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STUDY OF UNDERGROUND WATER QUALITY FROM INDUSTRIAL AREA OF KOLHAPUR CITY

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ABSTRACT

Kolhapur city is one of the industrial cities where different metal processing units such as machine fabricating and electroplating units are working from last many years. The present paper deals with water quality analysis of underground water from some bore wells located in Shivaji Udyamnagar Industrial area. The Physico-chemical parameters such as temperature, pH, turbidity, electric conductivity, dissolved oxygen, carbon dioxide, chemical oxygen demand (COD), biochemical oxygen demand (BOD), hardness, calcium, magnesium, chlorides, total solids (TS), total dissolved solids (TDS), sulphate, nitrate, phosphate and sodium were studied along with iron and lead. The bacteriological study of water such as MPN, SPC and *E. coli* were carried out from four sampling sites. The results were compared with WHO and ICMR standards. The results reveal that effluent discharge from industries may be responsible for changing the water quality.

INTRODUCTION

Water from underground sources fulfils the agricultural, industrial and domestic needs. Due to improved assessment and advances in well-drilling and pumping techniques, the demand of ground water is increasing considerably. There is environmental damage due to overpumping, intrusion of saline water into freshwater and contamination to recharge or due to direct discharge from industries into wells. Hence, even today large number of people have no access to safe and clean water. Kolhapur is agro-industrial city having large industrial areas. Some investigators have evaluated the underground water quality from villages around Kolhapur city and its non-industrial regions, mainly water supply from Kolhapur Municipal Corporation (Lomate 2002, Bhosale 2005). However, there are no data on underground water quality from the industrial areas of Kolhapur city. Therefore, the present study has been undertaken to evaluate the potability of underground water from an industrial area of Kolhapur city.

MATERIALS AND METHODS

Kolhapur is located in southwestern Maharashtra at an altitude of about 550 meters above MSL at latitude 16°40' to 16°45' north and 74°10' to 74°15' east. The study area selected for the underground water analysis was Shivaji Udyamnagar. The area includes small scale industries of fabrication, battery manufacturing units, electroplating, tanneries and automobile servicing centres.

Ground water samples were collected from four bore wells (GW I, GW II, GW III and GW IV) to study the ground water quality of industrial area from Kolhapur city. Sampling was carried out in the month of June 2005 to August 2005. The water samples were collected in sterilized 2-L plastic containers and analysed as per the standards procedures for the physico-chemical parameters such as temperature, pH, dissolved oxygen at site; and electric conductivity (EC), total solids (TS), total dissolved solids (TDS), turbidity, carbon dioxide, COD, BOD, hardness, calcium, magnesium, alkalinity, phosphate, sulphate, chlorides, fluorides, sodium and potassium in laboratory (APHA 1985). For metal analysis the water samples were collected in precleaned bottles and acidified with concentrated nitric acid for preservation. Metals were determined by atomic absorption spectrophotometer (AAS). For Bacteriological analysis, water samples were collected in separate sterilized glass bottles. MPN of coliforms, SPC and *E. coli* were determined with the McConkey's broth and nutrient agar medium.

RESULTS AND DISCUSSION

The results of physico-chemical analysis, metals and bacteriological analysis of ground water samples are presented in Table 1.

Temperature of water samples ranged from 28°C to 28.5°C. pH values of water samples were well within permissible limit (6.5 to 7.50) with neutral to slightly alkaline in nature. pH has no direct adverse effect on health (Khadsan & Khadu 2003). Electric conductivity varied from 972 µmhos/cm to 1080 µmhos/cm. The high values of EC are due to high concentration of ionic constituents present in waters, and reflect salinity, intrusion as well as pollution by industrial and domestic wastes (Abbasi & Vinithan 1999).

Total dissolve solids have crossed the permissible limit with values ranging from 593 to 735 mg/L. The higher values of dissolved solids can be related to solid waste deposits near bore wells (Sharma & Kaur 1998, Mehta 2003). Dissolved oxygen recorded was low at 1.8 to 2.1 mg/L. Low values of dissolved oxygen in ground waters indicate pollution by organic wastes. Hardness values (461.91 to 539.69 mg/L) were higher than the permissible limit. Hardness of water is an important parameter determining the suitability of water for drinking and domestic uses. Park & Park (1986) observed a correlation between hardness of water and its role in heart diseases. Hardness of water is also related to kidney diseases. Calcium and magnesium were higher than the permissible limits with calcium at 153 to 184 mg/L, and magnesium 88.6 to 91.3 mg/L.

