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# METAL TOXICITY IN UNDERGROUND DRINKING WATER AT MORADABAD, UTTAR PRADESH, INDIA

**GAURAV KUMAR RASTOGI and D. K. SINHA***

Department of Chemistry, K.G.K. (P.G.) College, MORADABAD – 244001 (U. P.) INDIA

## ABSTRACT

Five different underground drinking water samples were collected during the year 2006 from different India Mark II hand pumps of public places at Moradabad (Uttar Pradesh, India). Nine different trace metals in all the water sample were estimated by ICP-AES technique using Varian Liberty II ICP-OES and the data was compared with drinking water quality standards prescribed by W.H.O. for trace metals. The drinking water was found to be excessively contaminated with manganese as well as iron invariably at all the sites of study. The water was deficient of magnesium, a micro-nutrient at all the sites except at site No. IV and V. Lead and cadmium metal concentration was within desirable limits, however, copper was found to be absent at all the sites except at site No. III, where it was below the toxic limit. The drinking water is not contaminated with three toxic metals- chromium, cobalt and nickel as they were found to be below the detection limit and reported as ND. People exposed to waters of contaminated drinking water sites are prone to health hazards of metal toxicity and water quality management is urgently needed in the catchment area of study.

**Key words :** Metal toxicity, Drinking water, Inductively coupled plasma emission technique.

## INTRODUCTION

Water is also known as 'blue gold' and it is life for all living beings, yet over one billion people across the world are deprived of safe drinking water. The underground drinking water contamination is sometimes of geogenic origin and mostly, it is due to different kinds of anthropogenic activities of human beings. Underground drinking water is gradually accumulating pollutants since industrial revolution started[1,2]. Metals due to their natural abundance and by virtue of their natural usage in all spheres of life in their different chemical forms exist as ingredients of several compounds in the form of metals, inorganic, organic salts and complexes etc. Several adverse reports on metal exposure and toxicity have made human beings more conscious all over the world[3,4]. Trace metals ingested by the human body beyond tolerance limits can have severe consequences for health[5].

* Author for correspondence; E-mail: dkskgk@rediffmail.com

Children and pregnant women are more prone to toxicity of trace meatals. Objective of the present study is to assess the level of trace metal toxicity in underground drinking water at Moradabad (Uttar Pradesh, India) by using ICP-AES technique.

Moradabad is a 'B' class city of Western Uttar Pradesh having urban population more than 38 lakhs. Moradabad is situated at the bank of Ram Ganga river and its altitude from the sea level is about 670 feet. It is extended from Himalaya in north to Chambal river in south. It is at 28°20', 29°15' N and 78°4', 79°E. District Bijnor and Nainital are in the north, Rampur in the east, Ganga river in the west and district Budaun is in the south of district Moradabad. Moradabad has gone through rapid industrialization and population growth during the last few decades. Major industries are Brassware, Steelware, Paper mills, Sugar mills, Crushers, Dye factories and a number of associated ancillaries. Most of the industries and different kinds of human activities are multiplying the underground drinking water contamination

## EXPERIMENTAL

### Materials and method

Five different underground drinking water sites at Moradabad were selected to estimate nine toxic trace metals quantitatively. Commonly used India Mark II hand pump water sites at five different public places were selected. All the samples were collected and preserved following standard methods and procedures. A brief description of sampling site is presented in Table 1.

**Table 1. A brief description of sampling sites**

| Site No. & Name | Location of site | Type of source | Apparent water quality |
|---|---|---|---|
| I Bus Station | 3 km East to Collectorate | IM II handpump, Only source | Odourless, turns reddish brown on standing |
| II Rly. Station | 1 Km West to Site No. I | IM II handpump, Complementary source | Odourlee, colourless |
| III Distt. Hospital | 1 Km West to Collectorate | IM II handpump, Only source | Odourless, turns yellow on standing |

| Site No. & Name | Location of site | Type of source | Apparent water quality |
|---|---|---|---|
| IV Collectorate | 2 Km North-West to Site No. II | IM II handpump, Only source | Odourless, colourless |
| V Tel. Exchange | 1.5 Km South to Site No. IV | IM II handpump, Complementary source | Odourless, colourless |

Nine trace metals namely lead, cadmium, chromium, cobalt, manganese, magnesium, nickel, copper and iron were estimated by employing Inductively Coupled Plasma - Atomic Emission Spectoscopy (ICP-AES) technique using Varian Liberty Series II ICP–OES, made in Australia[6,7]. This is most modern and promising emission technique, which has been used for fast and accurate multi-element analysis.

