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- Short communication

A SIMPLE EFFECTIVE TREATMENT OF TANNERY EFFLUENTS

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ABSTRACT

Tannery effluents are one of the major sources of environmental pollution with various toxic parameters and the effluent generated during liming and pickling operations of leather processing are even more dangerous due to their high and low pH range, respectively. In the present work, liming and pickling streams generated during the production of chrome tanned cow hide shoe upper was treated at different ratios and optimized the pH range 6.5 - 7.5. The effluents were mixed at different ratios without adding any foreign chemicals and obtained the results 88% reduction of COD, 94% reduction of BOD and 97% removal of total solids.

Key words: Simple, Tannery effluents, Effective treatment

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. The tannery operation consists of converting raw hides and skins into leather during which it generates a significant amount of solid and liquid waste (Sekaran *et al*. 2007, Kanagaraj *et al*. 2006) and is considered as one of the most polluting industries having potential threat to our environment. When processing one metric ton of raw hide, 250 kg of leather is obtained as final product and 600 kg of solid waste together with 40,000 m^3 wastewater is produced (Hüffer and Taeger 2004). Leather industries are one of the largest water users and polluters resulting a high wastewater generation. On an average 45 - 50 m^3 of waste liquor is produced per ton raw hide production in the tanning industry (Ramasami 2001, Ludvik 1996, FAO 1999) and direct discharge of this effluent from industries has became a severe environmental problem (Ahmed *et al*. 2011). Chromium compounds in wastewater have an unfavorable effect on the life and growth of aquatic organism (FAO 1999) and Cr^{6+} is carcinogenic at very low levels and more toxic to aquatic environment (Wang 1986). Prolonged contact with certain chromium components may produce allergic reactions, dermatitis in individuals and in acute tubular necrosis of the kidney (Kolomaznik *et al*. 2000). So treatment of the tannery wastewater is a major issue for pollution control in leather processing countries.

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Research's have been carried out for the future sustainability of the tannery industry in respect of environmental pollution, the industry must aim to reduce the consumption of chemicals, water and energy resources and to minimize the production of solid and liquid waste to maintain a safe environment for both aquatic life and human health (Sepehr *et al*. 2005, Song *et al*. 1999, Barbooti *et al*. 2010, Buljan and Kral 2011).

Table 1. COD values of lime and pickle mixed liquor at different ratios after settlement.

Sample Name	1 hour			3 hours			24 hours			3 days			5 days		
	pH	COD (mg/l)	% reduc-tion	pH	COD (mg/l)	% reduc-tion	pH	COD (mg/l)	% reduc-tion	pH	COD (mg/l)	% reduc-tion	pH	COD (mg/l)	% reduc-tion
Lime: pickle (1 : 1)	10.2	14620	10	10.0	13780	15	9.24	13460	17	9.0	13440	18	8.9	10080	38
Lime: pickle (1 : 2)	9.30	11520	29	9.1	10720	34	8.64	10560	35	8.4	8640	47	8.30	4320	73
Lime: pickle (1 : 3)	8.10	9120	44	7.5	8260	49	7.70	7200	56	7.2	2400	82	7.0	2880	82
Lime: pickle (1 : 4)	7.50	4320	73	7.2	4240	74	7.0	3840	76	7.0	1920	88	6.8	1920	88

In Bangladesh most of the tanneries are situated in Dhaka where tannery wastewater is discharged to the neighborhood without any treatment which finally goes directly to the Buriganga River. About 21,600 m^3 of environmentally hazardous liquid wastes are emitted everyday from the tanneries located in Hazaribagh (HRW 2012). There are no well established model which provides a solution for wastewater treatment. In this study, the authors have shown that a simple but very effective measure can be taken to reduce the pollution load of tannery wastewater. Leather industries produce wastewater at many steps.

Table 2. BOD_5 values of lime and pickle mixed liquor at different ratios after settlement.

Sample name	1 hour			3 hours			24 hours			3 days			5 days		
	pH	BOD (mg/l)	% reduc-tion	pH	BOD (mg/l)	% reduc-tion	pH	BOD (mg/l)	% reduc-tion	pH	BOD (mg/l)	% reduc-tion	pH	BOD (mg/l)	% reduc-tion
Lime: pickle (1 : 1)	10.20	1250	32	10.0	1200	35	9.24	1150	38	9.0	950	49	9.1	800	57
Lime: pickle (1 : 2)	9.30	1050	43	9.1	1000	46	8.64	800	57	8.4	400	78	8.30	300	84
Lime: pickle (1 : 3)	8.1	250	86	7.5	250	86	7.70	200	89	7.2	150	92	7.0	100	94
Lime: pickle (1 : 4)	7.5	200	89	7.2	200	89	7.0	150	92	7.0	100	94	6.8	100	94

