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Impacts of Tannery Effluent on Environments and Human Health

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Abstract
Tannery industry is a primary pollutant of the environment and has a strong potential to cause soil and water pollution owing to the discharge of untreated effluent. It uses more than 250 chemicals for leather production and release a complex mixture of toxic organic chlorinated phenols, toxic Cr(VI), and other toxic pollutants such as sulphides, phenolic compounds, magnesium, sodium, potassium, azo-dyes, cadmium compounds, cobalt, copper, antimony, barium, lead, selenium, mercury, zinc, arsenic, PCB, nickel, formaldehyde resins, pesticides residues, mineral salts, dyes and solvents like grease and oils. Cr(VI) and chlorinated phenols are the basic prominent sewage toxic to biota and humans as well as other environments or ecosystems. Based on different researchers on different countries and different environmental samples like soils, waters, and vegetables in almost all (more than 99.99%) of Cr(VI) is above the permissible limit of WHO, FAO, EPA, and other countries maximum discharging and existing limits. Cr(VI) have different health effects and cause for acute toxicity, mutagenic, carcinogenic and high blood pressure for societies used untreated waste water contain large amount of Cr(VI) discharged from any tannery industries and also affect seed germination of the plants. The levels of Cr(VI) in the downstream river and spring water samples exceed from WHO permissible limit of total chromium in drinking waters (0.05 mg/L). The increased concentration of Cr(VI) in the water samples indicate the possible environmental pollution of downstream water bodies by the tannery effluent, soil and vegetables.
Keywords: Tannery, Effluents, Environments, Hexavalent Chromium

INTRODUCTION

Environmental pollution is one of the major problems of the world and it is increasing day to day due to urbanization and industrialization. The current pattern of industrial activity alters the natural flow of materials and introduces novel chemicals into the environment composed of water bodies, soil, plants, vegetables, human, and different living organism. Now a day one of a serious problem faced by the modern world is water pollution due to the increase in number of industries and this cause for other environmental pollution. Next to water, soil and air is the 2nd most important component of the environment, but it is the most undervalued, misused and abused earth and atmospheric resources respectively. Soil contamination has become a serious problem in all industrialized areas of the country. Soil is equally view as the ultimate sink for organic and inorganic form of contaminants discharged into the environment from industrial effluents. Most plants and animals depend on soil as a growth substrate for their sustained growth and development. The contamination of soils with heavy metals or micronutrients in phytotoxic concentrations generates adverse effects not only on plants but also poses risks to human health. High accumulation of metals affects both growth and metabolism and increases the production of reactive oxygen species in plants (Mahatma, 2010).

Vegetables are the other components of environments exposed to industries effluents and heavy metals. They grow at contaminated sites could take up and accumulate metals at concentrations that are toxic metals like Cr(VI) from different industries such as metal cleaning, plating baths, refineries, mining, electroplating, paper and pulp, paint, textile and tanneries (Weigert, 1991). From these, Tannery industry is a primary polluter of the environment and has a strong potential to cause soil, water pollution (with its high oxygen demand, discolouration and toxic chemical constituents (Song *et al*., 2000)), plants, vegetables, terrestrial and atmospheric systems owing to the discharge of untreated effluent. Tanning is the chemical process that converts animal hides and skin into stable and imputrescible products called leather (Hayelom and Adhena, 2014). The transformation of hides into leather is usually done by means of tanning agents and the process generates highly turbid, colored and foul smelling effluent (Hayelom and Adhena, 2014; Buljan and Kral, 2011). During tanning process there are three types of wastes such as air pollutant, water pollutant and solid pollutant are discharge during various steps namely: beam house operations, tan yard operations, post tanning operations and finishing operations (Durai and Rajasimman, 2011).

The characteristics of tannery effluent vary considerably from tannery to tannery depending upon the size of the tannery, chemicals used for a specific process, amount of water used and type of final product produced by a tannery. The tanning activity is vital for the leather industry and most tanneries in the world (about 90%) use chromium salts to provide better leather flexibility, better water resistance and a high shrinkage temperature. Unfortunately, chromium salts are not completely fixed by skins and the residual quantity (about 30% of the initial one) remains in the spent tanning liquor (Alfredo *et al*., 2007) and high concentration of Cr(VI) have carcinogenic, mutagenic and teratogenic effects on humans, many plants, animals, and bacteria inhabiting aquatic environments (Naik *et al*., 2007). It can cause a temporary effects such as dizziness, headache, irritation of eyes, skin or lungs, allergic reactions, poisoning of liver, kidney or nervous system or collapse due to lack of oxygen. Tannery effluents are ranked as the highest pollutants among all the industrial wastes and its types are: vegetable tanning, which does not contain chromium and used for heavy leather like shoe soles, handbags, straps and belts preparation and chrome tanning, which contains chromium and used for light leather (Manivasagam, 1987). The tanning industries are major contributors of chromium pollution in India, Pakistan, Burkina Faso, South Africa, Latin America, Asia and other developing countries like Ethiopia and Sudan which have more tannery industries. Since almost all leather industries release much amount of waste which consists of toxic chromium and phenolic solutions (Felsner, 1995). African leather industry is relatively insignificant compared to other worlds like Latin America produces more leather in 3 weeks than African industry produces in a year; which illustrated by figure 1, that shows the world output of leather in 1988, by region.

