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Pre-Treatment And Post-Treatment Of Leather Industrial Effluent By Microalgae: A Comparative Study

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Abstract

For many years, tannery industries have been a vital part of a country's economy. The untreated industrial effluent discharges, the solid waste and waste water generated during the leather manufacturing process are developing threats to the environment day by day and the prevailing management monitoring system of wastewater is inadequate. This research work includes the treatment of effluent arising out of a tannery business near Pallavaram employing indigenous microalgae. The characteristic values of the typical raw effluent parameters were analysed and compared to the values of phycoremediated effluent parameters, the results confirmed that the treated effluent had acceptable amount of physical and chemical features, along with heavy metals concentrations within acceptable limits.

Keywords: BOD, *Desmodesmus*, heavy metal pollutants, microalgae, phycoremediation, TDS.

Abbrevations : Cr – Chromium, RSM- Random Sampling Method, BIS- Bureau of Indian Standards

Introduction

India is a densely populous big country. Pollution like water pollution, has became more seriously problematic as human population increases in density. The overall country's economic growth contribution depends on industrial practices and agricultural practices. So, dealing with varied industrial pollutants like heavy metals, dyes, chemicals etc has became important. Heavy metals have significant impact on the land, air and water (Isiuku Beniah Obinnaa, Enyoh Christian Ebere. 2019.) . Hence, biological approaches can be used to remediate harmful wastewater chemicals from industry, as it is a more complex technology than other heavy metal removal advances (Verla et al.2019; Madhavan et al.2019). Bioremediation can indeed be done in several methodology but microalgae-based remediation is especially very effective and environmentally beneficial (Lofrano et al.2013). Algae has amazing potential and performance in waste water treatment since it can detoxify, transform and volatize a wide range of pollutants. Algal isolates were simple to culture and adapt to their surroundings, making them easy to manipulate in the laboratory (Madhavan et al.2019).

In this review, the *Desmodesmus* alga phycoremediation approach is used as a long-term solution to mitigate toxicity as a long-term solution. However, algal-mediated waste water treatment is still in its early or infancy stages, and biological remediation solutions are capable of dealing with global waste water challenges concerns in the long run would require necessitate multiple new innovative measures.

Materials and Methods:

Collection of Textile Industry Effluent

The waste water collection site was done in a tannery industry near Pallavaram town, Chennai city , Chengalpattu district, Tamil Nadu, India

Sample Analysis:

The sample pH was tested at the collection site using a digital pH metre. APHA-recommended techniques was used in the physio-chemical quantity of the sample effluent assessment before and after treatment (APHA 2017).

Algal Sample collection and algal isolation

Algae samples were taken from places of the effluent discharge sites along the Chromepet River. Isolation of microalgal cells were done before using a centrifuge. The Random Sampling Method (RSM) has been used to collect water samples (Uma Rani et al.2017). BBM culture media has been used to inoculate the collected algal samples. The medium's makeup has been listed in Table 1. Using the streak plate approach and serial dilution, *Desmodesmus* cultures were obtained (Saranya , Shanthakumar 2019). After a feasibility test, the chosen strain was included in the tannery wastewater treatment experiment, with the raw effluent serving as a control in laboratory conditions .

Results and Discussion:

Laboratory testing of the leather processing industrial liquid waste report during both before and after remediation showed that all wastewater criteria in the raw effluent were higher before treatment, while after treating with green algae (Desmodesmus) showed below the reduction limit and were much less than the BIS (Bureau of Indian Standards) values of drinking water .

The microalgae has the capacity to lower the Total Dissolved Solids (TDS) and to neutralize pH (Figure 1). Chemical and Biological Oxygen Demands in the untreated effluent were around 6655 and 1670 mg/L, respectively (Figure 3). TSS and TDS were similarly high, as were sulphate, and chloride (Figure 2 and 4). The wastewater treated with microalgae, on the other hand, has neutralized the acidity (pH) of the effluent (Sivasubramanian et al. 2009). The COD and BOD in the microalgae-treated effluent were reduced by around 48 and 11 mg/L, respectively . Noorjahan (2014) found a significant level of BOD (600-1622 mg/L) in textile effluents. BOD levels in tannery wastewater have also been found to be excessive (Kulkarni 1992). COD levels were higher in the untreated wastewater (2749.8 mg/L) than in the treated effluent (Arasappan Sugasini, Kalyanaraman Rajagopal. 2015). The use of microalgal therapy resulted in significant reductions in BOD and COD levels of 22% and 38%, respectively (Hanumantha Rao et at.2011).

