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# A Case Study of Impacts of Tannery Effluent of Leather Industry of Manpura Machedi on Ground Water Quality of that Area

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The leather industry is an important foreign exchange earner for India. Tannery uses a large number of chemicals during the process of discharging toxic wastes into the rivers and nearby land. A variety of chemicals are used in the tanning industries including sodium chloride, sodium carbonate, and ammonium chloride. The salts present in the effluent speed into the ground surface and thereby cause the pollution of ground water sources in the area. Contamination of ground water causes water scarcity for agriculture as well as for domestic purposes, the purpose of this study is to highlight the impact of tannery effluent on groundwater, its contamination and hence changes in the water quality.

*Keyword*: Tannery Effluent, Manpura Machedi, Ground Water, Leather Processing

## 1. Introduction

Leather is manufactured in a number of steps involving about 170 types of chemicals, that include sodium chloride, lime, sodium sulfate, fat, ammonium sulfuric acid, chromium sulfate and a number of dyes (Kankaria *et. al*., 2011).

The industry is highly water intensive also. Each tone of hide/skin tanned requires over 40,000 liters of water a day. Hence even a small tannery with a capacity to process 3 to 4 tones a day uses up well over 1,00,000 liters of water a day-the daily household requirement of at least 2,5000 people .After every step waste is generated and it contributes to the final effluent. These wastes contain high BOD, COD, high total dissolved solids, chrome salts and residual dyes.

All tanneries need a large amount of water for processing leather and depend on nearby ground/surface water sources for their daily requirements. The discharged effluents from the processing unit are either discharged into the nearby river or stored in large lagoons and pollution occurs as the dissolved salts percolate into the surrounding soil.

The groundwater sources are exploited to their fullest potential and polluted to a great extent. A state of severe pollution results from the cluster of tanneries in the close proximity to each other. Some of these industries can be a potential source of inorganic as well as organic toxicants including heavy metals (Timsina, 1988; EISP, 1987; Miyoshi 1987). Once these toxicants come in contact with the agricultural field they pollute the soil by increasing heavy metal concentration (Thukural and Kaur, 1987) and salinity level of the soil (carter *et al*, 1971; Wilcox and Resch, 1963).

The aim of the present study is to analyze various physio-chemical parameters of industrial effluents and study their effect on the ground water quality of Manpura Mchedi. Also, a survey was conducted to understand the toxic effects of tannery effluents on agriculture and day-to day life of people.

## 2. Materials and Method

A survey was conducted on the units of leather tannery in Manpura Mchedi. Information was collected regarding working periods of different units, production of waste discharges and their release through outlets into the environment.

### 2.1 Study Area

In Rajasthan hides and skins are abundantly available and to harness this raw material potential, the state government through RUDA, has taken up integrated package for the development of leather based industries in selected areas like Mongrol (Baran), Manpura-Machedi (Jaipur), Beawar (Ajmer) and Nagaur. Leather industry particularly leather-tanning creates pollution

Manpura Macheri is one of the Villages in Amber Mandal in Jaipur District in Rajasthan State. Manpura Macheri is located 21.9 km distance from its Mandal Main Town Amber. Manpura Macheri is 34.2 km far from its District Main City Jaipur and 32 km far from its State Main City Jaipur.

Near By Villages of this Village with distance are Jatawali (3.6 k.m.), Beelpur (4.2 k.m.), Sirohi (5.5 k.m.), Mahar Kala (5.9 k.m.), Dhawli (6.3 k.m). Nearest Towns are Amber (21.9 k.m.), Shahpura (22.7 k.m.), Govindgarh (23.3 k.m.), JamwaRamgarh (24 k.m.), Amber, Akhepura, Anop Pura, Barna, Beelpur, Bhoorthal are the villages along with this village in the same Amber Mandal.

### 2.2 Sampling and Testing

Based on the field survey, a number of sampling points were located, water samples of both treated and untreated wastes were collected for the purpose of physico-chemical analysis, given by APHA (1985) (Table1). It was followed by collection of groundwater from different points by random-sampling method.

