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Analysis Of Kasur Tannery Pre Treated Wastewater For Its Metal Toxicity

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ABSTRACT

In this paper analysis of Kasur tannery pretreated wastewater discharging form Common effluent pre treatment plant (CEPTP) is analyzed to find out its metallic toxicity. The concentrations of various metals such as Cr, Cd, Cu, Fe and Zn were computed and compared with the standards of wastewater for irrigation purposes proposed by WWF (2007). The results reveal that the concentration of Cr (0.283±0.003 mg L^{-1}) is much above the permissible limits, while the concentration of other heavy metals are as Cd (0.001±0 mg L^{-1}), Cu (0.02± 0.00351 mg L^{-1}), Fe (3.531± 0.03001 mg L^{-1}) and Zn (0.028± 0.00902 mg L^{-1}). The reveled that, pretreated wastewater cannot be used for irrigation due to the presence of excessive Cr.

Keywords: Kasur, Heavy Metals, Pre treated Tannery Wastewater, Cr.

INTRODUCTION

The leather industry is accepted as one of the highly polluting exclusively with reference to the effluent it liberates in the environment and contains high concentrations of dissolved organic and inorganic compounds and suspended solids that demand high amount of oxygen and also contain potentially harmful metal ions [1]. Wastewater released from industries particularly from the tanning industry contains a huge concentration of metals especially cadmium, chromium and copper. These effluents if discharged on the soil eventually percolate into ground and lead to contamination due to accumulation of lethal metallic elements and results into a chain of well known problems in living creatures because they cannot be fully degraded [2,3]. To remove toxic metal ions from pre treated tannery wastewater different techniques have been used. For example, for the removal of chromium from treated tannery wastewater Pistia plants (water lettuce) have been used.. Results showed that Pistia was able to accumulate hexavalent chromium from treated tannery wastewater containing soluble hexavalent chromium at reduced level of 2.78mg L^{-1}. Accumulation of hexavalent chromium in Pistia root and shoot ranged 17.46µg g^{-1} and 4.23µg g^{-1} respectively [4]. By the application of a chemical method, 98% of trivalent chromium was recovered by treatment with 2g $100mL^{-1}$ lime, maintaining the pH between7.7-8.2 and allowing for the settling time of about 120 min. While applying the biological treatment, 34 actinomycetes isolates were shown to tolerate up to 100mg L^{-1} of hexavalent chromium; five of them showed tolerance up to 2500mg L^{-1} [5]. *Trifolium alexandrinum (*Egyptian clover) roots and leaves accumulated the highest amount of metals. The mean concentrations found in the soil were chromium 1178µg g^{-1}, nickel 51.5µg g^{-1}, zinc 39.86µg/g, copper 21.3µg g^{-1}, and cadmium 1.09µg g^{-1} [6]. Cyanobacteria (*Anabaena flos-aquae*) have been used for the bioremediation of chromium in tannery wastewater. Cultures of *Anabaena flos-aquae* were grown in Allen and arnon's medium (free of nitrogen). The tannery wastewater was amended with growth medium at different dilutions (1:10, 1:100 and 1:1000). The results indicated that, higher the concentration of chromium (8ppm) greater was the chlorophyll and carotenoid content at 48 hours [7].

The purpose of this study is to carry out the analysis of pretreated tannery wastewater for its metal toxicity and find out whether this pretreated wastewater of tannery can be used for irrigation purposes or not.

MATERIALS AND METHODS

Samples Collection: The pretreated wastewater samples were collected from 16 different sites. Green channel (1.7Km) started from the CEPTP leads to the Pandoki drain where it finally disposes off in River Sutlej. Each wastewater sample was collected by a distance of 2Km. Table 1 demonstrates the sampling points, where the samples have been collected for analysis.

Parameters measured: The selected parameters for the physicochemical analysis of pretreated tannery wastewater samples after its discharge from CEPTP were as chromium (Cr), cadmium (Cd), Copper (Cu), iron (Fe) and Zinc (Zn).

Sampling procedure and preservation: Samples were collected and preserved according to the standard methods for water and wastewater (APHA, 2005).