Heavy metal uptake:

Level of heavy metals were found, as well as biosorption capacity of *Desmodesmus* was noted. Total chromium content was determined to be 37.15 mg/L, following that was by lead,zinc, and nickel, concentrations of 0.27 mg/L,0.28 mg/L, and 0.47 mg/L respectively. Chrome-tanning effluents picking procedure had the highest Cr concentration (2075 mg/L) (Manjushree Chowdhury et al.2015). All of the parameters were examined and compared to BIS's estimates of drinking water. The results are summarized in Table 2.

Conclusion:

Based on the results of above research studies it can be concluded that the extent of pollution created by tanneries can be treated by microalgae from the surrounding, which have enough capacity to mitigate the excess pollutants their surroundings and can be used to reduce the heavy metal concentrations in a specific time frame . Therefore, it is generally accepted that phycoremediation treatment is less energy-intensive and thus preferable in the effluent treatment.

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Table 1: Bold's Basal Medium Composition (BBM)

MEDIA COMPONENT	STOCK SOLUTION	CULTURE MEDIUM (1 litre)
$NaNO_3$	5 g/200 ml	10 ml
$MgSO_4.7H_2O$	1.5 g/200 ml	10 ml
K_2HPO_4	1.5 g/200 ml	10 ml
KH_2PO_4	3.5 g/200 ml	10 ml
NaCl	0.5 g/200 ml	10 ml
$CaCl_2.2H_2O$	0.5 g/200 ml	10 ml
EDTA-KOH solution		1 ml
EDTA stock	5 g/100 ml	-
KOH	3.1 g/100 ml	-
Acidified Iron Solution		1 ml
$FeSO_4$ x $7H_2O$	0.498 g/100 ml	-
H_2SO_4		1 ml
Boron Solution		
H_3BO_3	1.14 g/100 ml	1 ml
Trace elements solution		1 ml
$CuSO_4.5H_2O$	1.57 g/L	-
$ZnSO_4.7H_2O$	8.82 g/L	-
$MnCl_2.4H_2O$	1.44 g/L	-
$Co(NO_3)_2.6H_2O$	0.49 g/L	-
MoO_3	0.71 g/L	-

Table 2: Comparison of heavy metals in tannery effluent (before and after phycoremediation) with Drinking Water Standards (BIS , 2020)

S. No.	PARAMETERS	PRE-TREATMENT (mg/L)	POST TREATMENT (mg/L)	BIS (mg/L)
1	Arsenic as As	BDL(DL:0.05)	BDL(DL:0.05)	1.0
2	Cadmium as Cd	BDL(DL:0.01)	BDL(DL:0.01)	0.003
3	Total Chromium as Cr	37.15	BDL(DL:0.1)	1.0
4	Copper as Cu	0.20	BDL(DL:0.12)	1.0
5	Lead as Pb	0.27	BDL(DL:0.01)	0.5
6	Mercury as Hg	BDL(DL:0.001)	BDL(DL:0.001)	0.01
7	Nickel as Ni	0.47	BDL(DL:0.1)	1.0
8	Selenium as Se	BDL(DL:0.01)	BDL(DL:0.01)	0.5
9	Zinc as Zn	0.28	0.06	5.0

