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Effect of Concentration Level and Moisture Content on the Detection and Quantification of Nickel in Clay Agricultural Soil in Lebanon

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Abstract : Heavy metal contamination in agricultural soils in Lebanon poses serious environmental and health problems. Intensive efforts are employed to improve existing quantification methods of heavy metals in contaminated environments since conventional detection techniques have shown to be time-consuming, tedious, and costly. The implication of hyperspectral remote sensing in this field is possible and promising. However, factors impacting the efficiency of hyperspectral imaging in detecting and quantifying heavy metals in agricultural soils were not thoroughly studied. This study proposes to assess the use of hyperspectral imaging for the detection of Ni in agricultural clay soil collected from the Bekaa Valley, a major agricultural area in Lebanon, under different contamination levels and soil moisture content. Soil samples were contaminated with Ni, with concentrations ranging from 150 mg/kg to 4000 mg/kg. On the other hand, soil with background contamination was subjected to increased moisture levels varying from 5 to 75%. Hyperspectral imaging was used to detect and quantify Ni contamination in the soil at different contamination levels and moisture content. IBM SPSS statistical software was used to develop models that predict the concentration of Ni and moisture content in agricultural soil. The models were constructed using linear regression algorithms. The spectral curves obtained reflected an inverse correlation between both Ni concentration and moisture content with respect to reflectance. On the other hand, the models developed resulted in high values of predicted R2 of 0.763 for Ni concentration and 0.854 for moisture content. Those predictions stated that Ni presence was well expressed near 2200 nm and that of moisture was at 1900 nm. The results from this study would allow us to define the potential of using the hyperspectral imaging (HSI) technique as a reliable and cost-effective alternative for heavy metal pollution detection in contaminated soils and soil moisture prediction.

Keywords : heavy metals, hyperspectral imaging, moisture content, soil contamination
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