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Research Article

EFFECTS OF HEAVY METALS ON SOIL DURING BEFORE MONSOON AND AT MONSOON SEASON AROUND INDUSTRIAL ZONE FROM NASHIK DISTRICT

Kirti S. Patil^{*1}, R. S. Saler² and Gaikwad V. B³

¹*Department of Environmental Science, K.T.H.M. College, Gangapur road, Nasik-422002, MH, India

²Department of Botany, K.T.H.M. College, Gangapur road, Nasik, Maharashtra, India

³Principal, N.D.M.V.P. Samaj's K.T.H.M. College, Gangapur road, Nashik, Maharashtra, India

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ABSTRACT

Industrial ejection on an environment causes many problems, those ejections finally entered into soil and causes environmental pollution. Contamination of soil by heavy metals is one of the largest issues faced all over the globe and needs extensive attention as their occurrence above normal range is highly harmful to both plant as well as living things. Hence, it is useful to carry such study, so that heavy metals in soil can be determined with special focus on MIDC regions of Satpur, Ambad and Sinner in and around Nashik, MH, India.

Soil samples were collected before and at monsoon season. Total Forty different soil samples were collected from this region respectively. The samples were analyzed for heavy metals-were Cadmium, Chromium, Cobalt, Iron, Lead and Zinc. The samples were analyzed by using Atomic absorption spectrometer (AAS). Results showed that concentration of Cr, Fe, Pb, Co and Zn in soil was found above the beyond desirable limits given by WHO. Therefore necessary action must be taken by the responsible authorities to control the pollution due to heavy metals and protect the plants and animals in around these regions.

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INTRODUCTION

There are numerous activities by which high amount of heavy metals are released into soil, surface and groundwater those are due to Industrial manufacturing, farming activity and load carrying vehicles, mining and ultimately into the biosphere. Heavy metals concentration in crops is of great worry as there is state of being probable of food poisoning through the soil. Metals like Cadmium, Cobalt, Chromium and Lead are not required for plants growth, they are readily available in the soil and absorbed and stored by plants in poisonous form. If vegetables or crops are grown in such contaminated soil or irrigated with water containing such heavy metals increases risk to all living things. Most of the studies shows that use of waste water polluted with heavy metals for longer time, may enter into soil, which is beyond limits set by WHO.

The heavy metals get into soil by human activities such as smelting procedures used in heavy industries such as iron and steel, mining, chemical industry, road transportation and various household and human activities such as draining of manure, and recreational activities [L. Jantschi *et al*] [C. Stihl *et al*]. The presence of these metals in soil affect the growth of

plants and wildlife. [Cojcaru *et al*], [A. Ene *et al*], [I.V. Popescu *et al*]. The heavy metals effects are: disturb soil ecology, affect agricultural production, water quality, and ultimately affect the human as well as animal health by entering into food chain. There is close relation between these effects with the bioavailability of heavy metals, which are controlled by the speciation of metal ion in soil. Hence determining concentration of heavy metal ion in soil become essential.

Heavy metals occur in small amounts, naturally and can enter into water system through process of percolating, dust. As we having knowledge of heavy metals they cannot be decomposed, they are continuously being deposited and even get immersed in water, thus lead to pollution of body of water and in stabilize the ecosystem. The addition of these heavy metals in aquatic system is harmful to human health and can have its long term effects on ecosystem. [D.O. Ogoyi *et al*]

MATERIAL AND METHOD

Sample Collection

Soil samples were collected from Satpur, Ambad and Sinner regions of MIDC. Samples were collected from, nearby

*Corresponding author: Kirti S. Patil

Department of Environmental Science, K.T.H.M. College, Gangapur road, Nasik-422002, MH, India

industrial areas. Those soil Samples were collected before monsoon and at monsoon season. Soil samples collected from the water run-off in the industrial areas of the chosen agricultural sites. By use of standard methods of soil & water sample are analyzed by methods described in APHA Books.

Treatment of Samples

Soil samples were dried in oven at 110°C temperature. Each sample (2 gram each) was acid digested by using nitric acid. Later on these samples were kept on hot plate. After removing them from hot plate, samples were filtered in 100 ml graduated cylinder up to 35 ml.

Analysis of Samples

Samples of soil were taken to laboratories for analyzing presence of heavy metals like Cd, Co, Cr, Pb, Zn, Fe and exposed to Atomic absorption spectrometer. (Perkin Elmer, spectra AA220, Varian, 2002 installation by hot plate aquaria method).

