for 2 hours at 150°C, then it is cooled in the dessicator and titrated the sample of water against the standard ferrous ammonium sulphate 0.1 N and ferroin is used as indicator. As a result the obtained end point is reddish brown colour.

Calcuation

Chemical oxygen demand (mg/l) =(blank value – titrated value of the sample)×N of FAS×8000/ volume of the sample taken

8000 = mill equivalent weight of oxygen × 1000ml

6.8. Determination of chlorides

Chloride content present in the water sample is measured by titration with std. $AgNo_3$ in which $AgCl_2$ precipitates out. The end results of the titration process is may obtained by formation of red silver chromate from excess $AgNo_3$ and here the pottassium chromate is used as indicator.

Silver nitrate is added with the sample water, 50ml of water sample is pipetted out into a clean conical flack. The pottassium chromate indicator is added by one or two drops into it, then the solution turns yellow in color and then it is titrated against silver nitrate which is takes in the burette. As a result the end point is the change of yellow into reddish brown color. The titration is repeated with different dosage of absorbents.

6.9. Determination of sulphates

Sulphate is normally occurring anion found in all lands of natural particle, discharge of industrial waste and domestic sewage in water land to sulphate in drinking water. It may give offensive odor, objectionable taste and health effects. Sulphate ions are precipitated as $BaSO_4$ in acidic media (HCL) with barium chloride.

Take 100ml of sample in conical flask. Take 1ml of conc. HCL and take 1ml of distilled water is added with sample. Mix the sample well and boil the sample up to the volume reduced to 50ml. Take 20ml of barium chloride with the sample. Add the cooled barium chloride in the sample. Take 50ml of prepared sample and filter it with the filter paper. Residue filter in the filter paper is placed in the dish, then the dish is placed in the muffle furnace and heated to 550^0 temperature for 30minutes, take out the disk from the oven and cooled at room temperature and weight it (W_2). The amount of sulphate present in the sample present in the sample is calculated by (W_1-W_2). W_1 – empty weight of dish. W_2 – Weight of residue.

7. RESULT AND DISCUSSION

The following tables explains the values obtained from the treatment of tannery effluent by using Senna auriculata and cactus as adsorbent.

Characteristics of treatment of tannery water using cactus powder and senna auriculata are used as adsorbent shown in table 3:

Table 3: Treated values

S.NO	Parameter	4gm	8gm	12gm	16gm
1	pH	9	8.5	8.0	7.7
2	Turbidity (NTU)	351	243	122	6.8
3	Hardness (mg/l)	168	149	128	102
4	Dissolved oxygen (mg/l)	0	1	3	6
5	TDS (mg/l)	361	199	99.5	21
6	BOD (mg/l)	703	528	278	44
7	COD (mg/l)	789	395	221	102
8	Chloride (mg/l)	1520	1360	1202	930
9	Sulphate (mg/l)	985	721	523	375

