Studies on some selected metals of Siddheshwar reservoir at Hingoli, Maharashtra, India

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ABSTRACT: Investigations on the presence of chromium and cadmium metals in water using spectrophotometer from Siddheshwar dam in district Hingoli, Maharashtra state of India was studied during the period of July 2010 to June 2011. The chromium and cadmium are heavy metals used in a variety of industrial applications which are highly toxic to humans, animals, plants and microorganisms. The water was found to be uncontaminated with cadmium and contaminated with chromium when compared with their standard limits for drinking water prescribed by different organizations.

KEYWORDS: Trace metals, Mean, Drinking water, Permissible limit, Siddheshwar, Chromium, Cadmium.

INTRODUCTION

The problem of environmental pollution due to toxic metals has raise in front of many metropolitan cities. The toxic metals entering the ecosystem may lead to geo-accumulation, bioaccumulation, biotransformation and biomagnifications. Metals like iron, copper, zinc and other trace metals are important for proper functioning from biological systems and their deficiency or excess could led to a number of diseases [13]. Besides, the presence of toxic metals such as lead, mercury and cadmium in the environment has been a source of worry to the environmentalists, government agencies and health practitioners. This is mainly due to their health implication since they are non - essential metals of no benefits to human [17].The presence of these metals in ecosystem has far reaching implications directly to the biota and indirectly to man. In addition, food chain contamination by toxic metals has become a burning issue in recent years because of their potential accumulation in bio-system through contaminated water, soil and air. Therefore, a better understanding of toxic metal source, their accumulation in the soil and the effect of their presence in water and soil or plant system seem to be particularly important issue of present day research on risk assessments [11]. Dams are sinks for heavy metals that continuously wash off rocks and soils that are directly exposed to surface waters. The common sources of heavy metals are from dead and decaying vegetation, animal waste, wet and dry fallouts of atmospheric particulate matters and from anthropogenic activities.

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The role of trace metals in biochemical life processes of aquatic plants and animals and their presence in trace amounts in the aquatic environment are essential. However, at high concentrations, these trace metals become toxic [2]. Temperature is a limiting factor in the aquatic environment [7], [5]. Water temperature is probably the vital environmental variable. It affects metabolic activities, growth, feeding, reproduction, distribution and migratory behaviours of aquatic biota [12], [3], [4]. It affects solubility of gases in water, gas solubility decreases with increased temperature. Temperature is affected by time of the day; high temperatures may be recorded in daytime and become low at night. Hydrogen ion concentration or pH as one of the most important environmental characteristics decides the survival, metabolism, physiology and growth of aquatic organisms. Ramanathan et. al. [14] recommended optimum range of pH 6.8-8.7 for maximum growth and production of shrimp and carp. The pH of water is influenced by acidity of the bottom sediment and biological activities. High pH may result from high rate of photosynthesis by dense phytoplankton blooms. The pH value higher than 7 but lower than 8.5 according to Abowei [9] is ideal for biological productivity, but pH at below 4 is detrimental to aquatic life. The pH may be affected by total alkalinity and acidity, surface run off from surrounding rocks and water discharges. Chromium is the transition metal; with an average atomic weight of 52 and its electronic configuration is [Ar] 3d5 4s1. On the periodic table, chromium is the 24^{th} element and a member of group VI B along with molybdenum and tungsten [8]. Cadmium is also the transition metal; with an average atomic weight of 112.4 and an electron configuration is [Kr] 4d10 5s2. On the periodic table, cadmium is the 48^{th} element and a member of group II B along with zinc and mercury. The sources of chromium are industrial and municipal wastes, anthropogenic sources etc. The excess of chromium cause diarrhoea, nausea, low blood pressure, lung irritation, CNS disease, cancer, dermatitis, etc. in human beings. The sources of cadmium are electroplating wastes, impurity in all products containing zinc, industrial wastes, soil, and sewage. The effects of cadmium are hypertension, degenerative bone disease, injury to liver, growth retardation, CNS injury, diarrhoea and kidney damage. The Present study is focused on assessment of chromium and cadmium metals in surface water.

STUDY AREA

Siddheshwar dam constructed on Purna River at Siddheshwar village in the Taluka Aundha of district Hingoli in Maharashtra state. The river Purna, a tributory of Godavari river. It rises in the hills of Aurangabad district and after a winding course of about 250 miles, it joins Godavari at Purna. Siddheshwar dam serve as an important source of several benefits and facilities to the region of Hingoli, Parbhani and Nanded districts. This has been selected for carrying out the present research work. It is situated at northern part of Marathwada region of Maharashtra.

