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Monitoring of Heavy Metal Concentration in Groundwater of Hakinaka Taluk, India

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Abstract: In the present investigation, the heavy metal concentration such as iron, zinc, copper, lead and chromium, cadmium, arsenic and nickel in the ground water samples of the study area caused by natural and anthropogenic activities are studied.

Keywords: groundwater, Zinc, Harihar taluk, heavy metals

INTRODUCTION

Heavy metals designate a group of elements that occur in natural system in minute concentration and when present in sufficient quantities and are toxic to living organisms. The behavior of trace metals in groundwater is complicated and is related to source of group water and the bio-geochemical process in elemental conditions [1].Some metals are essential for normal functioning of the human body, whereas others are non-essential [2] Most of the metals are important for the growth, development and health of living organisms [3].

STUDY AREA: The state of Karnataka is situated in the southern peninsular India. Harihar is one of the taluk head quarters, situated about 18 km away from Davangere District (corporation city), Karnataka state.

PHYSIOGRAPHY : Harihar taluk is located between 14^0 30^1 E latitude and 75^0 53^1 N longitude. As a whole, the region has and dry and wet land also rocky areas with an average elevation of 700 mts above mean sea level. It comprises 85 villages with a total population of 1,35,804 as per 2001 census.

GEOLOGY : Harihar taluk has a geographical area of 995.45 Sq.kms. The taluk comes under granite and gneissic formation which is generally called as "hard rock terrain". However, green stone belt consisting of chlorite-schist, micaschist along with clay formations have been observed in the hard rock formations of this region.

RAINFALL: The average rainfall of Harihar taluk is 579.02mm. The taluk region receives rainfall mainly from Southwest monsoon and partially from North east monsoon with an annual rainfall season spreading over a period of five to six months

MATERIALS AND METHOD: The assessment of heavy metal concentration in ground water of study area was carried out for three seasons(Monsoon, Post monsoon and Premonsoon) in the year 2006-07.The 50 water samples are selected from identified borewells in the study areas and samples were collected in pre-cleaned black coloured carbuoys of 2litres capacity with necessary precautions. The sampling, preservation, digestion and preparations and the analysis of heavy metals in water samples are made as prescribed by standard methods of APHA 1998 using Atomic Absorptions Spectrophotometer (Perkin Elmer-403).

Table-1: Heavy metals Recorded in the Study Sites during the year: 2006-2007.

Location	**Heavy metals(mg/l)**							
	Fe	**Cd**	**Cr**	**Pb**	**Cu**	**Zn**	**Ni**	**As**
S-1	0.081	BDL	BDL	BDL	BDL	0.052	BDL	BDL
S-2	0.09	BDL	0.002	BDL	BDL	BDL	BDL	BDL
S-3	0.068	BDL	BDL	BDL	BDL	0.048	BDL	BDL
S-4	0.085	BDL	BDL	BDL	BDL	BDL	BDL	BDL
S-5	0.070	BDL	0.002	BDL	BDL	BDL	BDL	BDL
S-6	0.053	BDL	BDL	0.016	0.001	0.002	BDL	BDL
S-7	0.088	BDL	BDL	0.016	0.002	BDL	BDL	BDL
S-8	0.060	BDL	BDL	BDL	BDL	0.040	BDL	BDL
S-9	0.075	BDL	0.002	0.011	0.003	BDL	BDL	BDL
S-10	0.095	BDL	0.001	BDL	BDL	0.058	BDL	BDL
S-11	0.065	BDL	0.003	BDL	BDL	0.045	BDL	BDL
S-12	0.055	BDL	BDL	BDL	BDL	BDL	BDL	BDL
S-13	0.010	BDL	BDL	0.001	BDL	0.055	BDL	BDL
S-14	0.058	BDL	BDL	BDL	0.001	0.158	BDL	BDL
S-15	0.090	BDL	BDL	BDL	BDL	0.076	BDL	BDL
S-16	0.078	BDL	BDL	BDL	BDL	0.084	BDL	BDL
S-17	0.080	BDL	BDL	BDL	BDL	0.094	BDL	BDL
S-18	0.091	BDL	0.004	BDL	BDL	0.086	BDL	BDL
S-19	0.015	BDL	BDL	0.011	0.004	0.034	BDL	BDL
S-20	0.095	BDL	BDL	BDL	BDL	0.078	BDL	BDL
S-21	0.098	BDL	BDL	0.013	BDL	0.063	BDL	BDL
S-22	0.093	BDL	BDL	BDL	BDL	BDL	BDL	BDL
S-23	0.104	BDL	BDL	BDL	BDL	0.153	BDL	BDL
S-24	0.078	BDL	BDL	BDL	BDL	BDL	BDL	BDL
S-25	0.045	BDL	0.002	BDL	BDL	0.066	BDL	BDL
S-26	0.175	BDL	BDL	BDL	BDL	0.067	BDL	BDL
S-27	0.010	BDL	BDL	BDL	0.002	0.044	BDL	BDL
S-28	0.068	BDL	BDL	BDL	BDL	0.020	BDL	BDL
S-29	0.085	BDL	0.002	BDL	BDL	0.080	BDL	BDL
S-30	0.090	BDL	0.004	BDL	0.002	0.078	BDL	BDL
S-31	0.055	BDL	BDL	BDL	BDL	0.061	BDL	BDL

