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ORIGINAL ARTICLE

HEAVY METALS IN SOME INDUSTRIAL EFFLUENT SAMPLES AROUND PALGHAR AND TARAPUR MIDC AREA

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ABSTRACT:

Due to rapid industrialization and urbanization our environment has been polluted by toxic metals, inorganic salts, pesticides etc. through the discharge of industrial effluents. The present study monitored some heavy metals in the ambient environment of selected industrial effluents discharge locations around Palghar and Tarapur MIDC area. Samples of industrial effluent, drinking water and soil were collected in and around some industrial sites. The concentration of the metals varied depending upon the industrial effluent. The overall study indicated that, among all the metal the concentration of iron was relatively high and lead was low in collected samples. Addition source of Fe ions in waste water samples is from dye industry in which complex salt of Fe and Cr are used.

Keywords- toxic metals, pesticides, effluent.

INTRODUCTION:

Heavy metal pollution is currently receiving much attention in potable water due to stringent limits imposed by the public health authorities. Although the danger of toxic metal like Hg, Cd, Pb, As, Zn, Cu, Ni, Cr etc to the health have long been known, the problem was brought in to focus recently when various coastal waters, lakes and rivers were found dangerously polluted by heavy metals due to the industrial and agricultural activities (1-3). However some heavy metals like Cu, Cr, Zn etc. play an important role in metabolic activities of living organisms (4).

Disposal of treated and untreated industrial effluents containing hazardous metals, organic and inorganic matter of toxic nature on land is most widely practiced method in Indian cities (5). Several toxic pollutants are released in to the surrounding environment by Industries; some of them are heavy metals. The heavy metals present in the industrial effluents interact with organic and inorganic species and forms complexes. Insoluble complexes are deposited on the surface of the soil but the soluble complexes formed so far have a tendency to percolate through the soil strata, which affect the quality of groundwater, and soil gets deteriorated.

Metals take part in the process of biomethylation. Biomethylation of metals is the mechanism that plays an important role in the mobilization and transport of the metals (6). The toxic effects of heavy metal pollutants on marine biota have been well documented. It has been reported that heavy metal affect the various biochemical parameters of liver of fish (7).

For this investigation the samples were collected from the Palghar and Tarapur MIDC areas. These areas are one of the important industrial belts situated nearby Mumbai

MATERIAL AND METHODS:

In view of the deleterious effects exerted by heavy metals their determination has received increasing attention in environmental pollution monitoring. Inductively Coupled Plasma Atomic Emission (ICP-AES) Spectrophotometry provides a fast and multi element analysis tool. Out of the large number of metal ions detected qualitatively in the industrial wastewater amended soil and groundwater, our investigations were focused for a variety of reasons only on a few of these viz., Cu, Zn, Cd, Pb, Ni, Fe, As and Hg were detected by ICP-AES.

Detection of Cu, Zn, Cd, Pb, Cr, Fe, Ni, As and Hg by ICP-AES :

Inductively coupled plasma – Atomic emission spectrophotometric (ICP-AES) technique is of recent origin and is useful for the multi element determination of large number of samples containing metal pollutants. This technique is very rapid; reliable, the obtained accuracy is quite satisfactory. During the course of present study, this technique was used for the determination of Cu, Zn, Cd, Pb, Fe, Ni, As and Hg ions in industrial effluent, soil and water samples. HNO_3-HCl extract was used for the determination of above metals industrial wastewater and ground water samples (8), where as 4N HNO_3 amended soil extract (9) were used for the determination of metals in amended soil.

The above extract for all respective samples were prepared, stored in polythene bottles and analysed the concentration of metals by ICP-AES at Sophisticated Analytical Instrument facility (SAIF), Indian Institute of Technology, IIT, Mumbai. The concentrations of metals were directly observed in ppm.

RESULTS AND DISCUSSION:

The results thus obtained are being described and discussed under the individual headings.

Copper (Cu):

During the course of present investigation copper was found in all industrial wastewater samples (Table-1) the concentration of copper in Palghar and Tarapur MIDC at different sites was found to be in the range of 0.10-188.27 and 0.05-010 μg/ml respectively.

The principal use of for copper is in electronic equipment, brass and in electroplating industries. The high concentration of copper in industrial waste water sample may be due to the discharge from industrial and domestic waste and metal plating (10).

Zinc (Zn):

Zinc was found in all industrial wastewater samples (Table-1) the concentration of Zinc in Palghar and Tarapur MIDC at different sites was found to be in the range of 0.1-8.05 and <0.1μg/ml respectively. Zinc is discharged from pharmaceutical, paint pigment, several insecticides and cosmetic industries. Zn is used as a protective coating on the other metals, particularly in galvanizing iron and steel. It is an essential micronutrient and an essential constituent of alcohol dehydrogenase, carbonic anhydride, alkaline phosphates carboxyl peptidase B and other enzyme (11).

Cadmium (Cd):

Cadmium is very toxic metal it is usually mined and extracted from zinc ore, especially zinc sulphide. Industrially cadmium is used as an antifriction agent as a must proffer and in alloys. It is also used in semiconductors, control rods for nuclear reactors, electroplating bases, PVC manufacture and batteries (12).

