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POLLUTION DUE TO EFFLUENTS FROM TANNERIES / LEATHER INDUSTRIES IN N.W.F.P.

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Physico-chemical parameters of effluents from Tanneries (vegetable and chrome tanneries) were studied. The tanneries effluents usually discharged into the rivers streams without any pre-treatment were found to have high load of solids, COD, sulfides, phenols and chromium beside being highly coloured. The continued uncontrolled discharge of effluents with heavy pollution load would cause the deterioration of the ground water as well as adversely affects the surrounding environments of the tanneries/leather industries.

Key words: Tanneries, Effluents, Under ground water, Pollution.

Introduction

A rapid growth of industries has greatly enhanced the problem of water pollution. Industries like textile, paper, synthetic drug, insecticides and tanneries discharge large volume of highly objectionable wastes into the main water sources [1].

The extent of pollution depends upon the volume and frequency of effluents discharge per day and their characteristics. During daily operations waste water from a tannery varies largely in characteristics as well as in quantities from time to time. These effluents contain heavy sediment load, toxic metallic compounds, chemical, biologically oxidisable materials and large quantities of puterfying suspended matter. The vary large volumes of tannery effluents are due to use of large volumes of water which play a major role in different processes involved in hides and skins conversion into leather [2]. Water leaves the tannery as effluents, loaded with waste products and this pollutes the receiving water-body and the environment.

Although the tanning industry ranked third in its export earnings for our country, yet because of lack of measures for pollution control, environmental hazards caused by the tannery effluents are currently an acute problem. There are over two hundred major tanneries in Pakistan, out of which 50% are in Karachi while the rest are scattered throughout the country [3]. In NWFP a number of tanneries are in operation mostly in the near vicinity of Peshawar District (Fig.1). Presently their effluents with high BOD are discharged into the nearby stream thus causing the depletion of dissolved oxygen (DO) of the receiving water-body and seriously affecting the aquatic life. Alternatively, the effluents are discharged on open land (Fig.2 and 3) which results in increased salinity of the soil [4].

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A few reports on pollution load and characterization of tannery effluents from tanneries in Karachi area have been published. Recently, Beg *et al.* [5] have reported that the uncontrolled discharged of heavily polluted tannery effluents have contaminated underground water in Korangi Industrial area. Qureshi *et al.* [6] have reported the chemical and microbiological studies of effluents from Goat skin production units. In NWFP some preliminary work on the characteristics of effluents from a tannery have been reported but no details of sampling points or environmental pollution caused by these effluents have been described [7].

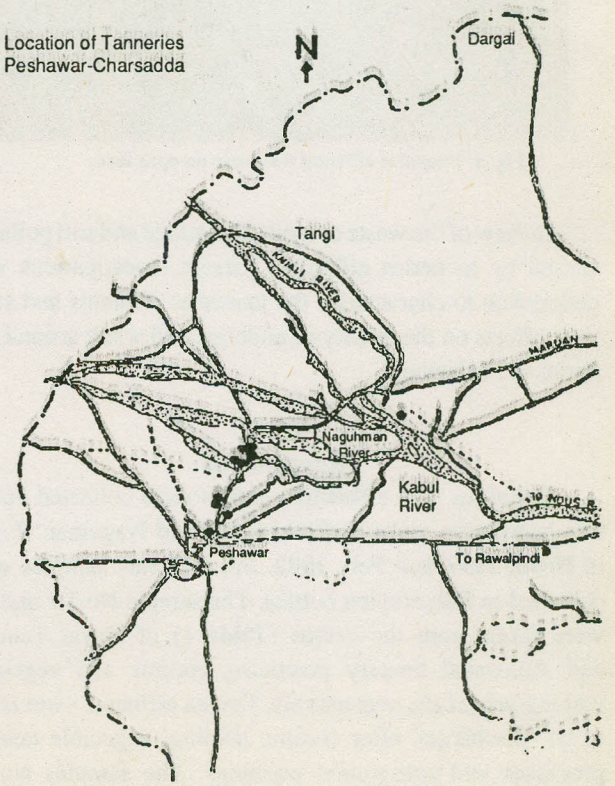

Fig. 1. Locational map of sampling site.

