Nature Environment and Pollution Technology © Technoscience Publications	Vol. 7	No. 2	pp. 261-266	2008

SEASONAL VARIATIONS IN DRINKING WATER QUALITY OF SOME BOREWELL WATERS IN URBAN AREA OF KOLHAPUR CITY

H. V. Vyas and V. A. Sawant
Department of Zoology, S. M. Dr. Bapuji Salunkhe College, Miraj, Maharashtra, India
Department of Zoology, Shivaji University, Kolhapur-416 004, Maharashtra, India

ABSTRACT

Present study has been made to investigate seasonal variations of water quality parameters in drinking water from some borewells in Kolhapur city. The samples were collected during the year 2005-2006 in summer, rainy and winter seasons. The water samples were analysed for various parameters such as pH, E.C., dissolved oxygen, alkalinity, chloride, total dissolved solids (TDS), total hardness, calcium, magnesium and sulphate etc. Certain parameters were higher than the permissible limit recommended by World Health Organisation (WHO) and BIS. The Study revealed significant changes in water quality during different seasons of in a year.

INTRODUCTION

Water is most important single substance for man's survival. Ground water is a major source of freshwater, which fulfils about 97% of freshwater requirements (Hussain & Ikbal 2003). During several decades ground water quality has emerged as one of the most important and confronting environmental issues (Kumar 2003). The quality of water is main concern for mankind since it is directly related to human welfare. Underground water quality depends upon geological origin and presence of chemical substances as studied by number of workers (Garg 2003, Narashima Prasad & Mansoor 2005).

Kolhapur is agro-industrial city suffering from severe pollution problem. The developmental activities in major sectors such as industries, transportation, agriculture, etc. are polluting the surface and ground waters. Ground water is highly susceptible to pollution from natural as well as anthropogenic activities. Other factors which may contribute to ground water pollution are geological formation, climate, depth of water table, soil texture and filtration rate etc. (Garg 1999). In certain areas of Kolhapur city, due to irregularity and less water supply from Kolhapur Municipal Corporation and non-availability of other water sources, borewell water is used to a large extent for domestic and drinking purposes. But these days the underground water quality is deteriorated because of domestic waste and industrial effluents. According to WHO about 80% of water pollution in developing countries like India is caused by domestic waste.

The present study is an attempt to estimate the seasonal variation in drinking water quality of borewell waters in Kolhapur city.

MATERIALS AND METHODS

The samples from scattered but selected borewells of Kolhapur city were taken in pre-cleaned 2-L plastic cans for assessment of drinking water quality during summer, rainy and winter seasons of year 2005-2006. Parameters like pH, electrical conductivity, total dissolved solids, alkalinity, chloride, hardness, calcium, magnesium, sodium, dissolved oxygen, and sulphate etc. were estimated by using standard methods (APHA 1998) and Trivedy & Goel (1986).

STUDY AREA

Kolhapur is located in south Maharashtra at an altitude of about 550 meters above MSL at latitude 16'84° N and longitude 74'81° east. The study area selected for ground water analysis is residential area. In urban area the solid waste dumps and domestic wastes near water sources contaminate the ground water. To study the drinking water quality and nature of pollutants in water, the four representative sampling sites of borewells were selected.

RESULTS AND DISCUSSION

The results of the study are given in Figs. 1 to 11. The pH value varied from 6.93 to 7.24, 7.49 to 7.89 and 6.82 to 7.11 in summer, rainy and winter seasons respectively. pH is very important in regulation of enzyme system. The sampling sites show distinct variation of pH in different seasons of the year. The pH was found to be maximum in all sites during rainy season and minimum in winter season. The observed pH values in all the sampling sites are within the prescribed limit of WHO and BIS (6.5 to 9.2).

