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Analysis of heavy metals in ground water of Kanpur Metro, U.P.

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ABSTRACT - This paper presents the distribution of heavy metals profile in ground water system during rainy season. In this study, five residential areas (Higher Income Group I-V, Minimum Income Group I-V, Lower Income Group I-V, Juggi Jhopari I-V, and Industrial Area I-V) were chosen and ground water samples were collected to determine the concentrations of heavy metals such as iron (Fe), copper (Cu), zinc (Zn), chromium (Cr), lead (Pb), manganese (Mn) and nickel (Ni). In this study, most of the heavy metals concentrations were exceeded to the maximum permissible concentration (MPC) as specified in the WHO standard for drinking water. These results played an important role in order to determine and visualize the location. Hence, these results can help the local authorities to take an action in terms of remediation purpose.

Key words - Heavy metals, Ground water, Pollution, Polluted water

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Ground water pollution is manmade problem which needs urgent attention of those concerned with pollution, pollution control and the consumer. However before we go into the realm of the specific problem of ground water in a city like Kanpur metro, it would be worthwhile to have a holistic picture of environmental pollution to get the right perspective. Investigations throughout the country, both in rural and urban areas have indicated the rise of various pollutants such as heavy metals (Cu, Cd, Zn, Pb, Ni, and Cr etc.) pesticides, nitrate, fluoride and bacteria in groundwater leading to various health hazards. Heavy metals are the constituents of large numbers of industrial, domestic and agricultural discharges. The toxicity of metal and its rate of uptake from solution depend on oxidation state of metal, (Pelligrini *et al*., 1999). So it is important to analyze them and study their speciation which has become an important tool in assessing environmental contamination. Bhand and Chaturvedi (1995) carried out speciation studies in the Khan River and reported distribution and variation in dissolved particulate concentrations of P, Zn and Cd.

EXPERIMENTAL METHODOLOGY

Area under study:

The present study covers the entire urban (residential) area of Kanpur metro.

Selection of sampling points:

After a survey of the city, five types of locations were chosen for collecting groundwater samples. Each type of location has have had five sampling stations which included mostly the hand pumps, and some dug wells. The sampling points were classified occupation wise using stratified Random Sampling techniques as HIG (I-IV), MIG (I-V), LIG (I-V), JJ (I-V) and IA (I-V).

Sample collection:

Samples from various groundwater sources were collected for the analysis of heavy metals.

The collected samples were analyzed in the laboratory as per standards methods.

Iron (Fe):

1g iron wire was dissolved in 50ml of 1:1 HNo_3 and diluted to 1000ml.

1ml= 1mg Fe

Copper (Cu):

1g metal was dissolved in 15ml of 1:1 HNo_3 and diluted to 1000ml.

1ml= 1mg Cu

Cadmium (Cd):

1g metal was dissolved in minimum 1:1 HCl and diluted to 1000ml.

1ml= 1mg Cd

Chromium (Cr):

2.828g. anhydrous $K_2Cr_2O_7$ was dissolved in about 200ml water. 1.5ml conc. HNO_3 and diluted to 1000ml with water.

1ml= 1mg Cr

Zinc (Zn):

1 Zinc metal was dissolved in 20ml 1:1 HCl and diluted to 1000ml with water.

1ml= 1mg Zn

Lead (Pb):

1.598g $Pb(NO_3)_2$ was dissolved in 20ml water and diluted to 1000ml.

1ml=1mg Pb

Manganese (Mn):

3.076mg manganese sulphate was dissolved in 200ml water and 1.5ml 1:1 HCl and diluted to 1000ml with water.

1ml=1mg Mn

Nickel (Ni):

1.273g of NiO was dissolved in minimum volume of 10 per cent HCl and diluted to 1000ml with water.

1ml=1mg Ni

Three standard metal solutions (100ml) and 100ml metal free water were selected and adjusted to pH 3 by 1N HNO_3. Standard metal solution and blank were transferred to a separatory funnel and 1ml ADPC, 10ml MIBK was added and shaken vigoursly. Aqueous layer was drained off and organic extract was directly aspirated into the flame and absorbance was recorded.

