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ASSESSMENT OF GROUND WATER QUALITY FROM INDUSTRIAL AREA LOTE M.I.D.C., 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 several factories drain their liquid wastes to the nearby river. The samples of water were collected from wells situated around the industrial area at one month interval throughout the year. The parameters *viz*., pH, EC, Na^+, Cl^-, Ca^{2+}, Mg^{2+}, HCO_3, SAR and RSC were estimated to assess the impact of industrial wastes on ground water. The results show that the present study most of the water samples below permissible limit of drinking water quality.

Key words : Water pollution, factory waste, water quality, ground water, domestic.

Introduction

Water is an important life supporting material and required for all biotic communities. Water is a factor of production in virtually all enterprises, including agriculture, industry and the service sector. The society depends on water for domestic needs, irrigation, sanitation, and disposal of waste. 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 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. Contaminated water when used for irrigation purpose affects the soil quality and crop health. The physico-chemical analysis of soil and ground water reveal the impact of industrial waste on soil health and pollution of ground water.

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. It is least in winter afternoon, when it may come down to about 60 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. Twenty water samples were collected every month. These water samples were collected in clean plastic and transparent bottles from the well. The samples were stored in refrigerator at 4^0C or added two to three drops.

Results and Discussion

The ground water at industrial area Lote MIDC, Maharashtra showed change in physico-chemical characteristic during throughout year (April, 2014 to March, 2015). The result of water quality status is depicted in tables 1 and 2.

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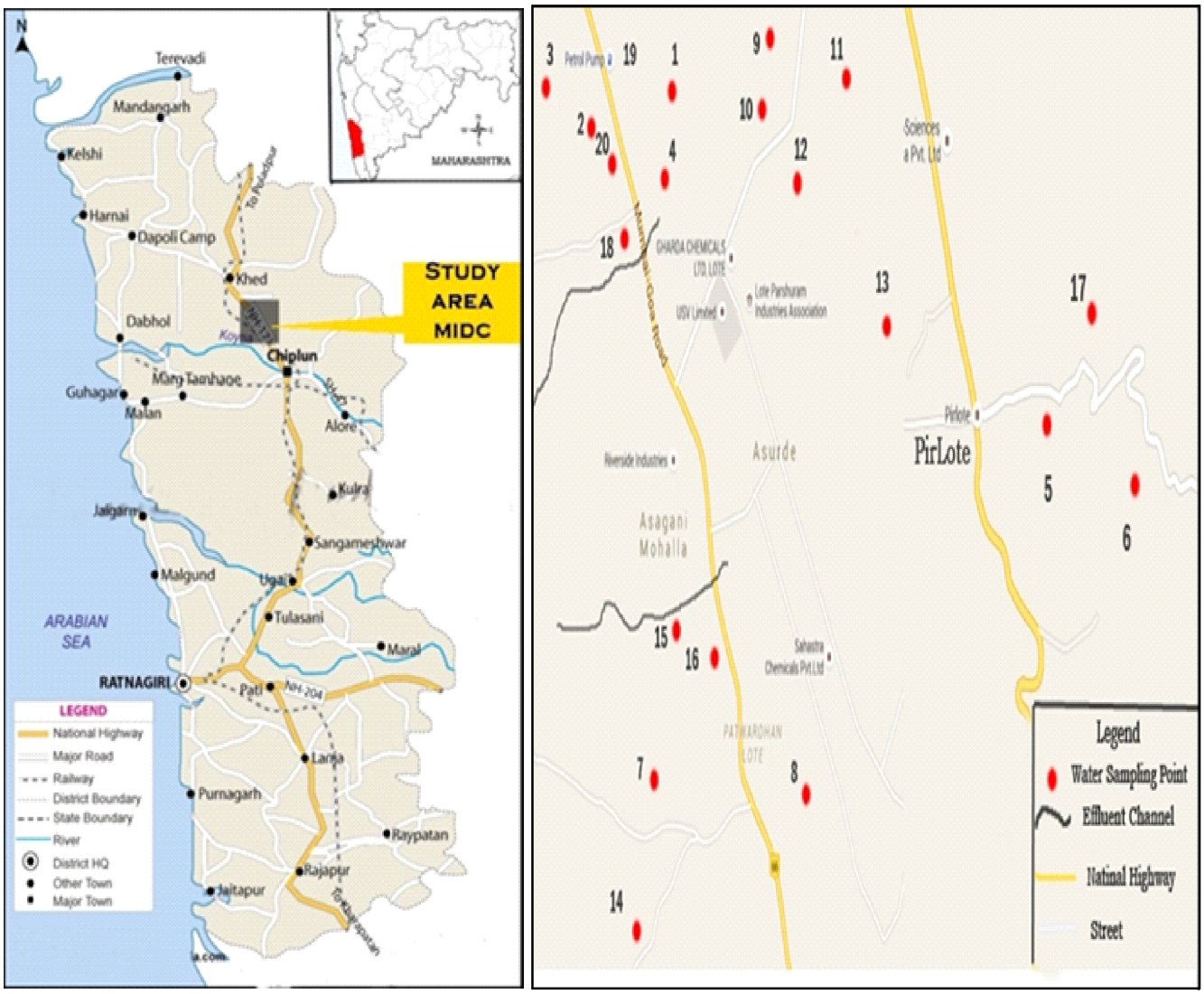