Laboratory analysis

Table 1: Shows the samples collected with their designated numbers and collection point/Area

Serial No. of Sample	Designated as	Collection Point/ Area
1	S_1	After settling tank
2	S_2	Lagoon no. 15
3	S_3	Green channel
4	S_4	Main hole (at a distance of 2km)
5	S_5	Main hole (at a distance of 2km from the previous point
6	S_6	Before mixing in Pandoki drain
7	S_7	Tannery wastewater enters in Pandoki drain
8	S_8	Pandoki drain Upper stream
9	S_9	Pandoki drain Upper stream
10	S_{10}	Pandoki drain Upper stream
11	S_{11}	Pandoki drain Lower stream
12	S_{12}	Pandoki drain Lower stream
13	S_{13}	Pandoki drain Lower stream
14	S_{14}	Pandoki drain before mixing in the Sutlej river
15	S_{15}	Sutlej river
16	S_{16}	Sutlej river

Inductively coupled plasma mass spectrometry (ICP-MS): Five heavy metals i.e. cadmium (Cd), chromium (Cr), copper (Cu), zinc (Z) and iron (Fe) were analyzed on ICP-MS (Inductively Coupled Plasma Mass Spectrometry). Filtered samples were used to run on the machine.

Data analysis and interpretation: After the completion of sampling and analysis, the data was compared with international standards for wastewater irrigation. The data was presented in the form of graphs for which mean and standard deviation were also calculated**.** One way Anova (Analysis of Variance) is also applied.

RESULTS AND DISCUSSION

Fig. 1 displays the graph showing the values of Chromium (Cr mg L^{-1}) for samples and compared with the proposed standard of wastewater for irrigation by WWF. The permissible limit for chromium (Cr) in wastewater used for irrigation purposes is 0.01 mg L^{-1} (2007). The maximum averaged concentration of chromium is observed for sample No.S_9 with ± SD i.e. 0.283±0.003 mg L^{-1} while the minimum averaged value is observed for sample No.S_7 with ± SD i.e. 0.002±0.001 mg L^{-1}. The high concentration of chromium is observed at the starting point of drain, which decreases with the run off. The results of the ANOVA table indicated that the mean Cr value across different sites show significant difference indicated by the P value=.000. The maximum chromium reading was observed in sample.S_9 i.e. 0.283mg L^{-1}. This is due to the heterogeneous character of the channel carrying wastewater that is closed up to S_7 and is open onward up to S_{16}. Thus former is not in contact with soil while latter passes through the reclaimed soil contains toxic metals particularly chromium at S_9. Thus the wastewater dissolves Cr from the reclaimed soil that translates into higher values of chromium. Moreover, these metals have been accumulated over a period of time thus showing a maximum value in sample no. S_9. Afterwards gradual decreasing chromium pattern is observed because wastewater in contact is not contaminated reclaimed soil.

Fig. 2 displays the graph showing the values of cadmium (Cd mg/L) for samples as compared with the proposed standard of wastewater for irrigation by WWF. Cadmium is acceptable at range in 0.01mg L^{-1} for wastewater used in irrigation (2007). The maximum averaged concentration of cadmium (Cd mg L^{-1}) with ±SD is observed for sample No.S_{10} to S_{16} is 0.001±0 mg L^{-1}. While zero cadmium concentration is found from sample No.S_1 to S_9. The value of cadmium concentration is observed at the point where Pandoki drain water mixes with pre treated tannery wastewater. The results of the ANOVA table indicated that the mean Cd value across different sites show significant difference indicated by the P value=.000.

Fig. 3 depicts the graph showing the values of copper (Cu mg L^{-1}) for samples as compared with the proposed standard of wastewater for irrigation by WWF. In international standards of wastewater for irrigation, the permissible limit for copper (Cu mg L^{-1}) is 0.2 (2007). The results indicate that copper is present in acceptable range in all samples. The maximum averaged value of copper (Cu) is observed with ± SD for sample No.S_9 i.e. 0.02± 0.00351 mg L^{-1}, while the minimum averaged value for copper is observed with ± SD for sample No.S_7 i.e. 0.004± 0.00115 mg L^{-1}. The concentration of copper slightly increases where the pre treated tannery wastewater joins the Pandoki drain then gradually decreases at the end of sampling sites. The results of the ANOVA table indicated that the mean Cu value across different sites show significant difference indicated by the P value=.000.

