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Nanocomposites of graphene oxide-hydrated zirconium oxide for simultaneous removal of As(III) and As(V) from water

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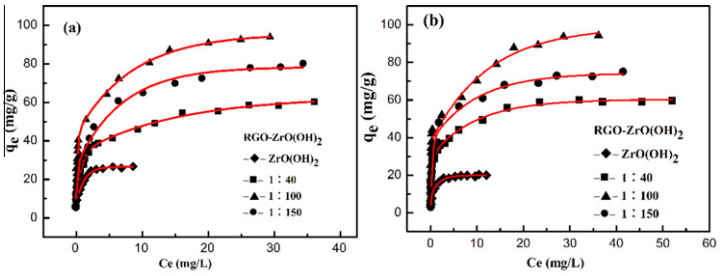
HIGHLIGHTS

- RGO–$ZrO(OH)_2$ was prepared by hydro-thermal co-precipitation method.
- RGO–$ZrO(OH)_2$ had high adsorption capacity for both As(III) and As(V).
- RGO–$ZrO(OH)_2$ showed high adsorption capacity in wide pH range.
- RGO–$ZrO(OH)_2$ exhibited good anti-interference ability to co-existing anions.
- Adsorption equilibrium of As(III, V) on RGO–$ZrO(OH)_2$ was obtained within 15 min.

GRAPHICAL ABSTRACT



Adsorption isotherm of (a) As(III) and (b) As(V) adsorption on RGO-$ZrO(OH)_2$.

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ABSTRACT

Hydrated zirconium oxide ($ZrO(OH)_2$) nanoparticles were modified with graphite oxide (GO) (denoted herein as GO–$ZrO(OH)_2$) by hydro-thermal co-precipitation reaction, and were used for the simultaneous removal of As(III) and As(V) from drinking water. The GO–$ZrO(OH)_2$ nanocomposites were characterized using Fourier transformer infrared spectroscopy, X-ray diffraction analysis, high resolution transmission electron microscopy, Zeta-potential, and specific surface area analysis. The size of $ZrO(OH)_2$ particles in GO–$ZrO(OH)_2$ is below 5 nm, and the specific surface area of GO–$ZrO(OH)_2$ is about 4 times that of $ZrO(OH)_2$ nanoparticles. The GO–$ZrO(OH)_2$ nanocomposites showed high adsorption capacity in a wide pH range, and the monolayer adsorption amounts calculated based on the Langmuir adsorption model were 95.15 and 84.89 mg/g for As(III) and As(V), respectively, which are 3.54 and 4.64 times that of $ZrO(OH)_2$ nanoparticles. The high adsorption capacity is attributed to good dispersion of $ZrO(OH)_2$ nanoparticles in the GO substrate. The GO–$ZrO(OH)_2$ nanocomposites can simultaneously remove As(III) and As(V) in water. Moreover, GO–$ZrO(OH)_2$ showed good anti-interference ability to co-existing anions, and exhibited excellent recyclability. The experimental results suggest that GO–$ZrO(OH)_2$ is a promising adsorbent for the removal of arsenic from drinking water.

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