Fig. 1 : Location of study area (MIDC) and water sampling points.

pH

The pH is a measure of acidity or alkalinity of water. It is known to be related to the availability of macro and micronutrient for plants (Ladwani *et al*., 2012). In present study, the pH of water at different seasons varied from 6.04 to 6.15, 5.50 to 6.06 and 5.56 to 5.97 with a mean value of 6.08, 5.77 and 5.89 in summer, monsoon and winter seasons, respectively.

However, laterite soil is acidic in nature and hence ground water is also acidic nature. In that area during monsoon season certain chemical and metals are percolating through rain water and accumulated in ground water, hence water had low pH value (Walakira, 2011) and it could be due to discharge industrial effluents, which are acidic and mix in the well water (Sunil *et al*., 2011).

Electrical conductivity

The electrical conductivity is the ability of a substance to conduct electricity. The conductivity of water is a more or less linear function of the concentration of dissolved ions (Kumar *et al*., 2012). The electrical conductivity of water were varied from 0.124 to 0.183 dSm^{-1} with a mean value of 0.150, 0.135 to 0.202 dSm^{-1} with an average value of 0.166 dSm^{-1} and 0.164 to 0.196 dSm^{-1} with a mean value of 0.185 dSm^{-1} during summer, monsoon and winter seasons, respectively.

Hence, all the samples collected from wells belonging excellent and good water categories throughout year. The electrical conductivity increased during monsoon and winter season due to increase in number of ions which is supported by salinity value (Ramesh *et al*., 2014) and lower during summer due to increased rate of precipitation (Kataria *et al*., 1994).

Table 2 : Month-wise periodical changes in physico-chemical status of ground water during April, 2014 to March, 2015.

Parameter	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March
pH	6.06	6.15	6.06	5.50	5.94	5.67	5.66	5.97	6.12	5.56	5.89	6.04
EC (dSm^{-1})	0.124	0.143	0.150	0.195	0.202	0.135	0.150	0.196	0.189	0.191	0.164	0.183
Bicarbonate (mg L^{-1})	71.38	81.15	82.97	53.69	63.45	74.41	68.93	70.77	84.18	78.70	89.69	101.68
Chloride (mg L^{-1})	200.69	208.50	212.05	189.35	199.29	193.61	197.87	216.31	209.92	214. 89	195.74	190.77
Sodium (ppm)	20.54	23.78	13.80	10.90	7.54	6.21	8.26	11.98	11.93	11.60	11.75	12.01
Calcium (mg L^{-1})	40.97	38.08	42.28	40.88	29.06	25.25	16.03	24.65	25.65	27.25	27.05	34.27
Magnesium (mg L^{-1})	12.65	10.94	16.29	12.77	6.81	4.50	3.77	4.62	4.50	5.23	6.93	5.11
SAR	0.868	1.086	0.678	0.456	0.503	0.394	0.683	0.814	0.792	0.709	0.717	0.696
RSC	0.240	0.530	0.494	0.063	0.386	0.621	0.624	0.567	0.776	0.626	0.819	0.964

Table 1 : Physico-chemical status of ground water from Lote MIDC during April, 2014 to March, 2015.

Parameter	Summer	Monsoon	Winter	Mean
pH	6.08	5.77	5.89	5.91
EC (dSm^{-1})	0.150	0.166	0.185	0.167
Bicarbonate (mg L^{-1})	84.74	68.69	80.84	78.09
Chloride (mg L^{-1})	199.99	198.43	207.32	201.91
Sodium (ppm)	18.79	9.34	11.81	13.31
Calcium (mg L^{-1})	37.77	30.70	26.15	31.54
Magnesium (mg L^{-1})	9.57	8.83	5.32	7.90
SAR	0.88	0.54	0.76	0.73
RSC	0.58	0.48	0.70	0.571

Carbonate and bicarbonate

The carbonate concentration was not found in any water samples in study period. The bicarbonate concentration in water during summer season varied from 71.38 to 101.68 mg L^{-1} with an average value of 84.74 mg L^{-1}, while during monsoon season ranged from 53.69 to 82.97 mg L-1 and its mean value of 68.69 mg L^{-1}. In winter season varied from 70.77 to 89.69 mg L^{-1} with a mean value of 80.84 mg L^{-1}.