## RESULTS AND DISCUSSION

Site-wise estimated amounts of different trace metals with their W.H.O. standards are enlisted in Table 2 [8]. Site-wise variation of lead, cadmium, manganese, magnesium, and iron concentrations in drinking water are presented in Figs. 1 to 5, respectively.

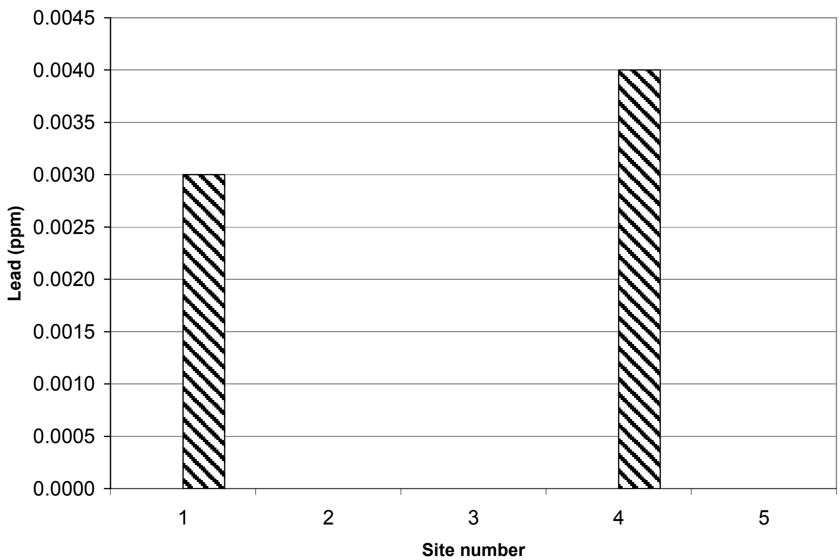


**Fig. 1: Site-wise variation of lead (in ppm)**

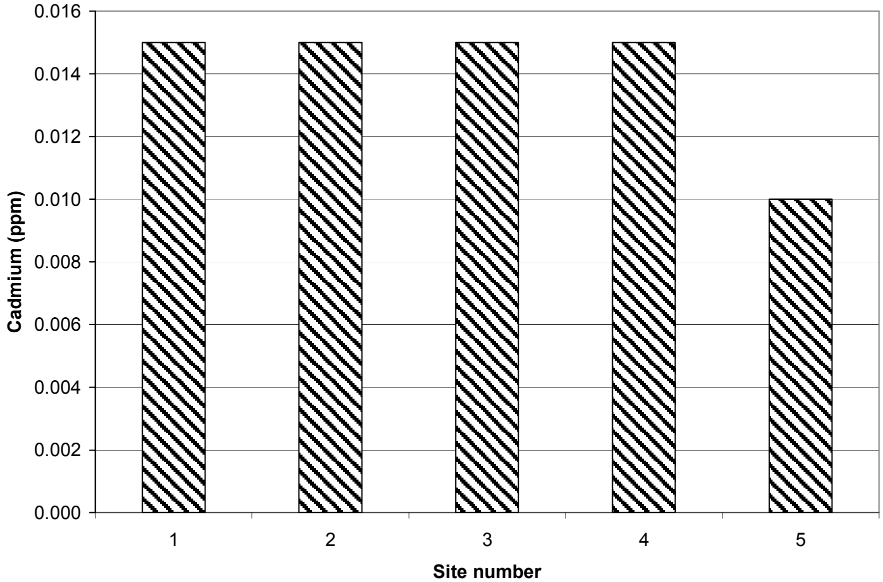


**Fig. 2: Site-wise variation of cadmium (in ppm)**

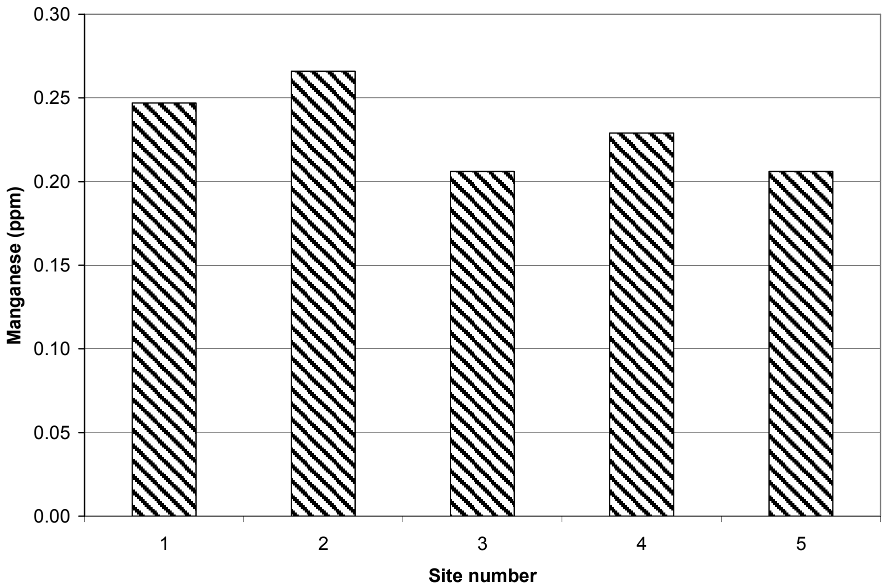


**Fig. 3: Site-wise variation of maganese (in ppm)**

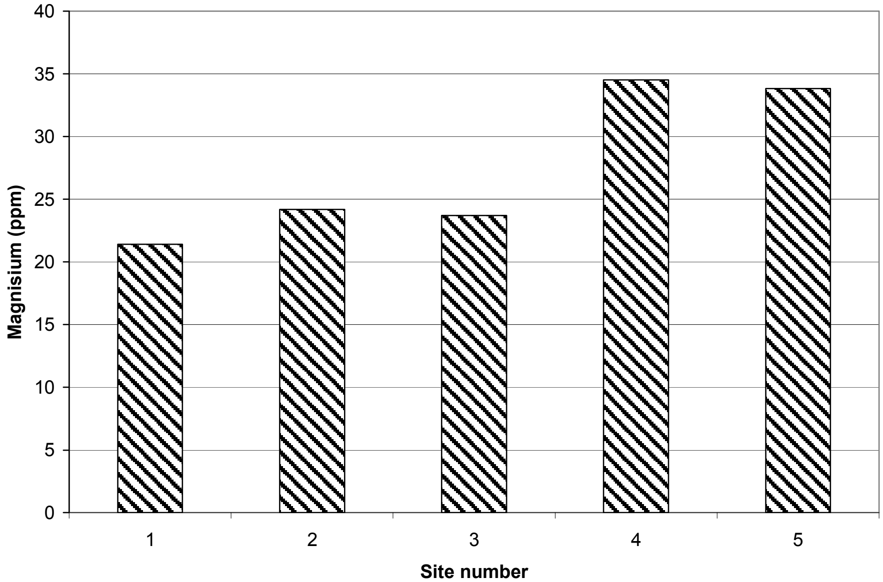


**Fig. 4: Site-wise variation of magnesium (in ppm)**

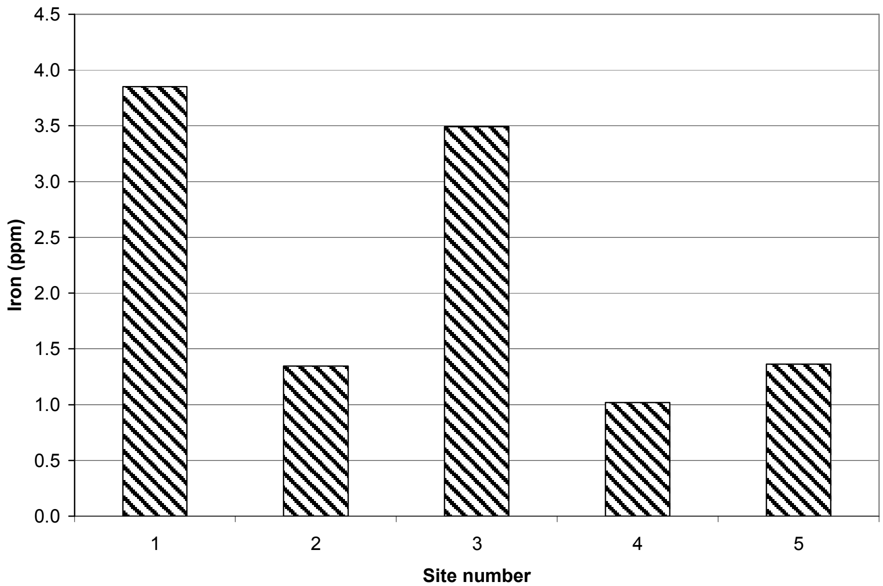


**Fig. 5: Site-wise variation of iron (in ppm)**

Critical analysis of the data is presented in Table 2. Figs. 1-5 reveal the following facts regarding the level of metal toxicity in underground drinking water at Moradabad during the course of study.

**Table 2: Site-wise estimated amount of different trace metals in ppm with their W. H. O. standards**

| Trace Metals | Site I | Site II | Site III | Site IV | Site V | W.H.O. Standard |