EXPERIMENTAL FINDINGS AND ANALYSIS

The results of heavy metal concentrates of groundwater in different residential areas (HIG I-V, MIG I-V, LIG I-V, JJ I-V, and IA I-V) of Kanpur metro during the rainy season are reported in Table 1, 2, 3, 4 and 5, respectively. Heavy metals

Table1: Variation of heavy metal concentration across sampling stations in Higher Income Group (HIG) during residential the rainy season

Parameters	HIG-I	HIG-II	HIG-III	HIG-IV	HIG-V
Fe^{++}	0.11	0.019	0.017	0.78	0.014
Cu^{++}	0.028	0.032	0.036	0.062	0.038
Zn^{++}	2.6	3.1	3.0	4.2	3.1
Cr^{++}	0.002	0.002	0.003	0.014	0.007
Pb^{++}	0.000	0.000	0.012	0.016	0.002
Mn^{++}	0.0004	0.10	0.010	0.027	0.001
Ni^{++}	0.902	0.988	1.09	1.22	1.602

Table 2 : Variation of heavy metal concentration across sampling stations in minimum income group (MIG) during residential the rainy season

Parameters	MIG-I	MIG-II	MIG-III	MIG-IV	MIG-V
Fe^{++}	0.11	0.019	0.017	0.78	0.014
Cu^{++}	0.028	0.032	0.036	0.062	0.038
Zn^{++}	2.6	3.1	3.0	4.2	3.1
Cr^{++}	0.002	0.002	0.003	0.014	0.007
Pb^{++}	0.000	0.000	0.012	0.016	0.002
Mn^{++}	0.0004	0.10	0.010	0.027	0.001
Ni^{++}	0.902	0.988	1.09	1.22	1.602

Table 3 : Variation of heavy metal concentration across sampling stations in lower income group (LIG) residential during the rainy season

Parameters	LIG-I	LIG-II	LIG-III	LIG-IV	LIG-V
Fe^{++}	0.11	0.019	0.017	0.78	0.014
Cu^{++}	0.028	0.032	0.036	0.062	0.038
Zn^{++}	2.6	3.1	3.0	4.2	3.1
Cr^{++}	0.002	0.002	0.003	0.014	0.007
Pb^{++}	0.000	0.000	0.012	0.016	0.002
Mn^{++}	0.0004	0.10	0.010	0.027	0.001
Ni^{++}	0.902	0.988	1.09	1.22	1.602

Table 4 : Variation of heavy metal concentration across sampling stations in Juggi Jhopahri (JJ) residential during the rainy season

Parameters	JJ-I	JJ -II	JJ -III	JJ -IV	JJ -V
Fe^{++}	0.11	0.019	0.017	0.78	0.014
Cu^{++}	0.028	0.032	0.036	0.062	0.038
Zn^{++}	2.6	3.1	3.0	4.2	3.1
Cr^{++}	0.002	0.002	0.003	0.014	0.007
Pb^{++}	0.000	0.000	0.012	0.016	0.002
Mn^{++}	0.0004	0.10	0.010	0.027	0.001
Ni^{++}	0.902	0.988	1.09	1.22	1.602

Table 5 : Variation of heavy metal concentration across sampling stations in Industrial Area (IA) residential during the rainy season

Parameters	IA-I	IA -II	IA -III	IA -IV	IA -V
Fe^{++}	0.11	0.019	0.017	0.78	0.014
Cu^{++}	0.028	0.032	0.036	0.062	0.038
Zn^{++}	2.6	3.1	3.0	4.2	3.1
Cr^{++}	0.002	0.002	0.003	0.014	0.007
Pb^{++}	0.000	0.000	0.012	0.016	0.002
Mn^{++}	0.0004	0.10	0.010	0.027	0.001
Ni^{++}	0.902	0.988	1.09	1.22	1.602

that were analyzed in this study were as iron (Fe), copper (Cu), zinc (Zn), chromium (Cr), lead (Pb), manganese (Mn), and nickel (Ni). For the protection of human health, guidelines for the presence of heavy metals in water have been set by different International Organizations such as WHO, EPA, European Union Commission (Marcovecchio *et al*., 2007), thus, heavy metals have maximum permissible level in water as specified by these organizations. Maximum contaminant level (MCL) is an enforceable standard set at a numerical value with an adequate margin of safety to ensure no adverse effect on Human health. It is the highest level of a contaminant that is allowed in a water system.

Heavy metal pollution of groundwater is also reported by Zaheeruddin and Shabeer (1996) in some parts of Delhi, Nag and Das (1992) in Burdwan district, Samuding *et al.* (2009) and Momodu and Anyakora (2010).

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