Effects of EDTA on adsorption of Cd(II) and Pb(II) by low permeability soil minerals and on soil minerals microscopic characteristics

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Ethylenediaminetetraacetic acid(EDTA) can serve as a washing agent in the remediation of low-permeability layers contaminated by heavy metals (HMs). Therefore, batch adsorption experiments, where quartz sands (SM1) and mineral mixtures (SM2) were used as low permeability soil minerals (SMs), were implemented to explore the effects of different EDTA concentrations, pH and exogenous chemicals on the HM-SM-EDTA adsorption system. Changes in microscopic characterizes of SMs were determined by instrument analysis to investigate the mechanisms. The **r**esults showed that the maximum Cd and Pb adsorption capacities ofSM1 and SM2 were reduced as the EDTA concentration increased. When the mole ratio (MR = moles of HM ions /sum of moles of HM ions and EDTA) was close to 0.5, the effect of EDTA was more effective; and Freundlich isotherm model fitted better to the data. It took 5 to 10 min for EDTA to begin taking its effect. EDTA worked well at pH below 7.0 and 4.0 for Cd and Pb, respectively. Low-molecular weight organic acids (LMWOAs) affected the system mainly by bridging, complexation, adsorption site competition and reductive dissolution. Cu^{2+}, Fe^{2+} ions could greatly increase the Cd and Pb adsorption on SM2. There were feature changes in mineral particles including attachment of EDTA and microparticles, agglomeration, connection and smoother surfaces, making the specific surface area decrease from 16.73 to 12.59 m^2/g. All findings indicated that EDTA could effectively and economically reduce the HM adsorption capacity of SMs at the reasonable MR value, contact time and pH. The extent of the effects of LMWOAs and exogenous metal ions on the HM- SM-EDTA system depended on the synthesis of diverse effects and the selectivity of EDTA, respectively. EDTA reduced the HM adsorption capacity of SMs not only by complexation with HM ions, but also decreasing SSA and blocking active sites. Hence, the acquired insight from the presented study can help to promote the remediation of contaminated soil and groundwater.