S-32	0.045	BDL	BDL	BDL	0.018	0.04	BDL	BDL
S-33	0.058	BDL	BDL	BDL	BDL	0.050	BDL	BDL
S-34	0.020	BDL	0.002	0.001	BDL	0.034	BDL	BDL
S-35	0.025	BDL	BDL	BDL	BDL	0.049	BDL	BDL
S-36	0.053	BDL	BDL	BDL	0.004	0.058	BDL	BDL
S-37	0.060	BDL	BDL	0.022	BDL	0.063	BDL	BDL
S-38	0.068	BDL	0.002	BDL	BDL	0.035	BDL	BDL
S-39	0.094	BDL	BDL	0.015	BDL	0.01	BDL	BDL
S-40	0.096	BDL	BDL	BDL	BDL	0.006	BDL	BDL
S-41	BDL	BDL	BDL	BDL	BDL	0.015	BDL	BDL
S-42	0.005	BDL	BDL	BDL	BDL	0.02	BDL	BDL
S-43	BDL	BDL	BDL	BDL	BDL	0.025	BDL	BDL
S-44	0.010	BDL	0.005	BDL	BDL	0.030	BDL	BDL
S-45	0.008	BDL	BDL	0.014	0.001	0.024	BDL	BDL
S-46	0.010	BDL	BDL	BDL	BDL	BDL	BDL	BDL
S-47	0.030	BDL	0.003	0.015	0.002	BDL	BDL	BDL
S-48	0.122	BDL	BDL	BDL	BDL	0.095	BDL	BDL
S-49	0.17	BDL	BDL	BDL	BDL	0.056	BDL	BDL
S-50	BDL	BDL	0.004	BDL	BDL	0.020	BDL	BDL

Note : BDL – below detectable level.

Table - 2 : Drinking Water Quality Standards (BIS, 1998)

Parameter	**BIS (1998)**	
	P(mg/l)	**E(mg/l)**
Iron	0.3	1.0
Zinc	5	15
Chromium	0.05	0.05
Copper	0.05	1.5
Cadmium	0.01	0.01
Lead	0.05	0.05

Nickel	-	0.02
Arsenic	0.05	0.05
Note : P-Permissible limit; E-Excessive limit.		

RESULTS AND DISCUSSION:

The findings of the present investigation are summarized in table-1 and was also been compared with drinking water standards (Table -2), which provides the comprehensive picture of the heavy metals characteristics of groundwater in the study area.

Iron (Fe) : It is the fourth most abundant element by mass in the earth's crust. In water, it occurs mainly in the ferrous and ferric state. Iron in surface water generally present in ferric state. It is an essential and non-conservative trace element found in significant concentration in drinking water because of its abundance in the earth's crust. Usually iron occurring in ground water is in the form of ferric hydroxide, in concentration less than 0.5 mg/l. The shortage of iron causes a disease called "anemia" and prolonged consumption of drinking water with high concentration of iron may lead to liver disease called as haermosiderosis [6].

In the present study, the iron content varied from a minimum of BDL to a maximum of 0.175mg/l. The values of iron were within the permissible limit of BIS drinking water standards. The BIS acceptable limit for iron is 1 mg/l.

