改性沸石和膨润土对铬酸根的吸附性能及机制研究

论文标题:改性沸石和膨润土对铬酸根的吸附性能及机制研究
Study on Adsorption and Its Mechanism of Chromate on Modified Zeolite and Bentonite
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论文单位 南京农业大学,点击次数 19,论文页数 59页File Size3504K
2007-06-01论文网 http://www.lw23.com/lunwen_323139257/
zeolite;; bentonite;;modified;; adsorption;;desorption;; chromate
本文主要研究了1)阳离子表面活性剂十六烷基三甲基溴化铵(CTAB)改性制成的有机沸石对水体中铬酸根的吸附性能及吸附机制，并用不同量的十六烷基三甲基溴化铵(CTAB)对天然沸石改性并制备不同改性程度的有机沸石，测定了沸石对CTAB的吸附量，比较了几种改性沸石对铬酸根的吸附性能及其与有机沸石胶体zeta电位的关系，探讨了沸石对铬酸根的吸附机制及沸石再生后对铬酸根的吸附能力；2) Fe／Al改性膨润土对水体中铬酸根的吸附性能；3) Fe改性膨润土对水体中氟离子的吸附初步研究。 铬酸根的吸附结果表明，与沸石原矿相比有机沸石对铬酸根的吸附容量更高，而铬酸根在有机沸石表面的吸附量随着体系离子强度的增加而显著减小，说明铬酸根的吸附以静电作用为主。研究还发现沸石经有机改性后表面电位由负变正，说明表面活性剂在沸石表面的吸附改变了沸石表面的电荷性质，这也是有机沸石能够对铬酸根发生静电吸附的主要原因。铬酸根的吸附量及吸附的铬酸根的解吸量先均随着体系pH值的升高而增加，分别约在pH=5.0和pH=6.0时达最大，随后铬酸根的吸附量和解吸量随着pH值的进一步增加逐渐减小。铬酸根的吸附量与解吸量之间的差值随pH升高而减小，说明在低pH条件下非静电吸附所占比例较高pH值条件下有所增加。不同量的十六烷基三甲基溴化铵(CTAB)对天然沸石改性并制备不同改性程度的有机沸石结果表明，随着cTAB加入量的增加，它在沸石表面的吸附量显著增加，制备成的有机沸石对铬酸根的吸附性能显著提高。改性后沸石胶体的zeta电位由负变正，而且随着CTAB用量的增加，zeta电位正值增加。铬酸根在有机沸石表面的吸附量随离子强度增加而减小，而且有机沸石吸附的大部分铬酸根可以被中性盐解吸，说明铬酸根的吸附以静电吸附机制为主。改性剂用量在0.15-0.3mol·kg~(-1)范围内，有机沸石再生后仍对铬酸根有很好的吸附性能，可以循环使用。 用沉降法提取粒径小于2微米的膨润土胶体，经过钠质化处理后分别用聚羟基铁和聚羟基铝对膨润土胶体进行改性，研究Fe／Al改性膨润土对水体中铬酸根的吸附性能。结果表明，与原矿相比，改性膨润土对铬酸根的吸附量有了不同程度的提高，铁改性膨润土对铬酸根的吸附量大于铝改性者。改性膨润土对铬酸根的吸附量随离子强度的增加而增大，随体系pH的增加而减小。铬酸根在改性膨润土表面的吸附以专性吸附机制为主，静电吸附所占比例很小。 Fe改性膨润土对水体中氟离子的吸附初步研究结果表明与砖红壤和未改性的膨润土原矿相比，Fe改性膨润土对氟离子的吸附量有不同程度的增加，改性膨润土对氟离子的吸附量在pH5.0左右最大。

This research includes three parts. First of all, the adsorption of chromate on zeolitemodified by cation surfactant CTAB and its mechanism were investigated; then differentquantity of cation surfactant CTAB was used to modify zeolite to different extent, theamount of CTAB adsorbed by zeolite was determined, and then the adsorption capacity forchromate was compared among these modified zeolites. The relationship betweenadsorption of chromate on modified zeolite and zeta potential in its suspension system wasalso investigated and the adsorption mechanism for chromate was discussed. Secondly,adsorption of CrO_4~(2-) by Fe/Al modified bentonites was investigated. At the last section,adsorption of F~- by Fe modified bentionites was studied. The main results are summarized as following: The modified zeolite had a greater adsorption capacity for chromate as compared withnon-modified zeolite. The amount of chromate adsorbed by modified zeolite decreased withthe increase in ionic strength, which suggested that the electrostatic interaction between themodified zeolite and chromate was the major mechanism. The Zeta potential of zeolitechanged from negative value to positive value after modified by cation surfactant, and thisindicated that the adsorption of cation surfactant on zeolite induced a change in its surfacecharge properties. The increase in positive value of surface potential was the main reasonfor electrostatic adsorption of chromate on the modified zeolite. Both adsorption ofchromate by modified zeolite and desorption of pre-adsorbed chromate increased with theincrease in pH, and reached a maximum value at pH 5.0 and 6.0, respectively, and thendecreased. While after that, the difference between adsorption and desorption of chromatedecreased with the increased of pH, suggesting that the adsorption through noneelectrostatic mechanisms at low pH value. Results showed that both adsorption of CTAB on zeolite and adsorption capacity ofthe modified zeolite for chromate increased obviously with the increase in the quantity ofCTAB added. The zeta potential of zeolite changed from negative value to positive valueafter modified by cation surfactant, and the value of the zeta potential also increased withthe increase in the quantity of CTAB added. This indicated that the adsorption of cation surfactant on zeolite induced a change in its surface charge properties. The amount ofchromate absorbed by the modified zeolite decreased with the increase in ionic strength,and most of chromate adsorbed on modified zeolite can be desorbed by neutral salt, whichsuggested that the electrostatic interaction between the modified zeolite and chromate wasthe major mechanism for the enhanced adsorption of chromate. When the quantity of CTABadded was in the range from 0.15 to 0.30 mol.kg~(-1), the used modified zeolite can be reusedas absorbent for chromate after renewing. Results indicated that modification of bentonite by Fe or A1 resulted in the increasein CrO_42 adsorption to some extent and Fe modified bentonites adsorbed much moreCrO4~(2-) than the one modified by A1. The amount of CrO_4~(2-) adsorbed by Fe/A1 modifiedbentonites increased with the increase in the ion strength and decreased with the increase ofpH. The adsorption of CrO_4(2-) on the Fe/A1 modified bentonites involved in specific andelectrostatic interaction of CrO_4(2-) with the modified bentonites, and the specific adsorptionwas the main mechanism for CrO_4(2-) adsorbed by Fe/A1 modified bentonites under theexperimental conditions. Preliminary results showed that modification of bentonite by Fe resulted in theincrease in F adsorption to some extent and Fe modified bentonites adsorbed more F thanthe latosols. The adsorption increased with the increase in system pH, reached a maximumvalue at about pH5.0, and then decreased with the further increase in pH.

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