

Pollution Level Caused by the Effluents of Leather Industry and their Abatement

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Abstract

This study concentrated on the physico-chemical characterization of effluents of leather industry and their reduction by filtration and coagulation processes as physical and chemical treatment. It was observed that the pH was basic and the TSS, TDS, BOD₅ and COD were very high in the case of raw effluent. By adopting settling and filtration through glass wool, the effluents were somewhat treated. After that, chemical treatments were imposed upon them by using different doses of FeCl₃ as coagulant and trimethyl ammonium chloride [(CH₃)₃NHCl] as coagulant aid. It was observed that best result was found by using coagulant (FeCl₃) of 120 mg/L dose and coagulant aid [(CH₃)₃NHCl] 12 mg/L dose near the neutral pH. So, it could be said that tannery effluents would be treated by following a combination process of settling, filtering and coagulating with FeCl₃ and [(CH₃)₃NHCl].

Keywords: Pollutants; BOD₅; COD; TSS; TDS; Effluents; Tannery

Introduction

Leather industry is one of the major earning sectors in Bangladesh. Bangladesh produces twenty million square meters of leather and leather products per year [1]. The leather is exported to some 70 countries throughout the world but predominantly in China, South Korea, Japan, Italy, Germany, Spain and The United States [2]. But at the same time, these leather tanning industries have been identified as one of the main causes of environmental pollution in the capital city of Dhaka of above 10 million people. In Bangladesh, there exists at present over 250 tanneries. Most of these are at Hazaribagh. There are 185 tanneries situated in this area [3]. Recently the area has been included at the list of top 10 most polluted places of the earth [4]. These tannery units during processing of raw hides and skins produce huge liquid wastages per day. The tanneries of Hazaribagh are liberating fat, and poisonous chemicals, lime, alkali, acids, bleaching agents, dyes, oils, hydrogen sulfide, heavy metals, etc. which are generally merged to the river of Buriganga without any action [5]. Generally tanneries of Bangladesh have no pollution control plant. This untreated liquor is discharged to drains and finally to nearby low lands, municipal sewers and rivers causing serious pollution to air, land and water and damaging land fertility as well as surface water system. Untreated tannery effluent also affects the local water supplies with various pollutants. The tanneries of Hazaribagh dump huge industrial wastes which are not treated simply by usual way [6]. Due to turbidity and colors, photosynthesis may be restricted affecting the primary link in food chain and aquatic life. However, the pollution load from the operating tanneries is contaminating the surface and ground water in the water quality of the river of Buriganga. 15800 m³/day of dissipated water with a BOD of 17600 kg/day and high chromium concentration is ejected from the tanneries at Hazaribagh [7]. This problem deteriorates further in the dry seasons due to lower dilution factors. Effluents from conventional post tanning operations including chrome salts, syntans, dyestuffs, fat liquoring agents (fats/oils), pigments and organic matters are the main pollutants. In this research, the pollution level of tannery effluent is measured and compared to the standard level. It is also showed that pollution level can be controlled by following different treatment technology.

Materials and Methods

Effluents were collected from the laboratory of Institute of Leather Engineering and Technology during shoe upper leather processing from cow hide. Different parameters like pH were measured according to the method of SLC-120 [8]. COD, the test measures the amount of oxygen required for chemical oxidation of organic matter in the

samples, was measured according to the method of DIN 38409. Again BOD₅, a method based on oxidation of organic matter by suitable micro-organism during a 5 days period was measured according to OXITOP measuring method. The total suspended solid (TSS) and total dissolved solid (TDS) were measured according to the methods of SLC-114 [9] and ASTM D 5907 respectively.

Results and Discussion

The collected tannery effluents were analyzed for determining the parameters named pH, TSS, TDS, COD and BOD₅. These parameters were measured and found as deviated from the standards. Most metals get soluble in water at low pH [10]. High amount of dissolved solid elements obstructs the density of water. Thus, it generates impact on osmoregulation of water and also lessens solubility of gasses [11]. The parameters of pH, TSS, TDS, COD and BOD₅ were found as 7.6, 5800 mg/L, 10500 mg/L, 4260 mg/L and 820 mg/L respectively in untreated condition. The untreated tannery effluents were settled and then filtered gradually with glass wool and finally treated with Coagulant of FeCl₃ (mg/L) and coagulant aid [(CH₃)₃NHCl].

