IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 12, Issue 2 Ver. II (February. 2018), PP 01-08
www.iosrjournals.org

Environmental Pollution due to Production of Wet-Blue Leather from Goat Skin

Raju Muhammad Shahidul Islam[1], Md. Redwanur Rahman[2], Md. Yeamin Ali[2], Mohammad Farhad Uddin[3]

[1]Deputy Director (Research), Bangladesh Technical Education Board, Dhaka
Former Lecturer (Tech), Department of Leather Technology, Bangladesh College of Leather Technology, Dhaka
[2]Institute of Environmental Science, University of Rajshahi, Rajshahi, Bangladesh
[3]Veterinary Surgeon and in Charge of Rajshahi Zoo, City Health Department, Rajshahi City Corporation, Bangladesh
Corresponding Author: Raju Muhammad Shahidul Islam

Abstract: *In this study the wastes both solid and liquid from the various stage in the production of wet blue from wet salted goatskin were observed. Then the various types of parameter related to the environmental pollution during this production was determined. The parameters are pH, color, odour, solid wastes, total solids, suspended solids, dissolved solids, total acidity, free mineral acidity, strong alkali, total Kjeldahl nitrogen, sulphates, sulphides, chlorides, chromium, basicity, BOD, COD etc. In case of pH of soaking effluent is closer to the standard value but during liming and pickling or chrome tanning they exceed the limit. More interestingly, bad odour and colour to the receiving effluents are the common pollution. Surprisingly, suspended solid in soak liquor is much higher than that of other liquors. Additionally, the BOD and COD values of different effluents are extremely higher than tolerable limit causing a great threat to our environment. The results show that every parameter, which was found in large amounts, can cause fatal environmental pollution.*

Keywords: Chemical mesurent, Pollution, Production, Wet-blue, Goat skin.

Date of Submission: 10-02-2018 Date of acceptance: 26-02-2018

I. Introduction

Different manufacturing processes, ranging from cottage industry to heavy industry are involved for the durable and flexible leather material by the tanning of putrescible animal rawhide and skin (Heidemann, 1993 [1]). The different forms of leather depending upon various tanning processes (Madhan et al., 2001 [2]), chrome-tanned leather (Heidemann, 1993 [3]; Chagne et al., 1996), aldehyde-tanned leather (Serra et al., 1991 [4]; Wojdasiewicz et al.,1992 [5]), synthetic-tanned leather (Dasgupta,1980 [6]), alum-tanned leather (Montgomery, 1987[7]; Takenouchi et al.,1997[8]) and rawhide (Bosnic et al.,2000 [9]). Cattle skins generally used for leather manufacturing, however, for soft leather items skin of other animals like lamb, deer, goats, etc. is also used (Heidemann,1993 [10]).

The manufacturing process for leather preparation can be divided into three basic sub-processes: preparatory stage/beam house stage, tanning stage and crusting stage (Suresh *et al.*, 2001[11]; Sivakumar*et al.*, 2010[12]). Environmental impact of tannery wastes containing waste water; hazardous chemicals such as chromium, synthetic tannins, oils, resins, biocides, detergents; careless disposal of solid wastes and gaseous emissions creates a negative image of leather industry.

A great deal of sludge generated from the tannery plants (Ramasami and Prasad, 1991[13]) render the solid waste management system highly inactive due tonon-biodegradability of the tanned leather (Dhayalan et al., 2007[14]; Lofrano et al., 2007 [15]). Leather itself is slow biodegradable and treatment of different chemicals during tanning process makes it resistant towards chemical, thermal, and microbiological degradation (Hagerman, 1980 [16]; Hanet al.,2001[17]).

The heavy metals are considered most toxic to humans, animals, fishes and environment which came from tannery waste, [18]). Waste water of tannery is harmful for all kind of animals [19]). Tannery waste water is harmful for animal worldwide. [20]). Environmental pollution caused by tannery wastes during tannery production [21]). The study aims to understand chemical measuring of environmental pollution due to production of wet blue leather from goatskin.

