GIAP Journals

Green Chemistry & Technology Letters
Vol 2, No 2, March 2016, pg. 110-114
eISSN: 2455-3611, DoI: 10.18510/gctl.2016.2211

IMPACT OF TANNERIES ON GROUND WATER CONTAMINATION IN UNNAO DISTRICT

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Article History: Received on 20th February 2016, Revised on 31st March 2016, Published on 07th April 2016

Abstract

Attempt is made to understand the impact of tanneries on ground water quality of Unnao. Study was undertaken to evaluate physico-chemical parameters and chromium, lead iron concentration in ground water near tannery industries. The results revealed that only two parameters fluoride and chromium are present in slight high concentration than permissible limit. Ground water quality % sample compliance / violation with respect to BIS standard were also studied.

Keywords: Ground Water quality, physico - chemical parameters, Heavy metals, Environmental hazards, Fluoride

INTRODUCTION

The overexploitation of natural resources creating problems all over the world. One of these resource without which it is not possible for us to sustain our lives, is water. The importance of ground water for the existence of human society cannot be over emphasized. Ground water is the major source of drinking water in both urban and rural India. Besides, it is also an important source of water for agriculture and industrial sector. In fact water is the source of life and livelihood; it is one of the key used to measure economy of the country. The tanning industry is one of the oldest and fastest growing industries in South, West Bengal and Uttar Pradesh. Tanneries use a large number of chemicals during the process, discharging toxic wastes thereby polluting the ground water. It is established that a single tannery can cause the pollution of ground water around radius of 7-8 km.[1]The deterioration in chemical physical and biological properties of water is brought about by human activities .[2,3] The large scale industrialization apart from its benefits to the masses has also generated a large number of toxic substance in the form of effluent. Khannaet. al.[4] reported the impact of paper mill effluent on water quality. Islam et. al.[5] studied the contamination of ground water by chemical fertilizers. Sharma et. al.[6] studied the residue levels of organochlorine insecticides in ground water of Unnao and observed that the residue HCH ranged from 0.000118 to 0.010063.Bhadra[7]et.al reported the effect of industrial effluents on ground water. The impact of tannery effluent on ground water, surface water and some aquatic animals is well document.[8-10] The present paper describes the impact of tannaries on ground water quality in Unnao.

Study area – This study is devoted particularly to the problem of ground water contamination by tannery in the vicinity of Unnao in the state of Uttar Pradesh.

Topographical statue of Unnao industrial area is of great importance and is congenial for industrial requirement being totally free from any residential vicinity and having availability of roadways and railways. Unnao industrial area is having about 50 industries at present comprising mainly of leather industries. Leather industries of Unnao have a common effluent treatment plant in October 1995. The district is named after its headquarter town Unnao. It is situated between rivers Ganga and Sai. The district has been popular from the view of history, literature, religious and cultural heritage.

Geographical Area – 4558 sq. km.

METHODS

Water samples from the hand pumps, tube wells, and wells (depending upon availability) have been collected from twelve villages of Unnao district near tanneries. The sampling stations are Preetampur (AS-1), Khailamass (AS-2), Shuklaganj (AS-3), Saffipur(AS-4), Jagdishpur(AS-5)near Model tannery (AS-6), Khiwazipur(AS-7), Tabbinagar(AS-8), Ajjgain(AS-9), Unnao bypass, Kallimitti(AS-10), Dahichauki(AS-11) and Bahunamau(AS-12).

Two water samples from each source were collected for all types. Sample was acidified with HNO_3 so as to lower down the pH of the sample and the precipitation of the metallic content on the walls of the containers. Physicochemical analysis of ground water includes pH, carbonates, bicarbonates chloride, sulphate, fluoride, hardness and some heavy metals like chromium, lead and iron. pH was measured by systronic pH- meter 335 digital type. The metallic parameters were estimated by atomic absorption spectrophotometer 3110 (perkinelmer) whereas colorimetric method was adopted to study fluoride content in the water sample. Other parameters were studied using standard methods of APHA (2002)[11]. The instruments were used in the limit of précised accuracy and the chemicals used were of analytical grade.

