环境科学学报
ACTA SCIENTIAE CIRCUMSTANTIAE

研究报告

张晓蕾,陈静,韩京龙,张高生.壳-核结构Fe_3O_4/MnO_2磁性吸附剂的制备、表征及铅吸附去除研究[J].环境科学学报,2013,33(10):2730-2736

壳-核结构Fe_3O_4/MnO_2磁性吸附剂的制备、表征及铅吸附去除研究

Preparation and evaluation of shell-core structured Fe_3O_4/MnO_2 magnetic adsorbent for Pb(Ⅱ) removal from aqueous solutions

关键词：壳-核结构 Fe_3O_4/MnO_2 磁性吸附剂 铅 吸附

基金项目：国家自然科学基金项目(No.51178453);烟台市科技发展计划(No.2012132)

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摘要：采用共沉淀法制备了具有壳-核结构的磁性吸附剂Fe_3O_4/MnO_2,对其性质进行了系统表征,并对其铅吸附行为进行了初步研究.透射电镜(TEM)结果表明,Fe_3O_4/MnO_2为大小不规则的纳米级细小颗粒.X-射线衍射仪(XRD)表征结果表明,Fe_3O_4/MnO_2具有尖晶石的结构.振动样品磁强计(VSM)测得比饱和磁化强度为54.7 A·m^2·kg^{-1}, 吸附剂磁性较强,易于磁分离;BET比表面积为76.5 m^2·g^{-1}.吸附试验结果表明,Fe_3O_4/MnO_2对铅具有良好的去除效果(特别是在低平衡浓度情况下),最大吸附量为142.0 mg·g^{-1} (pH=5.0);Langmuir等温线能更好地拟合Fe_3O_4/MnO_2对溶液中铅的吸附(R^2=0.852);吸附速率较快,在初始30 min内可达到平衡吸附量的80%,准二级动力学模型(R^2=0.959)能较好地描述吸附过程;溶液pH对Fe_3O_4/MnO_2吸附铅的影响较为明显,随pH升高,吸附量增大,但离子强度变化对吸附影响不大.

Abstract: An adsorbent with Fe_3O_4 as magnetic core and MnO_2 as shell was prepared by co-precipitation process. The adsorbent was characterized using multiple techniques and its performance for Pb(Ⅱ) removal from aqueous solution was investigated. The TEM image indicated that the shape of nanosized Fe_3O_4/MnO_2 particles was irregular. X-ray powder diffraction (XRD) analysis showed that the magnetic phase in Fe_3O_4/MnO_2 was spinel magnetite. The adsorbent has a highly specific saturation magnetization of 54.7 A·m^2·kg^{-1} and a specific surface area of 76.5 m^2·g^{-1}. The results of batch sorption experiments suggested that the Fe_3O_4/MnO_2 magnetic adsorbent was effective for Pb(Ⅱ) removal from water, particularly at low equilibrium concentration. The isotherm data was well fitted by Langmuir model (R^2=0.852) with a maximal Pb adsorption capacity of 142.0 mg·g^{-1} at pH 5.0. The adsorption of Pb(Ⅱ) was very fast and over 80% of the equilibrium sorption capacity was achieved within 30 min. The pseudo-second order model (R^2=0.959) was more suitable to describe adsorption kinetic data. The Pb(Ⅱ) adsorption increased with increasing values of solution pH and was not significantly affected by the change of ionic strength.

Key words: core-shell structure Fe_3O_4/MnO_2 magnetic adsorbent Pb(Ⅱ) adsorption