Physiochemical Analysis of Ground Water of Selected Area of Kaithal City (Haryana) India

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ABSTRACT: Ground water samples were collected from different locations in the radius of 25 km. of Kaithal city, Haryana(India). These water samples from 20 sampling points of Kaithal were analyzed for their physicochemical characteristics. Laboratory tests were performed for the analysis of samples for pH, Colour, Odour, Hardness, Chloride, Alkalinity, TDS etc. On comparing the results against drinking water quality standards laid by Indian Council of Medical Research (ICMR) and World Health Organization (WHO), it is found that some of the water samples are non-potable for human being due to high concentration of one or the other parameter. The usefulness of these parameters in predicting ground water quality characteristics were discussed. Thus an attempt has been made to find the quality of ground water in and around Kaithal City town, suitable for drinking purposes or not. [Researcher. 2009;1(2):1-5]. (ISSN: 1553-9865).

Key Words: Water quality parameters, physiochemical study, pollution study, drinking water.

INTRODUCTION

The quality of ground water depends on various chemical constituents and their concentration, which are mostly derived from the geological data of the particular region. Ground water occurs in weathered portion, along the joints and fractures of the rocks. In fact, industrial waste and the municipal solid waste have emerged as one of the leading cause of pollution of surface and ground water. In many parts of the country available water is rendered non-potable because of the presence of heavy metal in excess. The situation gets worsened during the summer season due to water scarcity and rain water discharge. Contamination of water resources available for household and drinking purposes with heavy elements, metal ions and harmful microorganisms is one of the serious major health problems. The recent research in Haryana(India)[1] concluded that it is the high rate of exploration then its recharging, inappropriate dumping of solid and liquid wastes, lack of strict enforcement of law and loose governance are the cause of deterioration of ground water quality. Thus there is a need to look for some useful indicators, both chemical and physical, which can be used to monitor both drinking water operation and performance. Kaithal City area comprises different types of Archaeancrystalline formations. At present there is no major industry in and around the study area, yet household waste water and garbage (municipal sewage) are directly discharged into the area. The water supply for human consumption is often directly sourced from ground water without biochemical treatment and the level of pollution has become a cause for major concern. The water used for drinking purpose should be free from toxic elements, living and non-living organisms and excessive amount of minerals that may be harmful to health. Keeping this in focus, the quality aspects of ground water in Kaithal City area were analyzed for general water quality. Hence, it is highly essential to examine the presence of toxic substances in distribution water for potable purpose before it is used for drinking.

EXPERIMENTAL

Sample collection

Water samples from the selected sites were collected during Sept2007-March 2008 and taken in pre-cleaned polyethylene bottles. The samples after collection were immediately placed in dark boxes and processed within 6 h of collection.

Physico-chemical analysis

The collected samples were analyzed for major physical and chemical water quality parameters like pH**,** Electrical conductivity (EC), Total Dissolved solids (TDS), total hardness (TH), Ca^{2+}**,** Mg^{2+}, as per the method Assessment of Ground Water Quality described in "Standard methods for the examination of water and wastewater American Public Health Association (APHA)[2].The parameters present in the water sample can be calculated by using various methods[3-4] . The pH of all the water samples was determined

using a pH meter(Model no 101 E, Systonic). Electrical conductivity was measured using a conductivity meter. The chloride, total hardness and total alkalinity were estimated by the standard methods of water and waste water[5-7].

RESULTS AND DISCUSSION

A total of 20 water samples from hand pumps, tube wells and Govt. supply used by people of Kaithal City were collected in clean polythene bottles and brought to the laboratory. The samples were chemically preserved by the addition of 3-5 ml concentrated HNO_3 per litre of the sample. The temperature, pH, conductivity and dissolved solids of the water samples were determined on the spot using a thermometer; pH meter, conductometer and TDS meter. Various standard methods (APHA-AWWA-WPCF, 1995; HMSO, 1986)[2] were used for the determination of other parameters. Total alkalinity was determined by visual titration method using methyl orange and phenolphthalein as indicator. Total hardness and calcium were measured by EDTA titrimetric method using EBT indicator respectively. Chloride was determined by Argentometric method using potassium chromate indicator. The chemical data were complied further to know location wise distribution. The data revealed that there were considerable variations in the examined samples from different sources with respect to their chemical characteristics. The results indicate that the quality of water considerably varies from location to location. The underground water is characterized by a relatively constant pH of around 6.0 and 6.9 in the samples collected from Friends Colony and HCTM College. Water sample with low pH(6.0) attributed to the discharge of acidic water into these sources by the agricultural and domestic activities. Samples collected form the Sampling points Sector 20 Area (8.23) and Old Anaj Mandi Area(7.38) were slightly basic which can be seen from its pH and alkalinity values. In fact 98% of all world ground water are dominated by Calcium and bicarbonate ions due to lime stone weathering in the catchments and under ground water beds[3]. In water buffered by the presence of bicarbonate, carbonate and hydroxyl ions, this temperature effect is modified. Though pH has no direct effect on the human health, all the biochemical reactions are sensitive to variation of pH. For most reaction as well as for human beings, pH value 7.0 is considered as best and ideal. In the present study pH value of water samples varied in a narrow range within the permissible limits in all sources. The pH is of the utmost importance in determining the corrosivity of water. In general, the lower the value of pH, the higher the level of corrosion. It has been observed that in some cases decrease in pH is accompanied by the increase in bicarbonate, carbonate and hydroxyl ions. Decrease in pH can be caused by the increase in the amount of organic carbon, total carbonate by the use of sewage.