Zinc (Zn) : Zinc is one of the important trace elements that play a vital role in the physiological and metabolic process of many organisms. Nevertheless, at higher concentration, zinc can be toxic to the organisms. It plays an important role in protein synthesis. Zinc is a metal which shows fairly low concentration in surface water, which is due to its restricted mobility from the place of rock weathering or from the natural sources [7].The permissible limit of zinc in water is 0.5 mg/l.

In the present study, the concentration of zinc ranged between a minimum of BDL and a maximum of 0.153 mg/l. The values of zinc are showed within the limit of drinking water standard.

Cadmium (Cd) : It is not an essential non-beneficial element known to have a toxic potential. The concentration of cadmium in lithosphere is low. It normally ranges from 1×10^{-4} to 2×10^{-4} mg/l. The main sources of cadmium are industrial activities as the metal widely used in electroplating, pigments, plastic, stabilizes and battery industries. Cadmium is highly toxic and responsible for several cases of poisoning through food. Small quantities of cadmium cause adverse changes in the arteries of human kidney. It replaces zinc biochemically and causes high blood pressures,

kidney damage and etc. It interferes with enzymes and causes a painful disease called Itai-itai. Cadmium concentrations in groundwater of the study area are below the detectable level. Nevertheless, cadmium in low concentration is quite toxic to human health [8].

Chromium (Cr) : It is an essential micronutrient for animals and plants. Chromium is considered as a relative biological and pollution significance clement. Generally the natural content of chromium in drinking water is very low ranging 0.01 to 0.05 mg/l except for regions with substantial chromium deposits [9].

In the present investigations, the chromium concentration is below detectable level in most of the bore well samples. However, the concentration of chromium wherever recorded is well within the limits of drinking water standards prescribed by BSI and WHO.

Lead (Pb) : It is an undesirable trace metal less abundantly found in earths crust. Read is also found in soil, vegetation, animals and food. It is a serious cumulative body poison. Lead inhibits several key enzymes involved in the overall process of haemo-synthesis whereby metabolic intermediate accumulates [10]. The study revealed that the concentration of lead is below the detectable level in most of the borewell samples. However the concentration of lead observed is within the safe limit of BIS (1998).

Copper (Cu) : It is one of the essential elements for human beings. It is widely distributed metal in nature. Copper can exist in aquatic environment in three forms namely soluble, colloidal and particulate. It is found in less quantity as an essential element for organisms. Excess of copper in human body is toxic and causes hypertension and produces pathological changes in brain tissues. Excessive ingestion of copper is responsible for specific disease of the bone [11]. In the present study, the concentration of zinc ranged between a minimum of BDL and a maximum of 0.020mg/l. The values of copper are showed within the limit of drinking water standard.BIS limit for copper is 1.5 mg/l.

Nickel (Ni): Nickel occurs in natural water as a divalent cation with pH range between 5-9. Nickel is a natural element of the earth's crust; therefore, small amounts are found in food, water, soil and air. Nickel occurs naturally in the environment at low levels. Nickel is used for nickel alloys, electroplating, machinery parts, stainless-steel, spark plugs and also as catalysts. Nickel is found in ambient air at very low levels as a result of releases from oil and coal combustion, nickel metal refining, sewage sludge incineration and other sources. Nickel in general, is associated with basic and ultra basic rocks . Nickel dermatitis, consisting of itching of the fingers, hands and forearms, it the most common effect in humans from chronic skin contact with nickel. However, nickel concentration in ground water of the study area is below the detectable level.

Arsenic (As) : It is a toxic non-essential element and occurs widely in nature. It commonly occurs in insecticides, fungicides and herbicides. Among its components,

arsenic (III) is most toxic. The main sources are pharmaceutical, paper, pulp and glass industries. High concentration of arsenic (III) compounds causes metabolic disorder. It also causes dermatitis and the irritation of upper respiratory passage, ulceration and perforation of nasal septum, lung cancer. However, the arsenic concentration in ground water of the study area is below the detectable level [8].

CONCLUSION:

In the present investigation, the heavy metal concentration such as iron, zinc, copper, lead and chromium are well within the permissible limits prescribed by the BIS standards. However, the concentrations of cadmium, arsenic and nickel in the ground water samples of the study area were found to be below detectable level.

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