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Review Article

Impact of Tanning Industries on Groundwater Quality of Chrompet and Pallavaram near a Metropolitan City in India

P.M.Velmurugan

Centre for Earth and Atmospheric Sciences, Sathyabama Institute of Science and Technology, Rajiv Gandhi Salai (OMR) Chennai.

Abstract

Tanneries use a large number of chemicals during the process of leather making, such as chromium sulphate, sodium chloride, and calcium hydroxide. The salts present in the effluent seep into the ground surface and thereby cause the pollution of ground water sources in the area. The present study was carried out with the objective of determining the extent of groundwater pollution caused by tanning industries in Chromepet area located south of Chennai, Tamil Nadu, and India. Water samples were collected from 22 locations in Jan 2018 and analyzed for chromium content. EC ranged from 1,035 to 5,655µS/cm and it was at permissible levels, in only 5.6% of groundwater samples. Normally, Chromepet and pallavaram area groundwater is not suitable for drinking purpose and it contains prominent level concentration of most major ions and chromium. This impact is due to the partially treated effluent discharged from the tanning industries into open drains. The Chromium concentration of this area was above the permissible limit (0.05 mg/l) in 86% of the groundwater samples. Chromate poisoning cause's severe skin disorders such as allergic dermatitis and liver and kidney damage and there is considerable evidence that chromium is carcinogenic. In view of this, it is of paramount importance to look for and to evaluate the chromium levels in the drinking waters of the area and assess their status of portability in the light of the criteria laid by Bureau of Indian Standards (B.I.S).

Keywords: *Contamination, chromium, groundwater, pollution, tanneries.*

In India, tanning industry holds a pride place because of the leather goods exported to other countries. In the recent decades, the growth rate of the leather industry in certain localities has shown how the wastes from these industries can cause irreversible damage to the water, soil and the

Environment in the vicinity B. S. Shankar (2009). It is estimated that 30-35 liters of water is used per Kilogram of leather processing, and it is generating about 680 million liters of effluent daily. In India

alone approximately 2000–3000 tons of effluents escapes into the environment annually from tanning industries. Most of the tanneries industries are located in the outskirts of several major cities such as Delhi, Kanpur, Mumbai, Calcutta, Chennai etc. (N.C. Mondal et.al, 2005). India is heavily polluted due to the disposal of untreated effluent from the

tanneries into open drains. The effluents from the tanning processes are sent to the Common Effluent Treatment Plant (CETP) by large scale industries after the formulation of stringent laws in 1991. Although CETP helps to some extent for the treatment of sewage, it is still not fitting for re-use due to high concentration of many ions. In adding, there is also huge amount of solid waste generated as sludge from water treatment. Since the solid wastes are rich in chemicals which are improperly disposed, the resulting leachate finds its way into the groundwater during rainfall recharge (K. Brindha & L. Elango, 2012). This problem persists especially in developing and under developed countries where proper treatment of waste is not carried out.

Impact on the environment by the tanning industries has been reported in several countries (A.A. Belay 2010, I.I. Sovaslan & R. Karaguzel, 2008 and S.S.Gowd & P.K. Govil, 2008). Leather is manufacturing in a number of steps involving about 170 types of chemicals, which include the chemicals like chromium sulphate, sodium chloride and calcium hydroxide. Therefore, the resultant effluent is enriched with chromium and salts.

All tanneries need a large amount of water for processing leather and depend on nearby ground/surface water sources for their daily requirements. The effluents discharged directly from the tannery industries to the nearby river or streams or in large lagoons and the pollution occurs as the dissolved salts percolate into the surrounding soil (Meenu Mangal, et.al., 2013).

A. Genesis of Chromium and Effects on human health

Chromium is absorbed through both the gastrointestinal and respiratory tracts (Vinutha, et.al., 2007) and (P. Lilly Florence, et.al., 2013) Chromium enters environmental waters from anthropogenic sources such as electroplating factories, leather tanneries and textile manufacturing facilities. Chromium also enters groundwater by leaching from soil.

B. Toxicological effects of chromium

The harmful effects of chromium in mass are associated with hexavalent chromium. In high doses, chromium cause digestive tract cancer in humans and there is evidence that there is an increased risk of lung cancer to workers who are exposed to high levels of chromium. Chromate poisoning causes severe skin disorders such as allergic dermatitis and liver and kidney damage.

Chromium VI is a human carcinogen, as determined by the International Agency for Research on Cancer (IARC), the U.S. Environmental Protection Agency (U.S. EPA), and The Office of Environmental Health Hazard Assessment, OEHHA. (K. Brindha and L. Elango, 2012) and (B. S. Shankar, 2015).