During the course of present study, the concentration of Cd in industrial wastewater samples Palghar and Tarapur MIDC was found to be < 0.1 μg/ml.

Lead (Pb):

According to rough estimation about 2,10,000 tons of lead are released annually in to the environment (13) in variety of ways like in fumes, dusts, from industrial effluents, Pb pipes, paints, pigments, varnishes, printing inks etc. Lead arsenate is used as a pesticide and borate finds use in plastic industries.

In the present study, the concentration of Pb in industrial wastewater sample at Palghar and Tarapur MIDC was found to be in the range of 1-1.5 μg/ml and less than 1.0-1.2 μg/ml, respectively. The high concentration of Pb in Industrial wastewater sample is due to the industrial discharge like dyeing and printing, plumbing, coal and gasoline etc.

Iron (Fe):

Iron is an essential micronutrient required in the trace quantities for the normal metabolism of plant and animals. It is a constituent of cytochromes and non-heme iron proteins involved in photosynthesis, nitrogen fixation and respiratory linked dehydrogenase (14).

During the course of present investigation (Table-1), the concentration of iron was found in all industrial wastewater samples the concentration of iron in Palghar and Tarapur MIDC at different sites was found to be in the range of 0.73-9.09μg/ml and 1.02-3.36 μg/ml respectively. Addition source of Fe ions in waste water samples is from dye industry in which complex salt of Fe and Cr are used. Higher amount of ferrous sulphate and ferric chloride are used for the precipitation of direct dye in treatment process.

Nickel (Ni):

Nickel is added in to the environment through tobacco smoke, chemicals, diesel oil, coal, catalyst, steel and non-ferrous alloys. It is used in a various forms in industry for nickel plating, as a catalyst as a mordant and in ceramic glaze due to resistance to corrosion and high strength over a wide temperature range (15). Hence, it is also released the environment through the industrial activities.

During the course of present investigation the concentration of Nickel in Palghar and Tarapur MIDC at different sites was found to be < 0.1 μg/ml.

Arsenic (As):

Arsenic is a toxic, non-essential element and widely occurs in nature. It is used in alloys, pesticides. It was formerly used in paints pigments but this use discontinued when it was found that under damp conditions, mould converted the arsenic to the highly toxic gases like arsine ($As_2 H_2$) and trimethyl arsine As $(CH_3)_3$ (16).

During the course of present investigation the concentration of As in industrial wastewater sample from Palghar and Tarapur MIDC was found to be detected < 0.1 μg/ml.

Mercury (Hg):

Mercury is a highly toxic metal. It is used in the production of electrical apparatus, in the chloro-alkali industry, which produces chlorine and caustic soda, in fungicides. Its compounds like mercuric sulphate are used as a catalyst in the production of acetaldehyde in industry. Hence, it is thrown in to the environment due to the industrial use (17).

When it enters in to the environment, various transformations can take place, the most serious of these is the transformation of metallic mercury to methyl and diethyl derivatives by anaerobic microorganisms.

During the course of present investigation the concentration of As in industrial wastewater sample Palghar and Tarapur MIDC was found to be< 0.1 μg/ml.

Chromium (Cr):

The aquatic chemistry, mobility and toxicity of Cr give chromium contaminated ground water. Contamination of soil and ground by chromium is a significant problem in several industrialized locations around the World. In a number of locations in India, chromium contamination of ground water has compromised the beneficial use of these resources (18).

During the course of present investigation (Table-1) chromium was found in all industrial wastewater samples the concentration of chromium in Palghar and Tarapur MIDC at different sites was found to be in the range of < 0.1-1.85 μg/ml and 0.15-0.66 μg/ml respectively.

The concentration of copper in ground water and amended soil at Palghar and Tarapur MIDC was 0.16, 1.69 μg/ml and 0.01, 15.12 μg/gm respectively (Tabel no. 1 &2). It clearly indicates that, there is a high rate of percolation of copper ions through the soil bed in this area. The surrounding population uses this groundwater for the various purposes like drinking, bathing and irrigation. However copper has been found toxic for human health. Large quantities of Cu in drinking water irritate stomach cause, neurological complaints, liver and kidney dysfunction, cancer and accelerate aging (19). Whereas deficiency of Cu can lead to high serum cholesterol and an increased risk of cardiovascular disease.

The concentration of Zinc in ground water and amended soil at Palghar and Tarapur MIDC was <0.1 μg/ml, 1.43 μg/gm and 0.1 μg/ml, 17.15 μg/gm respectively (Tabel no. 1 &2). The presence of high concentration of Zinc in the soil may induce toxicity commonly known as heavy metals phytotoxicity. In human the oral administration of high zinc usually does not cause any side effects but mild gastrointestinal complaints can occur. Cadmium was not detected in ground water as well as soil samples of both industrial areas.

The concentration of Lead in ground water and amended soil at Palghar and Tarapur MIDC was found to be less than 1 μg/ml. The high concentraion of Pb in amended soil indicates that the soils of this region have a tendency to adsorb higher amount of Pb species from the industrial discharge.