|---|---|---|---|---|---|---|
| Lead | 0.003 | ND | ND | 0.004 | ND | 0.10 |
| Cadmium | 0.015 | 0.015 | 0.015 | 0.015 | 0.010 | 0.05 |
| Chromium | ND | ND | ND | ND | ND | 0.05 |
| Cobalt | ND | ND | ND | ND | ND | - |
| Manganese | 0.247 | 0.266 | 0.206 | 0.229 | 0.206 | 0.10 |
| Magnesium | 21.398 | 24.171 | 23.693 | 34.518 | 33.824 | 30.0 |
| Nickel | ND | ND | ND | ND | ND | 0.02 |
| Copper | ND | ND | 0.001 | ND | ND | 0.05 |
| Iron | 3.852 | 1.346 | 3.491 | 1.020 | 1.364 | 0.50 |

ND – Not detactable (below detection limit)

Underground drinking water is not contaminated with reference to three toxic metals- chromium, cobalt and nickel at all the sites. Concentrations of lead and cadmium is within desirable limits at all the sites of study. Underground drinking water is excessively contaminated with manganese as well as iron metals invariably at all the sites. Manganese affects central nervous system and its poisoning leads to psychiatric disorders. Iron in high concentrations is injurious to human health and iron in ferric form imparts turbidity and colour to water. Copper is absent at all the sites except at site No. III and here, it is also within desirable limits. Drinking water is deficient of magnesium, a micronutrient at all the sites except at sites No. IV and V.

## CONCLUSIONS

On the basis of above discussion, it may be concluded that underground drinking water is not contaminated with reference to studied six toxic trace metals namely chromium, cobalt, nickel, lead, cadmium and copper at all the sites of study. Drinking water at Moradabad is deficient of magnesium micronutrient and some dietary supplement should be given to people dependent on this water. Underground drinking water is excessively contaminated with manganese and iron metals invariably at all the sites in the catchment area of study.

People exposed to waters of contaminated sites are prone to health hazards of manganese and iron metal toxicity and are also prone to deficiency of magnesium micro-nutrient. Drinking water quality management with reference to toxic trace metals is the need of hour.

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