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Spectroscopic techniques for assessing the possible use of phosphate rock by-products for the removal of trace elements in soils.

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The production of fertilizers from apatite results in the obtention of considerable amounts of phosphate rock byproducts, representing a serious environmental problem. In addition, soil contamination with heavy metals due to mining or metallurgical activities is a severe environmental problem, increased when soil use is changed to agricultural or urban uses. The aim of this work was to study the possibility of using phosphate rock byproducts for the in situ treatment of soils polluted by heavy metals, allowing to revalorise phosphate rock residues and at the same time, providing a low-cost solution for the contaminated soil.
The following methodologies were applied in order to characterise minerals phases present in phosphate rock residues: Wavelength Dispersive X-Ray Spectrometry (WDXRF), Scanning Electron Microscopy (SEM), Energy Dispersive X-Ray Spectrometry (EDS), thermogravimetry (TG) and Fourier Transform Infrared Spectroscopy (FTIR).
The results obtained showed that the samples studied had a fine texture, showing average contents of 71%, 24% of sand and 5% for silt, sand and clay, respectivaly. In addition, these materials showed basic-neutral pH values (7.5-9) and a cationic interchange capacity of 20.4 meq/100g. Studied samples showed a 22% of carbonates and a 13% of apatite in their composition and all of them showed 4 bands at 1.100, 1.044, 674 y 576 cm-1, corresponding to P-O vibrations in PO4 groups. OH band vibrations appeared at 3.700-3.550 cm-1, and detected band at 3.400 cm-1 and 633 cm-1 could correspond to occluded water. On the other hand, detected bands at 1.460-1.430, 874 cm-1 suggested the presence of $CaCO_3$ and carbonates in the apatite.
After sample characterization, the performance of these residues to adsorb trace element ions (Cd+2 and Pb+2) from acidic aqueous solutions (simulating acidic mine drainage) was studied. The use of spectroscopic techniques after mixing soils and phosphate rock products demonstrate that these residues could be used as an inexpensive adsorbent system for the immobilization of cadmium and lead, removing trace of these elements from polluted soils and then, facilitating soil use changes.