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Co-adsorption and sequential adsorption of the co-existence four heavy metal ions and three fluoroquinolones on the functionalized ferromagnetic 3D NiFe₂O₄ porous hollow microsphere

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Abstract: Functionalized magnetic microsphere NiFe₂O₄ (MS-NiFe₂O₄) with a 3D hierarchical porous hollow structure was fabricated using urea as the modifier and soft templates by a simple one-pot solvothermal method. The constructed MS-NiFe₂O₄ shows excellent dual functions which can not only undergo simultaneous rapid removal of the co-existence metal ions (Cu²⁺, Cd²⁺, Cr³⁺ and Zn²⁺ ions), but also availably adsorb fluoroquinolone (FQs) (ciprofloxacin (CIP), enrofloxacin (ENR) and norfloxacin (NOR)), and is easily recycled using an external magnetic field. The removal efficiency of eight targets could all reach up to 80% within 60 minutes at pH 5. The independent adsorption of single contaminants, the competitive adsorption of multiple heavy metal ions/organic contaminants, the simultaneous and sequential adsorption of the co-existence of inorganic and organic contaminants onto MS-NiFe₂O₄ were explored in detail. Competition adsorption occurred between the same type of contaminants. For different types of contaminants, four metal ions did not affect the adsorption of the other three FQs in the sequential and simultaneously adsorption system, and vice versa. The possible adsorption mechanism between targets and MS-NiFe₂O₄ was revealed.

Keywords: Functionalized magnetic hollow NiFe₂O₄ microsphere; Heavy metal ions; Fluoroquinolone; adsorption

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