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La-腐殖酸/Al_2O_3凝胶复合物的制备及其氟吸附性能

Preparation of La-humic acid/Al_2O_3 gels composite and its adsorption performance for fluoride in aqueous solution

关键词：腐殖酸钠 凝胶复合物 水处理 氟 吸附

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摘要：以腐殖酸钠为原料,采用凝胶聚合法制备La-腐殖酸/Al_2O_3凝胶复合物(标记为LHAGC).用N_2吸附-脱附试验,XRD,SEM,IR表征吸附剂的结构和形貌,并通过静态吸附试验探讨了LHAGC对水中F^-的吸附性能以及吸附饱和LHAGC的再生方法.试验结果表明, LHAGC对F^-等温吸附数据与Langmuir吸附等温方程拟合较好,最大吸附容量为219.30 $mg\cdot g^{-1}$,吸附过程符合准2级动力学方程,液膜扩散和颗粒内扩散过程控制着吸附速率;在pH值为5~11时,F^-吸附率较高;当水中Cl^-,NO_3^-,SO_4^{2-},HCO_3^- 或PO_4^{3-}以F^-质量浓度的15倍存在时,F^-吸附率仍能达到94%以上,LHAGC表现出较强的抗干扰能力.将F^-吸附饱和的LHAGC用浓度为10^{-1} $mol\cdot L^{-1}$的NaOH溶液进行脱氟,再用$AlCl_3$溶液将脱氟后LHAGC表面中和至pH值为5时所获得的再生吸附剂,再生率可达96.08%,由此表明LHAGC的潜在应用前景.

Abstract: A new adsorption material of La-modified humic acid/Al_2O_3 gels composite for adsorption F^- was developed and prepared by improved sol-gel and drying process using humic acid sodium and aluminum salt as the raw materials. The phase structure, microstructures and morphology of the materials were characterized by SEM, XRD and IR. The adsorption performance of the materials for F^- in aqueous solution and the regeneration of saturated LHAGC were investigated by static adsorption experiment. Our results show that adsorption of LHAGC can be well described by Langmuir adsorption isotherm and the maximum adsorption capacity of 219.30 $mg\cdot g^{-1}$ was obtained. The adsorption process complies with pseudo-second-order kinetic model and the absorption rate is determined by the liquid film diffusion and the intra-particle diffusion. The optimum fluoride removal efficiency is reached at the range of pH of 5~11. Even if the concentrations of Cl^-, NO_3^-, SO_4^{2-}, HCO_3^- or PO_4^{3-} reach up to 15 times of F^- concentration in aqueous solution, the materials exhibits good stability of absorption performance and the fluoride removal efficiency is higher than 94%. The maximum regeneration rate of 96.08% of the LHAGC can be obtained by optimizing the concentrations of NaOH and $AlCl_3$ and the pH value of the solution. Our studies show that the present materials have a potential application in the defluorination from contaminated water.

Key words: humic acid sodium gels composite water treatment fluoride adsorption

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