C. Toxicological effects of chromium on human

All reports of humans acutely poisoned by chromium compounds have involved compounds of chromium VI Agency for Toxic Substances and Disease Registry (ATSDR) (2008). In a mortality study about the groundwater contamination with hexavalent chromium (Cr+6) in the

Jinzhou area of China between 1965 and 1978 was assessed, a significant excess of overall cancer mortality was observed in five Cr (+6)-contaminated villages combined to the source of the contamination, (Edward Ming et.al., 2012) and (Koul Nishtha et.al., 2012), where 57% of the wells exceeded the European Community safe drinking water standard of 0.05 ppm (J. Zhang, and S. Li 1985).

A Recent analysis has revealed that 38% of municipal sources of drinking water in California have detectable levels of hexavalent chromium (R.M. Sedman et.al., 2006). This observation provided new imputs to characterize the carcinogenic risk associated with oral exposure to hexavalent chromium in drinking water. In the present study, discussions held by the authors with the Health Centre authorities revealed that, between January and November 2018, 10 residents were treated for dermatitis, 6 for indigestion and vomiting and 6 cases of septum perforation were identified in the tannery industrial area (study area), using the chromium contaminated water. It is in this regard, that the present study assumes great importance.

D. Details of Chennai City (Chorempet and Pallavaram)

This study was carried out in an around of Chromepet and Pallavaram areas where the groundwater, which was good quality even at 9–12 m depth, and it has been reported to have become salty (Tamil Nadu Social Development Report, 2000). Salinity in groundwater is a major problem around tanneries and it is due to the use of large amounts of sodium and calcium salts in the tanning processes (Mondal *et al*., 2005). In addition, concentrations of heavy metals such as copper, cadmium, chromium, zinc, iron and lead significantly greater than the Bureau of Indian Standards (BIS) (K. Brindha et.al., 2010) limit are also present in groundwater around tanneries in Vellore, Dindugal and Kancheepuram districts of Tamil Nadu. Bhattacharya (2004) stated that the tanneries in and around Chromepet and the close by Pallavaram area have discharged the sewages into open drains. The Chromepet area got its name from the ―chrome tanning‖ procedure practiced here.

Temperature starts rising towards the end of February. The area receives maximum rainfall from North-West monsoon and annual rainfall is 1,186 mm. The flow of groundwater is from west to east. Most of the study area consists of barren land and the land use pattern of this area is mainly of buildings, roads, Schools College and industries.

E. Details of the study area

The study area is a part of the major city of Chennai, Tamil Nadu, India. Samples were collected from Chromepet and Pallavaram areas (Fig.1) which is well known for tanneries (K.Ramesh and V .Thirumangai 2014). The geographic location of the area is between 80˚ 07’30‖ to 80 0’56‖ East longitude and 12 7’13‖ to 12 ˚58’56‖ North latitude. The area serves as a home town

for lots of small scale and large-scale tanning industries. Leather tanning is the familiar method followed in this area. The study area is 13 km far away from the Bay of Bengal. Topographically this region slopes gently towards the east. The climate

of the area is with low humidity and high temperature, and the temperature is around 18ºC - 27ºC during winter and during summer has a maximum of 35ºC - 42ºC is generally hot.

