Experimental Treatment of Tannery Effluent by using Phytoremediation

M. Saravanan[1] B. Pooventhan[2] R. Wilson[3] S. Logeswaran[4] G. Pradeep[5]
[1]Assistant Professor [2,3,4,5]UG Student
[1,2,3,4,5]Department of Civil Engineering
[1,2,3,4,5]Sree Sakthi Engineering College, karamadai, Coimbatore, India

Abstract— In India there are huge leather products producing industries are developed. . Through waste water of tannery industry produces high inclusion of toxic content, which is more dangerous in environment without treatment. The drawback of conventional technologies for waste water treatment have led to serious thinking on alternate, low cost, natural and energy saving technologies on water and wastewater treatment. Methods like Phytoremediation which employs floating plants, constructed wetlands, etc., for treatment of wastewater will be a better alternative to the conventional technologies. Floating plants such as seaweed has a remarkable ability in treating the polluted water. Hence the current study is focused on the treatment of industrial effluent using marine algae. The objective of the study is to determine the phytoremediation potential of seaweed on industrial effluent treatment. Batch study has been employed to find the pollutant reduction efficiency of seaweed. Thus this process becomes more economical and effective.

Keywords: Heavy Metals, Phytoremediation, Tannery Waste Water, Seaweed, Algae, Electrocoagulation

I. Introduction

Water is the essential source of life on earth as we need water in every walk of life on one side, on other side polluted water can be lethal for existing life. Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans, aquifers and ground water). This form of environmental degradation occurs when pollutants are directly or indirectly discharged into water bodies without adequate treatment to remove harmful compounds. Various treatment methods have been employed to clean up polluted sites. At present a wide range of phyto technologies have emerged to prevent environmental degradation. Different physical and chemical methods used for this purpose suffer from serious limitations like high cost, intensive labour, alteration of soil properties and disturbance of soil native micro flora. Phytoremediation is the name of a set of technologies that use plants to degrade, extract, or contain contaminants from soil and water. This topic has been the great deal of research over the last ten years.

Phytoremediation is the direct use of living green plants for in situ, or in place, removal, degradation, or containment of contaminants in soils, sludges, sediments, surface water and ground water. The mobilization of heavy metals by man through extraction from ores and processing for different applications has led to the release of these elements into the environment. Since heavy metals are non-biodegradable, they accumulate in the environment. This contamination poses a risk to environmental and human health .some heavy metals are carcinogenic, mutagenic, teratogenic and endocrine disruptors while others cause neurological and behavioral changes especially in children. Thus remediation of heavy metal pollution deserves due attention. Phytoremediation is a relatively recent technology and is perceived as cost-effective, efficient, novel, eco-friendly, and solar driven technology with good public acceptance. Phytoremediation is an area of an active current research. New efficient metal hyper accumulators are being explored for applications in phytoremediation and phytomining. Molecular tools are being used to better understand the mechanisms of metal uptake, translocation, sequestration and tolerance in plants. It presents great opportunity of using suitable plant species to clean up the environment.

II. Methods

A. *Phytoremediation Chamber:*

The phytoremediation process is conducted in a fish tank and the method of growing marine algae is by off-bottom line method. The seaweed is tied with twine and attached to the bamboo sticks which are fixed at the end of tank. The tank dimension is 60cm x 30cm x 45cm. The tank is kept at direct sunlight to make seaweeds grow. At last electrocoagulation method is done in the effluent.

B. *Electro Coagulation:*

- Electro coagulation is a broad spectrum treatment technology that removes total suspended solids (TSS),heavy metals , emulsified oils , bacteria and other contaminants from water.
- Electro coagulation is the passing of electric current through water has proven very effective in removal of contaminants from water.
- It has become affordable waste water treatment processes around the world by reducing electricity consumption and miniaturization of needed power supplies.

C. *Feed and Seed:*

The inoculum used was algae collected from well. Which contains micro-organisms and it helps to treat the tannery effluent. The phytoremediation chamber was fed with tannery wastewater, Collected from E.K.M leather processing company, Erode, Tamilnadu, India. The composition of the wastewater is shown in Table1.

D. *Experimental Procedure:*

Start-up process was carried without inoculum in 7 litre of effluent for five days. After that 1 litre of fresh water algae is added to the effluent, which was in under observation about 10 days. Then effluent is treated with electro coagulation using aluminium foil and stainless steel at 30 V power supply. All those three are processed in above mentioned at room temperature.

Parameter	Unit	Value	Limit
pH	-	4.67	5.5-9
COD	mg/l	6944	250
Chromium	mg/l	3.83	2.0
Cadmium	mg/l	1.29	2.0

Iron	mg/l	0.97	3.0
Chloride	mg/l	1153.9	600

Table 1: Characteristics of the Tannery Wastewater

Fig. 1: Experimental Setup of phytoremediation.

Parameter	Unit	Value	Limit
pH	-	4.85	5.5-9
COD	mg/l	6032	250
Chromium	mg/l	3.83	2.0
Cadmium	mg/l	1.29	2.0
Iron	mg/l	0.97	3.0
Chloride	mg/l	1153.9	600

Table 3: Characteristics of the Treated Wastewater

E. Advantages of aquatic phytoremediation

These green technologies as an ecofriendly present many advantages for decontamination of aquatic polluted media comparing other treatment systems (Ximénez-Embún et al., 2001; Bissen and Frimmel 2003; Ghosh and Singh, 2005; Kirkham, 2006; Verma et al., 2007; Olguín and Sánchez-Galván, 2010; Landmeyer, 2012; Wang and Calderon, 2012; Delmail et al., 2013).