RESULTS AND DISCUSSION

Table no 1 Concentration of Heavy metal in the soil samples collected from Satpur and Ambad region Before Monsoon season.

Sample No.	Cd mg / kg	Cr mg / kg	Fe mg / kg	Pb mg / kg	Zn mg / kg	Co mg / kg
ASS1	0.121	265	10884	2.44	46.1	11.3
ASS2	0.25	163	8987	4.05	57.9	4.955
ASS3	0.1	253	11236	3.62	98	9.2
ASS4	0.38	363	14890	18	815	3.49
ASS5	0.16	152	12103	2.66	45	6.56
SSS6	0.14	153	10250	4.69	51.2	6.28
SSS7	1.46	863	16270	41.4	540	25.3
SSS8	0.21	182	11181	9.43	82	5.56
SSS9	1	1078	16908	17.2	99.2	0.5
SSS10	0.22	108	12546	2.29	28.9	12.1
Range	0.1-1.46	108-1078	8987-16908	2.29-41.4	28.9-815	0.5-25.3
Mean	0.4041	358	12525.5	10.578	186.33	8.5245
Median	0.15	152.5	11176.5	3.675	48.1	6.42
S.D.	0.41457	317.6611	2507.2149	9.09087	252.7924	6.500205

Table no 2 Concentration of Heavy metal in the soil samples collected from Satpur and Ambad region In Monsoon season.

Sample No.	Cd mg / kg	Cr mg / kg	Fe mg / kg	Pb mg / kg	Zn mg / kg	Co mg / kg
ASS1	1.23	43.6	40621	130	1493	35.6
ASS2	0.88	49.2	36039	10.7	178	28.4
ASS3	1.96	56.7	42787	55.7	167	29.8
ASS4	1.86	65.5	65564	25.6	1317	33.2
ASS5	1.47	92.6	250140	49.4	357	41.3
SSS6	1.81	66	43859	53	299	34.7
SSS7	1.03	22.5	33756	64.4	744	34.9
SSS8	2.98	42	40040	14.3	758	39.9
SSS9	2.2	36.4	41634	16.8	494	33.7
SSS10	2.57	28.1	42214	17.7	740	32.7
Range	0.88-2.98	22.5-92.6	33756-250140	10.7-130	167-1493	28.4-41.3
Mean	1.799	50.26	63665.4	43.76	654.7	34.42
Median	1.64	79.3	146999.5	51.2	328	38
S.D.	0.843385	19.70	62687.4161	48.1188	432.8251	3.7632

ASS-Ambad soil Sample, SSS- Satpur soil sample

From table 1 and 2 Observations are follows:

Cadmium (Cd): Before monsoon season the concentration of Cd in soil samples was found between 0.1-1.46 mg / kg (Table no. 1), which was observed above the permissible limit set by

WHO. [Zaigham Hassan *et al*]. And in monsoon season the concentration of Cd was found more than before monsoon season, which is between 0.88-2.98 mg / kg (Table no. 2) in Satpur and Ambad region.

Chromium (Cr): Concentration of Cr before monsoon, in soil samples found between 108-1078 mg/kg (Table no. 1), which was recorded quite high as compare to the permissible limit set by WHO. Whereas in monsoon season the concentration of Cr was found less 22.5-92.6 mg/kg (Table no. 2).

Iron (Fe): Presence of iron in water is observed in the form of Fe²⁺ or Fe³⁺, which is in free form. It gives a bitter taste to water, the occurrence of iron into water is from natural geological sources, industrial wastes, and local discharge. High amount of iron (more than 10 mg/kg) results in increase in pulse rate and blood clotting in blood vessels, hypertension and tiredness. According to WHO report, the maximum permissible limit of iron in drinking water is: 1mg/l. The concentration of Fe in the soil samples was found between 8987-16,908 mg/kg before monsoon (Table no. 1). It means, the concentration of Fe in all the soil samples was beyond the limit given by WHO. Whereas, in monsoon the concentration of Fe was found beyond limits which is in between 33,756-2,50,140 mg/kg (Table no. 2).

Lead (Pb): Contamination by lead of the soil is a frequent issue; it get stored with age into bones, arteries and kidney, liver and spleen. It can enter in human body through food (65 %), water (20%) and air (15%). Concentration of lead in soil samples was found between 2.29-41.4 mg/kg (Table no. 1). In all the soil samples lead concentration was found beyond the specified limit given by WHO. In monsoon season, the concentration of Pb remained in very high range i.e 10.7 - 130mg. kg (Table no. 2).