The concentration of bicarbonate is lower during monsoon season due to dilution effect of rain water (Prasath *et al*., 2013). The data showed that bicarbonate concentration in groundwater samples was below the maximum permissible limit.

Chlorides

Chlorides are found in ground water through natural and anthropogenic sources, such as weathering of rocks and leaching of inorganic fertilizers, dumps or landfills, industrial effluents etc. (Yadav *et al*., 2014). The seasonal variation of chloride concentration in ground water during summer, monsoon and winter season varied from 190.77 to 208.50, 189.35 to 212.05 and 195.74 to 216.31 mg L^{-1} with an average value of 199.99, 198.43 and 207.22 mg L^{-1}, respectively found below permissible limit for drinking purpose.

The chloride concentration is lower in monsoon season as compared to summer and winter season might due to evaporation, dilution effect and anthropogenic influences as chloride readily transported through soil (Rao *et al*., 2013).

Sodium

Sodium is highly soluble chemical element, which is naturally found in ground water. The sodium concentration of ground water was in the range from 12.01 to 23.78, 6.21 to 13.80 and 11.60 to 11.98 ppm with a mean value of 18.79, 9.34 and 11.81 ppm during summer, monsoon and winter season, respectively.

During summer season maximum sodium concentration in ground water due to low water level and high evaporation losses (Yadav *et al*., 2014). In present study, the ground water samples contain sodium concentration below the maximum permissible limit.

Calcium

The calcium concentration in ground water ranged from 34.27 to 40.97, 16.03 to 42.28 and 24.65 to 27.25 mg L^{-1} with a mean value of 37.77, 30.70 and 26.15 mg L^{-1} during summer, monsoon and winter season, respectively. The data showed that ground water samples were below the maximum permissible limit of calcium concentration in ground water.

The calcium concentration is higher in ground water during summer season as compared to monsoon and winter seasons, there was continuous decreased during winter season. During summer season, higher calcium concentration in ground water was observed due to industries pollution, low water level and high evaporation (Deshmukh, 2014).

Magnesium

The variation of magnesium concentration in ground water varied from 5.11 to 12.65 mg L^{-1} with a mean

value of 9.57 mg L^{-1} during summer, 3.77 to 16.29 mg L^{-1} with an average value of 8.83 mg L^{-1} in monsoon and 4.50 to 6.93 mg L^{-1} with an average value of 5.32 mg L^{-1} in winter season, respectively. In present study, the ground water samples were below the maximum permissible limit of calcium concentration in ground water as drinking purpose.

During summer season higher magnesium concentration in ground water may be due to polluting industries situated near the water sources, low water level and high evaporation (Deshmukh, 2014).

Sodium Adsorption Ratio

The seasonal variation in Sodium Adsorption Ratio of ground water from 0.696 to 1.086 with a mean value of 0.883 in summer, while 0.543 was an average value found in monsoon and it ranged between 0.394 to 0.678 and it ranged from 0.709 to 0.814 with a mean value 0.758 during winter season.

The Sodium Adsorption Ratio of all the ground water samples found to be less than 10, which shown low sodium hazard making it suitable for irrigation in almost all type of soil. The sodium Adsorption Ratio is lower during monsoon season due to less amounts of sodium salts present in ground water (Bhadra *et al*., 2012).

Residual Sodium Carbonate

The Residual Sodium Carbonate in ground water ranged from 0.240 to 0.964, 0.063 to 0.624 and 0.567 to 0.819 with a mean value of 0.58, 0.44 and 0.70 during summer, monsoon and winter season, respectively.

During the study, the RSC values clearly indicated that the ground water is not having any residual sodium carbonate hazard. Residual Sodium Carbonate value is lower during monsoon season as compared to summer and winter season in ground water.

Conclusion

An assessment of the environment risk due to water pollution especially industrial wastes are the particular importance for agricultural and non-agricultural areas because that are directly affected to water quality, which also further effect on soil health and human health. For going research, that water is safe for irrigation purpose. But however, long term studies about contamination of ground water need to be examined.

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