Dissolved oxygen also fluctuated in ground water samples. The maximum dissolved oxygen was observed during rainy season (4.60 to 5.27 mg/L) (Fig. 4), which might be due to percolation of rain water. The rain water is rich in DO content. The minimum dissolved oxygen was observed during summer season ranging from 2.42 to 2.63 mg/L. Rising temperature causes low solubility of oxygen resulting in the decrease of DO content during summer season (Gyananath et al. 2000).

EC is an excellent indicator of TDS, which is a measure of salinity that affects the taste of potable water (WHO 1984). In the present study EC was maximum in summer season (652 to 920 µmhos/cm), and minimum in winter season (480 to 667 µmhos/cm) (Fig. 2). The variation in EC is also based on sedimentary structure and composition of rocks. These findings very well agree with the results of Muralidhar & Raju (1991) and Gyananath et al. (2000) in Nanded region.

Seasonal variation of TDS in ground waters, observed in the study area, shows that it increased during summer season in all the four sites (Fig. 3) ranging from 474.25 to 631.75. It decreases during winter season (mean value ranges between 331 and 458 mg/L). It is in close agreement with Gyananath et al. (2000) and Prajapati & Mathur (2002). The maximum permissible limit of total dissolved solids is 500 mg/L according to WHO standard. The TDS value in all the sites are beyond permissible level in summer season. Water containing high TDS concentration may cause laxative or constipation effects (Kumarasamy 1989).

The total hardness of the ground water samples varied from 216 to 412 mg/L in summer season, 168 to 364 mg/L in rainy season and 162 to 354 mg/L in winter season. Maximum value was recorded during summer season in site D (462 mg/L) in month of May, and minimum value during winter season (162 mg/L) in site B in the month of December (Fig. 5). The BIS and WHO permissible limit of total hardness in drinking water is 300 mg/L. From the observations it is evident that the higher hardness value in summer season is mainly attributed to rising temperature thereby increasing the solubility of calcium and magnesium salts (Garg 2003). The total hardness values of all sampling sites are below the permissible limit.

The calcium concentration in the present study area ranged from 63.55 to 98.05 mg/L in summer season, and 37.55 to 76.66 mg/L in winter season (Fig. 6). According to WHO and BIS, permissible limit of calcium is 75 mg/L.

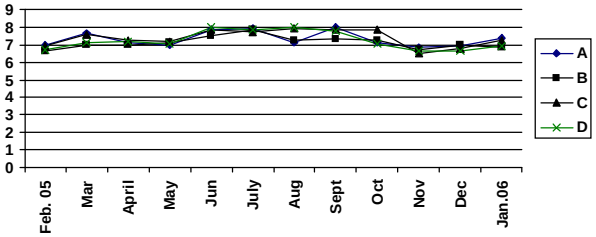

Fig. 1: Monthly mean values of pH.

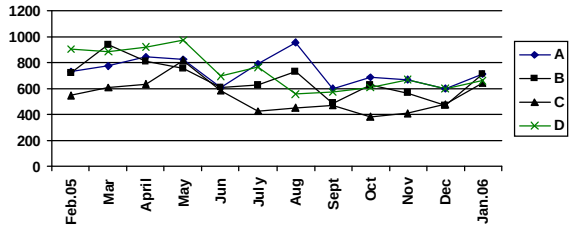

Fig. 2: Monthly mean values of electric conductivity.

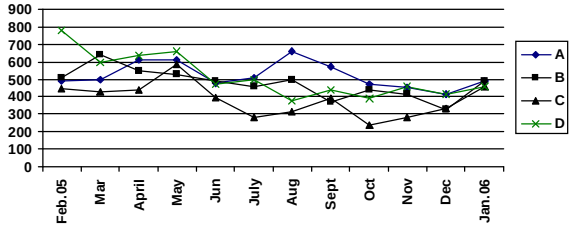

Fig. 3: Monthly mean values of TDS.