II. MATERIALS AND METHODS

Bangladesh College of Leather Technology Laboratory were used for conducted the research work and tanneries at Hazaribagh of Dhaka city were considered as the study area. To achieve the achievements of the research work at first we manufactured standard goat wet blue leather from wet salted goatskin using the recipe given below. During the processing of the wet blue leather we took the weight of raw trimmings, hair and fleshing. Again, we collected the liquor from all the steps to carry out some chemical analysis. In order to study the degree of pollution we selected some environmental parameters in respect with goat wet blue manufacture. The physical and chemical parameters are – pH, colour andodour, solid wastes (as raw trimmings, hair and flesh), total solids, suspended solids, dissolved solids, acidity & alkalinity, total Kjeldahl nitrogen, sulfates, sulfides content, chloride content, chrome content, basicity, BOD and COD. Methods of sample collection, preservation and % of chemicals are presented in table 1.

Table 1 Process and methodology for sample collection and preparing

Process	Methodology & % of chemicals
<u>Raw Weight = 0.5 Kg</u>(all % based on raw weight)	
Pre – Soaking:	500% Water at room temperature 0.4% LD - 600 (BASF) 0.2% Sodium carbonate Hauling 01 hour. Drain and rinse.
Main Soaking:	300% Water at room temperature 0.2% LD – 600 (BASF) 0.2% Sodium carbonate 0.2% Sodium sulfide Hauling 02 hours. Duration: 16 hours. Drain and rinse.
<u>Soaked Weight = 1.0 Kg</u>(all % based on soaked weight)	
Liming:	200% Water at room temp. 2.0% Slaked lime 2.0% Sodium Sulfide Hauling 03 hours. 2.0 % Sodium Sulfide 2.0% Slaked lime Hauling 01 hour. Rest 01 hour then Hauling 15 minutes/hour. Duration: 24 hours. Scudding by bend knife and fleshing by machine is done next morning and then wash with running water for 15 minutes.
<u>Pelt Weight = 1.0 Kg</u>(all % based on pelt weight)	
Deliming:	50% Water at room temperature 0.3% Boric acid Run 15 minutes 1.0% Ammonium Sulfate 0.4% Sodium meta bi-sulfite Run 1½ hour Check pH = 8.5 Check cross-section with Phenolphthalein = colorless. Drain 50% bath.
Bating:	50% Water at 40^{0}C 1.25% Bating agent (EG-98). Run 2 hours Drain and scudding is done. Check: Bubble test. Wash with running water for 15 minutes.
Pickling:	80% Water at room temperature 8.0 % Normal salt Run 10 minutes 0.5% Impropel CO (Na_2ClO_3) Run 10 minutes 0.5% Formic acid Run 10 minutes 0.8% Sulfuric acid (1:10) 3 installments with 30 minutes' interval Run 1 hour Check pH = 2.8 and then leave overnight. + 0.5% Hypo Run 30 minutes
Chrome tanning:	+ 3% Basic Chrome Sulfate powder Run 1 hour

Process	Methodology & % of chemicals
	+ 3% Basic Chrome Sulfate powder 0.5% Sodium formate Run 2 hours Check penetration.
Basification:	+ 100% Water Run 30 minutes 1% Sodium bi-carbonate (1:10) 3 installments with 30 minutes' interval Run 1 hour + 0.2% Preservative (Busan 30L) Run 3 hours Check pH = 3.8 Drain and pile up for ageing.

Chemical analysis of all the environmental parameter were measured by following the methods mentioned in the books 'Analytical Chemistry for Leather Manufacture' by P. K. Sarkar and 'Official Methods of Analysis' by Society of Leather Technologists' and Chemists (SLC), 1996. [22])

III. Result And Discussion

3.1 pH Value

Table 2 pH value of different effluents

Effluent	pH value
Pre-soaking	6.7
Soaking	8.7
Liming	13.2
Lime wash	11.0
De-liming	7.5
Bating	7.5
Pickling	2.4
Chrome tanning	3.5
Composite effluent	5.7
Tolerable limit	6.5 – 8.5

The table 2 shows the pH value of different effluents. The pH of soaking effluent is closer to the standard value but during liming and pickling or chrome tanning they exceed the limit. This low pH is responsible for the higher degree of corrosion in tannery area and the death of aquatic lives. Besides the higher pH is also corrosive and responsible for increasing alkalinity. So the receiving water must be treated to maintain the pH in the safe range.