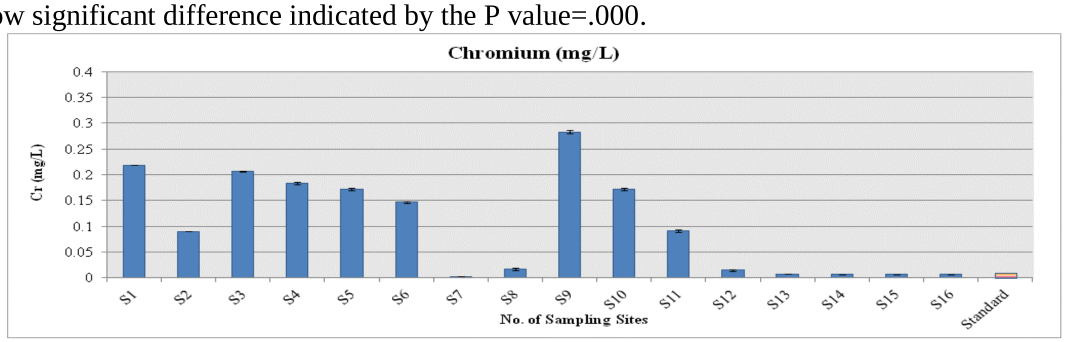

Fig.1 Graph showing the averaged values of chromium for samples and their comparison with the proposed standard of wastewater for irrigation by WWF.

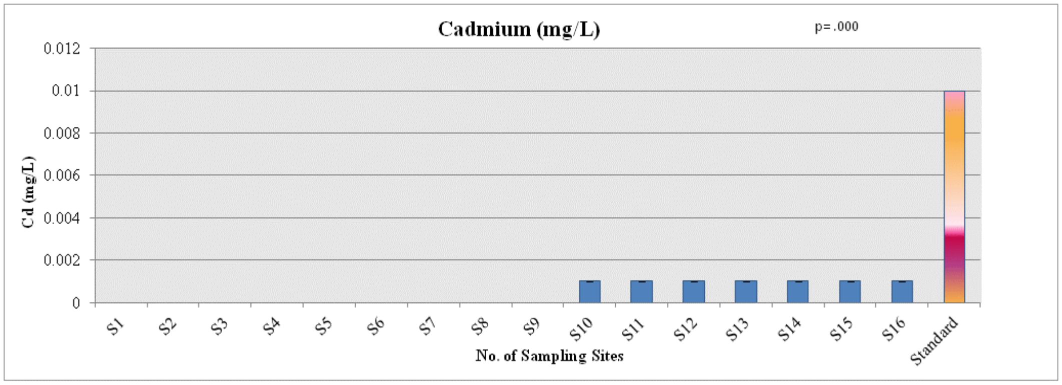

Fig.2 Graph showing the averaged values of cadmium for samples and their comparison with the proposed standard of wastewater for irrigation by WWF.

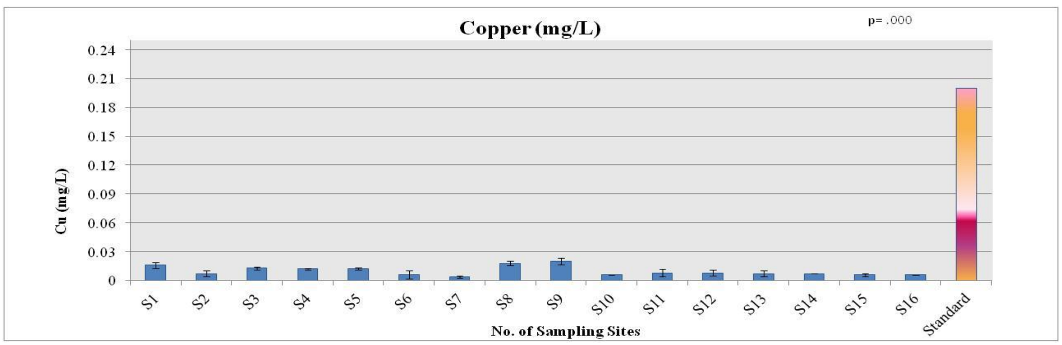

Fig.3 Graph showing the averaged values of copper for samples and their comparison with the proposed standard of wastewater for irrigation by WWF.

Fig. 4 represents the graph showing the values of iron (Fe mg L^{-1}) for samples and compared with the proposed standard of wastewater for irrigation by WWF. The maximum concentration of iron (Fe) is observed in sample No.S_{14} with ± SD i.e. 3.531± 0.03001 mg L^{-1} while the minimum concentration of iron is observed in sample No.S_{11} with ± SD is 0.197±0.002 mg L^{-1}. According to standard of wastewater for irrigation, iron (Fe) is acceptable at the range of 5mg/L (2007). Iron was present in acceptable range in all samples of wastewater collected. The results of the ANOVA table indicated that the mean Fe value across different sites show significant difference indicated by the P value=.000. The range of iron from S_1 to S_{13}, is between 0.2 -2.3mg L^{-1}, then there is a sudden increase in the concentration of Fe, from S_{14} to S_{16} i.e. 3.3-3.5mg L^{-1}. That is because of the accumulation of iron overtime at the end of the downward stream due to much slower movement of wastewater. Even so this range is within the permissible limits of wastewater for irrigation i.e. 5mg L^{-1}. Water pH, water aeration, reactions with organic matter and plant adaptation influences the availability of iron.