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RESULT AND DISCUSSION

The physico-chemical parameters for the samples collected are given in Table-1 and Table-2. The determination of pH is one of the most important parameter frequently used to conduct in water chemistry. The pH value of the water samples ranged from 6.6 - 7.4 and was found to comply with drinking water standards. The ground water samples were free from colour and odour.Therefore use of water for various purposes is acceptable. Chloride is one of the most common elements present in natural waters. In a normal man, the concentration of chloride in the body fluids has an average level of 100 ml/l. The tolerance levels of chloride vary with climate and excretions. It is the anion associated with sodium that has usually harmful effects on human health especially on cardio vascular vessels. It deficiency causes vomiting, cholera and high concentration causes nephritis and prostate enlargement. The perusal of chemical analysis shows that the concentration of chloride ion varies from 24-205 ppm. It is under acceptable limits of ISI standards and WHO standard. Sulphate ions when associated with high concentration of magnesium while sodium ions act as laxative and may cause gastric disorders. Sulphate concentrations exceeding 500 mg/l import bitter taste and may cause gastro intestinal irritation and catharsis. The concentration of sulphate ions varies from 20-270 ppm in all water samples, which is within the permissible limit of ISI and WHO standards limits. Fluorides are necessary for men and animals in minute quantities because fluoride is a component of bones and teeth. Fluoride deficiency causes dental caries by inhibition of glycolysis and excess intake causes fluorosis. The beneficial effects of fluoride to human health, when present in optimal level and harmful effects at high level are well known. Clinical studies have established that dental caries reduction to about 60% takes place with minimum mottling or dental fluorosis[12] (WHO 1970). Fluoride ion is also being incriminated as a carcinogen and mutagen, at present this aspect is not universally accepted[11]. It has been reported that the bone strength and risk of bone fracture depend on the total intake of fluoride from all sourses[12]. In the treated ground water samples the fluoride concentration varies from 0.39-2.03ppm. The fluoride concentrations above the permissible limits were observed in water samples from Preetampur, Khailamass, Tabbinagar, Ajjgain and DahiChauki. The alkalinity in water is due to the presence of hydroxyl, carbonate and bicarbonate ions. In sampling sites carbonates were not present as the pH values ranged from 6.6-7.7. The alkalinity values in the study area found to vary from 23.1 to 542.8 mg/l. Carbonate and bicarbonate are useful to determine the temporary hardness and alkalinity. High alkalinity values are indicative of the eutrophic nature of the water body. The hardness of water is related with production of leather from soap. It is primarily expressed by the sum of calcium and magnesium ions expressed as calcium carbonate. Other substances such as iron, magnesium and aluminium may also contribute to a very small extent. Through hard water have adverse effects on domestic and industrial supplies, these are found to have inverse correlation with heart diseases. Several investigators have reported that there are lesser cardiovascular diseases in areas of hard water[13]. The analysis results show that the hardness ranged from 190-370 mg/l. All the samples were found with desirable limit.

Chromium salts are widely used in industrial process and enter into water bodies through discharge of waste water. Chromium (Cr^{+3}) is found to be essential to humans and animals. The normal level of chromium in drinking water should be more than0.05mg/l.It may be carcinogenic above this limit. It can exist in oxidation states ranging from -2 to +6 but is present in aqueous systems mainly in the trivalent [Cr (III)] and hexavalent [Cr(VI)] chromates and dichromates states. Cr (III). Under anaerobic conditions, Cr (VI) is reduced to Cr (III), which hydrolysed and deposited as chromium oxide at neutral or slightly alkaline pH. At the sampling sites the reported range of chromium is 0.03 to 0.09 mg/l which is higher than the tolerance limit at ShuklaGanj, near Model Industry, Tabbinagar and Bahunamau. The areas contributing high levels of chromium in surface water which seems to percolate to the ground water near the tannery. The varying quantities 0.5 to 100 ppm of iron is ground water are well reported. W.H.O. has set a desirable limit of 0.3 mg/I and maximum permissible limit of 1.0 mg/l for drinking purpose. Iron in the sampling sites ranged from 0.03-1.05 mg/l which is according to drinking water permissible limit accepts at Tabbinagar (1.05 mg/l) and Preetampur (1.03 mg/l).Excess of iron gives bitter taste to water and causes strains on clothes. Excess of iron is deposited in the liver as haemosoderen and in this form it is not available for use in the body.