3.2 Colour and Odour

Table 3 Colour and odour of different effluents

Effluent	Colour	Odour
Pre-soaking	Earthy	Septic
Soaking	Yellowish	Septic
Liming	Grayish-Green	Foul
Lime wash	Clear	Nil
De-liming	Clear	Chlorineous
Bating	Yellowish	Septic
Pickling	Yellowish	Sulfurated
Chrome tanning	Bluish-Green	Foul
Composite effluent	Grayish	Medicinal
Tolerable limit	Nil	Nil

Table 3 shows the Colour and Odour of different effluents. From this table it is seen that the effluents from different steps of the wet-blue operation add bad odour and colour to the receiving water. We know that the people who use the receiving water for drinking and bathing purpose does not tolerate strong odour cause considerable smell nuisance and coloured water. So the effluents need to treat to remove the colour and bad odour before discharging in nature

3.3 TSS Values

Table 4 Total suspended solids (TSS) values in different effluents

Effluent	TSS (in ppm)
Pre-soaking	2320
Soaking	12860
Liming	2700

Lime wash	1798
De-liming	440
Bating	836
Pickling	2764
Chrome tanning	8400
Composite effluent	11771
Tolerable limit	200

Table 4 shows Total Suspended Solids (TSS) in different effluents. From this table it is seen that the amount of suspended solid in soak liquor is much higher than that of other liquors. It is understood from this the main source of suspended solid is soaking because of containing hairs, dirt, bloods sands etc. Again it is noticeable that, the TSS of composite effluent is lower than of soak liquor due to some reactions or biodegradation are happened here between various liquors. Though it is reduced but still much higher than tolerable limit. So it couldn't be minimized by self-biodegradation in nature. In this case some solids are to be changed into gaseous and liquid as well, which affect directly to the human health.

3.4 TDS VALUES

Figure1 Total dissloved solid (TDS) values indifferent effluents

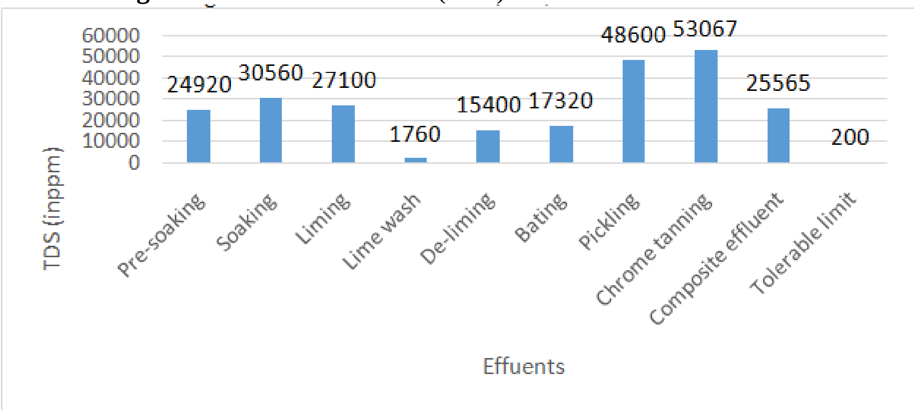

Fig. 1 shows the Total Dissolved Solids (TDS) in different effluents. From this table it is seen that the amount of dissolved solid in every liquor is beyond the tolerable limit. As it is known that the TDS contains some toxic elements, so if the TDS is higher than the toxicity level must be higher, which breaks the ecological cycle and causes ecological imbalance. So it should be minimized as much as possible.