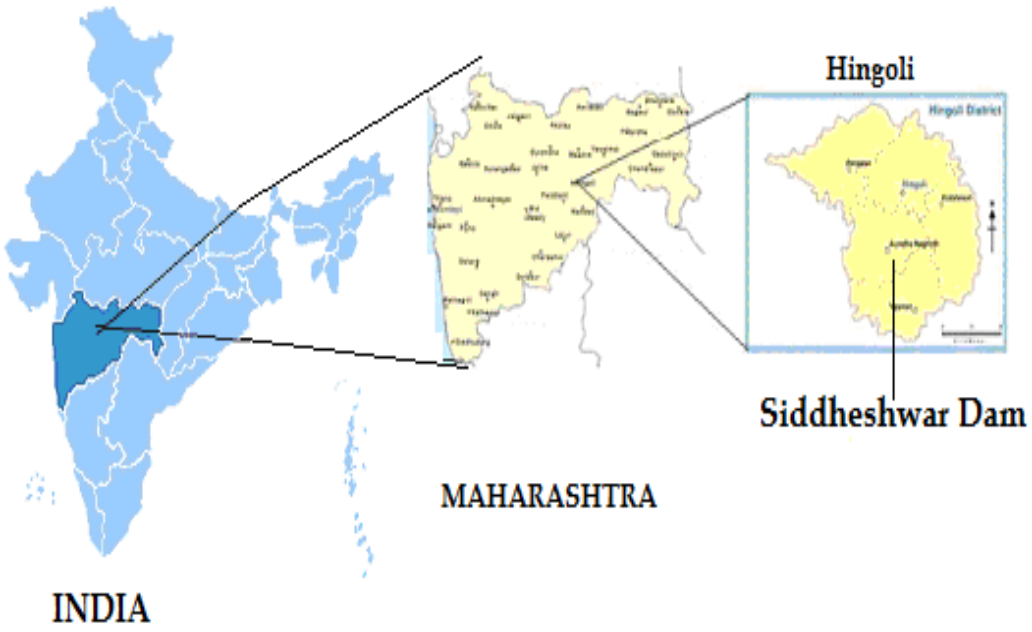

Figure 1: Location of Siddheshwar dam near Hingoli.

MATERIAL AND METHODS

The present investigation work has been undertaken for the systematic analysis of few metals from this reservoir. The water samples were collected from three sampling sites and named S_1, S_2 and S_3. The sampling site S_1 is near the wall of reservoir, S_2 is at middle of the dam and S_3 is near the pump house. The water sampling was carried out for the period of one year. Water containers were cleaned properly before use. The selected metals were estimated by the standard methods as given in APHA [1]. The Mean, Standard deviation and Variance are obtained by formulas as,

$$\text{Mean} = \frac{\sum x}{N}$$

$$\text{Standard daviation} = \sqrt{\frac{\sum (x - \bar{x})^2}{N-1}}$$

$$\text{Variance} = \frac{\sum (x - \bar{x})^2}{N-1}$$

In this formulas, $\overline{X}$ and $\overline{Y}$ are the values of the mean, N is the sample size and X and Y are two variables [16].

RESULTS AND DISCUSSION

Table 1: Variations in chromium and cadmium concentrations (mg/L) of Siddheshwar reservoir water during July 2010 to June 2011.

Month	Sampling Site	Temp (^{0}C)	pH	Cr (mg/L)	Cd (mg/L)
Jul	S_1	24	7.4	0.0	0.0
	S_2	23.9	7.4	0.0	0.0
	S_3	23.9	7.4	0.0	0.0
Aug	S_1	24.8	7.7	0.024	0.0
	S_2	24.4	7.5	0.0172	0.0
	S_3	24	7.3	0.0104	0.0
Sept	S_1	25	7.8	0.002	0.0
	S_2	24.8	7.75	0.004	0.0
	S_3	24.7	7.7	0.006	0.0
Oct	S_1	25.1	7.1	0.012	0.0
	S_2	25	7.1	0.014	0.0
	S_3	25	7.1	0.016	0.0
Nov	S_1	25.2	7.2	0.104	0.0
	S_2	25.3	7.15	0.115	0.0
	S_3	25.5	7.1	0.126	0.0
Dec	S_1	24	7.57	0.012	0.0
	S_2	23.9	7.55	0.056	0.0
	S_3	23.8	7.53	0.1	0.0
Jan	S_1	24	6.99	0.08	0.0
	S_2	24.5	6.97	0.08	0.0
	S_3	25	6.95	0.08	0.0
Feb	S_1	26	8.04	0.012	0.0
	S_2	25.5	8.06	0.011	0.0
	S_2	25	8.08	0.01	0.0
Mar	S_1	25	8.12	0.03	0.0
	S_2	25	8.16	0.04	0.0
	S_3	25	8.2	0.05	0.0
Apr	S_1	26	8. 18	0.04	0.0
	S_2	26	8.19	0.025	0.0
	S_3	26	8.21	0.01	0.0
May	S_1	27	8.24	0.04	0.0
	S_2	26.5	8.25	0.025	0.0
	S_3	26	8.26	0.01	0.0
Jun	S_1	27	8.10	0.0	0.0
	S_2	26.5	8.07	0.0	0.0
	S_3	26	8.05	0.0	0.0

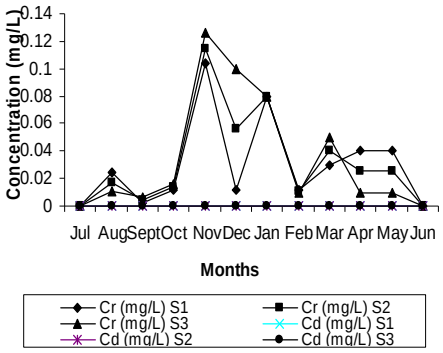

Figure 2: Monthly values Chromium and Cadmium (mg/L) content of the Siddheshwar dam water during July 2010 to June 2011.