Lead is highly toxic element used in industries as an anti-knocking agentin automobile fuel. It inhibits several important enzymes involved in the overall process of hemesynthesis. Higher level of lead (Pb) in the blood can cause kidney dysfunction and brain damage. The Pb levels in ground water samples ranged from 0.01-1.05 mg/l that was within the permissible limits.

Table 1: Physico-chemical parameters

Sample No.	Sampling Station	pH	HCO_3^- mg/l	Cl^- mg/l	T.H. mg/l	$SO4^{2-}$ mg/l	F^- mg/l
AS1	Preetampur	6.8	542.9	24	295	29	1.81
AS2	Khailasmass	7.1	542.2	107	190	70	1.41
AS3	Shuklagang	6.7	475.8	127	355	147	1.03
AS4	Saffipur	7.2	475.5	77	355	147	0.46
AS5	Jagdishpur	6.9	396.5	121	198	129	0.34
AS6	NearModel Tannery	7.3	475.2	184	247	20	1.03

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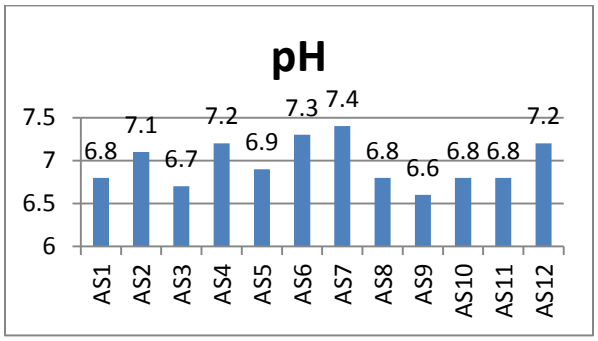
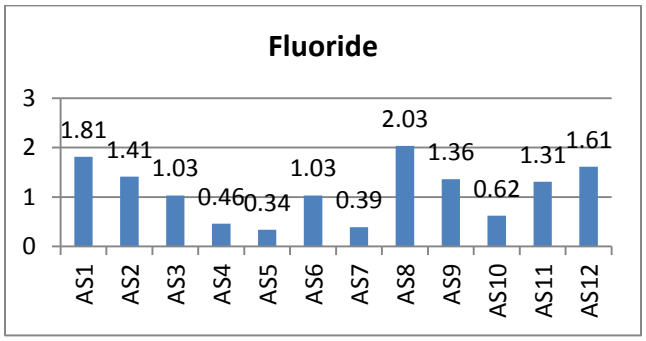
AS7	Khiwazipur	7.4	396.8	57	263	132	0.39
AS8	Tabbinagar	6.8	231.8	96	339	98	2.03
AS9	Ajjgain	6.6	317.2	162	276	158	1.36
AS10	Unnao Bypass	6.8	286.7	205	370	170	0.62
AS11	DahiChauki	6.8	231.8	210	199	105	1.31
AS12	Bahunamau	7.2	213.5	198	305	162	1.61

