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A Study on Heavy Metal Ion Contamination of Groundwater Reserves in Beed City, Maharashtra, India

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ABSTRACT

Ground water pollution causes irreparable damage to soil, plants, human and animals and spread epidemics and chronic diseases. Higher concentration of trace metals can cause biochemical effects such as inhibition of enzymes, genetic damage and hypertension etc. The present investigation is directed towards analysis of major metal ion concentration in the groundwater sources at the Beed city. The study revealed that the level of Cu ranged between 0.02 ppm at S_{15} to 0.1 ppm, for Zn the range was 0.12 ppm to 0.99 ppm, values for Cr were in the range of 0.005 ppm to 0.12 ppm and for Cd it was from 0.01 ppm to 0.009 ppm. It was found that the levels of Cu and Cd were exceeding the standard BIS limits for drinking water at certain sampling stations.

Keywords: *Heavy metal ions, groundwater, contamination, copper, zinc, chromium, cadmium, AAS.*

INTRODUCTION

Water is required everywhere, without which neither the life nor any development is possible. The daily demand of drinking water of a man is normally 7 per cent of his body weight. Thus it is vital for healthy growth. But it may become harmful for life if one uses water contaminated with harmful or toxic substances and pathogenic microorganisms coupled with poor sanitation [1]. The sources of water supply depend almost upon the rainfall and the resulting water bodies like springs, rivers, lakes, dug wells, bore wells, etc.

The most important source of drinking water for almost 70 per cent of Indian population is ground water and considered less polluted. But lack of sanitation, improper waste and surface contamination and 40 per cent or more of the disease outbreaks were attributed to polluted water consumption [2].

Present day urbanization is exerting unsustainable demand on water which is becoming scarce natural resource day by day. With population growth and increased pressure on natural systems, many regions are now subjected to water stress brought about by numerous human activities. A recent UNESCO Report indicates that a vast chunk of population in India has no access to safe drinking water and that about 66 million people still rely on un-safe ground water for consumption [3].

Ground water pollution is usually traced back to four main origins viz., industrial, domestic, agricultural and over exploitation. Studies carried out in India revealed that one of the most important cause of ground water pollution is unplanned urban development without adequate attention to sewage and waste disposal and treatment. The incidence of ground water pollution is highest in urban areas where large volume of wastes are concentrated and discharged into relatively small areas. The ground water contamination, however, is detected only some time after the subsurface contamination begin [4].

Ground water pollution causes irreparable damage to soil, plants, human and animals and spread epidemics and chronic diseases [5].

Due to increased industrial and mining activities, a number of metals find their way to water bodies. Many reports have appeared in literature dealing with environmental pollution due to heavy metals in India [6,7]. The detection of high levels of manganese in the ground water in certain parts of the Ganga basin, elevated levels of molybdenum, arsenic, selenium and manganese in the soil and water in some regions of India and possibly part of the heavy metal load of the coastal and estuarine zone in this subcontinent arise from geochemical activity [8,9]. Higher

concentration of trace metals can cause biochemical effects such as inhibition of enzymes, genetic damage and hypertension.

There is an increase in epidemiological and other evidences, indicating an association between water quality and mortality from cardiovascular and other chronic diseases. It has also been observed that diseases other than cardiovascular have been associated with heavy metals in water and statistically significant positive correlation between mortality from various types of cancer and concentration of several trace elements in water supplies have also been observed [10]. Higher as well as extremely lower concentration of trace metals in drinking water is equally harmful for human body system.

Copper in public water supplies enhances corrosion of aluminum and zinc utensils and fittings. The concentration of zinc in tap water is considerably higher than that in surface water owing to its leaching from galvanized pipes and brass and zinc containing fittings. Many nickel salts are water soluble, but the levels of nickel usually found in food and water are not considered as a serious health hazard. The introduction of cadmium to sewage and fertilizers from different sources can result in significant human exposure to cadmium. The health implications of cadmium exposure are exuberated by the relative inhibitory of human beings to excrete cadmium (it is excreted and then reabsorbed by the kidney), therefore, exposures are mainly of concern with respect to the toxicity of kidney and still under investigation as a risk factor for prostate cancer [11].

Advancement of human civilization has put serious questions to the safe use of ground water for domestic uses. Studies and survey on metal pollution in surface and ground water had been carried out in recent years at different places viz., Lucknow [12], Baroda [13], Mumbai [8], Kanpur [14], Chennai [15], Akola [16], Ichalkaranji [17] and Karnataka for river Tunga [11].

In the present investigation groundwater samples were analysed for concentrations of Copper (Cu), Zinc (Zn), Chromium (Cr) and Cadmium (Cd).

MATERIAL AND METHODS

In the present investigation 15 groundwater samples were collected randomly from different locations in the city and are analysed for concentrations of Copper (Cu), Zinc (Zn), Chromium (Cr) and Cadmium (Cd) using Atomic Absorption Spectrophotometer.

RESULTS

The findings of the present study are tabulated in table 1.

The levels of Cu were in the range of 0.001 mg/l (S13) to 0.1 mg/l (S1 & S4). The Cu level was found to be exceeding the BIS limits at S1, S3, S4 and S5, other sampling stations have showed the Cu levels well within the BIS limits.

The levels of Zn in the groundwater samples assessed were found to between 0.022 mg/l (S14) to 0.99 mg/l (S2). All the samples assessed showed Zn levels well within the limits as per the BIS standards.

The Cr levels were found to be between 0 mg/l to 0.12 mg/l. The Cr concentration exceeded only in case of sampling station S1, whereas at other sampling stations the Cr levels were well within the BIS standards.

The concentration of Cd in the groundwater samples assessed were found to be between 0 mg/l to 0.01 mg/l at S1 and S2. The Cd levels were as per the standards of BIS.

DISCUSSION

The investigation has revealed that the metal ions were almost within the permissible limits of BIS, except for Cu and Cr which showed values exceeding the BIS limits. It was observed that the sampling stations S1, S2, S3, S4 and S5 have shown accumulation of the metal ions. Although the present status is not of very much concern to human health, however it does shows the accumulation of the metal ions in groundwater sources. This may lead to serious concerns in future if accumulation of the metal ions continues and remedial measures are not brought into practice, since it is very difficult to reclaim a contaminated groundwater source.

Table 1 : Study of heavy metals pollution in surface and groundwater (ppm)

Sr. No.	Sampling station	Cu	Zn	Cr	Cd
Drinking water standards (IS : 10500, 1991)		**0.05**	**5.0**	**0.05**	**0.01**
1	S_1	0.1	0.9	0.12	0.01
2	S_2	0.02	0.99	0.01	0.01
3	S_3	0.09	0.12	0.005	0.009
4	S_4	0.1	0.5	0.01	0.001
5	S_5	0.007	0.27	0.001	0.001
6	S_6	0.005	0.066	0	0
7	S_7	0.01	0.04	0.001	0.001
8	S_8	0.006	0.067	0	0
9	S_9	0.005	0.24	0.001	0
10	S_{10}	0.004	0.2	0	0
11	S_{11}	0.003	0.144	0.001	0.001
12	S_{12}	0.004	0.048	0.001	0
13	S_{13}	0.001	0.104	0.001	0.001
14	S_{14}	0.005	0.022	0	0
15	S_{15}	0.002	0.099	0	0
	Average	**0.0241**	**0.2540**	**0.0101**	**0.0023**
	SD	**0.0379**	**0.3061**	**0.0306**	**0.0039**
16	S_{16} (Tap Water)	0	0	0	0

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