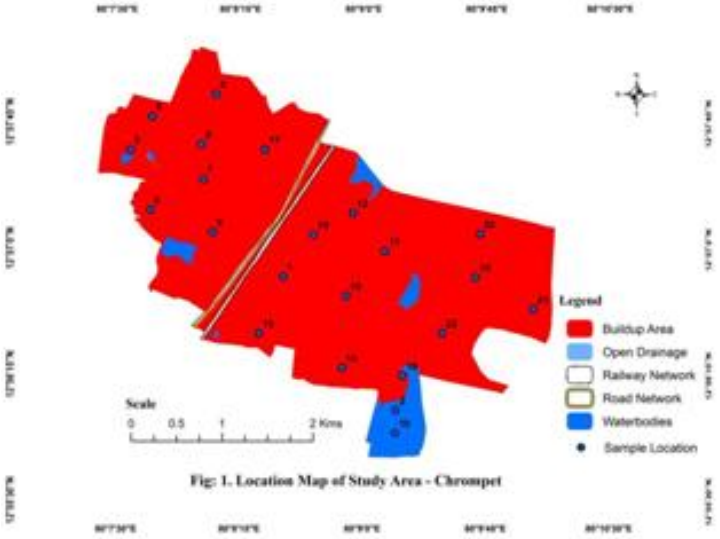

Fig: 1. Location Map of Study Area - Chrompet

II. MATERIALS AND METHODS OF ANALYSIS

Twenty two water samples were collected from the bore wells and open wells in and around the in industrial cluster, covering 1.4 Square km area and located very near to the residential area during both pre-monsoon (April 2018) and post-monsoon (November 2018) periods. The samples were taken from the area covering the entire residential populace using this water and were analyzed for chromium in the lab using an U-V-visible spectrophotometer in accordance with the Standard methods for examination of water and wastewater of American Public Health Association (APHA, 2002). The results obtained were evaluated in accordance with the standards prescribed under _Indian Standard Drinking Water Specification (BIS 10500: 2003) of Bureau of Indian Standards BIS (2003). The location map of the study area along with the sampling stations is presented in (Fig. 1).

III. RESULTS AND DISCUSSIONS

Twenty two groundwater samples were drawn from the bore wells, open wells and mini water supply schemes in the months of April and November 2018 and the water samples were analyzed for chromium. The analysis results are presented in Table I. Out of the twenty two samples analyzed for chromium, 16 (53.33%) were found to be non- potable as per Bureau of Indian Standards. The maximum concentrations of chromium are found to be 0.86mg/l and 0.99mg/l in post-monsoon and pre-monsoon seasons while the average concentrations are found to be 0.198 and 0.251 respectively (Table II). No appreciable differences in values are observed in the two seasons, though post-monsoon values are marginally higher. Chromium in several samples is alarmingly high, when compared to BIS permissible limit of 0.05mg/l. A high percentage (sixteen instances) of contamination due to chromium was

observed, with a peak concentration of 0.99mg/l in post- monsoon, as against BIS permissible limit of 0.05mg/l.

Chromium is one of the main pollutants from tanning operations. This may be the main reason for chromium contamination of groundwater in the study area, along with the anthropogenic activities, domestic sewage and wastewater run-off, which help in the percolation of chromium along with the percolating water and finally reaching the groundwater (H.C. Kataria et.al., 2011).

Discussions held by the authors with the Local Primary Health Centre authorities revealed that the excessive concentrations of chromium leading to severe skin problems such as dermatitis is evidenced by several residents in the area supporting a clear co-relation between the health disorders faced by the people and groundwater pollution due to excess chromium (B.S.Shankar 2009).

composition of groundwater is similar to that of the treated effluent. Overall, the groundwater in this area has been concentrated with the chemicals that are used during the tanning process, which indicate the impact of effluent discharged by the tanning industries. It is important to carry out removal of salinity along with chromium from the effluent during the treatment process. The investigations along with the discussions held with the health centre officials and general public of the area, clearly point out to the serious chromium contamination of the groundwater in the vicinity of the tanneries cluster and the ill-health faced by the residents. The less stringent effluent discharge standards for land application are a direct threat to the soil and water quality. Hence there is an urgent need for regulation of water quality for land application. Adopting cleaner technologies, such as organic tanning agents and going for engineered landfill for solid waste disposal to prevent infiltration of leachate can reduce the pollution. Setting up of a local area environmental monitoring committee could go a long way in abating the problem.

Chromium Reduction techniques

IV. Several Chromium removal techniques could be adapted, such as reduction, ion exchange, evaporation, electro dialysis, reverse osmosis and adsorption. Most of the above methods involve high capital investment, though adsorption technique through the use of activated carbon is quite economical and may be used with considerable removal efficien

V. CONCLUSION

The groundwater quality in the vicinity of tanning industries in Chromepet and pallavaram area of Chennai, India was studied and the following conclusions were arrived. A large percentage of groundwater samples collected from this study area is of brackish water type based on the concentration of TDS. Only 28% of the samples collected are desirable for drinking purpose and thus a larger part of groundwater is not suitable for domestic purpose. A major portion of groundwater of this area is hard water. Chromium is present in concentrations above the permissible limit in 86% of the groundwater samples. The chemical