The highest temperature 27^{0}C in the month of May 2011 and lowest 24^{0}C in the month of December 2010 at sampling station-1.The sampling station-2 showed the maximum temperature 26.5^{0}C in the month of May 2011 and minimum 23.9^{0}C in the month of December 2010. The sampling station-3 showed the maximum temperature 26^{0}C in the month of May 2011 and minimum 23.8^{0}C in the month of December 2010.

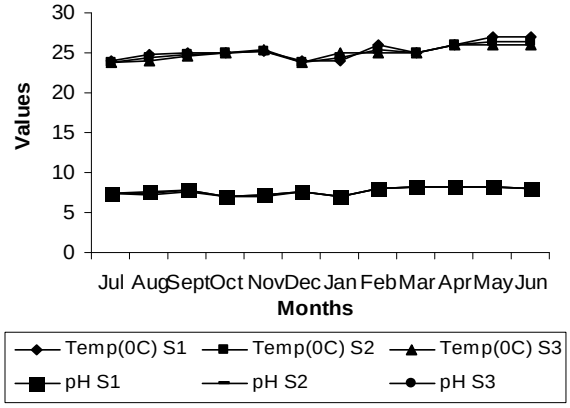

Fig. 3: Temperature (^{0}C) and pH of the Siddheshwar dam water during July 2010 to June 2011.

Table 2: Statistical observations of analyzed water parameters.

July 2010-June 2011					
Month	Sampling Site	Temp (0C)	pH	Cr (mg/L)	Cd (mg/L)
Mean	S_1	25.175	7.703	0.029667	0.0
	S_2	25.10833	7.669	0.032267	0.0
	S_3	25.01667	7.656	0.034867	0.0
S.D.	S_1	0.94014	0.447	0.032706	0.0
	S_2	0.892859	0.463768	0.03535	0.0
	S_3	0.779083	0.488	0.043576	0.0
Var	S1	0.883864	0.200	0.00107	0.0
	S2	0.797197	0.215081	0.00125	0.0
	S3	0.60697	0.239	0.001899	0.0
Min	S1	24	6.99	0.0	0.0
	S2	23.9	6.97	0.0	0.0
	S3	23.8	6.95	0.0	0.0
Max	S1	27	8.24	0.104	0.0
	S2	26.5	8.25	0.126	0.0
	S3	26	8.26	0.126	0.0

The highest pH 8.24 in the month of May 2011 and lowest 6.99 in the month of January 2011 at sampling station-1. The sampling station-2 showed the maximum pH 8.25 in the month of May 2011 and minimum 6.97 in the month of January 2011. The sampling station-3 showed the maximum pH 8.26 in May 2011 and minimum 6.95 in January 2011. In present work the mean values of pH was observed within the permissible limit. The maximum pH values occur in summer season could be by low water level, uptake of CO_2 by the photosynthetic organisms like phytoplanktons, microorganisms or aquatic plants and the minimum pH due to decaying of organic matter. The chromium concentration was estimated highest 0.104 mg/L in the month of November 2010 and lowest 0.0 mg/L in the month of July 2010, May and June 2011 at sampling station-1. In the sampling station-2, the concentration was recorded maximum 0.115 mg/L in the month of November 2010 and minimum 0.0 mg/L in the month of July 2010, May and June 2011. In the sampling station-3, the concentration was recorded maximum 0.126 mg/L in the month of November 2010 and minimum 0.0 mg/L in the month of July 2010, May and June 2011. The highest chromium values 0.104, 0.115 and 0.126 mg/L in November 2010 may be due to the mixing of colour pigments from idol immersion. The minimum concentration obtained in July 2010 and June 2011 due to dilution by rainfall. The cadmium metal content was not observed in all water samples. The permissible limit of cadmium for drinking water is 0.01 mg/L prescribed by ISI. This may be due to absence of any strong source of cadmium near the

study area. The cadmium dissolves in water upto the pH 8. It dissolves in water at very low and at very high pH also it present in absence of sulphide and phosphate in water [10]. Tiwary et.al. [15] detected chromium concentration ranged between 0.002 mg/L to 0.013 mg/L in summer season of the year March 2000 to February 2001 .For their study they selected different sites from Ganga river at Bihar region. Kar et. al. [6] found cadmium metal in the range of 0.001 – 0.003 mg/L from only twenty samples out of ninety six samples selected from Ganga river at West Bengal during the period of 2004-05. The average seasonal concentration of cadmium was 0.001 to 0.003 mg/L.

CONCLUSION

The recorded temperature maximum during summer and minimum in winter seasons. The observed mean values of pH were within the permissible limit (6.5-8.5). The concentrations of chromium in water varied throughout the study period. In present work mean chromium concentration was observed below than the permissible limit i.e. 0.05 mg/L [18]. The cadmium metal absent in all water samples.

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