© 2017 IJSRSET | Volume 3 | Issue 5 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

# Analysis of Concentration of Heavy Metals in Soil

**Jatin Singla*, Rita Mahajan, Deepak Bagai**
*PEC University of Technology, Electronics Department, Sector-12, Chandigarh, India

## ABSTRACT

Soil is one of the most important constituent of earth's ecosystem as it is responsible for the growth of plants, regulates the atmosphere and acts as a habitat for a number of organisms. Soil pollution by hazardous materials such as heavy metals is a serious issue as this toxic material may enter into the food chain and into the ground water through the soil and ultimately into the human beings resulting in serious health issues among them. Dadumajra is a major dumping site of Chandigarh city for disposal of municipal solid waste without any segregation. The aim of this study was to test the soil in the vicinities of the Dadumajra landfill for the concentration of heavy metals copper, zinc, iron and manganese and to compare the concentrations obtained with the concentration of same metals in soil samples collected from four other different parts of the city including park area, highly dense commercial and residential area, industrial area and forest area using ANOVA F–test. The results revealed that the concentration of copper and zinc in soil in the vicinities of Dadumajra landfill have a significant amount of higher concentration as compared to the soil in other parts of the city where as the concentration of iron and manganese in soil of different parts of the city did not show significant variation with the soil of Dadumajra landfill.

**Keywords:** Soil, Heavy metals, Landfills, E-waste.

## I. INTRODUCTION

E-waste which constitutes hazardous heavy metals is treated simply like any other type of municipal solid waste in India due to lack of awareness among the people about its consequences. Most of the e-waste treatment methods in India include informal ways such as treatment with acids, hammering, incineration and finally dumping the left over into the landfills [1, 2] and thus leading to heavy metal pollution of soil. From soil these heavy metals may enter the food chain finally ending up in human beings. Heavy metals such as copper, iron, zinc and manganese are essential micronutrients for the growth of plants as well as animals including human beings but their excessive intake has a very bad impact on human health. Higher dosage of copper can cause health hazards such as anaemia, liver damage, kidney damage, stomach related problems and intestinal irritation among the human beings [3]. Excessive intake of iron can lead to hereditary hemachromatosis leading to building of iron in tissues and organs of human beings and thus elevating the risk of arthritis, cancer, diabetes, liver problems and heart failure [4]. Higher dosage of zinc may lead to respiratory disorders, nausea, metal fume fever and epigastric pain [5]. Dadumajra landfill is the only designated dump yard in Chandigarh city consisting of 45.11 acres of land and is situated in sector 38 near Dadumajra labour colony where waste is being dumped without any source separation [6]. Garbage dump creates a constant pervasive stench and is creating a number of health issues among the residents of Dadumajra colony such as skin allergies, asthma, rashes on the faces, arms and legs and problems in lungs and chests [7, 8]. The previous study conducted on the leachate collected from Dadumajra landfill suggested that the leachates were rich in nutrients and can be used as fertilizers but concentration of different heavy metals is a factor which should be considered and needs to be verified to be in appropriate limits [9].

## II. METHODS AND MATERIAL

### A. Sample Collection

A total of twenty five soil samples were collected from five sites of the Chandigarh city which includes Dadumajra landfill area (LA), industrial area phase 1 and phase 2 (IA), Burail, sector 45 (CA), Kambala forest area (FA) and leisure valley park, sector 10 (PA) with five samples from each point and tested for the value of pH and concentration of heavy metals.

**B. Measurement of pH**

For preparation of samples for measurement of pH, 20 gm of oven dried soil from each of the collected soil samples was taken and mixed with 100 ml of distilled water to achieve 1:5 dilutions. The mixture was then well stirred and heated. The boiled mixture was then filtered through a 125 micron filter paper. The filtered solution was then kept at room temperature for around three hours to cool down. pH of the these prepared samples were then measured using Oakton pH 700 pH meter. The pH meter was calibrated using distilled water under constant temperature of around 25.2ºC before measuring pH of the soil samples and the same temperature was maintained during measurement of pH of the prepared soil samples.