BDL – Below Detection Limit; DL – Detection Limit

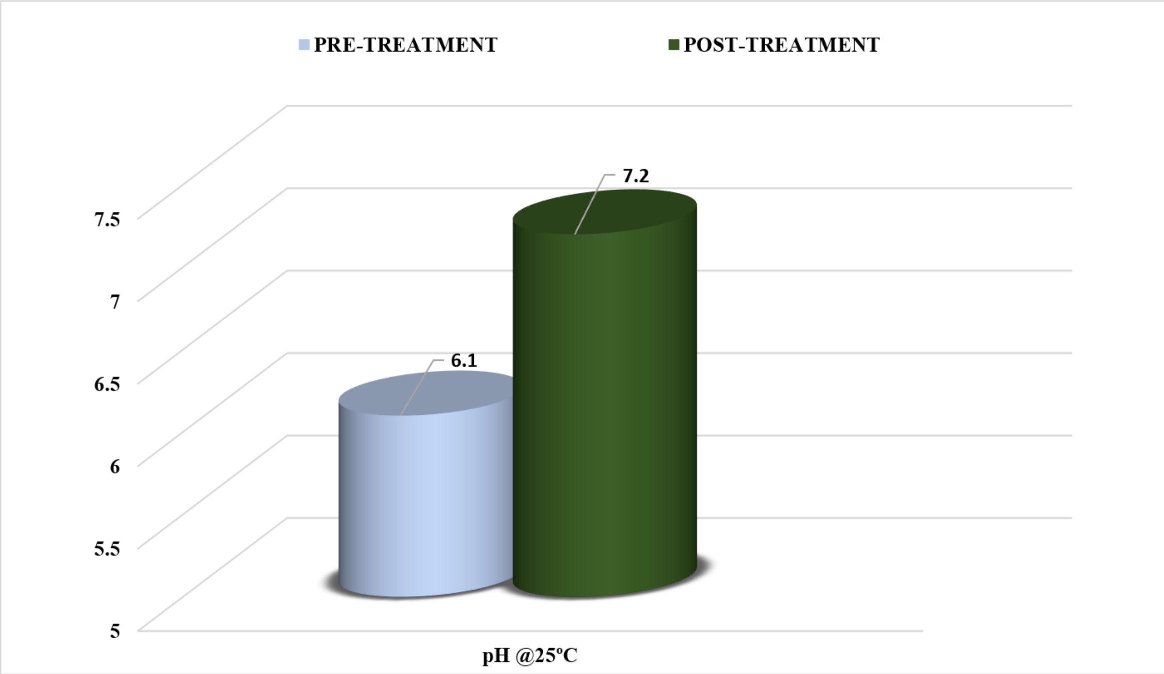

Figure 1: P^H of Tannery Effluent Before and After Phycoremediation Treatment with Microalgae (*Desmodesmus*)

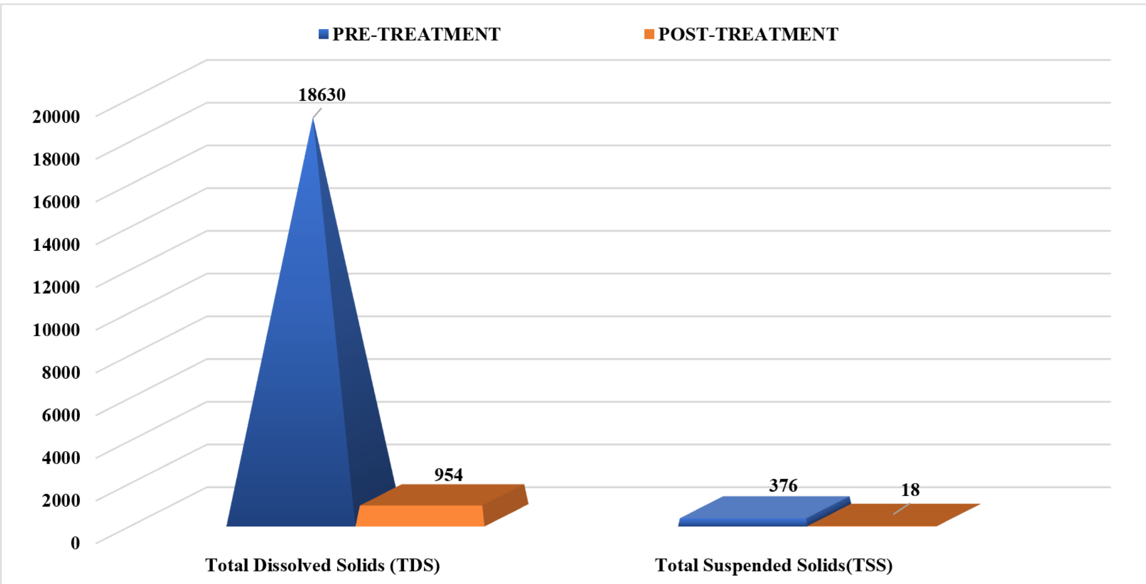

Figure 2: Comparison TDS and TSS values in tannery effluent before and after phycoremediation.

