Encapsulating UiO-66(Zr) in polyvinyl alcohol/sodium alginate beads for enhanced removal of Roxarsone from aqueous solutions

Rui Ma, Guangze Nie*

School of Environmental Science and Engineering, Nanjing Tech University, Nanjing 211816, China

Abstract: Roxarsone (ROX) is a common organic arsenic pollutant in water, and has significant risks to human health and the ecological environment. Herein, UiO-66(Zr)/polyvinyl alcohol/sodium alginate composite aerogel beads (UiO-66(Zr)@PVA/SA) was prepared as an adsorbent for enhanced removal of ROX. The composite adsorbent uniquely characterized by high porosity and an expansive specific surface area, offer a promising yet straightforward avenue for the effective capture of ROX through inner-sphere ligand complexation and electrostatic attraction. The microstructure of the synthesized UiO-66(Zr)@PVA/SA was examined using scanning electron microscopy and X-ray diffraction. Batch adsorption experimental results confirmed that UiO-66(Zr)@PVA/SA has remarkable adsorption capacity (88.35 mg/g, based on the Langmuir model), coupled with its rapid adsorption kinetics (250 min) for ROX removal. Moreover, UiO-66(Zr)@PVA/SA revealed exceptional selectivity toward ROX, even high concentrations of competitive anions present in the water. A demonstration of five consecutive ROX adsorption cycles resulted in no discernable capacity loss, indicating the robust regenerability of UiO-66(Zr)@PVA/SA. Column adsorption tests further demonstrated its excellent capability (2750 mL wastewater/g adsorbent). In light of these experimental outcomes, UiO-66(Zr)@PVA/SA clearly illustrates its potential as a future solution for ROX wastewater treatment, presenting a novel approach to developing superior adsorbents utilizing unpolluted raw materials for treating contaminated water.

Key words: UiO-66(Zr); Sodium alginate; Polyvinyl alcohol; Composite aerogel beads; Roxarsone

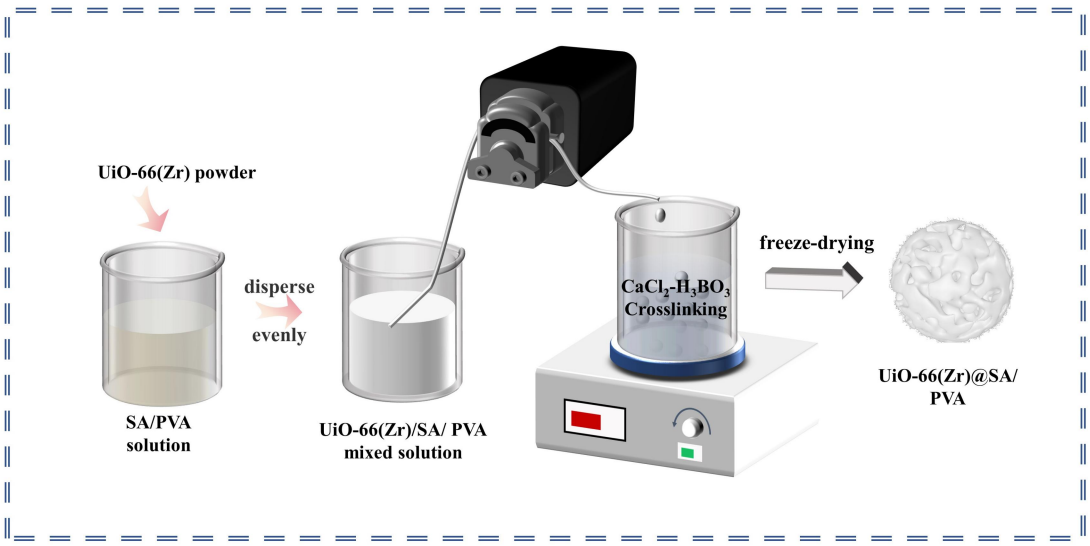

Fig. 1 Schematic representation for the fabrication process of UiO-66(Zr)@PVA/SA.