**C. Measurement of concentration of heavy metals**

For preparation of samples for heavy metal analysis, 10 gm of oven dried soil from each of the collected soil samples was taken and mixed with 20 ml DTPA solution in glass tubes. DTPA solution was prepared by mixing 3.434 gm of Diethylene Triamine Penta-acetic Acid, 2.940 gm of calcium chloride dehydrate and 26.6 ml of triethanolamine and pH value of this solution was maintained to be 7.3. Hydrochloric acid was used to maintain the pH value of DTPA to be 7.3. These glass tubes were then placed in orbital shaking incubator for two hours. The temperature of the orbital shaking incubator was maintained at 25.2 degree Celsius. After treatment in orbital shaking incubator for two hours, the samples were filtered using 125 micron filter paper. From each of filtered sample, 5 ml of the sample was taken and mixed with 20 ml of distilled water. These prepared samples were then tested for the concentrations of zinc, iron, manganese and copper using atomic absorption spectrophotometer LABINDIA AA7000 after calibrating the device with different metal solutions. Zinc was measured at a wavelength of 213.90 nm and the device was calibrated using 0.2 ppm, 0.4 ppm and 0.8 ppm zinc solution. Iron was measured at a wavelength of 248.30 nm and the device was calibrated using 1 ppm, 2 ppm and 4 ppm Fe solution. Manganese was measured at a wavelength of 248.30 nm and the device was calibrated using 0.5 ppm, 1 ppm and 2 ppm manganese solution. Copper was measured at a wavelength of 324.70 nm and the device was calibrated using 0.4 ppm, 0.6 ppm and 1 ppm copper solution.

The results of the pH values and the concentration of different heavy metals in different soil samples obtained were then analysed using ANOVA F-test [10] at a significance level of 5% to test whether the concentration of different heavy metals in soil in the vicinities of Dadumajra landfill have significant variation with the concentration of same metals in other parts of the city or not.

## III. RESULTS AND DISCUSSION

The concentration of copper was found to have maximum value of 20.38ppm in sample 4 of the Dadumajra landfill area and minimum value of 0.77ppm in sample 2 of Kambala forest area. The concentration of zinc was found to have maximum value of 20.08ppm in sample 5 of the Dadumajra landfill area and minimum value of 2.16ppm in sample 2 of the same area and hence maximum variation of concentration of zinc was found in the different samples of the Dadumajra landfill area only. The concentration of iron was found to have maximum value of 64.74ppm in sample 2 of the Dadumajra landfill area and minimum value of 15.07ppm in sample 3 of Burail, sector 45. The concentration of manganese was found to have maximum value of 14.08ppm in sample 4 of Burail area followed by 14.06ppm in sample 4 of the Dadumajra landfill area and minimum value of 2.86ppm in sample 2 of industrial area. All the samples were found to be in category of slightly basic nature with a maximum value of pH as 7.92 in sample 5 of the Dadumajra landfill area and a minimum value of pH as 7.05 in sample 1 of the Kambala forest area. The mean values of the results of the concentration of different heavy metals and results of mean values of pH of the soil samples obtained at each site are shown in table 1.

TABLE 1. MEAN VALUE OF PH AND CONCENTRATION OF DIFFERENT HEAVY METALS (IN PPM) AT EACH SITE

| Location | pH | Cu | Zn | Fe | Mn |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Dadumajra landfill | 7.60 | 11.218 | 14.462 | 35.698 | 11.794 |
| Leisure valley park, sector 10 | 7.27 | 1.812 | 6.72 | 22.348 | 7.274 |
| Burial, sector- 45 | 7.34 | 3.36 | 12.058 | 24.05 | 7.71 |
| Industrial area | 7.52 | 14.918 | 14.188 | 27.118 | 8.852 |
| Kambala forest area | 7.16 | 0.944 | 3.388 | 18.124 | 10.136 |

Mean values of concentration of different heavy metals follow the order as concentration of iron > zinc > manganese > copper at Dadumajra landfill area whereas concentration of iron > copper > zinc > manganese at industrial area and follows the order as concentration of iron > zinc > manganese > copper at Burial area and concentration of iron > manganese > zinc > copper at both Leisure valley park, sector 10 as well as at Kambala forest area. Copper was found to have minimum concentration as compare to the concentration of other metals in most of the areas expect the industrial area and iron was found to have maximum concentration in all the areas.