Fig. 5 displays the graph showing the values of zinc (Zn mg L^{-1}) for samples as compared with the standard of wastewater for irrigation. Zinc (Zn) is another important heavy metal. In international standard of wastewater for irrigation the acceptable range of zinc in 2.0mg L^{-1} (2007). The maximum concentration of zinc is noted for sample No.S_{11} with ± SD i.e. 0.028± 0.00902 mg L^{-1} and the minimum concentration of zinc is noted for sample No.S_4 with ± SD i.e. 0.005± 0.00252 mg L^{-1}. Analysis of all wastewater samples collected showed the concentration of zinc in acceptable limits. The results of the ANOVA table indicated that the mean Zn value across different sites show significant difference indicated by the P value=.000.

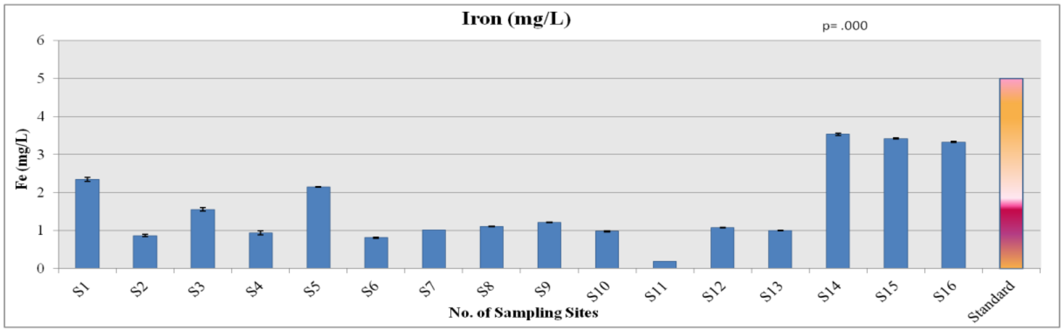

Fig.4 Graph showing the averaged values of Iron for samples and their comparison with the proposed standard of wastewater for irrigation by WWF.

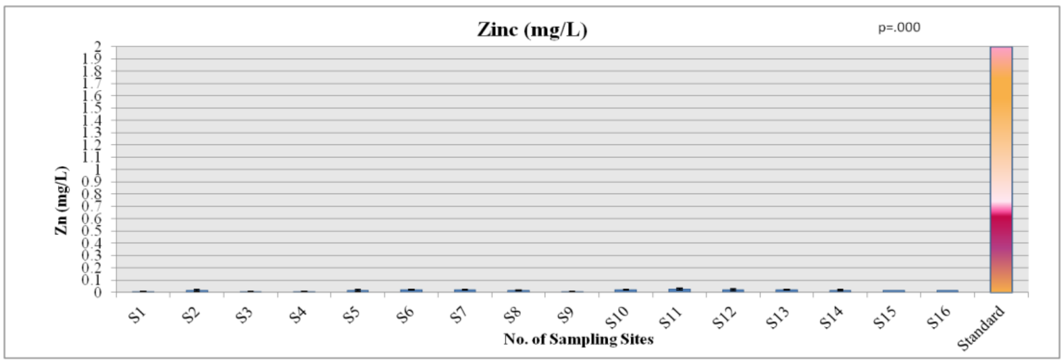

Fig.5 Graph showing the averaged values of Zinc for samples and their comparison with the proposed standard of wastewater for irrigation by WWF.

APPLICATIONS

The results of the work presented above are applicable to have an idea whether the tannery wastewater is fit for irrigation of land to produce agricultural crops; first by conducting its physicochemical analysis to determine different concentrations of parameters such as Cr, Cd, Cu, Fe and Zn,- and subsequent comparison of results with international standards of wastewater for irrigation to know the status of tannery wastewater for its fitness.

CONCLUSIONS

The present study concludes that the Kasur pre- treated tannery wastewater cannot be used for irrigation purposes because of the presence of toxic metals, particularly Cr that is the major polluting chemical in leather processing. When the parameters like Cr, Cd, Cu, Fe and Zinc are compared with the international standards of wastewater for irrigation purposes, it is reveled that all the parameters are in permissible limits except Cr. Thus this wastewater can't be applied to irrigate agricultural lands.

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