pH was positively correlated with electrical conductance and total alkalinity. The EC values were found higher at Sector 20 Area due to concentrated colloids in canal water and dissolved salts in Old Anaj Mandi. Very low conductivity was found at sampling points Chandana gate & Vashno Mata Mandir Area. The values of salts such as Ca, Mg, Cl^- and SO_4^{2-} suggested that the surface water sources posses' very low components, while underground water sources which are far away from surface ground water or Dam water source were found to possess higher amounts of components. Conductance is a function of water, hence a standard temperature, usually 25^0C, is specified in reporting conductivity. Higher the concentration of electrolytes in water the more is its electrical conductance.

In the present study, electrical conductance was highest in water sample of by Karnal By pass area and Sector 20 Area. It is well known that the conductance of water increases with salts. Total dissolved solids and conductivity can be used to delineate each other. Conductivity is proportional to the dissolved solids. Both showed analogous trend in seasonal variation[3].

The water samples from Chandana gate, Nursing Colony Area, Anaj Mandi area and old Anaj mandi Area were found to possess high TDS value when compared with the tolerance limit of 1500 ppm. Among this, the water sample from near old Anaj mandi Area having TDS in the order of 2900 ppm. The TDS was found to be low for the water samples collected from the Friends Colony and HCTM College. Samples from the sources Public Club Area, Hospital Area and water Works area showed low level of TDS of the range less than 250 ppm, which indicates that the recharging of under ground water through either rain water or by the water from near by canals.

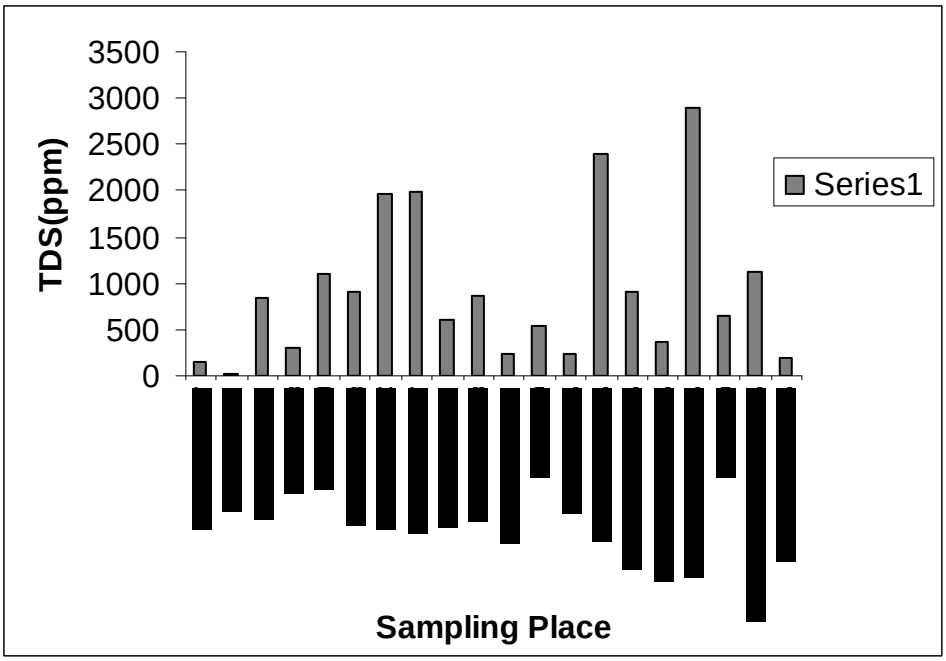

Figure: 1 TDS (ppm) values of various water samples collected in Kaithal City

The possibilities of dissolution of rockery minerals are very low. The Dissolved Oxygen of the water samples varies from 4.0 to 8.8 ppm from the all sampling locations.

