IMPACT OF TANNING INDUSTRIES ON GROUND WATER RESOURCES

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ABSTRACT

Ground water resources are strongly influenced by long term discharge of untreated industrial effluent; all these released pollutants have great ecological impact on the ground water quality. Industrial effluents, particularly from tanneries are generating a lot of pollutants in the environment. 15 (Fifteen) each ground water samples (summer and mansoon) were collected from Jajmau area of Kanpur city and analysed for their physico-chemical characterstics including pH, Electrical Conductivity (EC), Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Biological Oxygen Demand (BOD), Total alkalinity, Chemical Oxygen Demand (COD), fluoride, sulphate, nitrate-nitrogen and chromium were compared with water quality standards. The use-fulness of these parameters in predicting ground water quality and characteristics have been discussed in the study. So there is current need to identify such contaminants which are responsible for ground water deterioration. This study is an attempt towards exploring the impact of such contaminants on ground water resources.

Key Words : Tanning industry, Ground water, Water resources,Water quality, Impact

INTRODUCTION

Industrialization plays a vital role in growth and development of any country. The idea of industrialization originated in UK where the first industrial estate was established in Manchester in 1886. This rapid industrialization is also having a direct and indirect adverse effect on our environment. Industrial development manifested due to setting up of new industries or expansion of existing industrial establishments resulted in the generation of industrial effluents, spatially small scale cottage industries which discharge untreated effluents which cause air, water, soil and soil solid waste pollution. The present method of transportation of theses effluents and their ultimate disposal and treatment for making effluents innocuous and safe are inadequate, unplanned and their development at the hands of municipal bodies and corporation suffers through negligence and shortage of funds. With the apathy of industrialist towards the treatment of the effluents from their respective units prior to discharge to sewers or open surface drains, storm water canals, rivers, etc. Untreated water near the point of disposal, create foul smell and bad odor. This bad odor is due to decomposition of floating solids present in untreated sewage. The net result is large scale pollution of the water bodies which may act as a source of water supply for domestic use of inhabitants of localities. This loss of water quality is causing health hazards and death of human, livestock and death of aquatic lives, crop failure and loss of aesthetics.

It is alarming that most of the cities and industries in India are without wastewater treatment facilities. Large quantities of untreated municipal sewage and industrial effluents are being discharged directly to surface water or side by river body resulting producing a serious problem of water pollution. Due to high organic loads and toxic materials, the industrial effluents form a major source of water pollution. High

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levels of pollutants mainly organic matter in river water cause an increase in Biological Oxygen Demand (BOD)[1], Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), Total Suspended Solids (TSS) and fecal coliform. They make water unsuitable or unfit for drinking, irrigation[2] or any other use or purpose.

Worldwide water bodies are the primary means for disposal of waste, especially the effluents, from industries that are near them. These effluent from industries have a great deal of influence on the pollution of the water body[3], these effluent can alter the physical, chemical and biological nature of the receiving water body. The initial effect of waste is to degrade the physical quality of the water. Later biological degradation becomes evident in terms of number, variety and organization of the living organisms in the water[4]. Often the water bodies readily assimilate waste materials they receive without significant deterioration of some quality criteria; the extent of this is referred to as its assimilative capacity[5]. The input of waste into water bodies therefore does not always impact negatively on aquatic environment because of the self purification property of the water bodies. Industries turn out wastes which are peculiar in terms of type, volume and frequency depending on the type of industry and population that uses the product[6].

Present studies were carried out in the Jajmau industrial estate of Kanpur city of Kanpur, where large number of tanning industries are functioning and the study also comprises to identify the number of industries majorly contributing to water pollution in the area of industrial estate, their impact on ground water resources which can be identified by analyzing physico-chemical characteristics of ground water quality of the study area. The study was conducted in the month of May - June (summer) and August - September (Mansoon) 2009.

STUDY AREA

Kanpur city is situated between the parallels of 25^0 26' and 26^0 58' north latitude and 79^0 31' and 80^0 34' east longitude. It is situated on the most important holy river Ganga and is about 126 meters above the sea level. It is also situated on the main Delhi-Howrah railway trunk line, National highways No.2 and 25 and state highway.

Climate and Geologhy

Kanpur's climate is characterized by hot summer and dryness except in the south west monsoon season. The climate in Kanpur can be divided broadly into four seasons. The period from March to the mid of June is the summer season which is followed by the south-west monsoon, which lasts till the end of September, October and first half of November from the post -monsoon or transition period. The cold season spreads from about the middle of November to February.

