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Heavy metal toxicity in ground water of Khajuwala area Located in Bikaner division of western Rajasthan

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ABSTRACT

Concentration of heavy metals such as Mn, Pb, Zn, Fe, Co, Mo, Cr & Al together with Na & K in 16 water samples were estimated by AAS and flame photometer respectively in the month of Jan 2006. Fe, Pb and Na metals were found over the permissible level for drinking use (0.1-1.0, 0.05 and 175 ppm respectively) in well water of Khajuwala located in western region of Rajasthan. The highest concentration found was 1.22, 0.96 and 922 ppm for Fe, Pb and Na metal respectively. These results indicate that the water is not suitable for drinking purpose as well as for domestic purpose.

Key words: Ground water quality, heavy metal, Khajuwala, Rajasthan.

INTRODUCTION

With the rise in population and steady growth of industries, the demand of ground water has increased. Although the Indira Gandhi canal water is utilized for irrigation and drinking, ground water is the sole resources of drinking water for local population in major region of Bikaner district[1].

Most of the ground water sources are still supposed to be safe but once, source is contaminated, then practically it would be very difficult to clean that up. Ground water department , public health and engineering department (PHED), agriculture department and other government and private organizations measure the quality of ground water on the basis of some limited parameters only like pH, electrical conductivity (E C) total hardness, TDS, DO, BOD, COD, Cl^-.SO_4^{2-}, NO_3^-, CO_3^{2-}, HCO_3 Ca^{2+}, Mg^{2+}, Na^+ and K^+ etc. for ensuring the suitability of water for drinking, domestic agricultural purpose but some other ions, if present in lagre amount in water, also affect the quality of water and make water unfit for drinking, domestic, industrial and agricultural purpose.

The present study has been carried out to evaluate the heavy metal along with Na^+ and K^+ ions in ground water of Khajuwala and near vicinity, located in Bikaner division of Rajasthan state.

EXPERIMENTAL

16 ground water sample were collected form the different station of Khajuwala and surrounding area. The samples were collected during the months of Jan 2006. Samples were collected in sterilized bottles using standard method[2].

AAS method has been used for the determination of heavy metal and flame photometric method[3-4] was used for sodium and potassium.

Water analysis result

The results of well water samples from Khajuwala are presented in Table -1 and Fig. 1.

RESULT AND DISCUSSION

The effect of some ions on the nature of

Table - 1: Heavy metals (together with Na & K) in ground water

Metal	Water samples															
ion	1**	2**	3*	4**	5*	6**	7**	8*	9*	10**	11**	12*	13**	14**	15**	16**
K^+	79	61.02	5.4	65.05	10.6	60	16.06	5.6	10.6	54	18.05	11.06	28.1	31.5	74.9	47.2
Na^+	237.6	195	59.1	281.2	49.1	121.3	276.1	99.01	164.1	221.5	357	189.01	922	661	815.6	802
Mn	0.16	0.12	0.01	0.15	0.09	0.12	0.1	0.09	0.03	0.12	0.19	0.04	0.09	0.1	0.15	0.1
Pb	0.64	0.6	0.05	0.21	0.96	0.36	0.75	0.16	0.1	0.1	0.88	0.12	0.56	0.38	0.1	0.14
Zn	0.79	0.85	0.15	0.35	0.18	0.89	0.25	0.2	0.18	0.3	0.79	0.1	0.18	0.03	0.09	0.12
Fe	1.2	1.13	0.8	1.2	1.22	1.2	1.3	0.26	0.62	1.13	0.96	0.3	0.46	0.7	0.43	0.18
Co	0.06	0.08	0.06	0.06	0.03	0.13	0.15	0.01	0.05	0.14	0.11	0.03	0.01	0.02	0.01	0.11
Mo	0.15	0.21	0.06	0.21	0.16	0.11	0.2	0.31	0.29	0.46	0.23	0.3	0.4	0.41	0.33	0.2
Cr	0.11	0.11	0.02	0.02	0.04	0.16	0.14	0.12	0.1	0.19	0.02	0.1	0.02	0.12	0.11	0.1
Al	0.15	0.12	0.07	0.12	0.07	0.12	0.1	0.09	0.1	0.15	0.1	0.09	0.1	0.19	0.17	0.16

** tube-well water sample* *** hand-pump water sample*

water can be visualized as follows :

The application of fertilizers and insecticides introduce large quantities of nitrogen phosphate and potassium in water acquifers through leaching.

A nitrogenous material in sewage also causes serious water pollution. In experimental water samples, the amount of potassium was found to vary from 5.4-79 ppm.

Sodium is present in water, specially in sea water and deep aquifer systems. Source of sodium into water include weathering of igneous rocks, dissolution of salt deposits and exchange reaction between the calcium ion present in water and the sodium ions absorbed by particles of clay. It controls inter cellular and intra cellular osmosis discharge and maintains pH balance of blood with in the body and controls normal activities of muscles and nerves. In the present work sodium in drinking water is found from 49.1 to 815.6ppm, which is more than the maximum permissible limit(~175ppm) as prescribed by WHO and other organizations.

