adsorption-desorption reactions of copper in some soils and clay minerals domination therein

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Two surface soil samples (0-30) representing Nile alluvial and calcareous soils, two clay minerals (montmotillonite, palygorskite) and one organic material (humic acid) were selected to study the adsorption — desorption reactions of copper at different pH values.Different amounts of copper nitrate solution were used to provide a series of final Cu concentrations; namely: 0, 10, 20, 40, 80 and 100 fig Cu per mL. Copper nitrate solution adjusted at pH 5.0, 5.5 and 6.4. The amount of Cu sorbed by the samples was calculated as the differences between the added amount and that found in the final equilibrium solution.Also, the copper-enriched samples of the previous treatments were treated with DTPA solution to determine the amount of copper desorbed from the samples.The obtained results could be summarized as follows: A) Copper adsorption:- The amount of Cu adsorbed on alluvial and calcareous soils increased gradually with increasing the initial concentration of Cu.- Increasing pH values from 5.0 up to 6.4 was associated with an increase in Cu adsorption on alluvial and calcareous soils.- The obtained results for alluvial and calcareous soils agreed with the conventional Langmuir isotherm. where, the correlation coefficients obtained by the regression analysis at pH values 5.0, 5.5 and 6.4 were 0.979**, 0.987** and 0.983** for alluvial soil, respectively. The corresponding values for calcareous soil were 0.936**, 0.918** and 0.988** in the same order.- Freundlich equation is applicable to describe Cu adsorption isotherms for alluvial and calcareous soils at various pH values. where, the values of correlation coefficients were 0.981”, 0.971** and 0.905** for alluvial soil at pH values 5.0, 5.5 and6.4, respectively. The corresponding values for calcareous soil were 0.965, 0.983 and 0.953 in the same order.-Temkin isotherm model is suitable to be applied for the studied soils, where the correlation coefficients were 0.967**, 0.984** and 0.966** for alluvial soil, while it was 0.939”, 0.937** and 0.973** for calcareous soil at pH values 5.0, 5.5 and 6.4, respectively.2. Clay minerals:-Copper adsorbed on the surfaces of montmorillonite and palygorskite increased gradually with increasing the initial Cu concentrations up to 100 pg/ml. Adsorption of Cu on montmorillonite under different concentration:of Cu was higher than the corresponding ones observed with palygorskite.-The obtained results for montmorillonite and palygorskite minerals agreed with the conventional Langmuir isotherm. The correlation coefficients obtained by the regression analysis at pH 5.0, 5.5 and 6.4 were 0.959**, 0.973** and 0.916** for montmorillonite and 0.909**, 0.949** and 0.812** for palygorskite, respectively. The differences in the constant K (binding energy) between the clay minerals become wider as the pH increased.- Freundlich equation is suitable to describe Cu adsorption isotherms for montmorillonite and palygorskite minerals, where Cu adsorption increased with increasing pH values up to 6.4 for montmorillonite and up to 5.5 for palygorskitc. The values of the affinity parameter were, generally, higher for montmorillonite, while they were lower for palygorskitc. The values were 0.994**, 0.999** and 0.974** for montmorillonite at pH values 5.0, 5.5 and 6.4, respectively. The corresponding values for palygorskite were 0.969”, 0.985** and 0.977** in the same order.-Temkin isotherm model is suitable to be applied for the studied minerals, where increasing pH values from 5.0 up to6.4 was associated with an increase in Cu adsorption on the surfaces of montmorillonite and palygorskite minerals. The correlation coefficients were 0.954**, 0.966** and 0.960** for montmorillonite, while they were 0.943”, 0.960** and 0.905** for palygorskite at pH values 5.0, 5.5 and 6.4, respectively.2. Humic acid:- Increasing the initial Cu concentrations from 0 to 100 p.g/mL was associated with an increase of Cu adsorbed on humic acid. This increase was much pronounced at pH 5.5, where the highest adsorption of Cu was 8440 pg/g humic at initial Cu concentration of 100 pg/mL.The data was agreed with the conventional Langmuir isotherm, where the correlation coefficients were 0.875**, 0.937** and 0.970** at pH. 5.0, 5.5 and 6.4, respectively. The highest Cu adsorbed on humic acid was observed at pH 5.5.Freundlich equation is significantly suitable to represent Cu adsorption isotherms. The values of correlation coefficients were 0.955**, 0.988** and 0.993** at pH 5.0, 5.5 and 6.4, respectively.Temkin isotherm model is also suitable to be applied for humic acid, where the correlation coefficients were 0.874**, 0.935** and 0.961** at pH 5.0, 5.5 and 6.4, respectively.B) Copper desorption by:1. Soils:The amount of desorbed Cu by alluvial soil exhibited the highest values compared to the calcareous ones and was higher in alluvial soil than in calcareous one, especially at pH 6.4. Alluvial soil gave the highest desorption buffering capacity at various pH values compared to calcareous one.2.Clay minerals:- Increasing the added amounts of Cu increased the Cu desorbed at all pH values for both montimorillonite and palygroskite minerals. The highest increase was observed at pH 5.5, however, the lowest values by both minerals was obtained at high pH (6.4). The amount of desorbed Cu by montimorillonite exhibited the highest values compared to the palygorskite one. On the contrary, the amounts of desorbed Cu on montimorillonite were higher than the retained ones, while the opposite trend was observed for palygroskite.3.Humic acid:- Increasing the added amounts of Cu slightly increased the desorbed Cu at all pH values. The highest increase was observed at pH 5.5, however, the lowest values was obtained at low pH (5.0). The amounts of desorbed Cu from humic acid were slightly higher than the retained ones at pH 5.5.