3.5 TS VALUES

Figure 2 Total solid (TS) values indifferent effluents

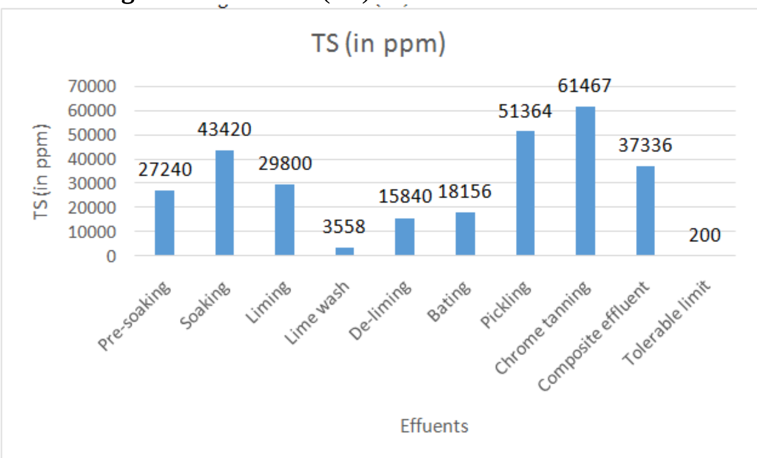

Fig. 2 shows the total Solids (TS) in different effluents. From this table it is seen that the amount of total solid in every liquor is beyond the tolerable limit. As it is known that the TS contains some toxic elements, so if it is higher than the toxicity level must be higher, which breaks the ecological cycle and causes ecological imbalance. Again we know that, the total solids include both total suspended solids and total dissolved solids. So if we can reduce the TSS as well as TDS then the TS must be minimized and we should do it.

3.6 USES OF SOLID WASTES

Table 5 Uses of solid wastes for different purposes

Solid wastes	Possible utilization
Used salts	Reuse for Curing and pickling.
Lime sludge	As a material for building construction and soil conditioner.
Lime protein	Substitute of casein and animal food.
Tail and body hair	Drugged, carpet and cushion industry.
Raw trimmings	Glue and gelatin manufacture.
Fleshing	Fat extraction for Soap industry.

Table 5 shows the Solid wastes on an average 100 MT of solid waste is being generate in Hazaribagh tanneries per day. They are mainly composed of trimmings of finished leather, shaving dusts, hair, fleshing, trimmings of raw hides & skins, etc. Besides bones, horns, hooves, tails, testis, pennies, etc. are comes from slaughter house as solid wastes. In wet blue production especially raw trimmings (11%), hairs (34%) and fleshing (39%) are being generated. All of these wastes are piled and staked by side of road and in the confined spaces of buildings & walls. The waste mass is lying for long time period and decaying, rotten, flew away by wind. These huge amounts of solid waste decomposed naturally and cause obnoxious odour as well as pollutes the air of the locality. But most of these solid wastes could be utilized scientifically in manufacture vanes end products. Here the possible utilization of solid wastes is shown in this table.

3.7 TOTAL ALKALINITY AND TOTAL ACIDITY

Table 6 Total alkalinity and total acidity indifferent effluents

Effluent	Parameter (in ppm)	
	Total Alkalinity	Total Acidity
Pre-soaking	0	425
Soaking	210	0
Liming	3548	0
Lime wash	314	0
De-liming	0	600
Bating	417	0
Pickling	0	14580
Chrome tanning	0	12500
Composite effluent	0	1500
Tolerable limit	0	0

Table 6 shows the total Alkalinity and Acidity in different effluents. From this table it is seen that the lime liquor and lime wash liquor contains large amount of calcium oxide, which is converted into calcium carbonate through calcium hydroxide. These raise the pH of water and dumped on the riverbed as sludge. Again, it is also found that though the acidity of pickle and tan liquor is much higher but reduced in the composite effluent by reaction naturally. In addition to mention that, total acidity includes both free mineral acids and bonded acids or acidic salts as well. So, in composite effluent reacting with alkali can reduce it. From the table-1 it is noticed that the pH of the composite effluent is 5.7. So if we can increase alkalinity slightly in the process after maintaining the total quality of leather production then the nature of the composite effluent would be closer to the neutral and tolerable limit.