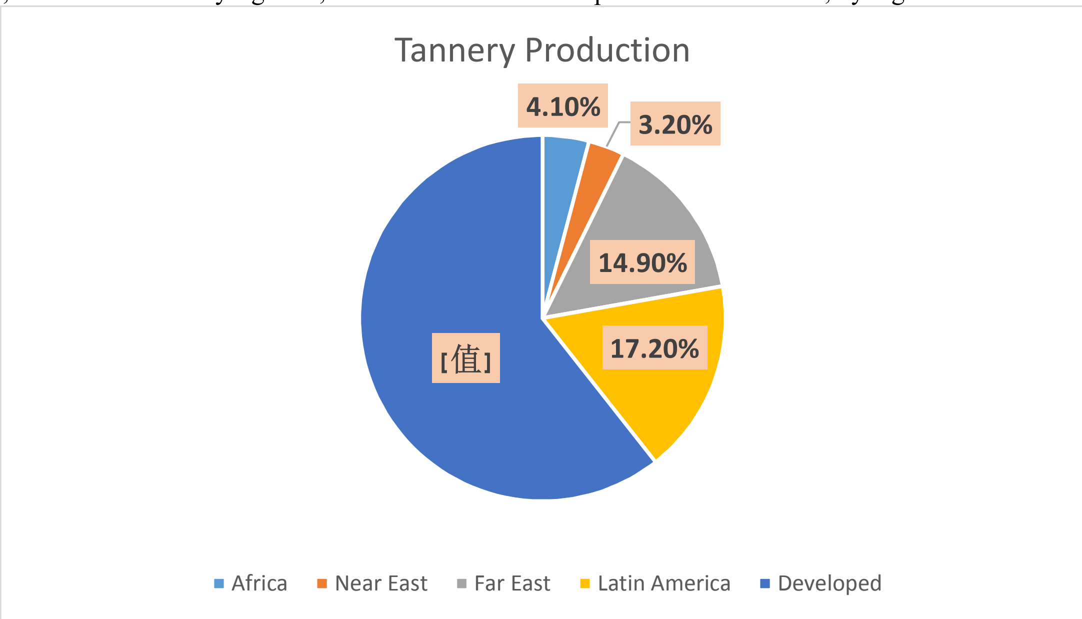


Figure 2: Comparative leather production output of the world in 1988 by regions (Felsner, 1995).

Sources of Environmental Pollutants

There are different sources of environmental pollutants and have different ways of mechanisms affecting the ecosystem as shown fig 2 below. Leather processing industry is one principal next to pesticide and paint processing industries compared to other industries.

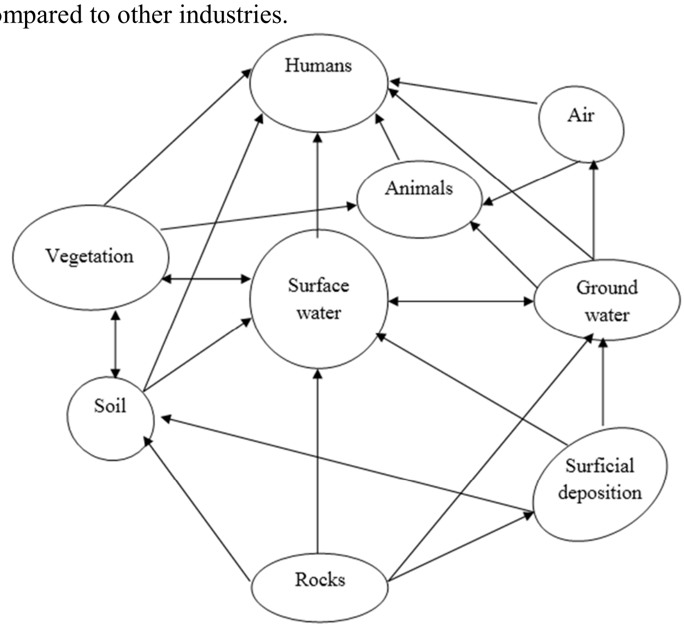


Figure 3: The flow diagram of toxic elements discharged as a waste from industries in the biospheres of plants, soil, air, water, animals and humans in the world environment (USGS, 2002).

Tannery operations leading to high pollution load to the ecosystem

The raw hide undergoes a series of chemical treatments before it turns into flattening leather in leather processing such a process known as tanning and it can categorized in to four stages (Durai and Rajasimman, 2011) and released three main group of tannery effluent: chrome-free effluents (emanating from the beam house-liming, deliming/bating, water from fleshing and splitting machines which contain high pH sulphides), high chrome-contain effluents (emanating from the tanyard-tanning and re-tanning, sammying (high Cr content and acidic), low chrome content soaking and other general effluents emanating mainly from post-tanning operations (fat-liquoring, dyeing) (Buljan *et al*., 2011) released to the environments.

The prime stages in leather processing are curing, soaking, liming, dehairing, detaining, deliming, bating, picking, degreasing and tanning. For all these steps use the chemicals like sodium sulphide, sodium bicarbonate, chromate and chloride, sodium sulphite, chromium sulphate, calcium salts, ammonium salts, acids, alkalis, fat, liquor, organic dyes, hydrogen peroxide, and formate which releases quite toxic chemicals of organic chlorinated phenols (e.g. 3,5-dichlorophenol), inorganic pollutants of Cr (VI), and other toxic pollutants like sulphides, phenolic compounds, magnesium, sodium, potassium, azo-dyes, cadmium compounds, cobalt, copper, antimony, barium, lead, selenium, mercury, zinc, arsenic, PCB, nickel, formaldehyde resins, dyes, solvents, pesticides residues and other mineral salts (Ros and Ganter, 1998) that causes severe health hazards and environmental problems to the entire ecosystems in all stages (Murugan and Sohaibani, 2010).

Chlorinated phenols and chromium were found to be closely associated with any tannery waste rather than others. Indeed chlorinated phenols like 3, 5-dichlorophenol act as an organic pollutant associated with the tanning industry have been found to be highly toxic and affect the cellular compounds of organisms exposed to a waste. Organic matter (protein and carbohydrate decomposition) - depression of the dissolving oxygen (DO) content of stream waters caused by microbial decomposition (Mwnyihija *et al*., 2006), salinity or $NaCl_2$ - small decrease in the solubility of non-polar organic compounds (e.g. naphthalene, benzene, toluene etc.) (Pepper *et al*., 1996), offensive odour (H_2S) - inhibition of the cytochrome oxidase and other oxidative enzymes, resulting in cellular hypoxia or anoxia, exposure to moderate levels of (50-100 mg/L H_2S) can result in Kerato-conjuntivitis, respiratory tract irritation and olfactory fatigue. Prolonged exposure to 250-500 mg/L will result in olfactory paralysis, severe lung and eye irritation, pulmonary oedema and unconsciousness in human (Dorman *et al*., 2000). However, one of the major disposals of tanning is chromium contaminated sludge produced as a by-product of wastewater treatment (Amita, 2005) in addition to other waste effluents and heavy metals. Leather processing requires large amount of chemicals as a raw materials at different processing stage and they release toxic chemicals to the environments as shown in figure 3 below.

