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Uses of some Homoionic Aluminosilicate minerals to improve irrigation water and some soil properties

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Equilibrium, kinetic and thermodynamic studies of Na^+ adsorption from aqueous solutions on homo-ionized K- and NH_4-kaolin

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Abstract
Egyptian kaolin clay (UnK) was homo-ionized with $K^+$and NH_4^+ to obtain K-K and N-K, respectively. The analysis of the molar leaching solutions of KCl, NH_4Cl or HCl revealed anoriginal cation exchange capacity of UnK up to 6.08meq per 100 g. The adsorption parameters of Na^+ on K-K and N-K were examined in aqueous solutions. The equilibrium adsorption data were evaluatedusing Langmuir, Freundlich adsorption and Dubinin–Radushkevich-Kaganerisotherm models. Freundlich model was the best that described the adsorption process and the maximum capacities (q_{max}) are found to be enhanced to 75.6 and 17.5 mg g^{-1}, respectively. The experimental data fitted well the pseudo-second-order kinetics model. The thermodynamic parameters such as standard Gibbs free energy (ΔG^{ads}), enthalpy (ΔH^{ads}) and entropy changes (ΔS^{ads}) for the adsorption process were calculated. The negative values of the Gibbs free energy confirm that the adsorption processes are spontaneous and thermodynamically favorable while the negative value of ΔH^{ads} supports the exothermic physicochemisorption of the adsorption process. Both homo-ionized kaolin samples are promising cheap adsorbents for lowering the sodicity of soil while gradually exchanging valuable nutrients for plants.
Keywords:Na^+; Adsorption equilibrium;Kaolin; Thermodynamics; Kinetics.

1. Introduction

Salt-affected soils are found in arid and semi-arid climates in morethan one hundred countries of the world, especially Egypt, where many regions are alsoaffected by irrigation-induced salinization[1]. This problem shall upsurge in the future by increasing the use of pretreated waste water in irrigation. Salinity becomes a problem when the total amount of salts which accumulate in the root zone is high enough to negatively affect plant growth depending on its type.

Due to the accumulation of salt, water uptake by plant roots in the soil become difficult thus disturbing water balance, while high concentrations of salts in plant tissue were found to be toxic.

Sodicityrefers to the sodium content of the irrigation water.Because of the relatively large size, single electrical charge, and hydration status of the sodium ion it particularly can cause soil dispersion. Sodic soil conditions make it difficult for plants to become established, for roots to penetrate the soil, and for plants to receive sufficient nutrients and water. Overall, those effects have negative impacts on plant yield and survival [2]. A soil is classified as sodic if exchangeable sodium percentage (ESP) exceeds 15% [3]. Hence, it should be reduced below this percentage.

Nowadays, many desalination technologies are in use toproducefreshwater from saline water. Electro-dialysis, vapor compression, multi-stage flash distillation, multiple-effect distillation, and reverse osmosis distillation have become standard desalination technology in the world at a recent decade[4]. Indeed, these technologies can produce large amounts of freshwater but they are costly and cannot target sodium selectively.

Due to low operational costs as well as itsfriendly aspects to

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