

Chemical Analysis of Heavy Metals Contamination in Soil From Industrial Area in Klang

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Structured Abstract

Background: Heavy metal contamination in soil, particularly in industrial areas, poses a significant threat to the environment and human health. Elevated concentrations of toxic metals such as lead (Pb), zinc (Zn), manganese (Mn), nickel (Ni), and copper (Cu) are often associated with rapid industrialization and urban development. Many heavy metals are also essential for plants because they act as cofactors, start enzyme reactions, are ductile and conductible, and stabilize cations. However, these metals turn toxic when their concentration is higher than what is required. Essential heavy metal deficiencies affect both agricultural productivity and human health. Non-essential metals can be dangerous even at extremely low concentrations.

Methods: Soil samples from six specified industrial locations were analyzed at two depths (topsoil and subsoil) using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). The samples were digested using a solution of nitric acid and hydrogen peroxide. To assess the extent of contamination, the Geo-Accumulation Index (Igeo) was applied to measure the levels of heavy metals in soil samples collected from an industrial area.

Results: The results indicated that zinc (Zn) had the highest contamination levels, with subsoil concentrations reaching 1771.60 mg/kg at S5 and 1410.00 mg/kg at S4. Nickel (Ni) recorded its highest level at S2 with 422.16 mg/kg, while lead (Pb) showed notable concentrations at S1 (219.44 mg/kg) and S3 (131.56 mg/kg). Based on the Geo-Accumulation Index (Igeo), Pb at S1 (Igeo = 2.80) was classified as moderately to strongly polluted, Ni at S2 (Igeo = 3.18) as strongly polluted, and Zn at S4 (Igeo = 3.85) and S5 (Igeo = 4.17) as strongly to very strongly polluted. Meanwhile, manganese (Mn) generally remained within the unpolluted range, except at S5 where it showed minor contamination (Igeo = 0.42).

Conclusion: These results confirm that the primary causes of soil contamination are human activities, such as emissions from automobiles and the discharge of industrial waste. To safeguard the ecosystem and public health in the Bukit Raja industrial area, the study emphasizes the critical need for environmental monitoring and the implementation of appropriate remediation techniques.

Keywords: Heavy metal, geo accumulation index, inductively coupled plasma-optical emission spectrometry

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