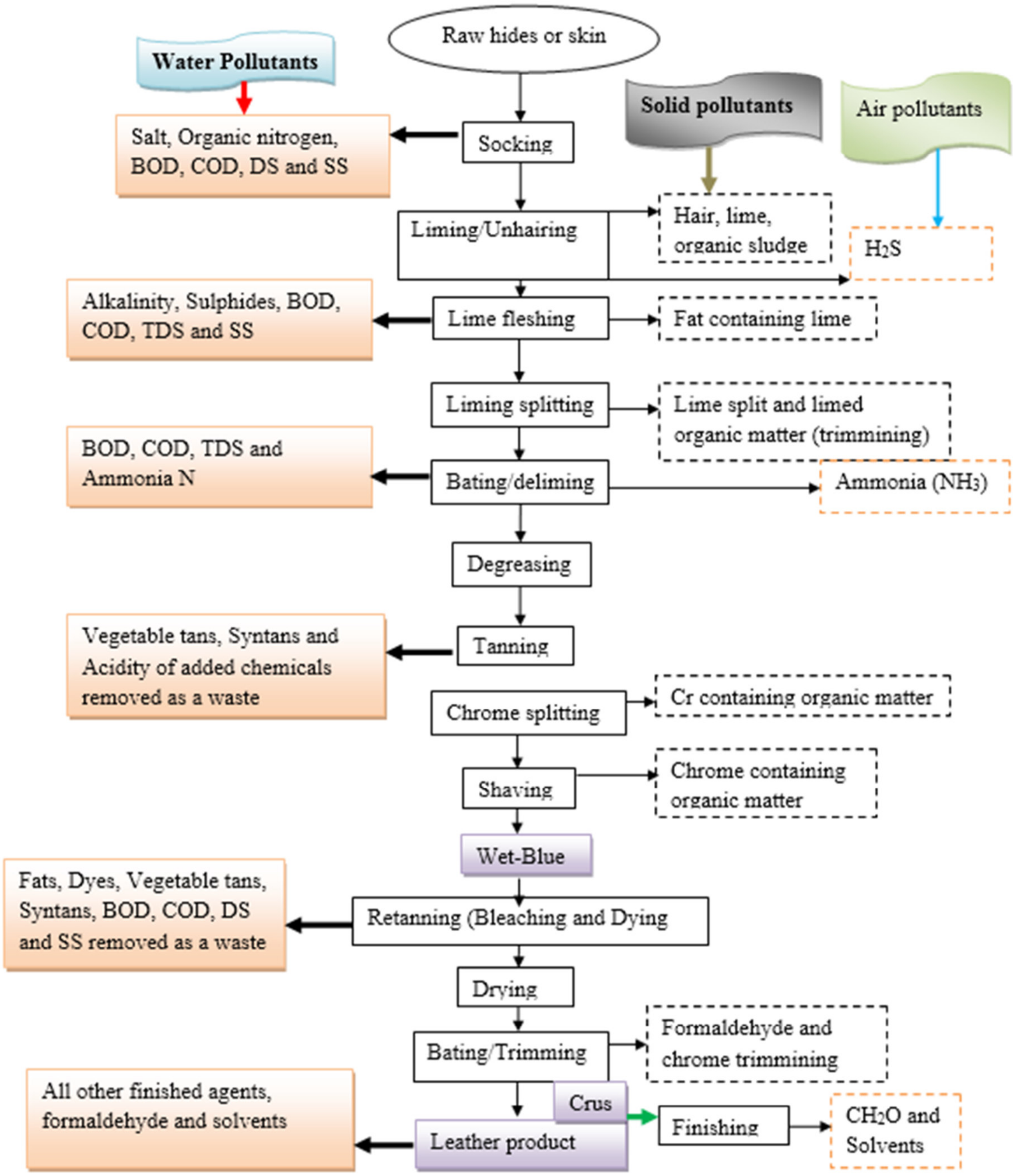


Figure 4: Schematic diagram indicating type of pollutants during the tanning process (UNEP 1994).

Effluent Sensitivity Environments

Chromium is extensively used in industries, like electroplating, paint and pigment manufacturing, textile, fertilizer, leather tanning and mining (Unal *et al*., 2010; Ganguli and Tripathi, 2002). Those industries discharge Cr(III) and Cr(VI) with waste effluent to the soil, surface water and vegetables. The most environments directly and indirectly affected or sensitive to tannery effluent are:

Soil profiles

Soil is a crucial for most plants and animals life as a growth substrate for their continual growth and development. In many instances the sustenance of life in the soil matrix is adversely affected by the presence of deleterious substances or contaminants of the organic and inorganic form of contaminants results from disposal of industrial effluents especially from tannery discharge. Leather industries located at Jajmau, Kanpur, are the major sources of heavy metal contaminations in the agricultural soil in the surrounding areas and have been used for irrigation. Continuing use of sludge for irrigation can cause heavy metal like Cd, Zn, Cr, Ni, Pb and Mn accumulation in surface soils and it can release heavy metals into ground water or soil solution available for plant uptake due to reduction of heavy metal retain capacity of the soil. The contamination of soils with heavy metals or micronutrients in phytotoxic concentrations generates adverse effects not only on plants but also poses risks to human health (Murugesan *et al*., 2008). The concentration of chromium was very high in the soil as agricultural lands are irrigated with wastewater rich in tannery effluents, which contains high concentration of chromium sulphate (Mohd, 2008). Care should be taken with phosphorus applications because high level of phosphorus in the soil can result in water pollution. At high immersions Cr(VI) is noxious, mutagenic, carcinogenic, teratogenic and in nature subsists mainly as the dissolvable, extremely poisonous anion. Moreover, using sodium chloride as raw material in tanneries release a high concentration of chloride and nitrate (Babyshakila, 2009) as the end product of oxidation of nitrogen whereas sodium carbonate, sodium bicarbonate, sodium chloride and calcium chloride in tanning causes the alkalization of the soil resulting to increase in pH of the soil (Mondal *et al*., 2005).