Manganese enters the water bodies through domestic wastes, industrial effluents and dry cell batteries. It is lethal to man in higher concentration. Its chronic exposure leads to neurological disorder[5]. In the present study, value of manganese in drinking water varies from 0.01 to 0.19, which is found in permissible limit (0.10-0.50 ppm).

Lead is a toxic ion, it has deleterious effect on gastrointestinal, renal, nervous and hemopeitic system[6]. Lead poisoning is serious, sometimes present fatal. Pregnant and young children are more susceptible for lead poisoning[7]. In the present observation, lead is found to be 0.05-0.96 mg/L, which is greater than the prescribed limit (0.05 ppm)

Major minerals having zinc are zinc blend, zincite and calamine. In nature, it is found in only one oxidation state *i.e.* +2, the same state is also found to be present in water. Concentration of zinc in the higher side of maximum desirable limit (5-15 ppm), causes vomiting and renal damage[8]. Zinc supplementation ameliorates lead induced

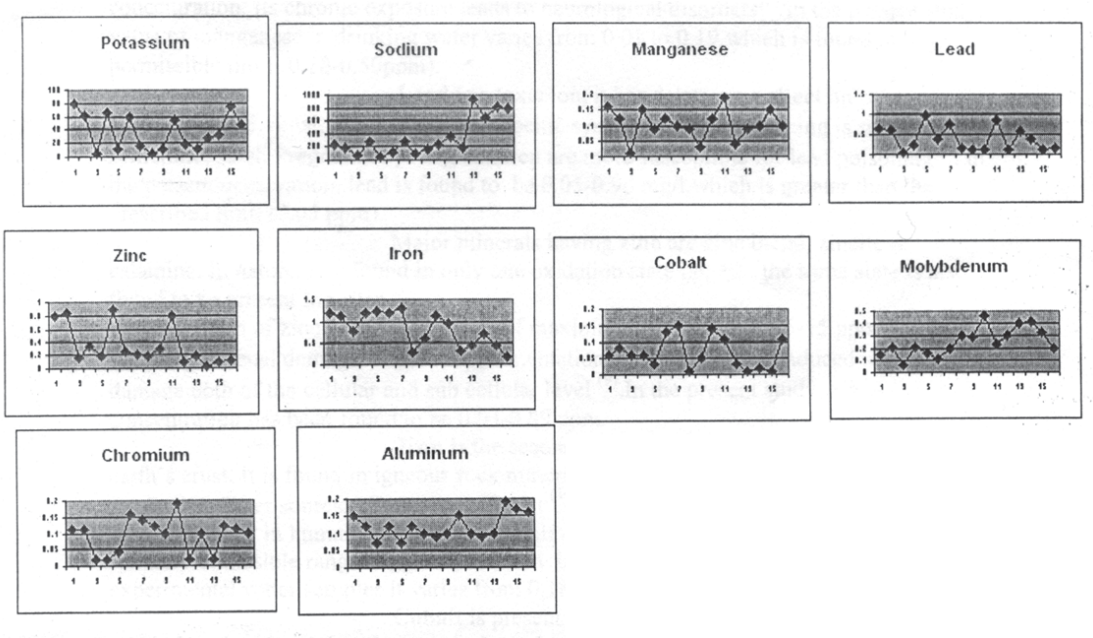

Fig. -1: Graphical representation of Heavy metal (together with Na & K) in water samples

testicular damage both of the cellular and sub cellular level[9]. In the present study, Zinc concentration has been found to be 0.03-0.89ppm.

Iron is the second most abundant metal, present in the earth's crust. It is found in igneous rock minerals like pyroxences, amphiboles, biotite and magnetite. Other sources of iron are effluent[10] coming form dye and textile industries. Iron deficiency in human body causes anaemia but its high amount leads to respiratory failure. Permissible range suggested for iron in drinking water is 0.3-1.0 ppm, but in experimental water samples it varies from 0.18 to 1.22 ppm.

Cobalt is present in +2 and +3 oxidation states in earth's crust and is found with sulphur and arsenic. It is accumulated in different parts of plant like root, stem, leaves and fruit[11] sources of Mo in drinking water is industrial smoke. It is essential to all organism and it is moderately toxic in higher amount. In the present observation, Co is found between 0.01 -0.15 and Mo is found between 0.06 - 0.46 ppm.

Chromium is found in three oxidation states i.e. +2, +3 and +6 in rock minerals in which easily soluble oxidation state is +6. Igneous rocks are higher in chromium content that other rocks. It is a toxic contaminate which gets accumulated in edible parts of plants and there by enter the human food chain. Accumulation of chromium in plants, makes the plant material unsuitable for human consumption and animal fodder[12]. Chromate poisoning causes skin disorder and liver damage. Chromium and copper have chronic toxicity, which results in loss of aquatic life and produce health risk in population[13]. Present data's indicate that the chromium concentration is higher in some areas.

Aluminum is relatively inaccessible except in acidic media as a result of insolubility of $Al(OH)_3$. It is moderately toxic to most of the plants and slightly toxic to mammals[14]. Aluminum has been found in permissible limit (except at few places), prescribed by W H O, I S and other organizations.

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