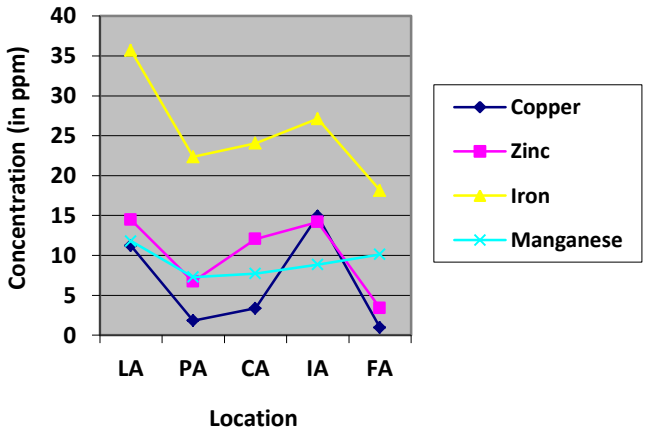


**Figure 1.** Mean concentration of different heavy metals at each site

Mean values of concentration of copper and zinc in soil samples of different sites showed a significant variation in Figure 1 and ANOVA test confirms that the difference in concentration of copper and zinc in soil of different sites is significant and cannot be ignored at a significance level of 5% where as the ANOVA test does not confirm the variation of concentration of iron and manganese in soil samples of different sites to be significant at a significance level of 5% and the variation can be ignored.

## IV.CONCLUSION

The analysis of concentration of heavy metals iron and manganese in soil in the vicinities of Dadumajra landfill did not show a significant variation with the concentration of same metals in soil of other sites of the city using ANOVA method leading to the conclusion that the variations in concentration of iron and manganese in soil of five different sites can be ignored and the soil at five different sites can be considered to have same concentration of iron and manganese at a significance level of 5%. From the results obtained, the soil in the vicinities of Dadumajra landfill showed a higher concentration of copper and zinc as compared to the soil of other sites of the city and the analysis of variation of concentration of these heavy metals in soil of different sites using ANOVA method confirmed this variation to be significant at a significance level of 5% leading to the conclusion that the variations in concentration of copper and zinc in soil of five different sites have a significant variation among themselves at a significance level of 5%.

## V. REFERENCES

[1] Awasthi, Abhishek Kumar, Xianlai Zeng, and Jinhui Li. "Relationship between e-waste recycling and human health risk in India: a critical review." Environmental science and pollution research international, 23(12) , 2016.

[2] Devi K.Syamala and Muthukrishnan N.Moorthy. “E-Waste Management in India - an Overview.” Global Journal for Research Analysis, 4(9), pp.-44-48, 2015, ISSN:2277–8160.

[3] Wuana, Raymond A., and Felix E. Okieimen. "Heavy metals in contaminated soils: a review of sources, chemistry, risks and best available strategies for remediation." Isrn Ecology 2011, 2011.

[4] Salonen, Jukka T., Kristiina Nyyssonen, Heikki Korpela, Jaakko Tuomilehto, Ritva Seppänen, and Riitta Salonen. "High stored iron levels are associated with excess risk of myocardial

infarction in eastern Finnish men." Circulation, 86(3), pp.- : 803-811, 1992.

[5] Plum, Laura M., Lothar Rink, and Hajo Haase. "The essential toxin: impact of zinc on human health." International journal of environmental research and public health, 7(4), pp.-1342-1365, 2010.

[6] Rana, Rishi, Rajiv Ganguly, and Ashok Kumar Gupta. "An assessment of solid waste management system in Chandigarh city, India." Electronic Journal of Geotechnical Engineering, 20, pp.-1547-1572, 2015.

[7] Gagandeep Singh Dhillon. "City's main garbage dump close by, people at dadumajra live with stench." The Indian Express, 2014.

[8] Walia Sahil, "These flies sit on my rashes and complicate problems: Dadumajra colony residents." The Indian Express, 2016.

[9] Kaur, Kamalpreet, Suman Mor, and Khaiwal Ravindra. "Removal of chemical oxygen demand from landfill leachate using cow-dung ash as a low-cost adsorbent." Journal of colloid and interface science, 469, pp. 338-343, 2016.

[10] C.R. Kothari, "Research methodology methods and techniques." New Age International Publishers, India, 2004