The water samples were tested for the presence of total dissolved salts, pH and hardness and other metal ions. TDS and pH of the sample water was tested with the help of a TDS meter and pH meter. Titration tests will be conducted to determine the hardness value in terms of $CaCo_3$.Other metal ions will be given for testing in the test-laboratory (Table 2).

Social mapping was used to understand the social structure of the village and to know the families whose livelihood opportunities are linked to the tanning industries. A questionnaire was prepared with the expert advice regarding health of human and cattle population of that area. While drawing the social map a discussion evolved around problems of polluted drinking and irrigation water. This led to the drawing of a resource map indicating clean and contaminated water sources and their impact on the fauna and flora.

## 3. Results and Discussion

Environment is under increasing pressure from solid and liquid wastes emanating from the leather industry. Liquid wastes discharged into sewage system and pastures cause significant pollution and is extremely hazardous to the environment. Table 4 gives the standards prescribed for a tannery and Table 5gives the characteristics of a typical raw effluent from a tannery.

The present investigation reveals low pH and significantly high conductivity, acidity, TS and salinity in the untreated and treated effluents (Table No. 1). Treated effluents had comparatively low Total Acidity (TA) and chloride than permissible limit. This indicated that the percolation of industrial effluent into the soil has gradually affected the groundwater quality and its portability in the in the long run. It might be suitable for irrigation out not for drinking.

The effect of effluents was adverse on the water quality, soil and health of human population, livestock and small ruminants (Table 2 & 3).

Effluents containing toxic chemicals have seeped into the arable land. Food crops like wheat, pearl

millet, Gram pea were cultivated in the past. But now, the agriculture is in decline because of constant disposal of tannery effluents. High conductivity values of tannery effluents indicates the presence of high levels of anions and cations which bear direct relation with salinity and osmotic potential (Trivedy and Goel, 1986).

The effluents have also affected health of livestock and humans. When cattle drink the water drawn from the wells or feed on grass, they become sick. Various complications like body weakness, skin ailments, allergies, neoplasia, gastrointestinal complications, and paralysis and body pain can be correlated to intake of groundwater from the sources of the areas close to the tannery.

USEPA regards all chromium compounds as toxic; Compounds of both Cr (VI) and Cr (III) have induced developmental defects in experimental animals that include neural defects, malformations, Cancer and total death (Beyersmann and Koster, 1987). High acidity of the effluent might be responsible for gastro-intestinal complications due to corrosion of intestinal mucosa. It has also been reported that heavy metals bind to sulphydryl groups of amino acid, inhibiting essential anyme function (Jerome and Ferguson, 1972).

The industry has been making the plea that available technology does not permit it to the legal requirements. Process economics do not allow them to treat their effluent adequately. This is particularly so as the units are very small. The investment in pollution abetment system as a proportion of the investment in the plan is very high.

At Manpura-machedi the inhabitants of the area have lodged protest against air and water pollution caused by these units (State of Environment Report for Rajasthan, 2007).

The industry has been using to advantage the fact that the legal processes in India are slow and it could take years before government can act.

As most of the tanneries are in the small sector and cannot afford expensive treatment systems on their own, Central Effluent Treatment Plant (CETP) has been set up in the year 2002.Although this is helping to some extent ,the water after treatment (Table 1) is still not fit for re-use by the industry or by the population. One major problem continues to be the high salinity of the water.

In addition there is no answer as to how the huge quality of solid waste generated from water treatment (The quality is estimated at 150 kg per tone of hide tanned).Since the solid waste is carelessly disposed of, it finds its way into the groundwater during the rainy season.

The present paper gave an opportunity to understand the diverse nature of the problem of the tannery effluent. Combining the results of laboratory water analysis with the real situation of the area surrounding the tannery. It has helped us to analyze the problem and draw conclusions with high degree of reliability.

It is also an opportunity for scientists and socialists to work together to tackle a serious environmental problem and learn from each others approaches.

