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ANALYSIS OF HEAVY METAL CONCENTRATION IN GROUND WATER AROUND INDUSTRIAL AREA MIDC LOTE, MAHARASHTRA, INDIA

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Abstract

The assessment of ground water quality of industrial area from Lote M.I.D.C. analyzed, it is utilized for drinking and domestic purpose and hence it is need to assess the quality of ground water. The heavy industrialization and the increasing urbanization are responsible for the rapidly increasing stress on the groundwater of the area. Therefore, considering this serious aspect the present study assesses the groundwater contamination due to heavy metals. The samples of water were collected from wells situated around the industrial area at one month interval throughout the year. The heavy metals namely iron, copper, zinc, manganese, nickel, chromium, cobalt and lead were determined by using Atomic Absorption Spectrophotometer (Perkin Elmer make model No. Aanyst 200). A comparison of the result of groundwater with WHO (1993) and BIS (1991) guidelines show that most of the groundwater sample contain heavy metal concentration below the maximum permissible limit.

Key words : Groundwater, heavy metal, industrial effluent, seasonal variation.

Introduction

Water is an important life supporting material and required for all biotic communities. Normally water is never pure in the chemical sense (Agale *et al*., 2013). In water impurities are in very low amounts, but due to rapid industrialization, over population, indiscriminate use of chemicals causing water pollution and exploitation of ground water disturbs the state of equilibrium of aquifer (Ramesh *et al*., 2014). The water used for drinking purpose should be free from any toxic elements, living and non-living organism and excessive amount of minerals that may be hazardous to health. Some metals are naturally found in the body and are essential to human health. For example iron, prevent anemia and Zinc is a co-factor in over 100 enzymes reactions. They normally occur at low concentration and are known as trace metals (Harte, *et al*., 1991). The effluents or waste from industries, sometimes percolate through subsoil and reached the ground water table forming contaminated pool, which disturb the natural ground water quality by changing its chemical composition (Pondhe *et al*., 1992). Contaminated water when used for irrigation purpose affects the soil quality and crop health.

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Materials and Methods

The study area includes parts of Lote M.I.D.C. (Maharashtra Industrial Development Corporation) in Ratnagiri district. The Ratnagiri district is geographically situated in latitude of 16.58^0 to 16.98^0 N and 73.18^0 to 73.30^0 E longitudes. In that area, soil is generally lateritic soil and monsoon season (June to October), winter (November to February) and summer (March to May) are occur. The region receives very high rainfall (above 3000 mm annually). Month of May is generally the hottest, with a mean maximum temperature of around 33^0-35^0C. During rainy season, humidity is as high as 90 to 98 per cent.

Twenty water samples were collected at one month interval for one year (April 2014 to March 2015) from the wells, which were situated around the industrial area and evaluated the seasonal variation of ground water. These water samples were collected in clean plastic and transparent bottles from the well.