In case of glass wool treatment, the parameters of pH, TSS, TDS, COD and BOD₅ were found as 7.9, 5700 mg/L, 9050 mg/L and 760 mg/L respectively. Here the parameters are better than the previous one. High COD can be for the large amount of inorganic compounds which are not generally influenced by the bacterial corrosion [12]. High level of total suspended solid in water results poor photosynthetic system in the aquatic process and hampers respiratory method of fishes a lot [12]. Again, the effluents were then treated with Coagulant of FeCl₃ (mg/L) and coagulant aid [(CH₃)₃NHCl] dose of (40+4), (80+8) and (120+12) respectively. Table 1 represents the values of the physicochemical parameters named pH, TSS, TDS, COD and BOD₅ of the untreated tannery effluents and after the treatment with glass wool filtration.

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Again, Table 2 represents these parameters of the effluents after being treated gradually with the Coagulant of FeCl₃ (mg/L) and coagulant aid [(CH₃)₃NHCl] (mg/L) dose of (40+4), (80+8) and (120+12) respectively.

In case of the dose of (40+4), the parameters of pH, TSS, TDS, COD and BOD₅ were found as 7.7, 800 mg/L, 6200 mg/L, 1450 mg/L and 590 mg/L respectively. Then for the dose of (80+8), these parameters were found as 7.3, 540 mg/L, 5780 mg/L, 1180 mg/L and 480 mg/L respectively which are better than the previous. Again, the best values of the analysis of these physicochemical parameters were found for the dose of (120+12). Here the values of these parameters of pH, TSS, TDS, COD and BOD₅ are 7.0, 220 mg/L, 4230 mg/L, 400 mg/L and 180 mg/L. With more coagulant doses these parameters are found in higher and nearer to the values of untreated form.

Conclusion

Leather industry has been facing a global challenge with respect to the ecological concern raised due to its waste streams. From the present observation it was observed that the tannery effluents possessed extremely high values of pH, TSS, TDS, BOD₅ and COD. The Values of these parameters were at a higher point than the standard values for ISW-BDS. For that reason, it is a great threat to human health and the environment to discharge the tannery effluent into surface water bodies. But it is a common scenario in Bangladesh that all the tanneries discharge their waste water directly or indirectly into the river without any treatment. This study makes clear that the filtration with glass wool reduce the pollution level to a certain extent. It is investigated that chemical treatment with using coagulant (FeCl₃) of 120 mg/L dose and coagulant aid trimethyl ammonium chloride [(CH₃)₃NHCl] 12 mg/L dose showed the best results that were below the standard prescribed limit. The used coagulant and coagulant aid in this study are cost effective also. So it can be suggested that the tannery effluents can be treated by the combination processes of filtration and coagulation using coagulant and coagulant aid to reduce the pollution.

Conflict of Interests

The authors declare no conflict of interest.

Parameters	Untreated Effluents	Glass Wool Filtered Effluents	Standards
pH	7.6	7.9	06-Sep
TSS	5800	5700	100 (mg/L)
TDS	10500	9050	2100 (mg/L)
COD	4260	3500	250/400 (mg/L)
BOD ₅	820	760	30/250 (mg/L)

Table 1: Physicochemical parameters (pH, TSS, TDS, COD and BOD₅) of untreated tannery effluents after the filtration through glass wool and the standards.

Parameters	Coagulant Dose of FeCl ₃ (mg/L) and Coagulant Aid[(CH ₃) ₃ NHCl] (40+4)	Coagulant Dose of FeCl ₃ (mg/L) and Coagulant Aid[(CH ₃) ₃ NHCl] (80+8)	Coagulant Dose of FeCl ₃ (mg/L) and Coagulant Aid[(CH ₃) ₃ NHCl] (120+12)
pH	7.7	7.3	7
TSS	800	540	220
TDS	6200	5780	4230
COD	1450	1180	400
BOD ₅	590	480	180

Table 2: Physicochemical parameters (pH, TSS, TDS, COD and BOD₅) treated with FeCl₃ and coagulant aid [(CH₃)₃NHCl].

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