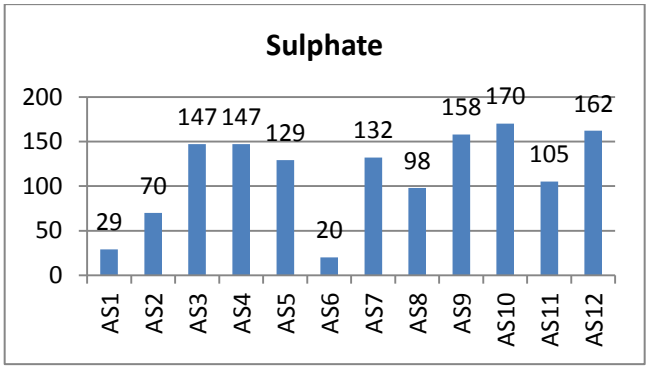
Table 2: Heavy metal Parameters

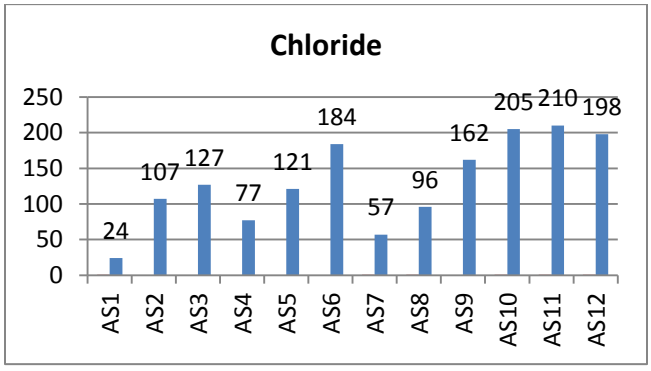
Sample No.	Chromium mg/l	Iron mg/l	Lead mg/l
AS1	0.03	1.03	0.03
AS2	0.03	0.48	0.02
AS3	0.08	0.30	0.03
AS4	0.04	0.37	0.05
AS5	0.05	0.49	0.04
AS6	0.07	0.62	0.05
AS7	0.04	0.85	0.02
AS8	0.09	1.05	0.01
AS9	0.06	0.61	0.03
AS10	0.03	0.77	0.04
AS11	0.05	0.73	0.01
AS12	0.07	1.00	0.01

Graphs showing values of Physico-chemical parameters









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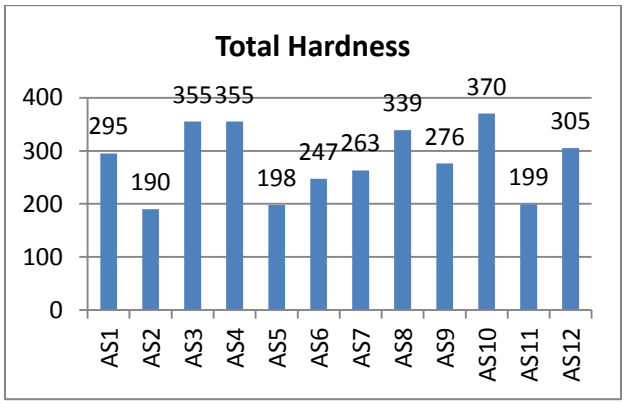
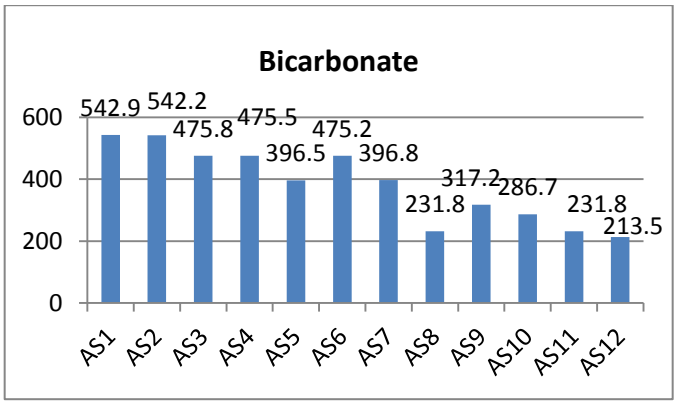
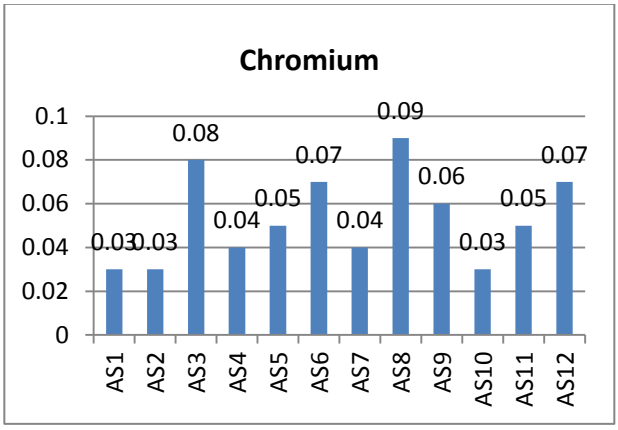
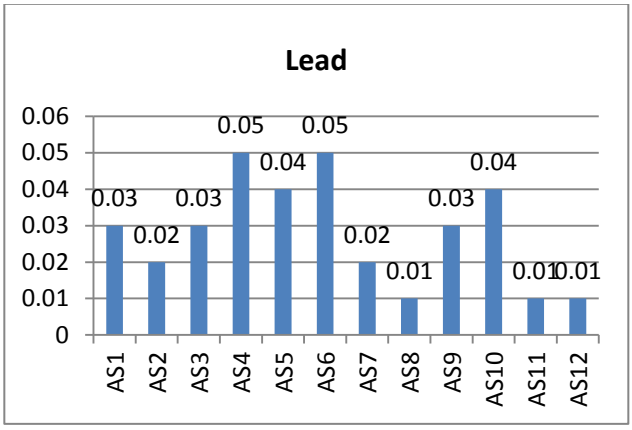
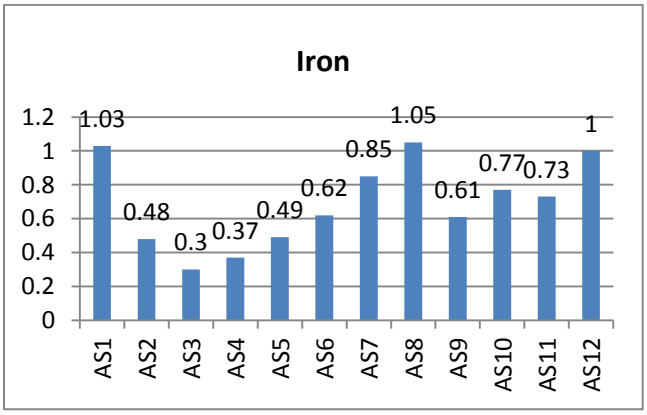