REFERENCES

- B.S.Shankar―Chromium pollution in the groundwater of an industrial area in Bangalore, India. Journal of Environmental Engineering and Science, vol.26, pp.305-310, 2009.
- N.C. Mondal, V.K. Saxena and V.S.Singh ―Assessment of groundwater pollution due to tannery industries in and around Dindigul, Tamilnadu, India‖. Environ Geol, vol.48, pp.149– 157, 2005.
- K. Ramesh, V.Thirumangai, ―Impacts of Tanneries on Quality of Groundwater in Pallavaram, Chennai Metropolitan City, Journal of Engineering Research and Applications, Vol. (4), 2014, 63-70.
- A.A.Belay , ―Impacts of chromium from tannery effluent and evaluation of alternate treatment options‖. J Environ Protect, vol.1, pp. 53–58, 2010.
- I.I. Soyaslan , and R. Karagüzel , ―Investigation of water pollution in the Yalvac basin into Egirdir Lake, Turkey‖. Environ Geol, vol. 55, pp.1263–1268, 2008.
- K.Vinutha, A.A. Jahagirdar, B. Veena Devi, and N. Nanda, ―Removal of chromium from industrial wastewater‖, Proceedings of International Conference on Integrated Water Resource Management, Bangalore, pp.287, 2007.
- S.S. Gowd, and P.K. Govil, ―Distriburtion of heavy metals in surface water of Ranipet industrial area in Tamil Nadu, India‖. Environ Monit Assess, vol.136, pp.197–207, 2008.
- Meenu Mangal, Mala Agarwal, and Davika Bhargava, ―A case study of impacts of tannery effluent of leather industry of Manpura Machedi on ground water quality of the area‖. Journal of Pharmacognosy and Photochemistry, vol 2. Pp.229-223, 2013.
- P. Lilly Florence and A. Paul Raj ―Ground water quality assessment of GangavalliTaluk, Salem District, Tamil Nadu, India using multivariate statistical techniques, Engineering Science and Technology: An International Journal , ISSN: 2250-3498, 2013.
- K. Brindha, and L. Elango, ―Impact of tanning industries on groundwater quality near a metropolitan city in India‖. Water Resour Management, vol.26, pp.1747–1761, 2012.
- Bhattacharya, S. (2004) Pallavaram colony residents complain of water contamination. The Hindu. Available from: http://www.hindu.com/2004/05/21/stories/2004052111880300.htm.
- B. S. Shankar―Environmental Impact of a Tanning Industrial Cluster on Groundwater Quality of Bangalore, India, with Special reference to Chromium, 4th International Conference on Chemical, Ecology and Environmental Sciences (ICEES'2015) Dec. 15-16, 2015 Pattaya (Thailand).
- Agency for Toxic Substances and Disease Registry (ATSDR), ―Toxicological profile for chromium (update). U.S. Department of Health and Human Services. Public Health Service. 1998.
- Edward Ming-Yang Wu, Shu-Lung Kuo ― Applying a Multivariate Statistical Analysis Modelto Evaluate the Water Quality of a Watershed, Water Environment Research, Vol. 84, 2012.

- Koul Nishtha, R.S. Lokhande and Dhar J.K ― Physico-Chemical, Bacteriological and Pesticide analysis of Tap water in Millennium city, Gurgoan, Haryana, India, International Research Journal of Environmental Sciences 1(2), 2012, 1-7.
- J. Zhang, and S. Li, S, ―Chromium pollution of soil and water in Jinzhou‖. Journal of Chinese preventive medicine, vol.21, pp. 262, 1987.
- R.M. Sedman, J. Beaumunt, T.A. Mcdonald, and S. Reynolds. S, ―Review of the evidence regarding the carcinogenicity of hexavalent chromium in drinking water‖. J Environ Sci Health c environ carcinog ecotoxicol rev. vol.24, pp. 155, 2006.
- P. Lilly Florence, A. Paulrajand P. Ramachandramoorthy ― Water Quality Index and Correlation Study for the Assessment of Water Quality and its Parameters of YercaudTaluk, Salem District, Tamil Nadu, India, Chemical Science Transactions, 2012, 139-149.
- K. Brindha L.Elango and V.G. Rajesh ― Occurrence of Chromium and Copper in Groundwater Around Tanneries in Chrompet Area of Tamil Nadu, Indian Journal of Environmental Protection, 30 (10), 2010, 818-822.
- APHA, ―Standard methods for the examination of water and wastewater‖, twentieth edition, American Public Health Association, Washington D.C, 2002.
- BIS, ―Bureau of Indian Standards IS: 10500‖, Manak Bhavan, New Delhi, India, 2003.
- H.C. Kataria, Manisha Gupta, Mukesh Kumar, SandhyaKushwaha, SherwatiKashyap, SonalTrivedi, Rani Bhadoriya And Naval Kishore Bandewar ― Study of Physico-chemical Parameters of Drinking Water of Bhopal city with Reference to Health Impacts, Current World Environment, 6(1), 2011, 95-99 .