3.8 TKN VALUES

Figure3 Total kjeldahl nitrogen (TKN) values in different effluents

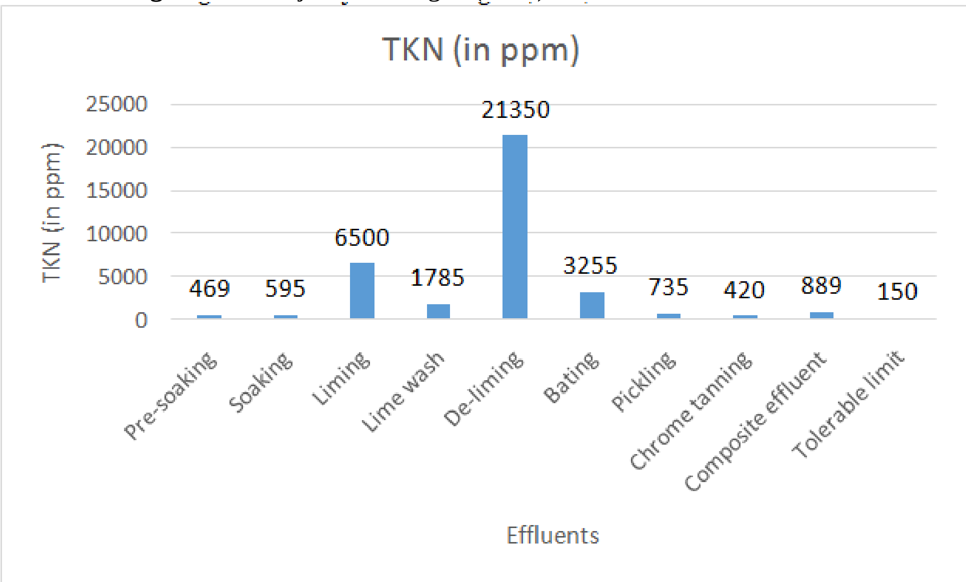

Fig.3 shows total Kjeldahl Nitrogen (TKN) in different effluents. From this table it is seen that the Total Kjeldahl Nitrogen (TKN) in most of the effluents are higher than tolerable limit. Thus the presence of this large amount of nitrogen will bring in several effects on the fish under aquaculture. So this high amount of TKN is required to minimize and to keep in safe range, which needs effluent treatment management. On the other hand, deliming liquors contain the maximum TKN due to using of nitrogen-based salt for processing pelts, which can be rethought for further modifying by ensuring the quality of leather.

3.9 TOTAL SULFIDE AND SULFATE CONTENT

Table 7 Total sulfide and sulfate content values in different effluents

Effluent	Parameter (in ppm)	
	Total Sulfide	Total Sulfate
Pre-soaking	0	618
Soaking	36	247
Liming	718	571
Lime wash	55	577
De-liming	21	1022
Bating	0	2320
Pickling	0	2060
Chrome tanning	0	1772
Composite effluent	195	2060
Tolerable limit	2	1500

Table 7 shows the total Sulfide and Sulfate content in different effluents. From this table it is observed that both the sulfate and sulfide crossing the limit in different liquors specially in composite flows having high content of sulfur based radicals, which requires processing before discharging this effluent to the nearest dumping spaces or river. Otherwise it would pollute the environment severely.

3.10 TOTAL CHLORIDE CONTENTS

Table 8 Total chloride contentsvalues in different effluents

Effluent	Total Chloride (in ppm)
Pre-soaking	5710
Soaking	5660
Liming	3660
Lime wash	2808
De-liming	5733
Bating	5803
Pickling	5780
Chrome tanning	5663
Composite effluent	5803
Tolerable limit	1000

Table 8 shows the total Chloride content in different effluents. From this table it is seen that the total amount of chlorides in most of the effluents are almost same and higher than tolerable limit indicating any use of salts or formation of chlorine based salts by reacting different chemicals of different effluents. Thus, the presence of this large amount of chlorides will bring in several effects on the plants. So, this high amount of this pollutant is required to minimize and to keep in safe range, which needs effluent treatment management.

3.11 TOTAL CHROMIUM CONTENTAND BASICITY

Table 9 Total chromium contentsvalues in different effluents

Effluent	Total Chrome (in ppm)	Proctor's Basicity (%)
Chrome tanning	3363	27
Composite effluent	1196	30
Tolerable limit	2	

Table 9 shows total Chromium content in different effluents. From this table it is observed that, the total amount of chromium in the tanning and composite effluents are extremely higher than tolerable limit causing a great threat to our environment it can be managed by reuse and recover of chromium as well as super control use of it. So, this high amount of this pollutant is required to minimize and to keep in safe range, which needs further effluent treatment management.