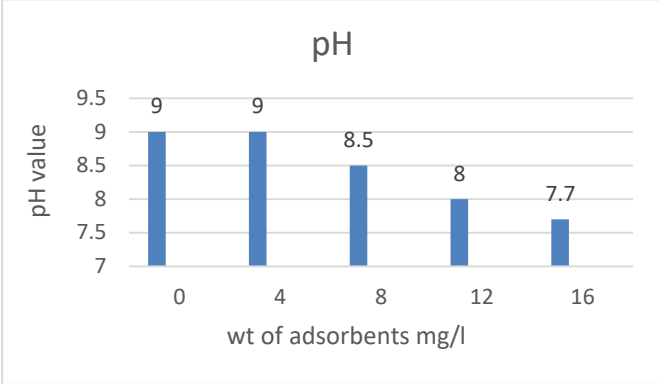


Figure 5: pH test graph

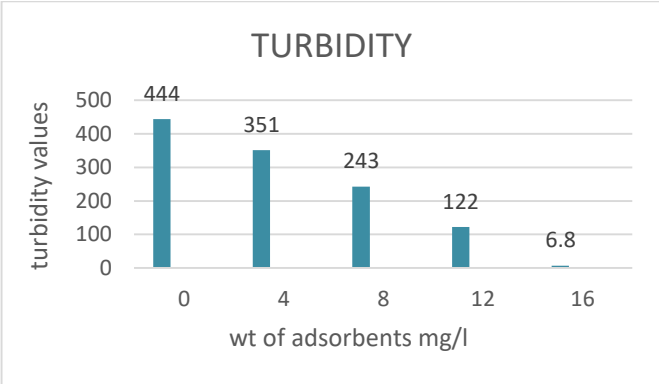


Figure 6: Turbidity test graph

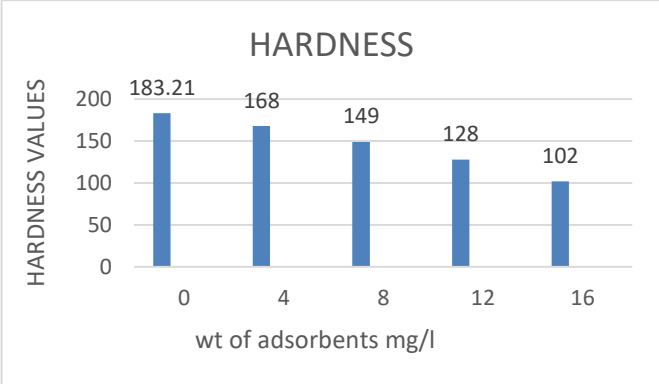


Figure 7: Hardness test graph

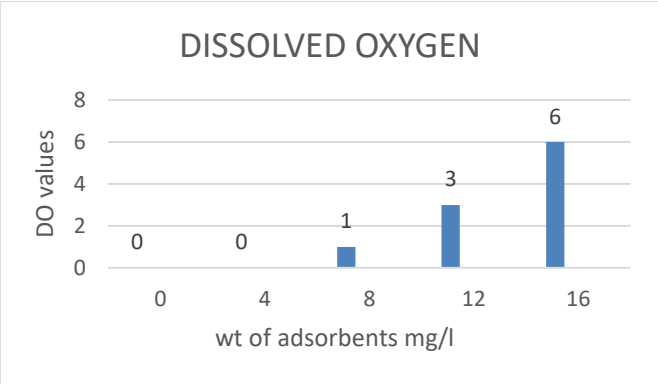


Figure 8: Dissolved oxygen test graph

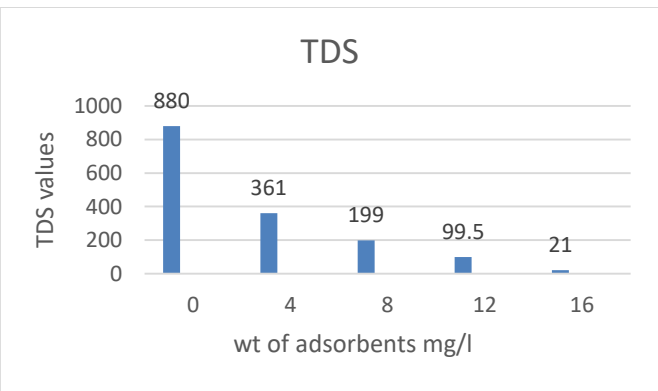


Figure 9: Total dissolved solids test graph

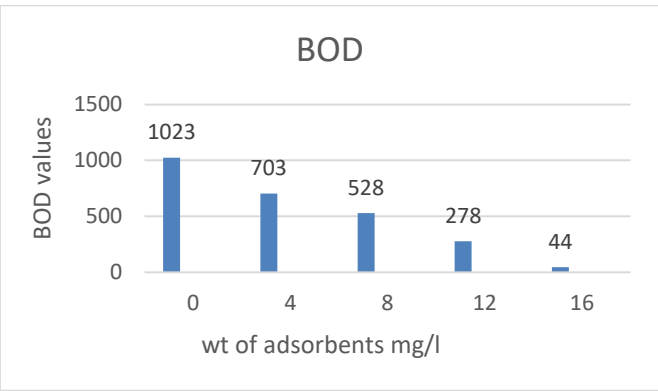


Figure 10: BOD test graph

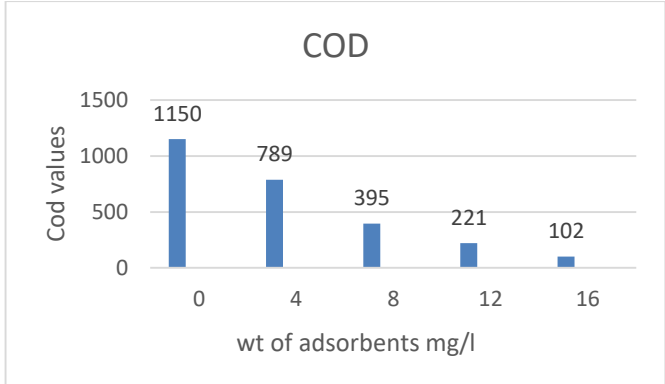


Figure 11: COD test graph

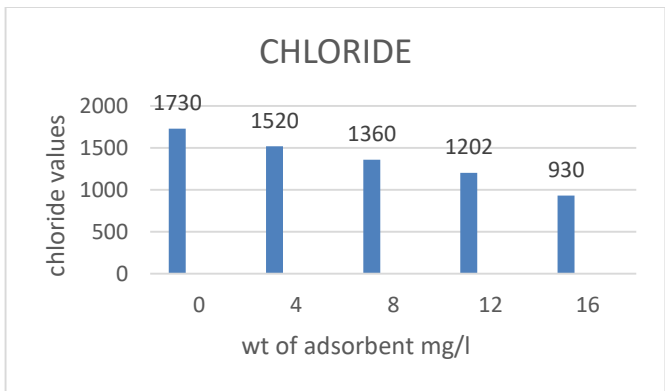


Figure 12: Chloride test graph

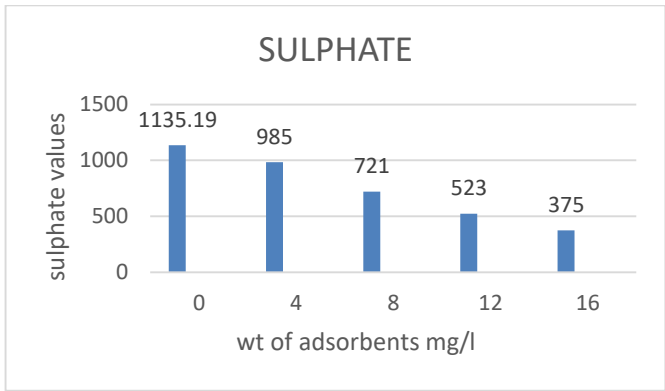


Figure 13: Sulphate test graph

8. CONCLUSION

The paper determines Cactus and Senna Auriculata seeds were used as a water purifier and it shows that it was an economical and an environmentally safe method of water purification process. The results indicates that the tannery effluents were not safe for discharging into public water bodies which creates more potential threats to human health and the environment. Cactus and Senna auriculate powder as a natural adsorbent for the treatment of tannery effluents. It reduces the total hardness, turbidity, chloride, BOD, COD, DO. It also act as a naturally occurring antimicrobial active agent against the microorganisms which are present in the drinking water and decrease the number of bacteria. Through this study it was found that cactus powder can be used as an adsorbent for preliminary treatment of tannery wastewater. In this study it was found that the pollutant parameters of tannery wastewater like turbidity, BOD, COD, chromium, iron, ammonia, hardness, sulphate, TS, TSS and chloride were reduced to the level of permissible, among the primary treatments available for tannery wastewater and it was found that adsorption is the best available method of treating tannery wastewater due to its low cost. So, cactus powder can be used effectively as an adsorbent for pre-treatment for tannery wastewater. The procedures developed are successfully applied for some industrial samples.

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