The climate is of a tropical nature and shade temperature varies from 2^0 C to 48^0C. Rainy season extends from June to September; with the period of maximum rainfall normally occurs during the month of July and August. About 89 percent of the annual rainfall is received during the monsoon months (June to September). The total rainfall in the district varies from between 450 mm to 750 mm. The annual rainfall in Kanpur Nagar was recorded 441 mm in actual in 2004 and 783 mm in general (Statistics Diary 2005). The relative humidity varies from 15% to 85%. The relative humidity in Kanpur ranges from less than 30 percent in the summer season to 70 percent in monsoon season. The district lies in the Ganga basin which is formed of alluvium of the early quaternary period. In the district, no hard or consolidated rock exposures are encountered. The main constituents (sand, silt and clay) of alluvium occur in variable proportions in different sections. The mineral products of the district of saline earth from which salt petre and salt are derived and limestone conglomerates (U.P. District Gazette, Kanpur).

MATERIAL AND METHODS

Samples and Sampling sites

Drinking water samples were collected from different locations spreading all over the area. 15 (fifteen) samples were collected from tube wells, a simple random sampling approach were adopted to collect the ground samples. The

study area was divided in the zones for sample collection purpose so that entire area can be covered. Sampling was carried out as per the procedure stated in the standard methods for water and waste water analysis APHA[7]. All samples were placed into thoroughly cleaned 1 liter polyethylene bottles tightly closed. Each bottle was rinsed with the appropriate sample before the final sample collection. The samples were placed in a cooler box and then taken to the laboratory for analysis purpose. Sampling was carried out in the Month of May - June (summer) and August - September (mansoon) season. The area is shown in **(fig. 1)** and different locations of industries are shown in the **Table 1** and **Table 2**.

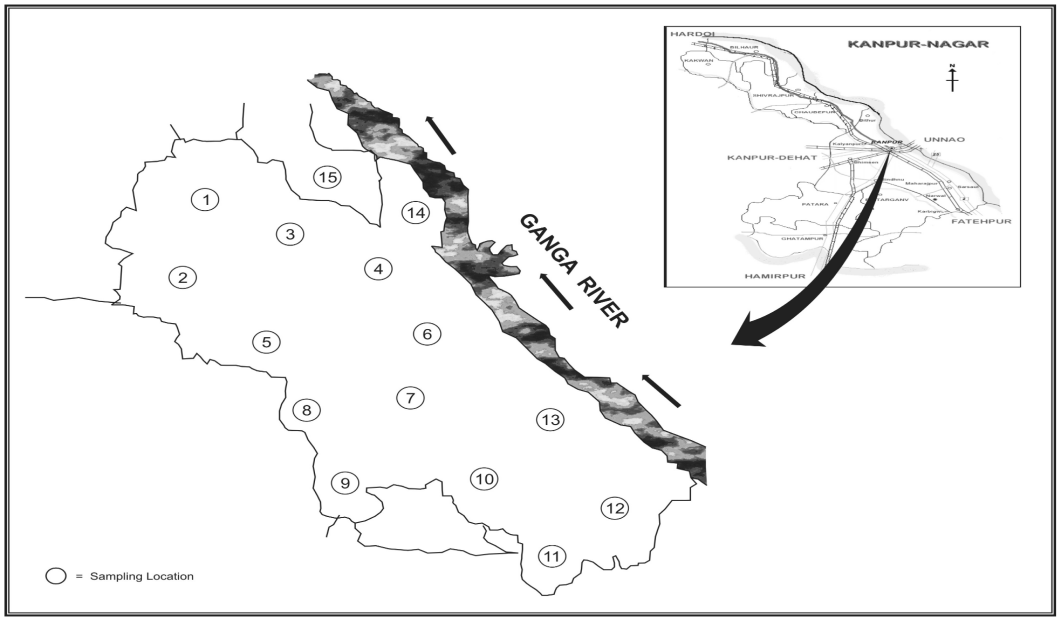

Fig. 1: Sampling locations

Experimental

Temperature

Temperature was noted using thermometric method at the site of sampling using portable calibrated mercury thermometer[8].

pH

pH of the samples was noted using potentiometric method using pH meter already standardized by using buffer solutions of known value before analysis.

Electrical Conductivity (EC)

EC is the measure of the ability of an aqueous solution to convey an electric current. This ability depends upon the presence of ions, their total concentration, mobility, valence and temperature. EC was determined by conductivity meter following the procedure of Richard.

Total Suspended Solids (TSS)

Total suspended solids are the portion of solids that usually remains on the filter paper. Suspended solids consist of silt, clay, fine particles of organic and inorganic matter, which is regarded as a type of pollution because water high in concentration of suspended solid may adversely affect growth and reproduction rates of aquatic fauna and flora. For TSS analysis, known amount of sample was filtered through the pre weighed filter paper. Filter paper was then dried at 103-105^{0}C in an oven. TSS was determined by using formula.

Total Dissolved Solids (TDS)

Total Dissolved Solid (TDS) is the measure of total inorganic salts and other substances that are dissolved in water. TDS was determined following the procedure of Richard by using Electrical Conductivity (EC) meter.