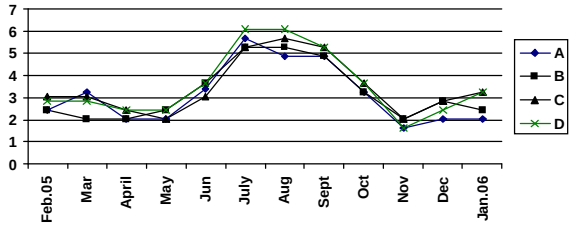

Fig. 4: Monthly mean values of DO (dissolved oxygen).

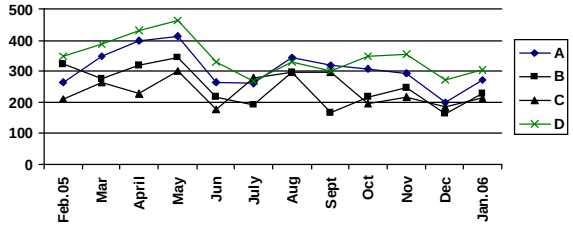

Fig. 5: Monthly mean values of total hardness.

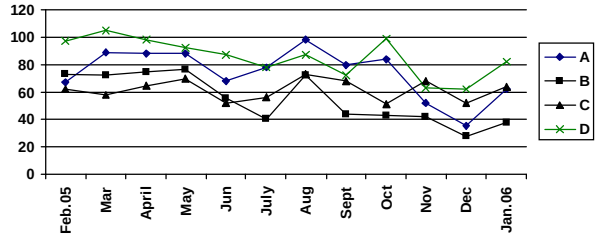

Fig. 6: Monthly mean values of calcium.

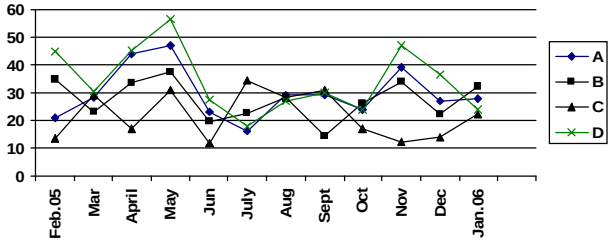

Fig. 7: Monthly mean values of magnesium.

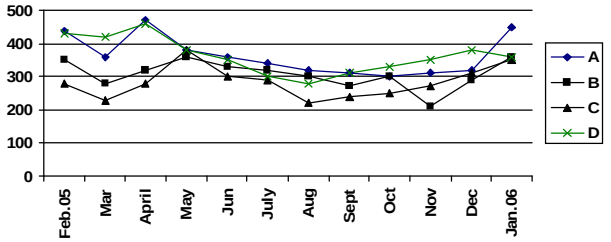

Fig. 8: Monthly mean values of total alkalinity.

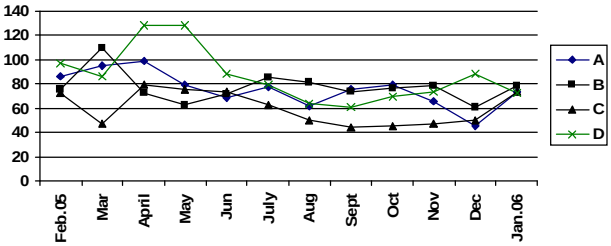

Fig. 9: Monthly mean values of chloride.

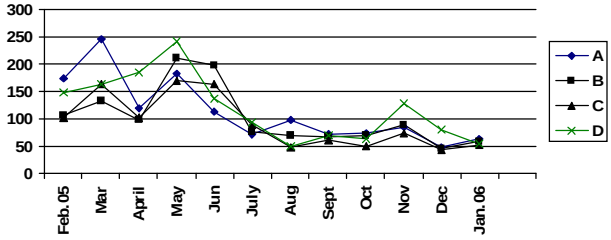

Fig. 10: Monthly mean values of sulphate.