Graph showing values of Heavy metal Parameters







CONCLUSION

Metals and minerals are not synthesized in the body,their requirement for the body is obtained from food grains and water. Any impairment in the body ultimately causes serious ailiments and thus causing ecological impact in the area. The present study of Unnao district showed that except some parameters like fluoride chromium and Iron (Table-3), there is not much concentration in water due to presence of industries. These three parameters are also present in slight high concentration than permissible limit. Ecological imbalances of that area appear to be normal.

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Table 3: Groundwater quality % sample compliance/ violation with respect to standards (bis standards drinking water specification) at unnao district

Sl. No.	Parameters	Year 2013	Standard BIS		% Sample Compliance/violation	Location sites showing violation
			Desirable (DL)	Permissable (PL)		
1	Fluoride		1.0 mg/l	1.5 mg/l	25% sample shows violation ie. Values after permissible limit. 33.33% sample shows values within the desirable limit and about 41.66 % sample shows values within permissible limit.	Preetampur, Tabbinagar and Bahaunamau sites shows fluoride violation due to natural factors as well as industrial impacts.
2	Chromium		0.05 mg/l	No relaxation	41.66% sample shows values within desirable limit.16.66 % sample shows values with standard.41.68% sample shows violation ie. Values after Desirable limit	Shuklaganj,Near model tannery, Tabbinagar and Bahaunamau sites shows Chromium violation due to high level of chromium seems to percolate to ground water near tannery
3	Iron		0.30 mg/l	1.0 mg/l	8.33% sample shows values with standard desirable limit.66.66 % sample shows values between desirable and permissible limit.16.66 % sample shows violation ie. Values after Permissible limit.8.35 % sample shows values with permissible standard.	Preetampur, Tabbinagar sites shows Iron violation due to presence of tannery industries very near.

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