Biological Oxygen Demand (BOD)

Biological Oxygen Demand (BOD) is expressed as weight of oxygen consumed per unit volume

of water during a defined period of time at a defined temperature was calculated following the procedure of Hamer. For this the sample of waste was incubated for 5 days at 20^0C in the dark. The reduction in dissolved oxygen concentration during the incubation period yields a measure of the biochemical oxygen demand.

Total Alkalinity

It was measured by titrating the sample against N/50 solution of sulfuric acid using methyl orange indicator, Chloride content was measured by titrating against N/50 solution of silver nitrate ($AgNO_3$) using potassium chromate as an indicator as prescribed in standard methods .

Chemical Oxygen Demand (COD)

It was determined by oxidizing the sample with excess acidified potassium dichromate solution and then titrating the excess dichromate against standard ferrous ammonium sulphate solution using ferrion indicator as prescribed in APHA[7].

Fluoride, sulphate, nitrate-nitrogen, chromium, were determined spectro photo metrically following the standard procedure recommended by APHA, AWWA, WPCF.

Heavy metals analysis

For the analysis of heavy metals viz copper (Cu), zinc (Zn), iron (Fe), manganese (Mn), nickel (Ni), cadmium (Cd), lead (Pb), and chromium (Cr). Only chromium (Cr) is analyzed in the above mentioned study. Samples were analyzed on Atomic Absorption Spectrophotometer (AAS) (Perkin Elmer model 2380) for concentration by using specific cathode lamp. AAS was calibrated for each element using standard solution of known concentration before sample injection.

RESULTS AND DISCUSSION

The results of analysis of the present study including physical and chemical properties of water samples including temperature, pH, turbidity, Total hardness, TDS, total alkalinity, sulphates, phosphates, nitrates and fluoride are presented in **Table 1** and **Table 2**. Water quality standards and guidelines corresponding to the Indian Council for Medical research (ICMR), United States Environmental Protection Agency (USEPA), Food and Agricultural Organisation (FAO), World Health Organisation (WHO), Central Pollution Control Board (CPCB) have been compared with the results under the given tables.

Physico - Chemical Analysis of Drinking Water Quality : Tubewell - Summer

Physico -chemical analysis of drinking water samples has been carried out to understand the impact of tanning industries on ground water resources. It has been explained in **Table 1** where number of parameters were analyzed and presented. These are further compared with the standard values of IS: 10500:1991 WHO[9].

In **Table 1**, pH and temperature ranges of ground water resources tube wells are depicted from 6.7-7.3 and 25.6 - 28.2^{0}C, it is slightly higher than the normal range of standard values while as Total Hardness (TH) ranges from 260-428 mg/L as compared with the standard values 300 mg/L, which on further compared shows slightly high than the normal value. Total Dissolved Solids ranges from 170 -395 mg/L and fluoride ranges from 0.3-1.12 mg/L as compared with standard values. Nitrate (NO_3) ranges from 62-98 mg/L which is compared to standard values shows the values ranges from 45 mg/L max. But permissible range is 50-100 mg/L. Sulphates (SO_4) and (PO_4) Phosphates are in the range of 12-45 mg/L and 0.05 - 0.15 mg/L respectively which is further compared with the standard values.

The values of total alkalinity are shown in **Table1** ranges from 109 - 428 mg/L as compared from the standard values, shows 200 mg/L, which is maximum. Sampling location/points number 5, 6 and 7 are having higher values of total alkalinity. Chromium was also analysed in ground water samples showing values in the range of 0.22 -0.55 mg/L, where as the standard value range is only 0.05mg/L.

Physico - Chemical Analysis of Drinking Water Quality : Tubewell - Mansoon

It has been explained in **Table 2** where numbers of parameters are analyzed and presented **Table 2** which is further compared with the standard values of IS 10500: 1991 WHO.

In **Table 2**, pH and temperature ranges of ground water resources tube wells are depicted from 6.95 - 7.3 and 25.0 -26.5^{0}C. It is slightly higher than

