THE INFLUENCE OF SYNTHESIS WASHING SPECIMEN ON THE MICROSTRUCTURE OF TITANATE NANOMATERIAL AND ITS ADSORPTION PROPERTY OF LEAD(Ⅱ)

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Introduction

Compared with the traditional treatment techniques of heavy metal in aquatic solutions, adsorption process is considered as one of the most effective and promising technologies. Titanate nanomaterials (TNs) have been reported as superior sorbents in wastewater treatment. The specific surface areas, pore volume, ion content of TNs and the molecular size of TNs were the major factors affecting the adsorption performance. However, less studies were conducted on the effect of washing specimen on the icon content of synthesized TNs and their further influences on the adsorption properties of the synthesized TNs.

Consequently this study focuses on the methods of washing specimen as an influencing factor in the ion (H^+ and Na^+) content of TNs surface and thereby the influence of the adsorption of Pb(Ⅱ) on TNs. By changing the way of washing sample, surfaces of TNs with different ionic (H^+ and Na^+) were The adsorption properties of Pb(Ⅱ) from aquatic solutions by TNs were further investigated.

Materials and methods

All the chemicals used in this study were of analytical or purity. The TNs were synthesized via the method as described by Wei *et al.* (2007). Hydrochloric acid (HCl) and deionized water were selected as washing specimen to form TNs-H and TNs-Na, respectively. In addition, kinetic studies were carried out to determine the adsorption kinetics of Lead (Pb) onto TNs-H and TNs-Na by a batch method. Detailed experiment protocol could be found in *Full paper*.

Results and discussion

Adsorption kinetics

As shown in Fig. 1, within the first 20 minutes of the whole process, adsorption capacity of TNs to Pb(Ⅱ) increased sharply. The adsorption capacity of TNs-H and TNs-Na reached at 74.14 $mg \cdot g^{-1}$ and 66.24 $mg \cdot g^{-1}$, respectively. With the further increase of contact time up to 20 min, adsorption capacity of TNs-H and TNs-Na could reach at 79.85 $mg \cdot g^{-1}$ and 141.03 $mg \cdot g^{-1}$, respectively. The results show that TNs-Na has a

better adsorption ability than TNs-H. In addition, Pseudo-first-order, Pseudo-second-order, and Intraparticle diffusion models as shown in Eq. 1, 2, and 3 in *Full Paper* were applied for the kinetic analysis of adsorption dynamic of TNs. Compared to the other two kinetic models, it is evident that the Pseudo-second-order model provided the best fit to the experimental data. The equilibrium adsorption capacities of 85.05 $mg \cdot g^{-1}$ and 142.34 $mg \cdot g^{-1}$ of TNs-H and TNs-Na calculated based on the model were consistent with the equilibrium adsorption capacities (85.59 $mg \cdot g^{-1}$ and 142.78 $mg \cdot g^{-1}$ of TNs-H and TNs-Na) from adsorption experiment, which indicates that the Pseudo-second-order model was suitable for describing the adsorption processes of TNs-H and TNs-Na to Pb(II).

Adsorption isotherms

Langmuir, Freundlich and Temkin isotherms were adopted to describe the experimental data, which can be expressed respectively as Eq. 4, 5 and 6 in *Full Paper*. Langmuir model provided the best fit to the equilibrium adsorption data. According to the literature, a good fitness of Langmuir isotherm indicates a monomolecular type of adsorption. In other words, the adsorption sites on the surface of adsorbent were evenly distributed, and pollutants adsorbed on the surface of adsorbent were non-interacting. Furthermore, according to the Langmuir isotherm, monolayer saturate adsorption capacity of TNs-H and TNs-Na to Pb(Ⅱ) were 20.43 $mg \cdot g^{-1}$ and 429.7 $mg \cdot g^{-1}$, respectively, which consist with the equilibrium adsorption capacity determined by experiment.

Conclusions

TNs-H and TNs-Na were all pure Titanate of plate morphology and monoclinic phase. The adsorption capacity of TNs-H to Pb(II) could be up to 120 $mg \cdot g^{-1}$. While, the adsorption capacity of TNs-Na to Pb(II) reached at 450 $mg \cdot g^{-1}$. The adsorption kinetics of both TNs to Pb(II) followed well the Pseudo-second-order model and Langmuir isotherm. Compared to TNs-H, TNs-Na had stronger absorption ability and lower cost. Consequently, with more sodium ions in surface synthesized by water-washing, TNs-Na had a stronger absorption ability and become a kind of immense potential adsorption material.

References

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