3.12 BOD AND COD

Table 10 BOD and COD values in different effluents

Effluent	Parameter (in ppm)	
	BOD	COD
Soaking	1100-2500	3000-6000
Liming	5000-20000	10000-30000
De-liming	1000-3000	2500-7000
Pickling	750-1500	1500-4000
Chrome tanning	1000-3000	2500-12000
Composite effluent	1000-3000	2000-7000
Tolerable limit	60	400

Source – Bangladesh Leather, April 1997. Vol-11, no-17

Table 10 shows BOD and COD in different effluents. From this table it is found that, the BOD & COD values of different effluents are extremely higher than tolerable limit causing a great threat to our environment. So, effluent treatment is necessary to keep these in safe range.

From a medium sized tannery, over 300 million cubic meters of waste liquor containing thousands of tons chemicals and solid waste are discharged daily by the leather Besides liquid waste, leather industry is facing another problem from disposal of solid wastes. [23]. Industrial activity and the inappropriate disposal of residues have turned heavy metal pollution into serious environmental problems. Tanners use a large number of chemicals during the process, discharging toxic wastes into rivers and water bodies. [24]. Elevated metals were found in metal workshop, tannery and e-waste sites, [25]. Tannery discharge are considering the highest pollutant among the industrial waste. [26]. The cultivation of crop plants in areas within and adjacent to tannery waste polluted lands and strategies has become limited due to their high cost and environmental pollution. [27].

IV. CONCLUSION

From this research, it is understood that, there are major polluting steps in the production of wet blue from wet salted goat skin. These are –

i) The chloride bearing soak liquor,
ii) The sulfide bearing lime liquor,
iii) The chrome bearing tan liquor.

So, the leather technologist should reduce significantly the effluent load by good housekeeping and by avoiding use of excessive floats and chemicals. Besides, the re-use of chemicals should be ensured. That is to say, a common effluent treatment plant (CETP) or at least chromium recovery plant should be established for immediate measures otherwise, this inhuman practice should be stopped as early as possible for the country's socio-economic and total need of environmental cause.

REFERENCES

[1]. Heidemann, E., *Fundamentals of Leather Manufacture*. Eduard Roether KG, Darmstadt, Germany, 1993.

[2]. Madhan, B., Jayakumar, R., Muralidharan, C., Gnanasekaran, C.S., 2001. *Improvements in vegetable tanning can acrylics be cotanningagents.J. Am. Leather Chem. Assoc. 96*, 120-126.

[3]. Heidemann, E., *Fundamentals of Leather Manufacture*. Eduard Roether KG, Darmstadt, Germany, 1993.

[4]. Serra, A., Cot, J., Gregori, J., Satorres, J., Bastoli, E., Robert, A., *Carbonyl compounds in tanning process. AQEIC Boletin Tec. 42*,1991, 246-257.

[5]. Wojdasiewicz, W., Szumowska, K., Skornicki, W., Przybylski, A., 1992. *Tanning with hides to the wet white stages.J. Am. Leather Chem. Assoc. 87*, 1992, 121.

[6]. Dasgupta,S., *Some thoughts on standardisation of synthetic tanning materials. J. Soc. Leather Technol. Chem. 64*,1980, 16e23.

[7]. Montgomery, K.C., *Alternatives to chromium tanning. Part III: effect of organic acid anions on aluminiumsulphatetannage of collagen. J. Soc. Leather Technol. Chem. 71*,1987, 59-67.

[8]. Takenouchi, K., Kondo, K., Nakamura, F., *Composition of complexes in citrate masked aluminium solutions & their affinity for collagen. In: Proceedings of the Centenary IULTCS Congress* (London), 1997, pp. 500-510.

[9]. Bosnic, M., Buljan, J., Daniels, R.P., *Pollutants in Tannery Effluents. Regional Programme for Pollution Control in the Tanning Industry in South-East Asia*, United Nations Industrial Development Organization (UNIDO), 2000.

[10]. Heidemann, E., *Fundamentals of Leather Manufacture*. Eduard Roether KG, Darmstadt, Germany, 1993.

[11]. Suresh, V., Kanthimathi, M., Thanikaivelan, P., Rao Raghava, J., Nair, B.U., *An improved product process for cleaner chrome tanning in leather processing. J. Clean. Prod. 9*,2001, 483-491.