Water profiles

Tannery effluents are of large scale environmental concern because they color and diminish the quality of water bodies into which they are released. Tannery waste also include biodegradable organic matter (e.g. proteins and carbohydrates) which have the main problem on depression of dissolved oxygen content in stream waters caused by microbial decomposition (Mwnyihija et al., 2006). This impact is primarily on loss of dissolved oxygen, which is detrimental to aquatic organisms and encourages anaerobic activity, which leads to release of noxious gases (Mwinyihija *et al*., 2006; Pepper *et al*., 1996).

Plant and Vegetables growth

Wastewater laden irrigation water affects the plant growth and yield (Barman and Lal, 1994) and the accumulation of toxic heavy metals are biomagnified at different trophic levels through food chain. Tannery wastewater produces phytotoxic effects, and high accumulation of heavy metals resulting in stress for plants (e.g salinity stress which affect various metabolic processes resulting in reduction of vegetative and later on reproductive growth of the plant) and greatly affects the process of respiration, photosynthesis, shorten germ sprouting and mitotic activity (Camplin, 2001) and also increases the production of reactive oxygen species (Moore and Ramamoorthy, 2001). The accumulation, however, depends on the plant species, the elements, its bioavailability, redox, pH, cation exchange capacity, dissolved oxygen, temperature and secretion of roots.

According to (Arifa *et al*., 2013) all the parameters of vegetative growth and biomass in all the cultivars of sunflower reduced due to an increase effluent discharge from tanneries and wastewater adversely affected the root and shoot development of all the cultivars of sunflower in higher treatment concentration as compared to counterparts grown in controls. Similarly, (Rusan *et al*., 2007; Kilicel and Dag, 2006 and Hewitt and Keller, 2003) reported the same effects of wastewater on the growth of maize, soybean and wheat plant. The higher level of salts like chlorides and sulphates in a tannery waste which might inhibit the average crop growth and developments of maize as reported by (Nath, 2009). Presence of excess amount of chromium, dissolved solids, chlorides, sulphides, high BOD and COD values in the effluent beyond the tolerance limit makes it unsuitable for crop growth (Bera and Bokaria, 1999) and inhibit seed germination and seedling growth at lower dilution of effluents (Mishra and Bera, 1995). So, more than 80% high concentrations of effluents proved deleterious to plant growth, both at vegetative and reproductive stages. Tannery sludge is a combination of hair, fleshing, shavings, splits, hide/skin trimmings, leather trimmings, buffing dust, leather finishing residues, general plant wastes, and waste water treatment sludge as shown in figure 2 above (UNEP, 1994) and severely affect the mitotic process and reduce seed germination in extensively cultivated pulse crops (Thangapandian, 1995).

Atmospheric Systems

The air we breathe is an essential ingredient for our wellbeing and a healthy life. Unfortunately polluted air is common throughout the world specially in developed countries from 1960s. Polluted air contains one, or more, hazardous substance, pollutant, or contaminant that creates a hazard to general human health. The main pollutants found in the air we breathe include, particulate matter, PAHs, lead, ground-level ozone, heavy metals, sulphur dioxide, benzene, carbon monoxide, nitrogen dioxide, H_2S and NH_3 waste discharging from tanning during unhearing limning and deliming bating process respectively affect atmospheric air (Mashhood and Arsalan, 2011 and Kan, 2009). Chromium present in the atmosphere originates from anthropogenic sources, which account for 60-70%, as well as from natural sources, which account for the remaining 30-40%. Industrial activities still remain the major source of pollution to the atmospheric systems. Average atmospheric concentrations of this metal are 1 ng/m^3 in rural to10 ng/m^3 in polluted urban areas and that their retention in the lung can pose carcinogenic risk.

Humans and Animal Health

Most micro-organisms are sensitive to Cr(VI) toxicity but some groups possess resistance mechanisms to Cr(VI) and can tolerate high levels by converting from toxic Cr(VI) to essential Cr(III) form. Chronic exposure of tannery workers from a period of five months to fourteen years represents a relevant risk factor for the development of diseases associated with genetic damage. Due to their unawareness of the toxic effluents of chromium, hydrogen sulphide, lead, zinc, cadmium and formaldehyde released from tanneries have a temporary effects such as dizziness, headache, irritation of eyes, skin or lungs, allergic reactions, poisoning of liver, kidney or nervous system or collapse due to lack of oxygen as well as long term illness like occupational asthma, ulcers, bronchitis, genetic defects and dermatitis in humans and animals health (Rajendran, 2010).

Chromium Impacts on the Biota

Chromium is an essential metal that is involved in the metabolism of glucose in humans and animals, but its Cr (VI) form is very toxic, mutagenic, and carcinogenic (Rahmaty *et al*., 2011 and Lee et al., 2008). In addition, Cr (VI) is highly mobile in most environments, mainly due to its soluble nature (Fukai, 1967) and it negatively affects the environment due to its eminent solubility, mobility and responsiveness. Soils and groundwater surrounds are the most fictile to Cr(VI) pollution from spills, unlawful disposition and unguarded stock piles of new techniques chromium products. Cr(VI) is extremely accessible to live organisms through multiple paths of entrance such as consumption, epidermal adjoin, breathing in, and absorption (in the case of plants and root ages) shown in figure 2. Cr(VI) it affects enzyme amylase in plant (which plays an important role during seed germination through hydrolysis of reserve starch and release in the energy) (Thevenot *et al*., 1992) and shortens seed sprouting of plants (Towill *et al*., 1978; Anon, 1974). Normally chromium is known to have chronic toxicity (above 5 mg/l) in drinking water (Adelekan and Abegund, 2011).