Alkalinity in terms of HCO_3^- of all these water samples ranged from 0.0- 1930 mg/L respectively. Chloride contents of these water samples ranged from 35-875 mg/L respectively. Calcium of water samples ranged from 25- 425 mg/L, respectively. Magnesium content of all water samples ranged from 35-485 mg/L. Total alkalinity is a measure of the ability of the water to neutralize acids. The constituents of alkalinity in neutral system include mainly carbonate, bicarbonate, hydroxide and other components which may contribute to alkalinity are $H_2BO_3^{2-}$, HPO_4^{2-} and HS^-. These compounds result from dissolution mineral substances in the soil and atmosphere [4-6].

Alkalinity is a big problem for industries also, as alkaline water if used in boilers for steam generation may lead to precipitation of sludge, deposition of scales and cause caustic embrittlement. This study also indicates that any industry establishment in this area must have alkalinity treatment plant prior to use of ground water or should go for some alternate water source.

Water hardness is the traditional measure of the capacity of water to react with soap, hard water requiring considerably more soap to produce lather. Hardness is one of the very important properties of ground water from utility point of view for different purposes. In the present study water was very hard and crossed the permissible limits. It is well known that hardness is not caused by a single substance but by a variety of dissolved polyvalent metallic ions, predominantly calcium and magnesium cation, although other cation likes barium, iron, manganese, strontium and zinc also contribute. The high concentration of total hardness in water samples may be due to dissolution of polyvalent metallic ions from sedimentary rocks, seepage and run off from soil. As we know calcium and magnesium, are the two principal ions. The concentration of total hardness in drinking water sources ranged between 75 and 1110 mg/L (Nawlakhe; 1995)[7], (Sastry *et al*)[8] also reported water samples from ponds, wells and hand pumps were very hard ranging from 222.8-1094.4 mg/L. In old Anaj Mandi Area tube well and well water showed high concentration of total hardness.

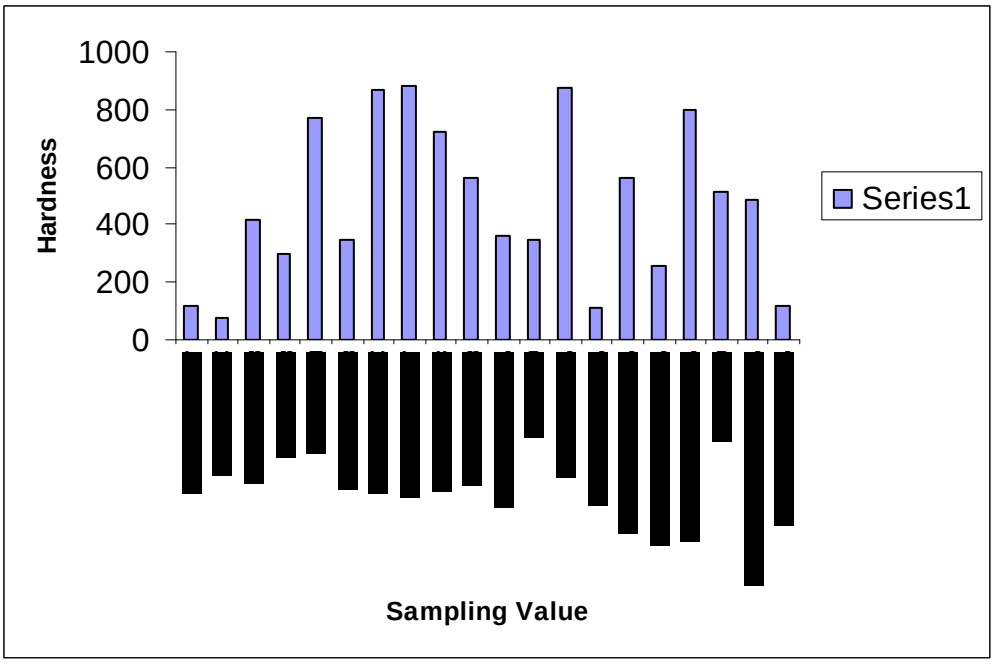

Figure: 2 Hardness (ppm) values of various water samples collected in Kaithal City Town

In the present study total hardness was positively correlated with fluoride, chloride, calcium and magnesium. The strong correlation-ship between these parameters could be due to changes in land use namely deforestation, disruption in internal sources of hardness and alkalinity, climatic factor or industrialization.

As calcium and magnesium are directly related to hardness and hence combined in discussion. The acceptable limits for calcium and magnesium for domestic use are 75 ppm and 30 ppm, respectively, in ground water. Whereas in case of non-availability of water sources, calcium up to 200 ppm could be accepted.