(a) Greatly cost effective; (b) Environmentally Compatible, green aesthetically; (c) Feasible globally technology (no need to high-tech equipment or material); (d) Easy maintenance (supply and energy) solar powered; (e) In situ and ex situ operation available; (f) Inhibiting deployment of contamination to atmosphere or soil by in situ operation; (g) Suitable for shallow depth contaminated water to hydrologic control of ground water; (h) Periodic treatment against continued treatments; (i) Different types of many contaminations can be treated in one time; (j) Produce biomass for renewable energy production; (k) Rapid mass propagation by tissue culture available; (l) Almost treatable for all kind of contaminations (organic, inorganic and radionuclides); (m) Operable approximately in all media (aquatic, sediment, soil and atmosphere); (n) Broad acceptable pH (2-10) for treatment; (o) Chelating molecules positively affected phytoremediation;

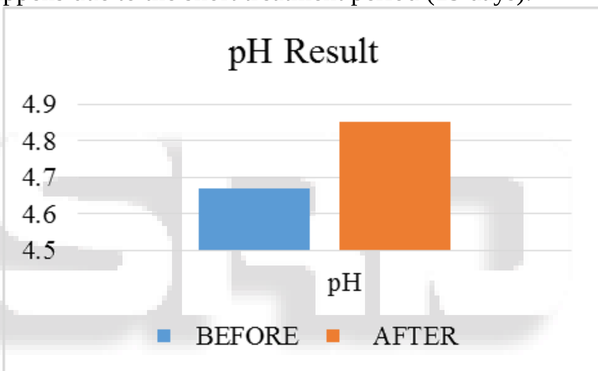
F. Disadvantages of aquatic phytoremediation

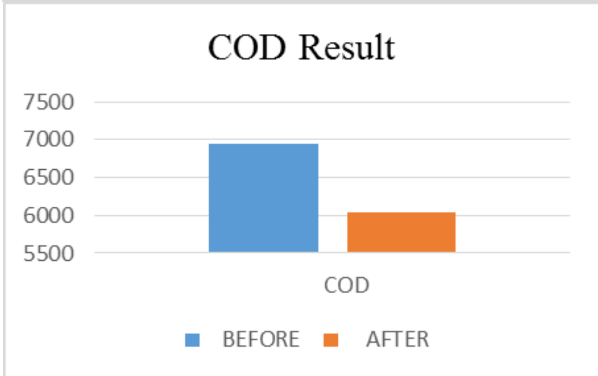
Same as each technology, phytoremediation suffer from disadvantages which should considered through applying (Mojiri et al. 2013; Assunção et al., 2003, Alkorta et al., 2004; Ghosh and Singh, 2005; Shiyab et al., 2009; Delmail et al., 2013, Kumar et al., 2013; Nan et al., 2013).

(a) Harvested biomass contains hazardous pollution; (b) Long time need for effective treatment; (c) Deep polluted media are limited treating; (d) Limited to climate growth condition (tropical, subtropical and tempered zoon); (e) Restricted to low concentration of polluted site; (f) Harvested biomass managing required; (g) Limited hyperaccumulator species introduced for aquatic media; (h) Leaves fall may cause spread contaminant; (i) Most of hyperaccumulator plants have limited roots and slow growing; (j) Most of hyperaccumulator species up take only limited elements; (k) Many of hyperaccumulators propagation system is sexual; (l) Recycling to soil and water by rain in volatilized pollutions; (m) Possibility of entering contaminated biomass to animal and human food chain.

III. Results and Discussion

After treated tannery effluent was tested and test results shown in table 3. It shows reduction in COD level about 13.16 %. pH increased (4.67 into 4.85). For treatment of waste water COD must be reduced about 90-95%. Its efficiency is good when treated with alkaline waste waters. But here just 13.16 % of COD reduction was achieved. This drawback is happens due to the short treatment period (15 days).





IV. Conclusion

In developing countries like India, the problems associated with waste water reuse arise from its lack of treatment. The challenge thus is to find such low-cost, low-tech, user friendly methods, which on one hand avoid threatening our substantial waste water dependent livelihood and on the other hand protect degradation of our valuable natural resources. The use of constructed wetlands is now being recognized as an efficient technology for waste water treatment, compared to conventional treatment systems, constructed wetlands need lesser material and energy, are easily operated, have no sludge disposal problems and can be maintained by untrained personnel. Seaweed proved to have a remarkable ability in treating industrial waste water. It gave a removal efficiency of 13.16 % in the COD test within few days. Among the aquatic plants some seaweed has been investigated extensively as wastewater purifier. But it cannot withstand high concentration of toxic elements in waste water. So one can conclude that Phytoremediation technology is one of the important technologies, and when such technologies are merged with existing technologies they can be proved as efficient technologies. Hence increasing of Treatment period will help to achieve treatment of tannery effluent and also the contaminants.

ACKNOWLEDGEMENT

This research work was done by the pleasant guidance and support of Mr.M.Saravanan, Assistant professor, Department of civil engineering, Sree Sakthi Engineering College, Coimbatore.

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