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On formal model quality criteria for discriminating competitive metal adsorption isotherms.

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We studied the competitive adsorption of Cu and Zn ions in different natural soils. We considered two Israeli soils, Bet Dagan and Yatir, both of which are slightly alkaline but with substantially different adsorption capacities (1.2% and 3.7% organic matter, and 16.2% and 36.9% clay content, respectively). Experiments under batch conditions were performed in single- and double-component systems to obtain adsorption isotherms. The equilibrium adsorption data were collected after 48 h contact time, with a soil-solution ratio of 1:50, initial soil pH=7, by varying the initial ion concentrations in the range 20-200 mg/l for Bet Dagan soil and 20-800 mg/l for Yatir soil. Experimental mono-component adsorption isotherms showed similar nonlinear behavior for Cu and Zn in both Bet Dagan and Yatir soils. The latter had maximum adsorption capacity about 4 times larger than the former. Cu and Zn exhibited almost the same affinity for both types of soils in single-component systems, while in competitive systems Cu adsorption increased significantly as compared to Zn. Experimental data obtained in single-component systems were analyzed with Langmuir, Freundlich and Redlich-Peterson (R-P) models. Measurements of adsorption behavior under double-component conditions were interpreted using different competitive models: unmodified, modified and extended Langmuir, unmodified and modified R-P models, and the Sheindorf-Rebuhn-Sheintuch (SRS) model. The results were examined using formal model quality criteria. These allow discrimination among different models on the basis on their goodness-of-fit to available observations, number of parameters, and quality of the available data and parameter estimates. The analysis suggested that for both soils, single-component data were better represented by Freundlich or R-P models. In double- component systems, the modified R-P model was identified as best in the case of Bet Dagan soil while the SRS model best described the behavior of the Yatir soil.