Adsorption removal of thallium (I) from aqueous solutions using a commercial manganese oxide

（酸化マンガン試薬による水溶液中のタリウム(I)の吸着除去）

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With the rapid development of economy, a large sum of thallium enters the aquatic environment from mining, metal smelting and industrial production, which aggravates the frequent occurrence of thallium(I) pollution incidents around the world, affecting the safety of ecosystem and human's health. Many studies indicate the available methods for Tl removal, including adsorption, oxidation-reduction precipitation, solvent extraction and ion exchange processes. This study examined the commercial manganese oxide as an adsorbent material for Tl(I) adsorption removal because of its high reactivity, low operation cost and high economic feasibility.

Batch experiments were conducted for the adsorption of Tl(I) in aqueous solution, including influencing factors of contact time, adsorbent dosage, equilibrium pH, ionic strength, and coexisting cations on Tl adsorption removal, then adsorption kinetic characteristics and thermodynamic properties were studied. Thallium contents were measured using UV-VIS and ICP-MS with the Open facility under standard analytical conditions.

From the result of Tl(I) concentration measurement, the adsorption of Tl(I) was strongly affected by ionic strength and MnO_2 dosage, removal efficiency increasing with the decrease of ionic strength and increase of adsorbent dosage. In the process of experiment, coexisting cations including Ca^{2+} and Mg^{2+}, having a certain inhibitory effect on the adsorption of Tl(I) by manganese dioxide. The experimental data reached equilibrium within 2 hours and were fitted well by the pseudo-second-order model. Moreover, when the initial concentration of Tl(I) ranged from 10 ppb to 1 ppm, under a temperature of 288 (room temperature), 298, 308, 318 K, the adsorption were fitted well by the Freundlich isotherm, and the maximum adsorption capacities of MnO_2 for Tl(I) were up to 11.92, 14.03, 13.70, 12.89 mg/g, respectively. The adsorption of Tl ions on MnO_2 occurs via a cation exchange mechanism and K_d was used to evaluate the migration ability and separation efficiency of Tl in two phases. The increase of temperature had a negative effect on adsorption capacity, suggesting that the adsorption was an exothermic and spontaneous process. The results indicated that commercial manganese dioxide could be an economical adsorbent for Tl(I) in aqueous solutions.