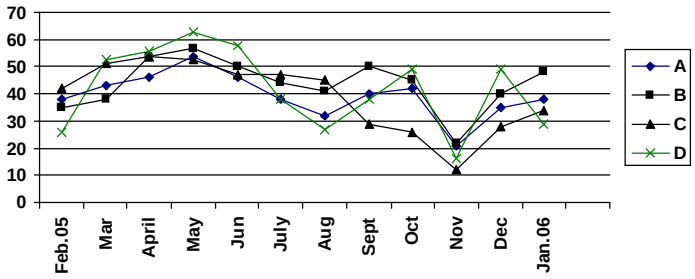

Fig. 11: Monthly mean values of sodium.

In all sampling sites the calcium content was found above permissible limit at some sites. The varying level of calcium content in water sample of different sampling sites as observed in the present study is in close agreement with Dasgupta & Purohit (2001). The excess calcium in the human body causes hypercalcemia, coma and death (Dasgupta & Purohit 2001).

The magnesium content in study area was found from 26.28 to 44.33 mg/L, 20.95 to 25.59 mg/L and 16.25 to 31.04 mg/L in summer, rainy and winter seasons respectively. The amount of Mg in water samples was low as compared to the amount of Ca in water. Mg was maximum in summer season, and minimum in rainy season (Fig. 7). The amount of Mg was low in rainy season indicating possible increase in water table (Scanton 1989, Hoyle 1989, Gyananath et al. 2000). The magnesium content in many sampling sites was above the permissible limit of 30 mg/L. The observed result is in close agreement with Patil et al. (2002) in Bhusawal town in Maharashtra.

The sodium content in drinking water was found to be 45.25 to 52.5 mg/L in summer season, and 25 to 38.75 mg/L in winter season (Fig. 11). The prescribed limit of sodium (250 mg/L) was suggested by WHO. The sodium content in borewell water observed in the present study is within the permissible limit.

The chloride in the study area ranges from 68.65 to 109.69 mg/L in summer season, and 50.75 to 73.13 mg/L in winter season (Fig. 9). During summer season highest value of 109.34 mg/L was recorded at site B, and minimum value of 47.20 mg/L at site C. The WHO and BIS recommended limit of chloride as 250 mg/L. From the observed results, the chloride content in ground water was below the permissible limit of WHO and BIS standards. The excess sodium and chloride in drinking water may induce heart failure (Brooker & Johnson 1984) and hypertension (Hussain & Ikbal 2003).

Alkalinity values were recorded in the range of 295 to 417 mg/L in summer season, and 262.5 to 332.5 mg/L in rainy season. The alkalinity was maximum in summer season and minimum in rainy season (Fig. 8). According to the WHO and BIS standards permissible limit of alkalinity is 200 mg/L. The higher value of alkalinity indicate presence of bicarbonate, carbonate and hydroxide in water body (Jain et al. 2000). The maximum values during summer season can be attributed to the maximum salts in bore water. The sewage or domestic wastes are source of organic matter. Decomposition of organic matter by microbes leads to formation of CO_2 in water, which increases the concentration of carbonate and bicarbonate increasing the level of alkalinity in water. Decrease in alkalinity was observed in rainy season which may be due to dilution effect. Percolation of rain water dilutes the salt content in water.

In the present study sulphate concentration was observed is in the range of 134.5 to 209 mg/L in summer, 54.75 to 81.25 mg/L in winter and 88 to 103 mg/L in rainy season (Fig. 10). Sulphate content at all the sampling sites was found to fall within the BIS permissible limit of 150 mg/L in all the seasons.

CONCLUSION

Analysis of physico-chemical parameters like pH, dissolved oxygen, electrical conductively, total dissolved solids, total hardness, calcium, magnesium, sodium, chloride, alkalinity and sulphate content of water from four bore wells of urban area were carried out in summer, rainy and winter seasons during 2005-2006. All physico-chemical parameters such as electrical conductivity, TDS, total hardness, calcium, magnesium, sodium, chloride, alkalinity and sulphate showed higher values in summer season. pH and dissolved oxygen were maximum in rainy season.

Thus, it can be concluded on the basis of these studies that physico-chemical characteristics of water samples was influenced by seasonal variations.

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