[12]. Sivakumar, V., Swaminathan, G., Rao, P.G., Muralidharan, C., Mandal, A.B., Ramasami, T., *Use of ultrasound in leather processing Industry: effect of sonication on substrate and substances e new insights.Ultrason. Sonochem. 17*,2010, 1054-1059.

[13]. Ramasami, T., Prasad, B.G.S., *Environmental aspects of leather processing. In: Proceedings of the LEXPO-XV.* Calcutta, India, 1991.

[14]. Dhayalan, K., NishadFathima, N., Gnanamani, A., Raghava Rao, J., Nair, B.U., Ramasami, T., *Biodegradability of leathers through anaerobic pathway. Waste Mgmt. 27*, 2007, 760-767.

[15]. Lofrano, G., Aydin, E., Russo, F., Guida, M., Belgiorno, V., Meric, S., *Characterization, fluxes & toxicity of leather tanning Bath chemicals in a large tanning district area (IT). Water Air Soil Pollut. Focus 8*,2007, 529-542.

[16]. Hagerman, A.E..Han, B., Jaurequi, J., Tang, B.W., Nimni, M.E.,*Proanthocyanidin: a natural cross linking reagent for stabilizing collagen matrices*,Purdue University, West Lafayette, IN, USA, Ph.D., 1980, Res. Part A 65, 118-124.

[17]. Han, B., Jaurequi, J., Tang, B.W., Nimni, M.E., *Proanthocyanidin: a natural cross linking reagent for stabilizing collagen matrices. J. Biomed. Mater. Res. Part A 65*, 2001, 118-124.

[18]. Govind, P., &Madhuri, S. *Heavy metals causing toxicity in animals and fishes. Research Journal of Animal, Veterinary and Fishery Sciences*, *2(2)*, 2014, 17-23.

[19]. Senthilvelan, T., Kanagaraj, J., Panda, R. C., & Mandal, A. B. *Biodegradation of phenol by mixed microbial culture: an eco-friendly approach for the pollution reduction. Clean Technologies and Environmental Policy*, *16(1)*, 2014,113-126.

[20]. Islam, M. S., Ahmed, M. K., Raknuzzaman, M., Habibullah-Al-Mamun, M., & Islam, M. K. Heavy *metal pollution in surface water and sediment: a preliminary assessment of an urban river in a developing country. Ecological Indicators*, *48*, 2015, 282-291.

[21]. Dixit, S., Yadav, A., Dwivedi, P. D., & Das, M. *Toxic hazards of leather industry and technologies to combat threat: a review. Journal of Cleaner Production*, *87*, 2015, 39-49.

[22]. Sarkar, P.K. *Analytical Chemistry for Leather Manufacture*, Kolkata, India.

[23]. Kanagaraj, J., Senthilvelan, T., Panda, R. C., &Kavitha, S. *Eco-friendly waste management strategies for greener environment towards sustainable development in leather industry: a comprehensive review. Journal of Cleaner Production*, *89*,2015, 1-17.

[24]. Ajayan, K. V., Selvaraju, M., Unnikannan, P., &Sruthi, P. *Phycoremediation of tannery wastewater using microalgae Scenedesmus species. International journal of phytoremediation*, *17(10)*,2015, 907-916.

[25]. Islam, S., Ahmed, K., &Masunaga, S. (2015). Potential ecological risk of hazardous elements in different land-use urban soils of Bangladesh. *Science of the total Environment*, *512*, 94-102.

[26]. Nagpure, N. S., Srivastava, R., Kumar, R., Dabas, A., Kushwaha, B., & Kumar, P. *Assessment of pollution of river Ganges by tannery effluents using genotoxicity biomarkers in murrel fish, Channa punctatus (Bloch)*, 2015.

[27]. Herath, I., Iqbal, M. C. M., Al-Wabel, M. I., Abduljabbar, A., Ahmad, M., Usman, A. R., &Vithanage, M. *Bioenergy-derived waste biochar for reducing mobility, bioavailability, and phytotoxicity of chromium in anthropized tannery soil. Journal of Soils and Sediments*, *17(3)*,2017, 731-740.

Raju Muhammad Shahidul Islam "Environmental Pollution due to Production of Wet-Blue Leather from Goat Skin." IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT) 12.2 (2018): 01-08.