Fig. 2. Tanneries effluents combined Drianage.

Fig. 3. Tanneries effluents discharge on open land.

In view of the waste of land, air, aquatic and soil pollution caused by tanneries effluents, present investigations were undertaken to characterise the tanneries effluents and study their effects on the quality of underground water around tanneries in Peshawar.

Experimental

Sampling. The effluents samples were collected during two successive visits to Charsaddah and Naguman (Fig.1) in Nove. 1991 and Feb. 1992. Six effluents samples were collected in Polyethylen bottles. The sample No.1.1 and 2.1 were taken from the drums (Table 1) of Hayat Tannery and Altawakal tannery practicing chrome and vegetable tanning processes, respectively. Drums effluents were ready to be discharged after chrome tanning/ vegetable tanning processes and subsequent washings. The samples No.1.1 and 2.2 were collected from the outside drain having the com-bined effluents of the two tanneries. Sample No.1.3 was taken from a temporary pond full of effluents at the back of the said tanneries. Sample No.2.3 was a composite sample taken from smaller pools of effluents in to the same pond area.

Separate samples were collected for each physio-chemical parameter and preserved by adding appropriate preservatives HNO_3, H_2SO_4 and $CuSO_4$. $5H_2O$ $(CH_3COO)_2$ Zn and NaOH (1M) were immediately added in samples for estimation of Metals, COD, phenols and sulfides, respectively [8]. All samples were brought to the laboratory in a bucket containing ice and then placed in a refrigerator prior to analyses.

Physico-Chemical analyses. A few parameters *e.g.* pH, colour temperature and dissolved oxygen (D.O) were measured at the time of sampling prior to the addition of preservatives (Table.2), while detailed chemical analyses were carried out in the laboratory within the permissible time period [8]. Each parameter was determined by prescribed standard methods [9]. Total solids were determined gravimetrically, while COD, sulfides, alkalinity, hardness and acidity were estimated by volumetric methods, Chromium and phenol contents were measured spectrophotometrically [9] and sodium, potassium were estimated Flame photometrically [8, 9].

TABLES 1. DETAIL OF SAMPLES COLLECTED FROM HAYAT AND ALTAWAKAL TANNERIES AT NAGUMAN AND CHARSADDA (NWFP).

Sample no.	Location	Dates of samples collection
1.1	Drum (H.T.)	18.11.91
1.2	Drain (H.T.)	18.11.91
1.3	Pond (H.T. & T.T.)	18.11.91
2.1	Drum (T.T.)	24.2.92
2.2	Drain (T.T.)	24.2.92
2.3	Pond Area (H.T.& T.T.)	24.2.92

H.T. : Hayat Tannery (Chrome tanning process)
T.T. : Altawakal Tannery (Vegetable tanning process).

TABLE 2. PHYSICAL PARAMETERS OF EFFLUENTS.

Sample no.	Colour	pH	Temperature (°C)	Dissolved Oxygen (DO)
1.1	Dark green	3.14	24.0	9.0
1.2	Deep voilet	8.50	21.5	8.5
1.3	Green	6.00	19.5	7.5
2.1	Voilet	2.00	19.0	6.4
2.2	-	9.50	17.5	Nil
2.3	Dirty Green	9.00	17.2	0.4

Results and Discussion

Effluents Samples. The waste water discharge whether continuously or intermittently have variable parameters at different time of discharge. The continuously discharged effluent (90%) is not highly polluted whereas the intermittently discharge, constituting only 10% of the total volume is highly contaminated and causes pollution [10]. All effluent samples except No.1.3 correspond to the second type of effluents i.e. intermittently discharged effluents and would be expected to have very high load of pollutants. The physical parameters of the effluents as well as water samples are discribed in Table 2.