Zinc (Zn): It is considered as one of the important heavy metal, which plays an important role in the consumption and metabolic processes of many organisms such as protein synthesis. Yet, high concentrations of Zn is toxic for living things. Concentration of Zn in soil samples found between 28.9 -815 mg/kg (Table no. 1), which was above the permissible limit set by WHO. Whereas in monsoon season the concentration of Zn was found between 167-1493 mg/kg (Table no. 2).

Cobalt (Co): The WHO specified limit for Cobalt is 10 mg/kg. Concentration of Co in the soil samples was found between 0.5 -25.3 mg/kg (Table no. 1). In all the collected samples the concentration of Co was beyond desired limit set by WHO. In monsoon, the concentration of Co was found between 28.4 - 41.3 mg/kg (Table no. 2).

Table no 3 Heavy metal concentration in the soil samples obtained from Sinnar region pre Monsoon season.

Sample No	Cd mg / kg	Cr mg / kg	Fe mg / kg	Pb mg / kg	Zn mg / kg	Co mg / kg
SiS1	0.057	0.89	7.63	1.44	9.21	0.21
SiS2	0.02	0.45	6.67	0.64	0.42	0.061
SiS3	0.019	1.56	10.4	0.74	0.49	0.13
SiS4	0.021	1.46	6.8	0.53	0.51	0.092
SiS5	0.019	1.2	6.99	0.51	0.43	0.15
SiS6	0.014	1.73	6.82	0.64	0.34	0.051
SiS7	NA	1.24	6.82	0.47	0.32	0.02
SiS8	0.005	1.21	6.64	0.52	1.31	0.023

SiS9	0.017	1.53	6.8	0.1	0.8	NA
SiS10	0.055	1.17	2.74	0.36	10.21	NA
Range	0.005-0.057	0.45-1.73	2.74-10.4	0.1-1.44	0.32-9.21	0.02-0.21
Mean	0.02522	1.244	6.831	0.595	2.404	0.0921
Median	0.019	1.225	6.82	0.525	0.5	0.0765
S.D.	0.02938	0.35171	1.73788	0.327421	3.670308	0.062601

Table no 4 Concentration Heavy metal in the soil samples obtained from Sinnar region in Monsoon season.

Sample No.	Cd	Cr	Fe	Pb	Zn	Co
	mg / kg	mg / kg	mg / kg	mg / kg	mg / kg	mg / kg
SiS1	0.499	115	12937	5.55	69.6	8.54
SiS2	0.252	26.9	12821	4.35	64	4.9
SiS3	0.25	73.9	11799	4.85	47.4	5.05
SiS4	0.19	134	10824	2.51	28.2	9.14
SiS5	0.216	107	12448	3.53	46.1	8.31
SiS6	0.197	103.5	11025	3.05	31.5	5.2
SiS7	0.252	115	11002	2.31	67.1	4.65
SiS8	0.211	69.79	12529	5.05	51.35	8.39
SiS9	0.215	112	12057	3.65	25.62	8.79
SiS10	0.379	47.67	12105	2.88	40.55	9.02
Range	0.19-0.49	26.9-134	10824-12937	2.31-5.55	25.62-69.6	4.65-9.14
Mean	0.26619	90.476	11954.7	3.773	47.142	7.199
Median	0.233	105.25	12081	3.59	46.75	8.35
S.D.	0.09315	32.5270	734.5960	1.08344	15.2178	1.8529

SiS- Satpur soil sample

From table 3 and 4 observations are as follows:-

Cadmium (Cd): The samples collected from Sinnar region before and in monsoon season (Table no. no 3 and Table no. no. 4). had range between 0.005-0.057 mg/kg and 0.19-0.49 mg/kg respectively which was substantially low as compare to Satpur and Ambad region samples. (Table no. 3 and Table no. 4).

Chromium (Cr): The range of Cr in soil samples collected from Sinnar region before and in monsoon season was 0.45-1.73mg/kg and 26.9-134 mg/kg respectively which was low as compare to Satpur and Ambad region samples. (Table no. 3 and Table no. 4).

Iron (Fe): The range of Fe in soil samples collected from Sinnar region before and in monsoon season was 2.74-10.4mg/kg and 10824-12937 mg/kg respectively which is similar to Satpur and Ambad region samples. (Table no. 3 and Table no. 4).