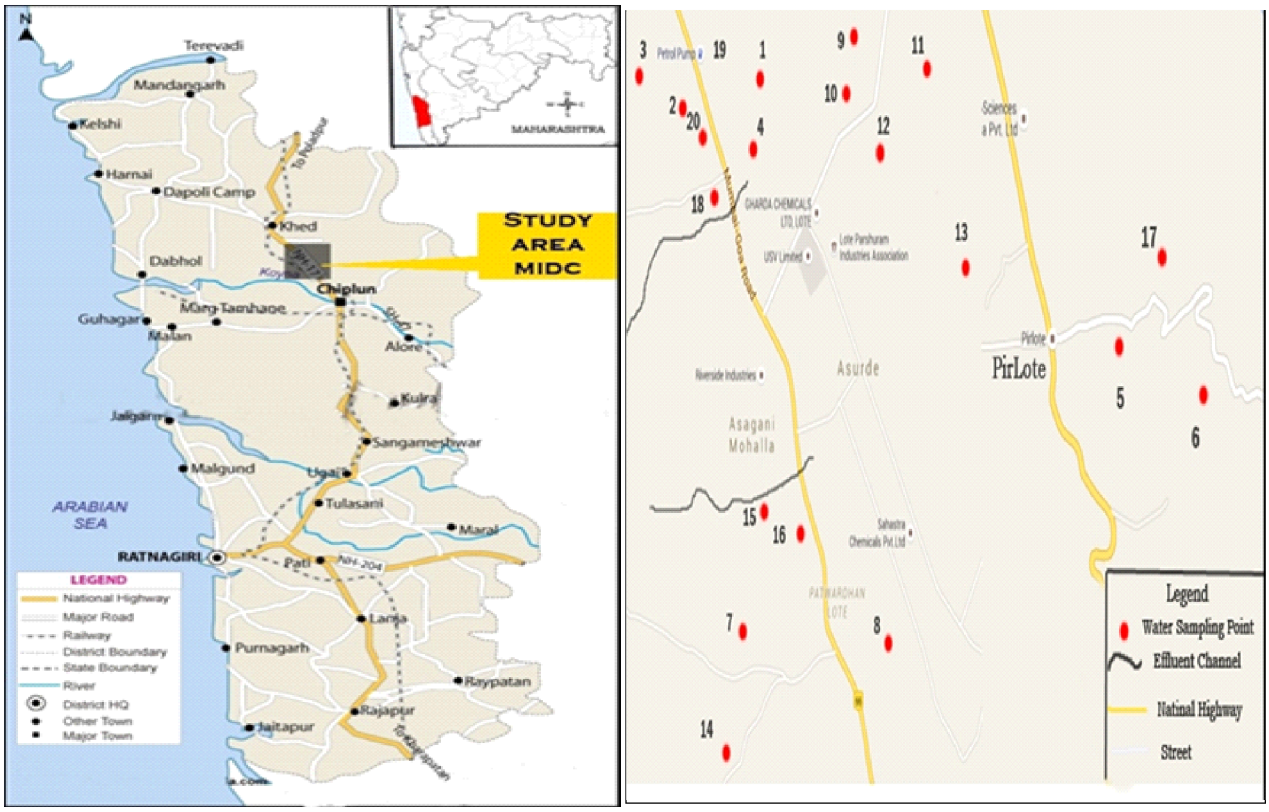

Fig. 1 : Location of study area (MIDC) and water sampling points.

Results and Discussion

Iron

The iron concentration in ground water varied from 0.057 to 0.086, 0.069 to 0.084 and 0.071 to 0.079 mg L^{-1} with a mean value of 0.073, 0.075 and 0.076 mg L^{-1} during summer, monsoon and winter season, respectively. In monsoon and winter higher concentration of iron in ground water was observed due to leaching of industrial wastes during rainy season and natural presence of iron oxides in laterite soil (Thomas *et al*., 2011).

Zinc

The concentration of zinc in ground water during summer season varied from 0.048 to 0.054 mg L^{-1} with a mean value of 0.05 mg L^{-1}, while 0.046 mg L^{-1} was an average value in monsoon season and its range was between 0.043 to 0.051 and 0.049 to 0.051 mg L^{-1} with a mean value of 0.050 mg L^{-1} during winter season.

In present study, the zinc concentration was lower during monsoon season due to dilution effect of rain water (Madhukar *et al*., 2013) and higher during summer and winter due to depletion of water leading to greater concentration of metals and concentration effect (Thomas *et al*., 2011).

Copper

Toxicity of copper to aquatic life is dependent on the alkalinity of water, as water is generally more toxic to aquatic fauna at lower alkalinities (Train, 1979). The copper concentration present in ground water ranged from 0.020 to 0.071 mg L^{-1} with a mean value of 0.045 mg L^{-1}, 0.022 to 0.081 mg L^{-1} with a mean value of 0.046 mg L^{-1} and 0.066 to 0.070 mg L^{-1} with a mean value of 0.068 mg L^{-1} during summer, monsoon and winter seasons, respectively.

Manganese

The concentration of manganese in ground water varied from 0.037 to 0.093, 0.010 to 0.053 and 0.013 to 0.033 mg L^{-1} with a mean value of 0.072, 0.031 and 0.026 mg L^{-1} during summer, monsoon and winter season, respectively.

In present study, manganese concentrations in ground water are higher in summer season and continuously decrease up to winter season. Manganese compound exist naturally in the environment as solid in the soil and small particles in the water. These are usually settled to earth in dust particles. Humans enhance manganese concentration in the air by industrial activities and through burning fossil fuel (Deshpande *et al*., 2013)

Table 1 : Heavy metal concentration in groundwater around MIDC Lote, Maharashtra.

Heavy metal	Summer	Monsoon	Winter	Mean
Iron (mg L^{-1})	0.073	0.075	0.076	**0.075**
Zinc (mg L^{-1})	0.050	0.046	0.050	**0.049**
Copper (mg L^{-1})	0.045	0.046	0.068	**0.053**
Manganese (mg L^{-1})	0.072	0.031	0.023	**0.042**
Nickel (mg L^{-1})	0.051	0.041	0.036	**0.042**
Chromium (mg L^{-1})	0.054	0.030	0.037	**0.040**
Cobalt (mg L^{-1})	0.008	0.005	0.008	**0.007**

due to various anthropogenic activities, industrial effluents, old plumbing and household sewage (Warmate, 2011) and discharge of adjoining industries *viz*., tannery, chemical manufacturing etc. and also large amount of particular matter in the canal, which retained chromium as adsorbed ions (Mandol *et al*., 2011).

Cobalt

The concentration of cobalt in ground water during summer, monsoon and winter season varied from 0.005 to 0.011 mg L^{-1} with a mean value of 0.008 mg L^{-1}, 0.003 to 0.007 mg L^{-1} with a mean value of 0.005 mg L^{-1} and 0.006 to 0.009 mg L^{-1} with an average value of 0.008 mg L^{-1}, respectively. During monsoon season cobalt concentration is lower in ground water as compared to summer and winter season due to heavy rainfall (Mondol *et al*., 2011).

Table 2 : Month-wise periodical changes in heavy metals concentration of ground water around MIDC Lote, Maharashtra.

