Toxicity Evaluation of Metals in Groundwater of Central Industrial Area of Bhilai-Durg Twin City.

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Abstract -Heavy metal toxicity is important for proper functioning of human body but at certain concentration only if its concentration exceed from prescribed limit then it can cause major threat for human being and there are several health risks associated with it. Fresh water is basic right of human being therefore its quality is one of the most important concerns for living beings. The study was executed to evaluate the heavy metals impact on water quality of the central industrial area Bhilai, Durg District, Chhattisgarh with the help of Metal Index Pollution. In our study we make an attempt to know the concentration of four heavy metals namely Pb, Fe, Cr and Zn in water of different locations of industrial area of Bhilai. The concentration of heavy metals was compared with drinking water quality standard given by the World Health Organization (WHO and Indian standard IS10500 (2012).

Keywords: Heavy Metals, Metal Toxicity, Impact of Heavy Metal, Metal Index, Human Being, Water Quality, WHO.

INTRODUCTION

Heavy metals are generally occurs in natural waters; some are present at low concentrations and are biologically important in aquatic environment, but some are toxic. Metals in natural waters are induced from various sources. Natural geological weathering of rocks and soils, directly exposed to surface waters, is usually the largest natural source. Several studies have shown that metals exist at low concentrations in natural waters, partially in soluble ionic forms and partially forms bound to inorganic or organic particulate matters, and their toxicity can be attributed mainly to their soluble forms .Besides the natural processes, metals may enter into the aquatic system due to industrial activities. Heavy metals can enter into water by industrial waste water, therefore Water contamination or pollution is defining as presence of foreign matter that deteriorates the quality of the water, through water toxic metals enter into human body which can be dangerous because they tend to bio accumulate means an increase in the concentration of a chemical in a biological body in period of time, as compared to the chemical's concentration in the environment.

Heavy metals are mainly pollutant of environment and its toxicity is major problem of increasing for environmental reasons (Jaishankar et al., 2013; Nagajyoti et al., 2010). The generally found heavy metals in waste water arsenic, cadmium, chromium, copper, lead, nickel, and zinc, all of which cause risks for human health and the environment (Lambert et al., 2000). They are necessary for health, but in large amount of any of them may cause acute or chronic toxicity. Heavy metals toxic when they are not metabolized by the body and accumulate in the soft tissues.(Smith, et al.1998). The most commonly found heavy metals in waste water include copper, lead, chromium, nickel, zinc, iron, cobalt and cadmium all of which cause risks for human health and environment. Heavy metal toxicity is a major risk for human being and there is numerous health risks associated with it. The toxic metal is harmful for the human body and its proper functioning; they may target the metabolic processes.

Water quality is one of the most important concerns for living beings; therefore the study was executed to evaluate the heavy metals impact on water quality of the central industrial area Durg District, Chhattisgarh. In our study we make an attempt to know the concentration of four heavy metals namely Pb, Fe, Cr, Zn in water of different locations of central industrial area with the help of Metal Index calculation. Metal index calculation is one of the important method to evaluate the presence of toxic metals in water The concentration of heavy metals was compared with drinking water quality standard given by the World Health Organization (WHO and Indian standard IS10500 (2012).

AIM – This study was conducted to investigate the heavy metal pollution of water in the industrial region of Chhattisgarh.

EXPERIMENTAL AREA

Study area – Bhilai is district of Durg(C.G.) in eastern central India, the city is located 32km^2 west of the state's capital Raipur, it is urban area & it is pollution is 1,006,407, it is highest recorded temperature is 37ºC, lowest 21ºC & annual rainfall 1247.0 mm the major source of employment is steel industries. sampling sites were setup in Bhilai-Durg area which was in range of 10kms close to industrial area.33 sample area were selected among the selected area 4 were pond water and remaining were ground water samples & immediately brought to laboratory & preserved with nitric acid to avoid precipitation of the metals. Mainly collected in January- June 2016