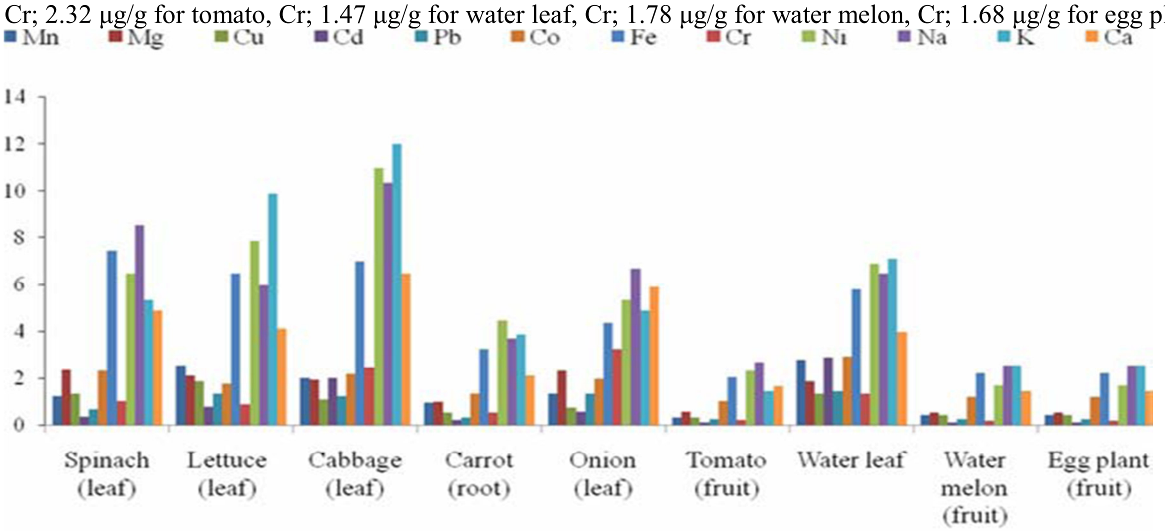
Effluent Physico-Chemical Parameters

Based on different researcher there were different output physic-chemical parameters of tannery sewage in water, soil and vegetables contaminated by untreated sewage discharging at different times in various areas as shown below in table 1 below. According to (Babyshakila, 2009) physicho-chemical characteristic of tannery effluent varies between read and black soil types both under controlled and different concentrated effluents. This also have direct effects on plant chlorophyll and starch contents as well as protein and ascorbic contents i.e as effluents concentration increases the value of plant chlorophyll and starch contents as well as protein and ascorbic decrease in plant or vegetables.

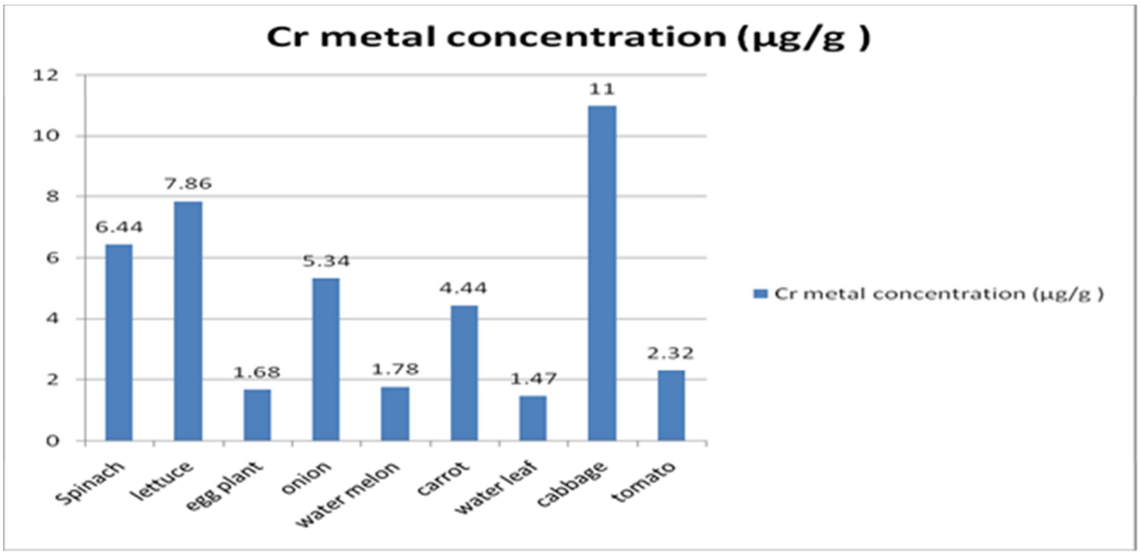
Table 3: Physico-chemical characteristics of tannery effluent collected from the outlet of tannery industry in different countries and related WHO, FAO and USEPA.