Table -1: Physico- chemical characteristics of ground water samples

Source : Tube well												**Season: Summer**	
S\N	**Sample No**	**Temp ^{0}C**	**P^H**	**Turbidity (NTU)**	**Conductivity (u s/cm)**	**T. Hardness**	**TDS**	**T. Alkalinity**	**SO_4**	**PO_4**	**NO_3**	**F^-**	**Cr**
1	TWS 1	25.6	6.7	8.0	378	315	242	235	18	0.1	94	0.32	0.03
2	TWS 2	25.9	6.9	4.0	425	318	280	148	15	0.12	98	0.45	0.5
3	TWS 3	26.2	7.2	0.7	372	428	245	245	38	0.15	68	0.98	0.035
4	TWS 4	25.9	7.0	0.9	428	268	280	278	38	0.05	66	1.20	0.29
5	TWS 5	26.2	6.9	0.6	435	275	286	328	18	0.06	72	1.00	0.32
6	TWS 6	26.1	6.8	0.7	378	279	242	302	17	0.05	85	0.90	0.12
7	TWS 7	26.2	7.1	0.5	372	325	238	418	12	0.11	92	0.50	0.022
8	TWS 8	26.5	7.0	0.4	295	308	190	298	35	0.08	84	0.30	0.45
9	TWS 9	26	6.9	0.3	335	406	220	308	45	0.11	69	0.45	0.38
10	TWS 10	25.8	6.9	0.5	428	428	280	418	12	0.1	72	0.85	0.55
11	TWS 11	25.6	7.2	0.6	319	301	206	428	18	0.85	68	1.00	0.12
12	TWS 12	25.8	7.0	0.4	320	298	208	315	17	0.82	66	1.12	0.24
13	TWS 13	28.2	7.3	0.35	430	270	275	295	13	0.8	62	1.00	0.022
14	TWS 14	26	7.2	0.32	278	260	176	118	12	0.85	65	0.85	0.047
15	TWS 15	26	7.0	0.40	298	265	191	109	18	0.05	62	0.83	0.065

Other parameters are in mg/L

Table -2: Physico- chemical characteristics of ground water samples

Source : Tube well													Season: Mansoon
S\N	**Sample No**	**Temp ^0C**	**P^H**	**Turbidity (NTU)**	**Conductivity (u s/cm)**	**T. Hardness**	**TDS**	**T. Alkalinity**	**SO_4**	**PO_4**	**NO_3**	**F^-**	**Cr**
1	TWM 1	25.6	6.98	0.7	392	210	251	218	16	0.12	95	0.55	0.025
2	TWM 2	26	6.95	0.6	795	205	515	198	18	0.14	68	0.95	0.24
3	TWM 3	25.2	7.02	0.4	378	208	241	212	17	0.10	69	0.85	0.85
4	TWM 4	25.9	7.0	0.5	398	215	254	218	14	0.82	72	0.82	0.15
5	TWM 5	25.6	6.98	0.7	675	218	433	219	13	0.06	82	0.56	0.52
6	TWM 6	26.4	6.95	0.8	725	206	468	215	10	0.62	92	0.56	0.6
7	TWM 7	25.02	7.02	0.4	625	268	402	325	18	0.15	85	0.82	0.87
8	TWM 8	25	7.01	0.3	498	315	321	328	17	0.43	75	0.90	0.69
9	TWM 9	26	7.0	0.6	392	308	249	428	19	0.44	62	1.02	0.55
10	TWM 10	26.2	7.12	0.7	425	508	274	435	12	0.32	85	1.00	0.49
11	TWM 11	26.5	7.03	0.75	478	425	306	429	10	0.4	88	1.02	0.38
12	TWM 12	26.02	7.0	0.82	595	378	382	325	13	0.41	35	0.80	0.47
13	TWM 13	25.2	7.15	0.86	628	372	405	475	14	35	29	0.50	0.65
14	TWM 14	26.2	7.3	0.7	620	325	398	218	14	0.42	48	0.62	0.95
15	TWM 15	25.2	6.96	0.62	628	328	404	209	16	0.86	62	0.78	0.099

Other parameters are in mg/L

the normal range of standard values while as Total Hardness (TH) ranges from 205-508 mg/L as compared with the standard values 300 mg/L. This on further compared with the standard values range shows slightly higher than the normal value. Total Dissolved Solids (TDS) ranges from 168-425 mg/L and Fluoride (F) ranges from 0.5-1.02 mg/L as compared with standard values. Nitrate (NO_3) ranges from 29 - 95 mg/L. which on further compared to standard values shows the values ranges from 45 mg/L max. But permissible range is 50-100 mg/L. Sulphates (SO_4) and Phosphates (PO_4) are in the range of 10-19 mg/L and 0.06-0.86 mg/L respectively which is further compared with the standard values. The values of total alkalinity are shown in **Table 2** ranges from 198 - 475 mg/L as compared from the standard values, shows 200 mg/L which is maximum. Sampling location or point's number 5, 6 and 7 are having higher values of total alkalinity. The value of chromium ranges in between 0.025 - 0.95 mg/L as depicted in **Table 2** mansoon, which was further compared with the standard value range of chromium.

Industrial effluent is the most common source of water pollution in the present day and it increases yearly due to the fact that industries are increasing because most countries are getting industrialized. The extent of discharge of domestic and industrial waste is such that rivers receiving untreated effluent cannot give dilution necessary for their survival as good quality water sources. The transfer of unfavorable releases from industries is detrimental to human and animal health and safety[10,11]. There is thus a challenge of providing water in adequate quantity and of required quality to minimize hazards to human health and conserve the water bodies and the environment.

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