Lead (Pb): The range of Pb in soil samples collected from Sinnar region before and in monsoon season was 0.1-1.44 mg/kg and 2.31-5.55 mg/kg respectively which was substantially high in a range. (Table no. 3 and Table no. 4).

Zinc (Zn): The range of Zn in soil samples collected from Sinnar region before and in monsoon season was 0.32-9.21 mg/kg and 25.62-69.6 mg/kg respectively which was permissible range. (Table no. 3 and Table no. 4).

Cobalt (Co): The range of Co in soil samples collected from Sinnar region before and in monsoon season was 0.02-0.21 mg/kg and 4.65-9.14 mg/kg respectively which was substantially low as compare to Satpur and Ambad region samples. (Table no. 3 and Table no. 4).

From the above observations we can say that the soil at the Satpur, Ambad MIDC region is more contaminated than Sinnar MIDC area with heavy metals.

CONCLUSION

Control soil sample having following Heavy metal values = Chromium =0.05 mg/kg ,Cadmium =0.05 mg/kg ,Cobalt = 0.55 mg/kg, Lead =0.19 mg/kg ,Iron = 35 mg/kg ,Zinc = 15 mg/kg.

The results of the present study shows that the concentration of cadmium at Ambad and Satpur was in the range of 0.88-2.98 mg / kg, which was above acceptable limit of WHO i.e. 0.02 mg /kg. But the concentration of cadmium in Sinnar was in the range of 0.19-0.49 mg/kg in Monsoon season, which was lower than that of Ambad and Satpur areas. But at all the selected sites its concentration was above acceptable limit.

In case of Chromium the acceptable limit set by WHO is 1.30 mg / kg it was little bit in control at Ambad and Satpur regions. Before monsoon it was 108-1078 mg/kg and in monsoon it was in the range of 22.5 -92.6 mg/kg. But in Sinnar region it was in range of 0.45 -1.73 mg/kg and 26.9-134 mg/kg during before and in monsoon season respectively. It is really at high toxic level.

The acceptable limit of Lead set by WHO is 2mg / kg. At Ambad and Satpur the range was found between 2.29-41.4mg/kg and 10.7 -130 mg/kg during before monsoon and at monsoon season respectively. It is beyond the acceptable limit. But at Sinnar the range was 0.1-1.44 mg/kg and 2.31-5.55 mg/kg during pre-monsoon and in monsoon season respectively which is above acceptable limit.

The permissible limit set by WHO for Zinc is 0.60 mg /kg. At Ambad and Satpur region the range was between 28.9-815 mg/kg and 167-1493 mg/kg during before and in monsoon. At Sinnar before and in monsoon season the range was 0.32-9.21mg/kg and 25.62-69.6 mg/kg respectively. At all these sites the range was above the acceptable limit set by WHO.

High amount of iron (Fe) i.e. more than 10 mg/kg is harmful to human health. At Ambad and Satpur it was found between 8987-16908mg/kg. Whereas, in monsoon the concentration of Fe was found between 33756 -250140 mg/kg. The samples collected from Sinnar region before and in monsoon season was 2.74-10.4 mg/kg is in a permissible range but in monsoon season it is beyond acceptable range which is 10824 -12937 mg/kg respectively. Which was by and similar to Satpur and Ambad region samples.

In Ambad and Satpur region Iron level is too high in monsoon season.(33756 -250140 mg/kg)

The WHO specified limit for Cobalt is 10 mg/kg. Concentration of Co in the soil samples was found between 0.5-25.3 mg/kg and 28.4-41.3mg/kg during before and in monsoon season at Ambad and Satpur. In all the collected samples, concentration of Co was beyond acceptable limit set by WHO.

The range of Co at Sinnar region during before and at monsoon was 0.02-0.21mg/kg and 4.65-9.14 mg/kg respectively which was considerably low as compare to Satpur and Ambad region samples.

From the above observations we can say that heavy metal concentration in soil in the selected area, is quite high and therefore proper steps must be taken to control it. In the coming time the concentration of these heavy metals can not only pollute the nearby area but also affect the other parts through various natural as well as human forceful activities. Also the soil at the Sinnar MIDC region is less contaminated with heavy metals as compare to the Satpur and Ambad region. The soil at Satpur and Ambad MIDC area is mostly polluted ,so proper care must be taken and awareness among nearby farmers should be done.

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