The pH of the effluents range from very acidic i.e. 2.0 to highly alkaline i.e. 9.5 (Table 2). The samples No.1.3 and 2.3 which were being directly discharged into the stream were highly alkaline and the pH of the latter was even greater than the permissible value i.e. 6.5 - 8.5. Such a high pH could effect the metal ion solubility in water while the lower pH is responsible for the conversion of sulfide to H_2S.

The dissolved oxygen content varies from 0.4-9.0 mg/1 indicating a high BOD/COD for some of the effluent samples. Effluent (sample No.2.3) with cow D.O. but high COD would cause further depletion of D.O. in the receiving water-body considered to be harmful for the aquatic life.

Temperature of the effluents (all samples) was found to be lower than the permissible limit, 30°C [12] for the effluents that can be discharged into the surface water.

Colour of the effluents is also an important measure with regard to pollution caused by industrial wastes. Highly coloured effluents effect the water quality of the receiving water body for aquatic life as inadequate light affects their growth. The effluents under study were found to be highly coloured and would be effecting the water quality of river Kabul which is the receiving body for these effluents. The chemicals parameters of the effluents studied are given in Table 3 alongwith the permissable limit for each parameter.

Both suspended and dissolved solids are the major pollutants present in tannery wastes. The suspended matter of tannery waste causes very high turbidity in the receiving water-body and thus prevent light from entering the water, thereby interfering with the normal growth of biological population. On the other hand substantial portion of the dissolved solids from a tannery comprises of volatile organic matter which are responsible for the highly putrefactive characteristics of tannery wastes [12]. The dissolved solids content range from 4000-51000 mg/L with maximum (51,000 mg/L) in the effluents from chrome tannery while the suspended solids matter is present in the vegetable tannery effluent. The pond sample (sample 1.3) has lowest concentration of suspended matter, indicating the settling of solids with the course of time. The pond samples also contain the lowest concentration of dissolved solids among the six effluents samples studied, which could be due to volatilization of organic matter as well as due to seepage of dissolved solids into the soil. As seen from Table 3 the solid content of this as well as sample No.2.3 (discharged directly into the river Kabul) is very high compared to the permissible limit. Chemical oxygen demand (COD) indicates the concentration of organic matter in the effluents which may be oxidized by strong oxidizing agent [12]. For tannery effluents under study (COD) ranges from 376-22, 880 mg/L with the highest concentration in the chrome spent effluent (sample 1.1). The effluent from vege-

TABLE 3. CHEMICAL PARAMETERS OF TANNERY EFFLUENTS.

Parameter (mg/L)	Sample no. 1.1	1.2	1.3	2.1	2.2	2.3	Permissible limit.13,14
Total solids	51,653	16,440	4,328	26,627	5,544	10,386	3530
Dissolved solids	51,073	15,242	4,028	22,441	4,934	8,757	3500
Suspended solids	580	1,189	300	4,186	610	1,629	30
COD	22,880	2,900	376	14,267	713	1,258	75
Total Nitrogen	436	201	105	114	39	75	-
Sulfides	3.2	11.2	8.8	128.5	8.5	64.96	2.0
Sulphates	3,277	1,118	1,090	4,088	730	705	600
Alkalinity	Nil	700	600	Nil	53	78	-
Acidity	4,472	146	108	2,114	12	15	-
Hardness	-	1,917	598	1,570	566	600	-
Calcium	-	133	47.8	165.5	166	165.6	-
Magnesium	-	396	116	364.7	36.55	45	-
Chromium	540	13.12	0.6	Nil	1.16	2.32	0.2
Phenols	Nil	0.296	0.444	0.407	0.481	1.37	0.1-0.2

table tanning has COD 1426 mg/L i.e. about 1.5 times less than that from chrome tanning effluent. Sample No.1.3 and 2.3, which are being discharged directly to the river have COD as high as 376-1258 mg/L which is much higher than the maximum allowed value (Table 3).

