Exploring the Fine Fraction from Landfill Mining: A Comprehensive Case Study of the Boragaon Dump Site in Guwahati, India

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Abstract

Landfill mining targets the issue of legacy waste at municipal solid waste (MSW) dump sites in developing countries such as India. The soil-like material or fine fraction is one of the four primary residues of landfill mining (Hogland, 2002). This fine fraction constitutes around 60-80% of the overall landfill-mined residues, hence its utilization is of the utmost significance. Due to the distinct waste composition and the improper disposal of mixed MSW, the characterization studies conducted globally cannot be effectively applied to the Indian context (Singh and Chandel, 2020). Hence, this study focuses on a comprehensive assessment of the fine fraction in order to contemplate its utilization alternatives. The improper disposal of mixed MSW at the Boragaon dump site in Guwahati, India poses a significant concern due to its proximity to Deepor Beel- a wetland site recognized under the Ramsar Convention and serves as a crucial habitat for migratory and aquatic birds. This study investigates the fine fraction from landfill mining at the Boragaon site.

The analyses included geotechnical, physicochemical, and heavy metal characterization, as well as the assessment of their bioavailability and leachability. The findings indicated that fine fraction is classified as a well-graded non-plastic sand with a low specific gravity and bulk density values of 2.15 and 1.01 g/cm3, respectively and high porosity of 69% owing to organic matter. The shear strength parameters were determined to be 10.7 kPa and 40.3°, indicating characteristics typical of an organic soil. Moreover, fine fraction contained macro-nutrients with the following values, 2.6% nitrogen (N), 0.1% phosphorus (P), and 9.4% potassium (K), and organic matter of 18.3% comparable to those of a city compost. The fine fraction also demonstrated elevated measures of total heavy metals. Based on the bioavailability and leachability tests, Cu, Zn, Mn, and Fe had the highest potential to enter the food chain and impact biodiversity, thereby polluting the geoenvironment. Given the evident ability of the fine fraction to cause pollution within the geoenvironment, appropriate treatment and utilization methods have been suggested.

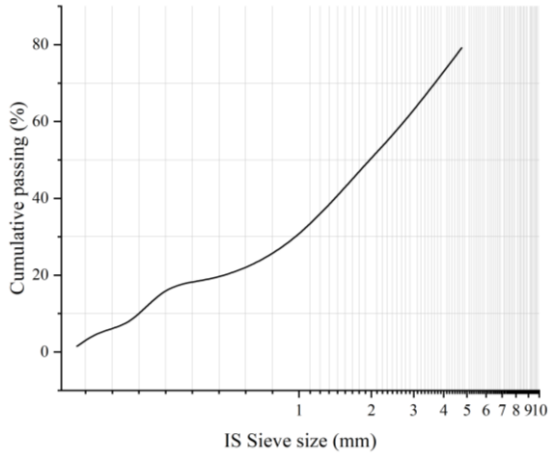

Figure 1 Particle Size Distribution of Fine Fraction

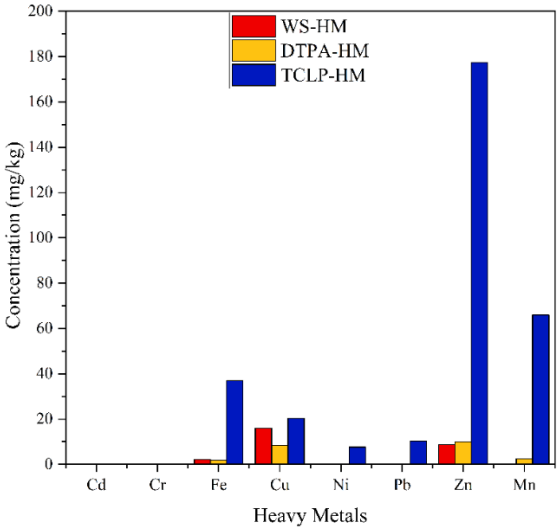

Figure 2 Bioavailability and Leachability of Heavy Metals

References

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