MATERIAL & METHOD

Sample collection - In present study 33 water samples were collected by a polyvinyl chloride 250ml bottle at sampling area. Water samples were collected from these area including effluent (n =3), surface water (n= 1) and ground water (n=29) during Jan-June, 2016. Samples were taken from residential area around industrial area & analyzed to find the concentration of toxic metals in ground water sample The locations of sample area were determined by GPS receiver. The samples were kept in refrigerator at 4°c. Collected sample were immediately brought to laboratory and preserved for the further analysis. The metal content (Pb, Cr, Fe, and Zn) was measured by Atomic Absorption Spectroscopy (AAS)

Metal index (MI)- is based on a total trend evaluation of the present status. The higher the concentration of a metal compared to its respective MAC value, the worse the quality of the water. MI value >1 is a threshold of warning (Bakan et al., 2010). According to (Tamasi and Cini, 2004), the MI is calculated by using the following formula:

$$MI = \sum_{i=1}^{n} \frac{Ci}{(MAC)_i}$$

Where Ci is the concentration of each element, MAC: maximum allowable concentration.

Result & Discussion

Table 1: Descriptive statistics for the studied elements.

Metal	Max	Min	Mean	SD	WHO Standard
Pb mg/l	0.778	0.041	0.1157	0.15879	0.01 mg/l
Fe mg/l	1.811	0.024	0.38985	0.41471	0.3 mg/l
Cr mg/l	0.51	0.011	0.08	0.11532	0.05 mg/l
Zn mg/l	3.805	0.009	0.4983	0.88832	3 mg/l

The mean values, standard deviations, minimum and max of the obtained results are represented in Table -1,it shows concentration of all sample area with different different parameters. The. Concentration of Pb,Fe& Cr, Zn are exceeded in permissible limit as prescribed by WHO for drinking water. Thus the concentration of sample areas are showing that there is need of water treatment for Heavy Metals as well as for few parameters so that we can be able to drink pure water without contamination

Table 2: Correlation between concentrations of element in ppm.

S.No.	Metals	Pb	Fe	Cr	Zn
1	Pb	1	-0.0265668	0.02285721	-0.04163017
2	Fe	-0.0265668	1	-0.091481026	0.31542338
3	Cr	0.02285721	-0.091481026	1	0.0790543
4	Zn	-0.04163017	0.31542338	0.0790543	1

- Correlation is significant at the 0.05 level and **at the 0.01 level.

The positive correlation between Pb and Cr, Fe and Zn showing that the source are same for pollution . The correlation ship values of heavy metals for study area is giving guidelines for source of pollution and showing that study area is contaminated with toxic metals.

Table -3 Metal index value of sample area along with status of metal pollution of study area

Study Area	Metal Index Value	Status of Metal pollution
SUPELA	8.3608	Threshold of warning
KOHKA	12.21	Threshold of warning
KOTRABHATA	5.865	Threshold of warning
JUNWANI	34.62	Threshold of warning
KATULBOD	8.125	Threshold of warning
BORSI	8.865	Threshold of warning
HANODA	9.376	Threshold of warning
DHANAURA	9.8338	Threshold of warning
KHAMHARIA	7.031	Threshold of warning
PURAI	8.519	Threshold of warning
UMARPOTI	12.788	Threshold of warning
RISALI	14.349	Threshold of warning
NEWAI	9.477	Threshold of warning
UTAI	20.391	Threshold of warning
PATORA	12.6594	Threshold of warning
DUMARDIH	10.97	Threshold of warning

- Metal index are noteworthy tools for drinking water quality assessment and have been effectively applied all over the world. The applied method considers the collective effects of the studied elements (Cr, Fe, Pb and Zn) with harmful effects of a consumed contaminated drinking water . Metal index denotes the trend evaluation of the present status by all measured metals (Table 3). According to metal index values, all selected stations are seriously threatened with metal pollution for drinking purpose (MI > 1), MI reaches in range of 5.865 to 34.62which showing threshold of warning in central industrial area .

CONCLUSION

The metal index pollution rating at sampling sites clearly showed that the status of the water body in central industrial was not within the WHO standards and guidelines for drinking in several areas. The concentration of heavy metals are exceeding in most of sample area, Pb exceeded WHO limits for drinking water in most of samples. Fe & Cr presence in samples are exceeded WHO limits for drinking water in most of samples. On the basis of obtained result we can suggest that effective water treatment action should be taken by government to minimize concentration of heavy metals in water. There should be monitoring over the concentration of heavy metal in ground water.

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