



**INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS**

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Thesis Title: EXPERIMENTAL INVESTIGATIONS OF LEACHING OF SODIUM, CALCIUM, POTASSIUM, AND ZINC THROUGH REFUSE SOIL FROM BORAGAON LANDFILL (GUWAHATI)

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SHORT ABSTRACT

Landfills are one of the prominent forms of disposal of waste generated from urban areas. The waste dump landfills interact with atmosphere, rainwater, and soil moisture and produce landfill leachates. The leachate may migrate through the vadoze zone and cause pollution of the subsurface aquifer. In recent years, public as well as scientific community have raised intense concerns over pollution of groundwater resources due to spillage of hazardous elements from land surface to the underlying aquifer. This entire environmental phenomenon of landfill leaching is one of the most important issues of concern in urban areas.

Landfill leaching is also an important environmental matter of concern in the city of Guwahati, Assam, India. Unscientific dumping of wastes are observed in many commercial centers, in and around the city. The effort of municipal authority to prevent such dumpings has become unsuccessful due to lack of infrastructure as well as civic sense of the citizens. The Guwahati municipal authorities have earmarked the site at Boragaon, near Deepor Beel, as the location to dispose all the municipality wastes generated from Guwahati. Deepor Beel is a wetland of international importance since it is the only Ramsar site of the North Eastern India. Though scientifically designed landfill waste dumps are planned for the site, the project is not fully functional and the municipal wastes are dumped near Deepor Beel. The landfill was initially designed as a controlled landfill for an estimated capacity of 50 tons per day for an active period of 10 years. However, due to rapid urbanization as well as population growth, the daily waste generation exceeds the holding capacity of the present landfill. Therefore, the wastes are dumped in an unscientific way at Boragaon. These unscientifically dumped wastes consist of many harmful and toxic elements such as zinc (Zn), chromium (Cr), nickel (Ni), lead (Pb), etc. that can cause different types of pollution to the environment. The wastes may also contain nutrients like sodium, calcium, and potassium, etc. that may potentially leach to the surface and subsurface water bodies. Experimental and analytical investigations of

leaching of above components are essential to bring scientific inferences on environmental impacts due to such unscientific waste disposals. Therefore, there is a need for scientific investigation of this acute environmental problem at Boragaon site, to arrive at effective remedial measures to be adopted by the local municipal authority.

Targeting the above needs, the present research study aims to understand the leaching mechanisms of heavy metal and nutrients from the refuse soils of uncontrolled landfills of Boragaon waste dump site. The refuse soil from the landfill site and the locally available normal soil were used in the experimental investigation using column apparatus. The experiments investigated the influence of various factors like the height of the landfill refuse soil, height of base soil layer (or normal soil layer), and inflow filling rate of water, on leaching of a heavy metal, Zn, and some nutrient elements like Na, Ca, and K. For this purpose, three different types of column leach apparatus – viz. short cylindrical column, long rectangular column, and three-dimensional trapezoidal column are fabricated. In the column leach apparatus, landfill refuse soil is stacked over the normal soil. Water is poured from the top, of the column, using a regulatory device in such way that it mimics the rainfall scenario. The effluent liquid coming out from the bottom is collected at various time intervals and using Atomic Absorption Spectrometer (AAS) and flame photometer, the concentration of various elements are determined in the effluents.

The above experiments were categorized into various combinations based on – height of landfill refuse soil; height of base soil layer; water ponding depth; and inflow filling rate. From the above categorized experiments, various inferences as well as the influences of these parameters, on leaching, are drawn from the concentration versus time data of the nutrients and heavy metal. Besides, empirical analysis is also performed to determine the relationship between the leached concentrations of the nutrients, in the effluents, and the aforementioned geometrical and temporal parameters. The regression relations – linear; polynomial; logarithmic; and exponential equations were tested on the experimental data for empirical model development and the exponential empirical models predicted well the concentrations of nutrients for the independent experiments, which were not part in the model development. The statistical interpretation of Zn leaching through the two-layer soil system indicates the desorption of Zn from the refuse soil into the percolating water.