



Adsorption of heavy metals onto iron minerals in the presence of organic acids

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Adsorption of Cu, Pb and Zn in the ternary model systems, consisting of iron (goethite or ferrihydrite) minerals, solution of the metal and low-molecular organic acid (oxalic, citric or glutamine) was studied as function of organic ligands concentrations and pH. The experiments were carried out at constant pH values ranging from 3 to 7 and acid/metal (or metals) molar ratios of 0, 1, 2, 4, 8 and 10.

At pH 4.5-5.0 the sorption isotherms of these heavy metals fitted the Langmuir equation (L-type). The order of decreasing relative affinities of metals without organic acids was $Cu > Pb > Zn$ for goethite and $Pb > Cu > Zn$ for ferrihydrite. The pH₅₀ (the pH value at which 50% of the total sorption of the elements has occurred) was 4.90 and 5.90 for copper and 5.20 and 4.40 for lead on goethite and ferrihydrite respectively. At pH 4.5 in the presence of oxalic acid an adsorption of Cu on the surfaces of goethite increased by increasing oxalate/metal molar ratio up to 4 and then slowly decreased. Vice versa, adsorption of Pb on the mineral increased up to an oxalate/Pb molar ratio of 6 and then slightly decreased by further increasing oxalate concentration. So, at these ratios the pH₅₀ for Cu shifted to 3.9 and for Pb decreased to 4.8. Adsorption of lead by ferrihydrite increased up to molar ratio 6/1 and then was practically constant that may be attributed to the large surface area of this oxide.

The effect of oxalic and citric acids on the adsorption of copper and lead (ratio metal/acid 1/1) at all studied pH values was similar. There was same character of effect of citric acid increasing concentration on adsorption of Cu and Pb by goethite; however amount of adsorbed Pb in the presence of citric acid from the ratio acid/metal 4/1 was increased sufficiently.

We have demonstrated that in the absence of organic acids the adsorption of each trace element was reduced by the presence of increasing concentrations of the other metal. However, at the studied low metals concentrations this reduction occurs due to kinetic factors. Organic acids added together with the mixture of the metals sufficiently increased the adsorption of Cu and poorly affected the adsorption of Pb compared to the metals without organic substance.

Finally, we found that the addition of oxalate to goethite one hour before that of the metals also did not change Pb adsorption and increased Cu adsorption but the amount of the adsorbed metal was less than at the simultaneous addition.

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