

Assessment of Heavy Metal Contamination in Soil and Groundwater Due to Leachate Migration from an Open Dumping Site

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Abstract : Indiscriminate disposal of municipal solid waste (MSW) in open dumping site is a common scenario in developing countries like India which poses a risk to the environment as well as human health. The objective of the present investigation was to find out the concentration of heavy metals (Pb, Cr, Ni, Mn, Zn, Cu, and Cd) and other physicochemical parameters of leachate and soil collected from an open dumping site of Tezpur town, Assam, India and its associated potential ecological risk. Tezpur is an urban agglomeration coming under the category of Class I UAs/Towns with a population of 105,377 as per data released by Government of India for Census 2011. Impact of the leachate on the groundwater was also addressed in our study. The concentrations of heavy metals were determined using ICP-OES. Energy dispersive X-Ray (SEM-EDS) microanalysis was also conducted to see the presence of the studied metals in the soil. X-Ray diffraction analysis (XRD) and Fourier Transform Infrared (FTIR) spectroscopy were also used to identify dominant minerals present in the soil samples. The trend of measured heavy metals in the soil samples was found in the following order: Mn > Pb > Cu > Zn > Cr > Ni > Cd. The assessment of heavy metal contamination in the soil was carried out by calculating enrichment factor (EF), geo-accumulation index (Igeo), contamination factor (Cfi), degree of contamination (Cd), pollution load index (PLI) and ecological risk factor (Eri). The study showed that the concentrations of Pb, Cu, and Cd were much higher than their respective average shale value and the EF of the soil samples depicted very severe enrichment for Pb, Cu, and Cd; moderate enrichment for Cr and Zn. Calculated Igeo values indicated that the soil is moderate to strongly contaminated with Pb and uncontaminated to moderately contaminated with Cd and Cu. The Cfi value for Pb indicates a very strong contamination level of the metal in the soil. The Cfi values for Cu and Cd were 2.37 and 1.65 respectively indicating moderate contamination level. To appportion the possible sources of heavy metal contamination in soil, principal components analysis (PCA) has been adopted. From the leachate, heavy metals are accumulated at the dumping site soil which could easily percolate through the soil and reach the groundwater. The possible relation of groundwater contamination due to leachate percolation was examined by analyzing the heavy metal concentrations in groundwater with respect to distance from the dumping site. The concentrations of Cd and Pb in groundwater (at a distance of 20m from dumping site) exceeded the permissible limit for drinking water as set by WHO. Occurrence of elevated concentration of potentially toxic heavy metals such as Pb and Cd in groundwater and soil are much environmental concern as it is detrimental to human health and ecosystem.

Keywords : groundwater, heavy metal contamination, leachate, open dumping site

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