Parameters	USEPA (2004)	WHO (1996)	FAO (1985)	Conc. by Aklilu et al.; 2012	Conc. by Babyshakila, 2009
Colour	-	-	-	-	Brown
Odder	-	-	-	-	Offensive
Temperature (ºC)	40.0	40.0	-	23.9	-
Turbidity				-	Turbid
Total hardness				-	5400
pH	6 - 9	6 - 9	-	7.14	10.5
EC (µs/cm)	1000	-	-	9420	24500
BOD (mg/l)	300.0	30.0	-	147.29	35
COD (mg/l)	500	250	-	930.6	318
TDS (mg/l)	500	2100	-	319	17150
TSS (mg/l)	-	-	-	-	258
Cadmium, Cd (mg/l)	0.2	0.01	0.01	0.0056	-
Copper, Cu (mg/l)	73.3	0.2	0.2	0.0093	-
Chromium, Cr (mg/l)	2.0	0.1	0.1	3.91	193
Iron, Fe (mg/l)	5.0	-	5.0	1.70	-
Lead, Pb (mg/l)	0.3	0.5	-	0.98	-
Zinc, Zn (mg/l)	99.4	0.2	2.0	0.21	108
Nickel, Ni (mg/l)	-	-	-	-	5.5
Sodium, Na (mg/l)	-	-	-	-	600
Magnesium, Mg (mg/l)	-	-	-	-	5100
Carbonate, CO_3^{-2} (mg/l)	-	-	-	-	10423
Bicarbonate, (mg/l)					1440
Nitrite NO_3^- (mg/l)	-	-	-	-	0.07
Fluoride, F^- (mg/l)	-	-	-	-	10
Chloride, Cl^- (mg/l)	-	-	-	-	2300
Sulphate,SO_4^{2-} (mg/l)	-	-	-	-	1080
Nitrate, NO_3^- (mg/l)	-	-	-	-	440
Nitrogen, N (mg/l)	-	-	-	-	0.99

The physico-chemical analysis result of the tannery effluent was found higher in COD, EC, Pb and Cr from the recommended discharge limit whereas the concentrations of Cd, Cu, Zn, and Fe were found less than the maximum limit. In the analyzed effluent sample the electrical conductivity was recorded higher than the standard limits, which indicates the presence of high concentration of salts in the solution and bears direct relation with osmotic potential. According to (Muhammad et al., 2011), the concentrations of chromium in the soil were found in the range of 246-1980 mg/kg in which is above the permissible limit of 100 mg/kg in Dutch as well as USEPA, 2004 standards. Also in different plant, and water samples Cr exceed the Netherland and WHO standard permissible limits of 1.30 mg/kg and 0.1 mg/L respectively and permissible limits of 2.3 mg/kg according to FAO/WHO-Codex alimentarious commission, 2001. From the result of different researcher cabbage shows the highest concentrations of the metal, followed by lettuce > spinach > onion > carrot > tomato > water melon > eggplant > water leaf as shown in fig.4 and 5. In a similar way, the concentrations of Cr; 6.44 µg/g for Spinach, Cr; 7.86 µg/g for lettuce, Cr; 11.00 µg/g for cabbage, Cr; 4.44 µg/g for carrot, Cr; 5.34 µg/g for onion, Cr; 2.32 µg/g for tomato, Cr; 1.47 µg/g for water leaf, Cr; 1.78 µg/g for water melon, Cr; 1.68 µg/g for egg plant.



(a)



(b)

Figure 5: Concentration of different metals (a) and concentration of chromium (b) in different vegetables and waste water discharged from tannery industry.

Different countries show different result of heavy metals (mg/L) in the out let of tannery effluent according to table 2 below explained by (Adhikari *et al*., 1993; Jurwarkar *et al*., 1991).

Table 4: Concentration of different metals (mg/L) in different countries tannery waste/effluent.

Name of countries	Cd	Cr	Ni	Pb
Ethiopia	0.0056	3.91	-	0.98
Allahabad	3.5	60.4	32.3	76.8
Delhi	1.5	82.0	191.5	41.7
Jaipur	7.3	176.2	37.5	66.0
Pagladanga	4.0	101.0	ND	200.0
Topsia	2.0	101.3	ND	185.0
Nigeria	1.0	5.25	12.0	2.34

Source: Adhikari et al., 1993; Jurwarkar et al., 1991

According to (Naidu et al., 1998) there was a marked difference in sludge Cr concentrations between Australian and Indian tannery industries. While the concentration of Cr in the Indian tannery industry sludge generally ranged from 1179-16,158 Cr mg/kg whereas in the Australia showed concentrations ranging from 10,000-150,000 Cr mg/k. As a result the concentration of Cr in soil samples taken around tanneries in India and at the historically contaminated sites in Australia exceeded the WHO, US-EPA and Australian National Health and Medical Research Council guidelines for contaminated soils.

Tannery Effluent Treatments Technology

Tannery wastewater is generally treated by various physico-chemical and biological methods and by a combination of both. Physical and chemical processes are frequently employed to treat contaminated sites, but often do not destroy contaminants (Bouwer *et al*., 1994). Treatment of tannery effluent through the use of activated sludge process has been reported by many research workers (Tare *et al*., 2003; Ahmad *et al*., 2002). All these studies indicate a BOD_5 removal of 90 to 97% for the tannery effluent concluding activated sludge process as highly useful for such treatment purpose. Removal of Cr(VI) from industrial effluents is not only essential because of its toxicity to humans but also it affects soil fertility by inhibiting biodegradation of organic pollutants due to its ability to inactivating enzymes and precipitating proteins of soil microbial organisms. Despite the use of various physic-chemical methods such as: Precipitation by hydroxides, carbonates and sulfides, ion-exchange resins, adsorption on activated carbon, and membrane separation and bioremediation to remove the heavy metals, the effluents/sludge emerging out of the leather industries (Srivastava, 2006). By applying industrially proven low-waste advanced methods such as the use of salt-free preserved raw hides and skins, hair-save liming, low-ammonia or ammonia-free deliming and bating, advanced chrome management systems, etc., it is possible to decrease significantly the pollution load, namely: COD and BOD_5 by more than 30%, sulphides (S^{2-}) by 80-90%, ammonia nitrogen by 80%, total Kjeldahl nitrogen (TKN) by 50%, chlorides by 70%, sulphates by 65%, and chromium by up to 90%. In general there are many different phase tannery effluent treatment methods. Those are:

Preliminary treatment: Used in the case of common effluent treatment plants for examining tannery clusters often found in developing countries to remove large particles, sand/grit and grease, but also to significantly reduce the content of chrome and sulphides before the effluent is discharged into the collection tank.