Heavy metal	April	May	June	July	August	Sept	Oct	Nov	Dec	Jan	Feb	March
Fe(mg L^{-1})	0.077	0.057	0.084	0.076	0.075	0.069	0.07	0.071	0.076	0.078	0.079	0.086
Zn(mg L^{-1})	0.054	0.048	0.046	0.043	0.045	0.047	0.051	0.05	0.051	0.05	0.049	0.049
Cu(mg L^{-1})	0.02	0.043	0.03	0.025	0.022	0.072	0.081	0.066	0.066	0.069	0.07	0.071
Mn(mg L^{-1})	0.085	0.093	0.053	0.037	0.032	0.024	0.01	0.013	0.022	0.033	0. 034	0.037
Ni(mg L^{-1})	0.059	0.055	0.055	0.046	0.036	0.034	0.033	0.037	0.032	0.033	0.040	0.038
Cr(mg L^{-1})	0.06	0.054	0.037	0.033	0.017	0.025	0.038	0.039	0.032	0.041	0. 044	0.048
Co(mg L^{-1})	0.005	0.011	0.007	0.004	0.003	0.005	0.005	0.006	0.009	0.009	0. 009	0.008

Nickel

Nickel is used mainly in the production of stainless steel, non-ferrous alloys and super alloys directly emitted from these steel industries. The seasonal variation of nickel concentration in ground water summer season ranged from 0.038 to 0.059 mg L^{-1} with a mean value of 0.051 mg L^{-1}, while 0.041 mg L^{-1} was an average value during monsoon season and it ranged between 0.033 to 0.055 mg L^{-1} and 0.032 to 0.040 mg L^{-1} with a mean value of 0.036 mg L^{-1} in during winter season.

Throughout study, the most of water samples contain nickel concentration in ground water above the permissible limit for drinking purpose (BIS, 1991; WHO, 1984) due to the presence of water soluble salts (Kumar *et al*., 2001) and leaching effect of heavy metal results as the excess amount of that metal in the ground water (Bharti *et al*., 2013). In general, low pH also favors the exchangeable and soluble nickel concentration (Parth *et al*., 2011).

Chromium

The seasonal variation of chromium in ground water during summer, monsoon and winter seasons varied from 0.048 to 0.060 mg L^{-1}, 0.017 to 0.038 mg L^{-1} and 0.032 to 0.041 mg L^{-1} with a mean value of 0.054, 0.030 and 0.037 mg L^{-1}, respectively.

In summer season, the samples contain chromium concentration in below the maximum permissible limit

Lead

The concentration of lead was not found in any water samples throughout year.

Conclusion

The analytical data shows most of the water samples were contain heavy metal concentration below permissible limit and nickel concentration is above permissible limit in groundwater as per prescribed by BIS and WHO. But this study emphasizes the need for regular groundwater quality monitoring to assess pollution activity from time to time for talking to appropriate management measure in time to mitigate the intensity of pollution activity. Thus to keep groundwater free from excess level of Fe, Mn, Zn, Cu, Ni etc and other ions the following recommendation should be taken into account.

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References

Agale, M. C., N. G. Patel and A. G. Patil (2013). Impact of sugar effluents on quality of ground water from Dahiwad Village, Dist- Dhule (M.S.). *Scholars Research Library*, **5(2)** : 58-60.

Bharti, P. K., P. Kumar and V. Singh (2013). Impact of industrial effluents on ground water and soil quality in the Vicinity of industrial area of Panipat city, India. *Journal of Applied and Natural Science*, **5(1)** : 132-136.

BIS (1991). *Bureau of Indian Standards* IS: 10500, Manak Bhavan, New Delhi, India.

Harte, J., Holdren Cheryl, Schneider Richard and Christine Shirley (1991). Toxics A To Z : A Guide To Everyday Pollution Hazards, Berkeley, CA: University of California Press, pp. 103.

Kumar, S., R. Kushwaha, S. Sarpa, A. B. Gupta and A. Bhargava (2001). Impact of textile industry on ground water quality of Sanagar, Jaipur. *Journal Indian Water Work Association*, **33(4)** : 321-326.

Mondol, M. N., A. S. Chamon and B. Faiz (2011). Seasonal variation of heavy metal concentration in water and plant sample around Tejgoan industrial area of Bangladesh. *Journal of Bangladesh Academy of Science*, **35(1)** : 39-41.

Parth, V., N. N. Murthy and P. R. Saxena (2011). Assessment of heavy metal contamination in soil around hazardous waste disposal sites in Hyderabad city, India. *Journal of Environmental Research and Management*, **2(2)** : 27-34.

Ramesh, K. and L. Elango (2014). Impact of ground water quality from industrial East coastal town, Southern India. *International Journal of Engineering Research and Application*, **4(1)** : 346-354.

Thomas, D. R., B. Sunil and C. Latha (2011). Physico-chemical analysis of well water at Eloor industrial area. *Current World Environment*, **6** : 259-264.

Train, R. E. (1979). *Quality criteria for water*. Washington: UAEPA. pp. 256.

Warmate, A. G. and T. J. K. Ideriah (2011). *J. of Ecology and the natural environment*, **3(2)** : 54-57.

WHO (1984). *Guidelines for drinking water quality*, World Health Organization, Geneva.