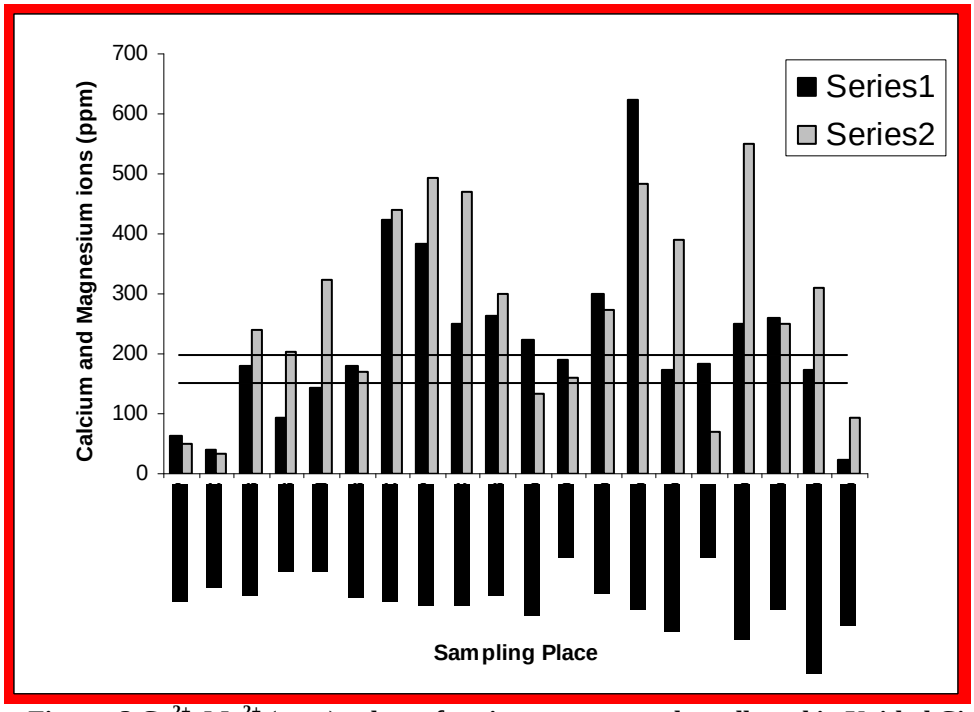

Figure: 3 Ca^{2+}, Mg^{2+} (ppm) values of various water samples collected in Kaithal City

Chloride ions are very high in water of Anaj mandi area and very less in HCTM water sample. The results are given in figure 4

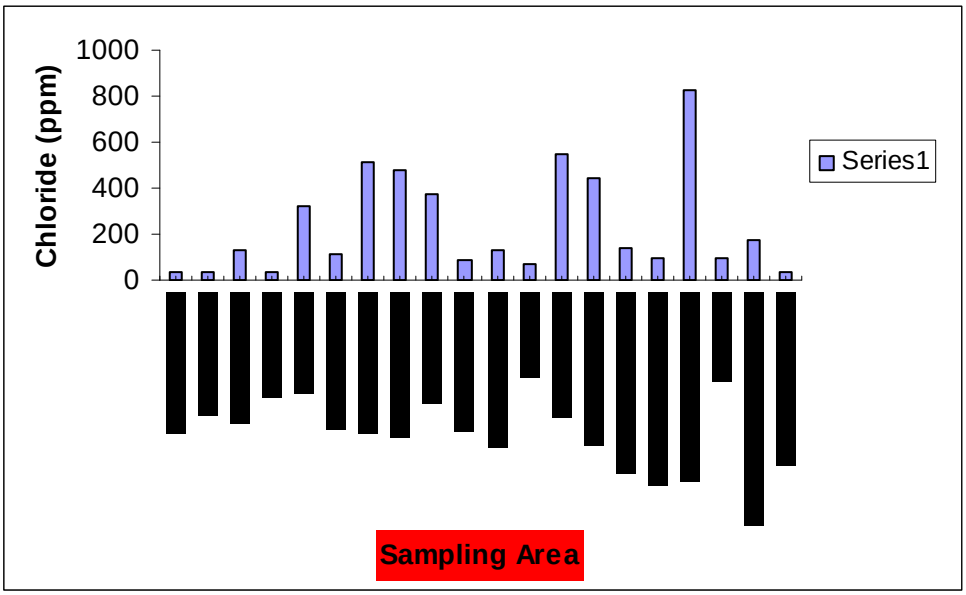

Figure: 4 Chloride (ppm) values of various water samples collected in Kaithal City.

Conclusions

The ground water which were taken from the various places of in and around Kaithal City town were analyzed and the analysis reports that the water quality parameters like pH, EC, Cl^-,TDS ,Ca^{2+}, Mg^{2+} and Hardness lies within the maximum permissible limit prescribed by WHO and ICMR. Except few parameters like DO, few samples were reported with lower DO than the permissible level, but this value does not have any impact for the water to use for drinking purpose. ***According to this report, the ground water in and around HCTM College, Water Works Area are suitable for drinking, agriculture and industries and really it is not harmful to human beings.***

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