Physical-chemical treatment (primary): a method basically used for the removal of settleable organic and inorganic solids by sedimentation, and the removal of materials that will float (scum) by skimming. Approximately 25-50% of BOD_5, 50-70% of TSS, and 65% of the oil and grease are removed during primary treatment. The effluent and sludge from primary sedimentation are referred to as primary effluent and sludge.

Biological treatment (secondary): used for the removal of biodegradable dissolved and colloidal organic matter using aerobic biological treatment (in the presence of oxygen) processes by aerobic micro-organisms that metabolize the organic matter in the wastewater, thereby producing more micro-organisms and inorganic end products (principally CO_2, NH_3, and H_2O).

Advanced treatment (tertiary): is employed to reduce residual COD load and/or when specific waste water constituents are not removed by previous treatment stages.

Sludge handling and disposal: Effluent treatment plants produce treated, “cleaned” effluent and sludge because inherently the primary aim of waste water treatment is the removal of solids and some potentially hazardous substances from the waste water. Furthermore, biologically degradable organic substances are converted into bacterial cells, and the latter are removed from the waste water.

CONCLUSION

Very scanty data are available about the spatial distribution of the pollutants from the sources, their extent and concentrations, and their effects on natural vegetation and cultivated crops. Even if there is no more published data or finding of all researchers on tannery industries effluent effects on human and animals health and as well as atmospheric air in different countries including Ethiopia there were some researchers found that tannery waste is the major environmental pollutants and acute and chronic human as well as living organisms health effects. Tanning use more chemicals during different process like hexavalent chromium, chlorinated phenols, azodyes, cadmium compounds, antimony, lead, selenium, mercury, arsenic, polychlorinated biphenyls (PCB), formaldehyde resins and pesticides residues and released more toxic by-products to the surrounding. From those chemicals, hexavalent chromium is one of a major hazardous tannery effluent highly discharged from tanning sewage to soil, water and vegetables. It is very toxic and in almost all researchers finding the concentration is more than the permissible levels in sewage water, soil and vegetables stated by FAO, WHO and EPA including my country. This leads to toxic and carcinogenic for humans. Those chemicals and dusts enter to humans through inhalation, skin absorption and food chains. Waste water from the tannery effluent has a fast interaction with environment. As a result cheap management must practice, lower amounts of sludge are amended with agricultural soil to enhance the productivity and an integrated of physical, chemical and biological treated waste waters are also used for irrigation purpose. Since irrigation of the plants with raw effluents adversely affects the plant process of respiration, photosynthesis, mitotic activity, more stress growth and development and also increase acidity of a soil.

REFERENCES

Adelekan B. A. and K. D. Abegunde (2011); Heavy metals contamination of soil and groundwater at automobile mechanic villages in Ibadan, Nigeria. International Journal of the Physical Sciences, 6(5), pp. 1045-1058.

Adhikari, S.; Gupta, S.K. & Banerjee, S.K. (1997); Long-term effect of raw sewage application on the chemical composition of ground water. Journal of Indian Society of Soil Science, India.

Ahmad M. S. (2002); Biological Treatment of Tannery Wastewaters, M.Sc Thesis, Institute of Environmental Engineering and Research, UET, Lahore.

Aklilu Asfaw, Mengistu Sime, Fisseha Itanna (2012); Determining the Effect of Tannery Effluent on Seeds Germination of Some Vegetables in Ejersa Area of East Shoa, Ethiopia. International Journal of Scientific and Research Publications, 2(12).

Alfredo C.; Leondina, D.P.; Enrico, D. (2007); Ind. Eng. Chem. Res. 46, p. 6825.

Amita DA, Verma S, Tare V, Bose D. (2005); In: Oxidation of Cr (III) in tannery sludge for Cr (VI): Field observations and theoretical assessment. J. Hazd .Mat. B. 121: pp. 215-222.

Anon. (1974); Medical and Biological effects of pollutants: Chromium. National Academy Press, Washington.

Arifa Zereen, Abdul Wahid1, Zaheer-Ud-Din Khan and Andleeb Anwar Sardar (2013); Effect of Tannery Wastewater on the Growth and Yield of Sunflower (Helianthus Annuus L.). Bangladesh J. Bot. 42(2): pp. 279-285.

Babyshakila P. (2009); Effect of Diluted Effluent on Soil Properties and Plant Growth. Advanced Studies in Biology, 1(8), pp. 391-398.

Bera, A.K. and Kanta Bokaria, (1999); Effect of tannery effluent on seed germination, seedling growth and chloroplast pigment content in mungbean (Vigna radiata L. Wilczek). Environ. Ecol., 17(4), pp. 958-961.

Buljan J. and Kral I., (2011); Introduction to treatment of tannery effluents. United Nations Industrial Development Organization (UNIDO) Vienna.

Camplin WC (2001); Effects of paper and pulp factory of Indonesia on the growth and yield potential of cereal crops. Environ. Pollu. 33(13): pp. 324-331.

Codex Alimentarius Commission (FAO/WHO), (2001); Food additives and contaminants-joint FAO/WHO Food standards programme. ALINORM 01/12A:

Durai, G. and Rajasimman M., (2011). Biological treatment of tannery waste water, a Review. journal of environmental science and Technology, 4 (1): pp. 1-17.

EPA (2003); Standards for Industrial Pollution Control in Ethiopia Prepared By: The Environmental Protection Authority Ethiopia and The United Nations Industrial Development Organization Ecologically Sustainable Industrial Development (ESID) Project US/ETH/99/068/ Ethiopia.

Felsner, G., (1995); "Status of the leather industry in eight African countries assisted by UNIDO." Paper presented at the 47th annual convention of the Society of Leather < Technologists and Chemists. Halfway house.

Fukai, R., (1967); Valency state of chromium in seawater. Nature, 213: p. 901.