Alkalinity (365.27 to 473mg/L) in ground water samples was also above the standard limit. It is due to presence of salts such as carbonates, bicarbonates and silicates etc. All the ground water samples from study area have higher alkalinity which can be attributed to the concentration of calcium and magnesium salts. The leaching process through surface water during rainy season can also add to higher value of alkalinity. Concentration of sodium and potassium were higher than the permissible limit, and ranged from 36.33 to 54 mg/L and 2.6 to 4.33 mg/L respectively. Chloride, sulphate and phosphate values in ground waters were within permissible limit.

Excess quantity of iron was reported in ground waters ranging from 3.21 to 5.05 mg/L. It has crossed the excessive limit of WHO standards. It may be due to industrial effluents and discharges from automobile garages. Long term consumption of drinking water with high concentration of iron leads to liver diseases as haemosiderosis (Mehta 2003).

The lead influences growth, and its excess leads to damage to brain, kidney and liver (Taqui Khan 1986). Lead concentration in GW II is higher than the permissible limit. It may be due to wastewater from electroplating and battery manufacturing units.

MPN of coliforms is a presumptive test to estimate coliform bacteria. GW I and GW IV reported faecal coliforms at 25/100 mL and 45/100 mL respectively. It makes water nonpotable since, it is indication of water contamination with faecal matter because of poor sanitation. SPC is standard

Table 1: Physico-chemical parameters of ground water resources from industrial areas of Kolhapur city.

Parameters	GW I	GW II	GW III	GW IV
Temperature,°C	28.2 ± 2.7	28.2 ± 2.5	28.5 ± 2.7	28.2 ± 2.7
pH	7.6 ± 0.01	7.2 ± 0.3	7.6 ± 0.3	7.2 ± 0.2
Turbidity, NTU	1.8 ± 0.6	6.1 ± 4.4	4.3 ± 2.2	5.3 ± 2.9
EC, µmhos/cm	1048.6 ± 62.3	1080.3 ± 99.8	972.0 ± 66.0	1007.3 ± 94.1
TS, mg/L	685.5 ± 208.4	638.4 ± 448.7	683.3 ± 341.7	793.1 ± 133.8
TDS, mg/L	634.0 ± 542.2	593.1 ± 411.0	628.7 ± 309.04	735 ± 87.8919
Dissolved oxygen	1.68 ± 0.10	1.91 ± 0.45	2.13 ± 0.23	1.94 ± 0.18
Hardness	469.0 ± 29.3	539.7 ± 140.7	521.2 ± 106.7	474.8 ± 43.7
Calcium	153.8 ± 43.5	191.4 ± 8.9	184.5 ± 11.4	163.4 ± 28.2
Magnesium	91.3 ± 29.9	91.3 ± 40.3	90.4 ± 38.2	88.6 ± 35.3
Chlorides	175.1 ± 67.4	153.7 ± 16.9	176.7 ± 69.1	172.9 ± 71.1
Alkalinity	473.1 ± 71.6	398.2 ± 22.1	403.3 ± 24.2	365.3 ± 137.3
Sulphate	182.9 ± 52.0	128.8 ± 113.6	205.8 ± 93.5	166.6 ± 71.9
Phosphate	0.55 ± 0.04	0.12 ± 0.12	0.06 ± 0.04	0.44 ± 0.66
Sodium	54.0 ± 43.7	36.7 ± 2.5	36.3 ± 14.7	38.3 ± 12.0
Iron	3.72 ± 1.02	3.95 ± 1.59	3.23 ± 2.88	5.05 ± 4.15
Lead	BDL	0.06 ± 0.06	0.02 ± 0.01	0.13 ± 0.07
Coliform MPN/100 mL	25	BDL	BDL	45
Total Coliform SPC/mL	200	BDL	BDL	250

Values are mean ± standard deviation; All values are in mg/L except pH otherwise stated.

plate count method used for enumeration of microorganisms. In the present study it ranged in ground waters from 200/mL to 250/mL respectively.

CONCLUSION AND RECOMMENDATIONS

It is significant to note that the quality of ground water is deteriorated in the industrial area of Kolhapur city. This is mainly because of percolation of sewage and industrial effluents constantly through surface water in rainy season. Therefore, it is advisable that the constant monitoring and treatment of ground water is essential, as prerequisite for use of this water for drinking purpose. If, this is not feasible, it is recommended that this water be used only for industrial purposes. Because of excessive amounts of iron, sodium, calcium, magnesium and hard nature of water, it is not suitable for drinking purpose.

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