Left-over proteins, from the tannin process, form the major source of nitrogen in tannery wastes. The nitrogen content of effluents was found to very from 39-456 mg/L. The chrome tan liquor (sample 1.1) has maximum conce ntration of nitrogen and sample 2.2 has the lowest conce ntration of nitrogen. The combined effluents i. e. the pond sample that were being discharged to the river water appear to have higher nitrogen content than the permissible concentration. Sulfides are highly objectionable pollutent not only because they produced H_2S, which is of foul ordour and toxic to human beings [8.10] but also because being strong reducting agent these exert marked demand on the limited amount of oxygen present in water body. The sulfide content of tannery effluents may range from very low to thousand mg/L. In the samples under investigation it varies from 3.2 - 128.5 mg/L. The effluent from vegetable tanning (Sample 2.1) has highest concentration of sulfide while the chrome tanned liquor has the lowest concentration i.e. 3.2 mg'L. The combined effluent (sample 1.3 and 2.3) have 8.8 and 8.5 mg/L sulfide which is much higher than the permissible limit (Table 3).

Chromium is the major harmful metallic pollutant present in tannery effluents. It is known to cause perforations, bronchiogenic carcinoma etc. [1] to continuously exposed human beings. The effluents that can be discharged directly to the surface water may contain Cr(VI) content as high as 0.2 mg/L [13]. The effluents under investigations have Cr (total) as high as 540 mg/L. The highest concentration was found to be present in drum sample (1.1) of the Hayat tannery whereas the lowest was observed in the pond sample (1.3). The lower concentration of Cr in sample No. 1.2 and 1.3 may be due to the mixing of the effluents with the effluents from vegetable tannery and also with the effluents from various processes within the same tannery. However, the effluents discharged into the river i.e. sample No.1.3 and 2.3 still have higher chromium concentration than the allowed value (Table 3). The phenols concentration in the effluents varies from 0.296 mg/L to 1.37 mg/L. Sample No.1.3 and 2.3 have 0.44 and 1.37 mg/L phenols respectively. While the permissible value for such effluents is much smaller (Table 3). The phenols are highly toxic and some of them especially chlorinated phenols are reported to be carcinogenic. Higher phenol concentrations could be harmful to aquatic life as well as to the animals drinking polluted river water.

Effluents from both vegetable and chrome tanning tanneries are highly acidic because of the presence of the free mineral acids. However the combined drain effluents (sample 1.2 and 2.3) have lower acidity which may be due to the neuterlization of acids due to the mixing of effluent with the waste water from other tanning process e.g. limining or deliming.

Conclusions

The present study has revealed that the tanneries effluents being discharged into the river (Kabul) have high load of solids, COD, phenols, chromium and sulfides beside being highly coloured. The concentration of these parameters were found to be very high compared to the permissable limits which may deteriorate the quality of surface as well as ground water in the area. This would not only effect the aquatic life but also render water unsuitable for drinking purposes by human beings and cattles. A recent study in NWFP on Kabul River Pollution has shown higher concentration of BOD, chromium, sulphide, chloride contents in river water samples taken at Jehangira, (tanneries and other industries area) compared to their concentrations in water samples taken at Warsak and Khairabad areas which are away from industries [15].

The adverse effects of these effluents are also obvious from the quality of the ground water in the near vicinity of the tanneries. Our studies which are in progress have shown the well water samples within 2 Km of tanneries to have high concentrations of chromium, sulfides, phenols and total dissolved solids, rendering well water unsuitable for drinking/domestic purposes. Details of these investigations would be published elsewhere. However, immediate measures to control the indiscriminate discharge of tanneries effluents is the dire need to avoid irrevokable loss of drinking water sources in Charsadda Naguman area.

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