Among them present authors considered two different waste liquors, namely liming and pickling liquor having pH 9 - 12 and 3 - 3.5, respectively. These two different types of tannery waste liquors are mixed in different ratios without using any additional chemicals and this simple operation resulted to cleaner water. In view of developing a cost effective wastewater treatment process for tannery industries, above liquors were collected from Hazaribagh. The characteristics of wastewater were determined in accordance with standard

method for the analysis of water and wastewater (APHA 1985). The characterization of wastewater such as pH, chemical oxygen demand (COD), biological oxygen demand (BOD) and total solid (TS) was made. All reagents and chemicals used in COD and BOD determination were Merck, analytical grade. The pH value of the collected liquors were 12.0 (Lime) and 2.80 (Pickle). Both the liquors were mixed together in different ratios and were allowed to settle for 1, 3, 24 hours, 3 and 5 days and then 100 ml of each of them were pipetted into sample bottles for further analysis. The pH value of the ratios 1 : 1, 1 : 2, 1 : 3 and 1 : 4 of lime and pickle were obtained 10.2, 9.5, 8.0 and 7.7, respectively. The COD of source (fresh) lime liquor and source (fresh) pickle liquor were found to be 16320 and 1440 mg/l respectively. The COD values for mixtures of different ratios and at different times are shown in Table 1.

The above observations show that when lime and pickle liquors are mixed together there is a remarkable reduction in COD values. And there is a clear correlation between the pH and the COD value of effluent mixtures. The mixture having pH closer to neutrality (pH 7) have the lowest COD value. With the decrease of pH of the mixture more pollutants reduced as indicated by the decrease in COD values. The reduction efficiency of COD after 1 and 3 hours were 73 and 74%, respectively for 1 : 4 ratio liquors. The reduction of COD values of the same ratio liquor after 3 and 5 days was 88 % indicates that further settling process becomes sluggish. That means during the first 1 to 3 hours of plain settling provides maximum settling. Longer periods of settling are time consuming and reduce process economy and results in only a slight increase in the COD removal. BOD values of source lime liquor and pickle liquor were found to be 1850 and 250 mg/l respectively. Similar to the above, BOD of all the mixtures was analyzed. The BOD after the settlement of 1, 3, 24 hours, 3 and 5 days of different mixtures are given in table 2.

From the above results it is clear that for 1 : 1 ratio, the BOD value is not reduced significantly even after 5 days settling. The reduction efficiency of BOD after 1 hour and 5 days were 89 and 95%, respectively for 1 : 4 ratio liquors. The reduction of BOD for the 1 : 4 ratio after 1 hour settled gives excellent result and also indicates that further settling process does not improve too much. This implies that first 1 to 3 hours of plain settling provides maximum settling time. Total solid, TS of fresh lime liquor and pickle liquor were measured and obtained the values were 54353 and 17200 mg/l, respectively. The TS values of above mentioned ratios were measured.

After 1 hour settling, the observations showed that the TS value for the ratios 1 : 1, 1 : 2, 1 : 3 and 1 : 4 are 45900, 43710, 32400 and 25490 mg/l, respectively while after 24 hours settlement, the % reductions for the same ratio are 54, 65, 82 and 89% respectively. The significant amount of TS is reduced for 1 : 4 ratio with 24 hours settling time. It indicate that most of the solids were settled within 24 hours. As the settling continues,

further settling took place but to a lesser extent. No significant difference was observed when comparing with the sludge volume measured after 5 days with that at 24 hours of the settling process. This reduction is due to precipitate formation caused by acid-base reaction occurred between lime and pickle liquor. The reduction of TS after 3 and 5 days settling in ratios 1 : 1, 1 : 2, 1 : 3 and 1 : 4 are 82, 90, 96, 96 and 94, 95, 96, 97%, respectively. This indicated that most solids had settled within 24 hours; further prolonged settling does not reduce the settling sludge volume to any economic extent. In this study, we obtained the maximum percentage of reduction of COD, BOD and TS from tannery wastewater are 88, 94 and 97% in 1 : 4 of lime and pickle liqours. These percentages of reduction are quite close to the acceptable range for the discharge of tannery effluents.

The effluents generated during liming and pickling operation of leather processing are very harmful for aquatic life as well as for total environment due to their high and low pH range, respectively. In this study, present authors tried to minimize the environmental impact of tannery effluent focusing lime and pickle streams and they were treated to minimize their pollution load by a simple and economically viable method with an objective of introducing some new aspects of tannery effluent treatment especially for tanneries of Bangladesh. In the present work, liming and pickling streams were mixed at different ratios. This simple operation resulted effluent with pH very close to neutral and causes a remarkable reduction of COD, BOD and TS values. So it can be concluded that this simple operations can be an effective option for the treatment of lime and pickle liquor in very economical way to fulfill the tannery effluent standard for discharge. In this method, no need to spend additional money to reduce contamination of wastewater at a great extent which is the most significant achievement of this study.

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