Ganguli, A. and A.K. Tripathi., (2002); Bioremediation of toxic chromium from electroplating effluent by chromate-reducing Pseudom onas aeruginosa A2Chr in two bioreactors. Ap pl. M icrobio l. Biotechnol., 58: pp. 416-420.

Hayelom Dargo and Adhena Ayalew (2014); Tannery Waste Water Treatment: A Review. International Journal of Emerging Trends in Science and Technology 1(9): pp. 1488-1494.

Hewitt F and Keller T (2003); Water pollution impact on bean and cereals. J. Agronomy. 11(3): pp. 175- 185.

Jurwakar, A.S.; Jurwakar, Asha, Deshbharatar, P.B. and Bal, A.S. (1991); Asian Experiences in Integrated Plant Nutrition, 178-201, RAPA. FAO, Bangkok.

Kilicel F and Dag B (2006); The relationship between some heavy metal concentrations in soil, leaves and fruits of starling delicious (Malus communis Lam.). Turk. Review. Analy. Chem., 25(4): pp.271-283.

Lee, S.E., J.U. Lee, H.T. Chon and J.S. Lee, (2008); Microbiological reduction of hexavalent chromium by indigenous chromium-resistant bacteria in sand column experiments. Environ. Geochem. Health, 30: pp. 141-145.

Mahatma Gandhi, (2010); Effect of tannery effluent on water and soil profile, plant growth and human health, India; pp. 3-7

Manivasagam N. (1987); Industrial effluents origin; characteristics effects, analysis and treatment, Shakti publications, Coimbatore, India, pp. 79-92.

Mashhood Ahmad Khan (Dr.) and Arsalan Mujahid Ghouri, (2011); Environmental Pollution: Its Effects on Life and Its Remedies. Journal of Arts, Science & Commerce, 2(2), pp. 276-284.

Mishra, P. and A.K. Bera (1995). Effect of tannery effluent on seed germination and early seedling growth in wheat. Seed Res., 23, pp. 129-131.

Mohd. Musheer Altaf, Farhana Masood, Abdul Malik, (2008); Impact of Long-Term Application of Treated Tannery Effluents on the Emergence of Resistance Traits in Rhizobium sp. Isolated from Trifolium alexandrinum. Turk J Bio, 32, pp. 1-8.

Mondal, N.C., Saxena, V.K and sinha, V.S. (2005). Impact of pollution due to tanneries on ground water, regime, current science, 88, pp. 1988-1993.

Muhammad A.I, Muhammad NC, Shujah Z, Muhammad I , Khuram A , Asma I, (2011); Accumulation of Heavy Metals (Ni, Cu, Cd, Cr, Pb) in Agricultural Soils and Spring Seasonal Plants, Irrigated by Industrial Waste Water, Pakistan.

Mwinyihija M, Strachan NJC, Dawson J, Meharg A, Killham K (2006); An ecotoxicological approach to assessing the impact of tanning industry effluent on river health. Arch Environ. Contam. Toxicol., 50: pp. 316-324.

Naik, S.J.K., Pawer, A.C., Vani, K., Madhuri, K and Devi, V.V, (2007); Cytogenic analysis in human to assess the Impact of metal pollution from Jeedimetla Industrial area, Hyderabad. A.P, Indian pollution Research, 26(2), pp. 263-265.

Nath K (2009; Long term effects of tannery effluents toxicity on crops and modulation of toxicity through zinc, iron, and potassium. Res. Environ. Life Sci., 2:pp.193-200.

Pepper IL, Gerba CP, Brussean ML (1996); Pollution Science, Academic press Inc., 194.

Rahmaty R, Khara J. (2011); Effects of vesicular arbuscular mycorrhiza Glomus intraradices on photosynthetic pigments, antioxidant enzymes, lipid peroxidation, and chromium accumulation in maize plants treated with chromium. Turkish Journal of Biology, 35, pp.51-58.

Ros M, Ganter A., (1998). Possibilities of reduction of recipient loading of tannery waste Slovenia. Water Sci.. Tech. 37.

Rusan H, Kamre L and Manser T (2007); Wastewater irrigation impacts on crops with respect to heavy metals. Crop Sci. 5: pp. 114-118.

Song Z, Williams CJ, Edyvean RJ, (2000); Sedimentation of tannery wastewater. Water Res.. 34.

Srivastava, S.; Indu, S.T. (2006); Soil Biology and Biochemistry.

Tare V., Gupta S. and Bose P. (2003); J. of Air and Waste Management Association, pp. 53976-982.

Thangapandian V, Sophia M, Swaminathan K. (1995). Cytological effect of tannery effluents on root resistances of Allium cepa Linn test system. J Environ Biol. 16: pp. 67-70.

Thevenot, C., C. Lauriere, C. Mayer, Cote-Simond, and J. Daussant (1992). α Amylase changes during development and germination of maize kernels. J. Plant Physiol., 140, pp. 61-65.

Thomas, G.C. (1993);; Qualitative and Instrumental Analysis of Environmentally Significant Elements, John Wiley and Sons: New York.

Towill LE, Shriner CR, Drury JS. (1978); Reviews of the environmental effects of pollutants Chromium(lll). National Academy Press, Cincinnati, OH.

Unal D, Isik NO, Sukatar A. (2010); Effects of Chromium VI stress on green alga Ulva lactuca (L.). Turkish Journal of Biology 34, pp. 119-124.

UNEP IE/PAC (1994); Tanneries and the Environment -A Technical Guide, Technical Report (2nd Print) Series No 4, ISBN 92 807 12764.

USEPA (2004); Drinking Water Contaminants, National Primary Drinking Water Regulations.

USGS, (2002); U.S. Geological Survey Minerals Information Publications Service 984 National Center. Reston, VA 20192.

Weigert P., (1991); In: Metal Loads of Food of Vegetables Origin Including Mushrooms, (Ed.E.Merian) Weinheim, VCH, pp. 458-468.

WHO, (1996); Permissible limits of heavy metals in soil and plants, (Genava: World Health Organization), Switzerland.