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Research Article

Assessment of Heavy Metals in Contaminated Soil and Plants Around the Landfill of Nizamabad-Dist, Telangana State

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Abstract

One of the worldwide biggest problem is contamination. Contamination with heavy metals is a potential threat to the environment and the community. In certain parts of the biosphere many adverse effects of the landfills are reported. Accumulation of toxic compounds, especially of heavy metals having a highly hazardous effect, can cause undesirable changes in the biosphere with hazardous consequences. The landfill leachates loaded with pollutants like heavy metals percolates in to soil and in turn enters in to plants present around the landfill site. In the present study soil and Plant material samples were collected from contaminated soil and plants present around the landfill of Nizamabad and assessment of heavy metal was done by Atomic Absorption Spectrophotometer. The experimental results showed that Copper and Arsenic concentration is higher in soil and all the determined metal concentrations are higher in plants. The presence of heavy metals more than toxic levels in soil and plant samples indicates impact on the environment and the public health and it also recommends need of Site-specific policies on heavy metal pollution control for Nizamabad landfill site.

Keywords: Heavy Metals; Pollution; Soil; Leachate; Plants; Spectrophotometer

Introduction

Soil is a complex, heterogeneous medium which is a key resource for human survival. Soils are major sink for heavy metals in to the environment. The growth in population, urbanization and industrialization has led to the increase in the generation of solid waste all over the world. It is believed that the rate of waste generation is increasing day by day in developing countries like India. The common method of disposing the solid waste is landfilling.

The social and environmental impacts imposed by Landfills received attention in recent decades. The enormous amount of solid waste generated in, Nizamabad is dumped into landfill sites. Surface water percolating through the trash can dissolve or leach harmful chemicals. Heavy metals are particularly insidious and lead to the phenomenon of bioaccumulation and biomagnifications. These heavy metals may constitute an environmental problem, if the leachate migrates through the soil into the ground water. The soil pollution arises due to the leaching of waste from landfills and the most common pollutant involved is the metals like lead, nickel, cadmium, chromium, copper and arsenic. The concentration of heavy metals in landfill is generally higher at earlier stages because of higher metal solubility as a result of low pH caused by production of organic acids. The sources of Heavy metals in the landfills are batteries, consumer electronics, household waste, paints chips, lead foils, motor oils, plastics and glass materials. Many researchers reported the contamination of soil with the heavy metals by landfilling of waste generated in unscientific manner.

Materials and Methods

Study area

The soil and plant material samples were randomly collected each from 3 selected locations at the landfill site of Nizamabad which is spreads over the 55 acres of land at Nagaram village. Samples were collected as per standard procedures. Samples were immediately taken to laboratory and analysis was carried out according to standard methods.

Analysis of soil for heavy metals by atomic absorption spectrophotometer

Soil samples from the selected locations were collected in triplicates and were dried at 105^0C to constant weight. Three replicates of 0.25 g sediments were acid- digested in microwave. For each microwave extraction vessel 5 ml of conc. nitric acid, 2 ml hydrochloric acid and 2 ml of hydrofluoric acid were added. The vessels were capped and heated in a microwave unit at 800 W to a temperature of 210^0c for 20 min with a pressure of 40 bars. The digested samples were analyzed for the metals by AAS using flame atomization. Results were expressed on dry weight basis.

Analysis of plants for heavy metals by Atomic Absorption Spectrophotometer

Live plant parts i.e. shoots were collected randomly from the plants found in target study area. All the samples were air dried for seven days. The samples were oven dried at 60^0C temperature to a constant weight and ground to powder. Three dried samples were digested with a mixture (3:1) of conc nitric acid and hydro

fluoric acid in the microwave. To each microwave extraction vessel 6 ml of nitric acid and 2 ml hydrofluoric acid together with 0.8 g of plant sample was added. The vessel was capped and heated in a microwave unit at 800 W to a temperature of 190^{0}C for 20 min with a pressure of 25 bars. The digested samples were diluted to 50 ml and subjected to analysis of the metals by AAS using flame atomization. Results are expressed on dry weight basis of each component.

Soil Sample	As	Cd	Cr	Cu	Ni	Pb
S-1	53	2	3	140	12	85
S-2	25	3	4	117	10	67
S-3	20	3	3	104	6	56
Toxic levels	22	5	100	100	100	100

Table 1: Heavy metal concentrations in soil samples (ppm).

Plant Sample	As	Cd	Cr	Cu	Ni	Pb
Nerium	8	6	8	56	34	198
Calatropis	5	8	7	55	33	193
Dhatura	4	7	5	53	32	188
Toxic levels	2	5	10	40	40	150

Table 2: Heavy metal concentrations in plant material (ppm).

Results

Assessment of heavy metals in soils around landfill site showed that amounts of some heavy metals are several times more than toxic levels. The heavy metal concentrations in the soil samples are shown in Table 1. In soil samples the concentration of heavy metals are in the order of Cu > Pb >As> Ni > Cr > Cd. Among the analyzed heavy metals Copper had the highest concentrations up to 140 ppm in the soil samples. While Cadmium shows the low concentrations up to 2 ppm. The heavy metal concentrations in the Plant samples are shown in Table 2. In plant sample the heavy metals are in the order of Pb > Cu > Ni > Cr > As > Cd. Among the analyzed heavy metals Pb had the highest concentrations up to 198 ppm in the plant samples. While Arsenic shows the low concentrations up to 4 ppm in the plant samples. Significant differences in heavy metal concentrations were found between 3 soil sampling sites and 3 different plant samples. Our results show that the investigation area runs a risk of copper, arsenic pollution in soil samples and all the determined metal pollution in plant samples [1-10].

Discussion

The solution to this problem comes from the concept of Phytoremediation (phytoextraction, phytostabilization and rizofilteration) as well as Bioremediation (bioleaching, biochemical processes). Phytoremediation and Bioremediation are low cost effective, eco-friendly, pleasant approaches most suitable for developing countries and cities like Delhi, Bhopal and Hyderabad. Phytoremediation is the engineered use of green plants to remove environmental contaminants like heavy metals from soil or water. Despite this potential, Phytoremediation is yet to become a commercially available technology in India. Bioremediation of the waste at landfill site is a eco friendly and cost effective. Waste treatment plants are required to prevent further threat to the people living around the land fill areas.

Conclusion

Land filling is the versatile problem resulting in badly affecting the quality of soil and plants. This is a big risk of environmental pollution which is very hazardous to human health. Nizamabad Landfill requires proper design and construct the facilities to prevent pollution. Regular monitoring is required over a large period, in order to verify the influence of seasonal variations on the contaminant concentrations with time.

The study recommends that new sanitary landfill sites should be designed as per scientific principles to minimize the adverse effects associated with solid waste disposal in open land areas and to prevent further contamination of soil as well as water.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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