Lead is classified as being potentially hazardous and toxic to most forms of life. It has proved to be responsible for quite a number of diseases in humans such as chronic neurological disorders especially in fetuses and children. It replaces calcium in bones as well as poisons the nerves and hence affects the brain.

The concentration of Iron in ground water and amended soil at Palghar and Tarapur MIDC was 13.51 μg/ml, 713.88 μg/gm and 0.84 μg/ml, 840.9 μg/gm respectively (Tabel no. 1 &2). Iron is an essential micronutrient required in the trace quantities for the normal metabolism of plant and animals. It is a constituent of cytochromes and non-heme iron proteins involved in photosynthesis, nitrogen fixation and respiratory linked dehydrogenase.

The higher concentration of iron in ground water sample at Palghar MIDC is due to the streams carrying industrial effluents around these areas from where the samples collected. ISI and WHO have set a desirable limit 1.0 μg/ml for drinking water cause lung cancer (20).

During the course of present investigation, the Ni concentration in groundwater sample at Palghar and Tarapur MIDC was found to be less than 0.1 μg/ml and the concentration of Ni in amended soil sample at Palghar and Tarapur MIDC was found to be 5.1 μg/gm and 3.9 μg/gm, respectively (Tabel no. 1 &2).

Nickel takes part in the ordinary metabolism in micro-organisms that fix the nitrogen by affecting the hydrogenase enzyme. A number of studies have pointed out that nickel has a nutrient importance, where it is engaged in the composition of the nucleic acids, DNA and RNA. However nickel related health effects such as cardiovascular and renal effects in animals have been reported (21). Nickels toxic effects upon humans are related to dermal, lung and nasal sinus cancers. Arsenic and Mercury were not detected in ground water as well as soil sample from both industrial areas.

Chromium is a highly toxic heavy metal pollutant in the environment is known to interfere with biological systems. The extensive use of chromium in different industries such as lather, textile,

electroplating, ceramics and photography has resulted in the discharges of chromium compounds in to the aquatic ecosystem.

The concentration of Chromium in ground water and amended soil at Palghar and Tarapur MIDC was 1.52 µg/ml, 2.66 µg/gm and 0.21 µg/ml, 63.9 µg/gm respectively (Tabel no. 1 &2). The species of significance from an environmental impact perspective is Cr (VI). It has high solubility in aqueous media, therefore very mobile in ground water and is a strong oxidizing agent which makes toxic to biological systems (22).

Table No. 1: The concentration (µg/ml) of heavy metals in industrial wastewater.

Palghar MIDC									
Sample No	Cu	Zn	Cd	Pb	Fe	Ni	As	Hg	Cr
1	0.10	<0.1	ND	<1	9.09	ND	ND	ND	1.85
2	188.27	8.050	ND	1.5	0.73	ND	ND	ND	<0.1
3	2.68	0.685	ND	1.0	4.15	ND	ND	ND	0.21
Tarapur MIDC									
Sample No	Cu	Zn	Cd	Pb	Fe	Ni	As	Hg	Cr
1	0.05	<0.1	ND	1.0	1.02	ND	ND	ND	0.15
2	0.07	<0.1	ND	1.2	3.36	ND	ND	ND	0.66
3	0.10	<0.1	ND	<1	1.45	ND	ND	ND	0.22

* ND for Ni,As,Hg,Cd means less than 0.1 ppm.

Table No.2: The concentration in (µg/ml) of heavy metals in Tarapur MIDC groundwater samples.

Palghar MIDC									
Sample no.	Cu	Zn	Cd	Pb	Fe	*Ni*	As	Hg	Cr
1	0.16	<0.1	ND	1.0	13.51	ND	ND	ND	1.52
Tarapur MIDC									
Sample no.	Cu	Zn	Cd	Pb	Fe	*Ni*	As	Hg	Cr
1	0.01	<0.1	ND	1.1	0.84	ND	ND	ND	0.21

* ND for Ni,As,Hg,Cd means less than 0.1 ppm.

Table No. 3: The concentration in (µg/gm) of heavy metals in Tarapur MIDC amended soil samples.

Palghar MIDC									
Sample no.	Cu	Zn	Cd	Pb	Fe	*Ni*	As	Hg	Cr
1	1.69	1.43	ND	1.2	713.88	5.1	ND	ND	2.66
Tarapur MIDC									
Sample no.	Cu	Zn	Cd	Pb	Fe	*Ni*	As	Hg	Cr
1	15.12	17.15	ND	1.4	840.9	3.9	ND	ND	63.9

* ND for As, Hg, Cd means less than 0.1 ppm.

CONCLUSION:

The present study indicates greater impact of industrial activities on underground water quality in Tarapur (Boisar) city as compared to Palghar. It may be attributed to the fact that most of the wastes of

Boisar city are discharged through drains in to the nallah, there is dumping of wastes at various land sites. Greater solidity problem in the ground water of Palghar and Boisar city, however, seems to be attributable to geological reasons.

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