**Table 1:** Analysis of Physico-Chemical Parameters of Tannery Effluents (Treated and Untreated Samples)

| Parameters | Untreated Effluents | Treated Effluents |
|---|---|---|
| Colour | Black | Greenish Black |
| pH | 3.21 | 4.04 |
| Conductivity ($S^{-1}$) | 1.00 | 0.60 |
| Temperature ($^0C$) | 38 $^0C$ | 39.5 $^0C$ |
| TS (mg/L) | 60000 | 49300 |
| TDS (mg/L) | 34200 | 28600 |
| Total Acidity (mg/L) | 2300 | 1500 |
| Calcium (mg/L) | 196 | 160.32 |
| OD (mg/L) | 0 | 0 |
| COD (mg/L) | 2500 | 2200 |
| Chloride (mg/L) | 4200 | 4900 |

**Table 2:** Analysis of Physico-Chemical Parameters of Groundwater of Samples of Surrounding Areas

| Parameter | BW1 | BW2 | H.P. |
|---|---|---|---|
| Colour | Transparent | Turbid | Transparent |
| pH | 6.97 | 6.00 | 7.20 |
| Conductivity ($S^{-1}$) | 0.343 | 0.720 | 0.530 |
| Temperature ($^0C$) | 34 $^0C$ | 34 $^0C$ | 34.5 $^0C$ |
| TS (mg/L) | 1200 | 1500 | 700 |
| TDS (mg/L) | 700 | 8600 | 600 |
| Total Acidity (mg/L) | 500 | 1200 | 1000 |
| D.O. (mg/L) | 3.5 | 2.0 | 3.0 |
| COD (mg/L) | 0 | 18 | 10 |
| Chloride (mg/L) | 1600 | 3270 | 3000 |

(HP = Hand pump Sample, (13 Kms North East of Tannery) BW1 = Bore well Samples, (14 Kms North-West of Tannery) BW2 = Bore Well samples2 (3Kms North of Tannery)

**Table 3:** Effect of Tannery Discharge on 250 People

| Parameters | No. of people affected | Percentage of people affected |
|---|---|---|
| Body Weakness | 89 | 35.6% |
| Skin ailments | 54 | 21.6% |
| Allergies | 32 | 12.8% |
| Neoplasia | 28 | 11.2% |
| Gastrointestinal Complications | 35 | 14% |
| Memory Loss | 12 | 4.8% |
| Paralysis | 2 | 0.8% |
| Body Pain | 30 | 12% |

**Table 4:** Average Tannery Raw Wastewater Characteristics

| Parameter | Quantity |
|---|---|
| Biological Oxygen Demand(BOD) | 95 |
| Total Kajeldahl(ammonia +organic)Nitrogen TKN | 17 |
| Total suspended solids(TSS) | 140 |
| Total Chromium | 4.3 |
| Oil and Gress | 19 |
| Sulfides | 8.5 |
| pH | 1.0-13 |

**Sources:** Environmental Guidelines, The World Bank Environment Department, September1988.Units kg/tone of raw hide processed, except pH.

**Table 5:** Tolerence Limits for Effluents from the Tanning Industry in India

| Characteristics | Into inland Surface waters | Into public sewers | On land for Irrigation | Into marine coastal areas |
|---|---|---|---|---|
| Color | Absent | - | Absent | Absent |
| Total dissolved solids(mg/L) | 2,100 | 2,100 | 2,100 | - |
| Suspended Solids(mg/l) | 100 | 600 | 200 | 100 |
| BOD(mg/l) | 30 | 350 | 100 | 100 |
| pH Value | 6.0 to 9.0 | 6.0 to 9.0 | 6.0 to 9.0 | 6.0 to 9.0 |
| Chlorides(mg/l) | 1,000 | 1,000 | 600 | - |
| Hexavalent Chromium(mg/L) | 0.1 | 2.0 | 0.1 | 1.0 |
| Total Chromium(mg/l) | 2.0 | 2.0 | 2.0 | 2.0 |
| Sulphides(mg/l) | 2.0 | 5.0 | - | 5.0 |
| Sodium (%)<br>Chemical Oxygen Demand | -<br>250 | 60<br>- | 60<br>- | -<br>250 |

Tolerance limit for Industrial Effluents, Indian Standards Institution, December, 1985.

## 4. Acknowledgements

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