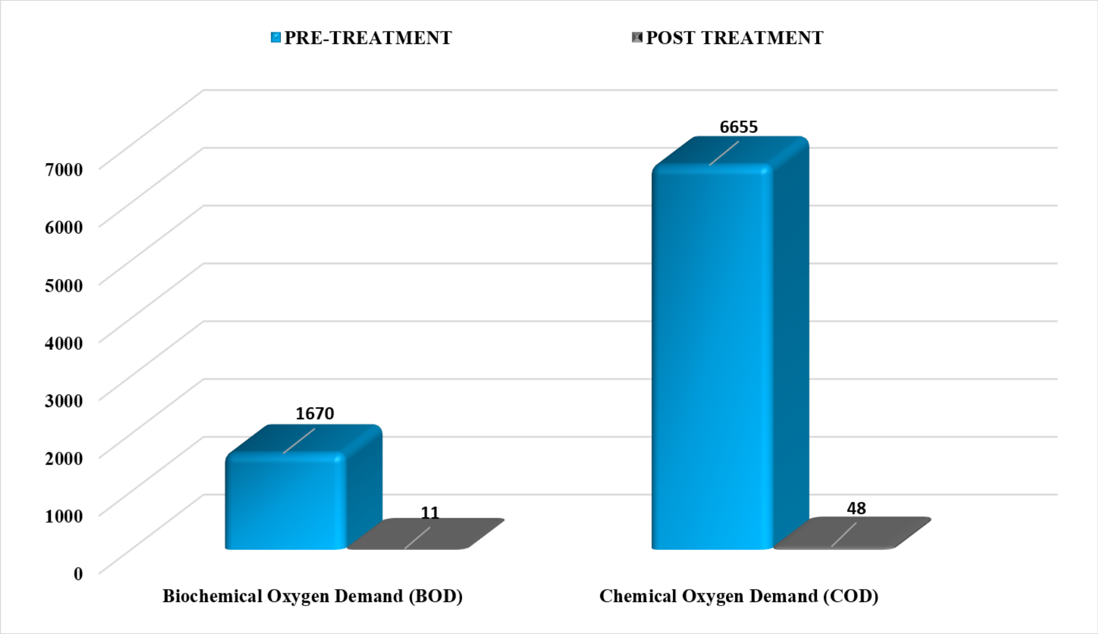

Figure 3: Analysis of BOD and COD in tannery effluent before and after phycoremediation with Microalgae

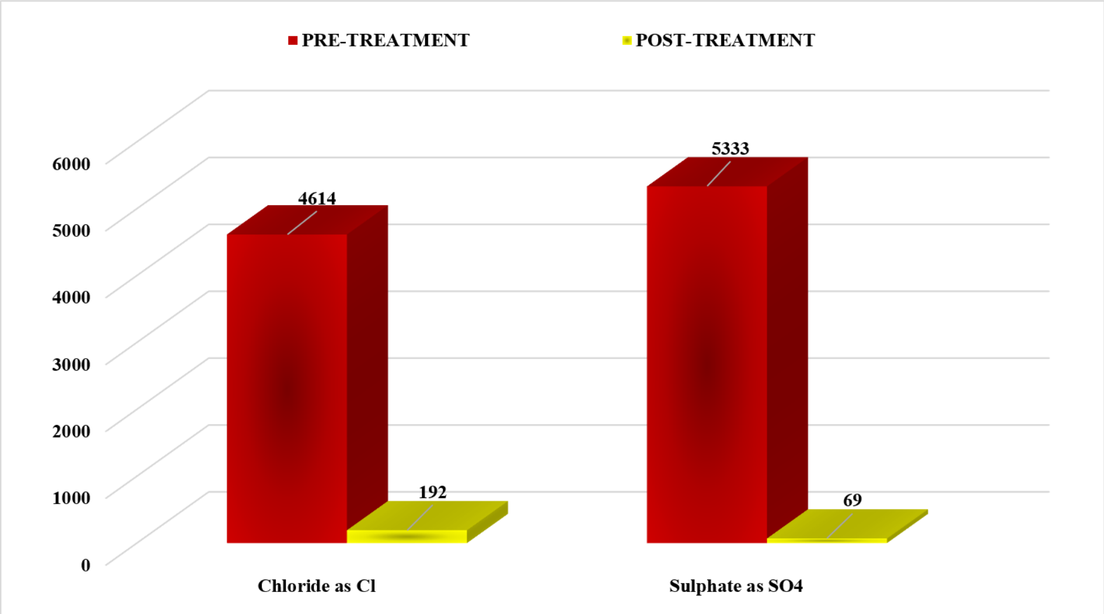

Figure 4: Comparision of Sulphate and Chloride present in tannery effluent before and after phycoremediation