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裂隙中滞水区对溶质运移影响的模拟分析

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摘要　　无论是野外还是室内试验所涉及到的均是变隙宽的粗糙裂隙。重点探讨带滞水区的裂隙形态对其中溶质式示踪剂运移的影响及导致的运移特征变化。采用的模拟方法是考虑对流与分子扩散步骤的随机粒子追踪方法。数值模型区域选择均质导水介质。不同程度的分子扩散模式用于比较其对溶质运移结果——穿透曲线特征的影响。尝试从不同穿透曲线的特征分析来解析带滞水区裂隙的几何形态及相对分子扩散程度对溶质运移的影响。研究结果表明，在不带滞水区的单裂隙中，溶质几乎同时流出系统。对于相同分子扩散尺度下的带较宽或较深滞水区的裂隙，其对应的穿透曲线的高峰值明显降低并伴随着明显的"拖尾"现象。模拟结果还表明在较高尺度分子扩散条件下，其穿透曲线具有相类似的特征。

关键词　数值分析；裂隙；滞水区；溶质运移；非均质介质

分类号

SIMULATION ANALYSIS OF EFFECT OF STAGNANT POOL IN FRACTURE ON SOLUTE TRANSPORT

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Abstract

The more common situations both in field and in laboratory involve nonorthogonal fractures of unequal aperture. The effect of crack shape in stagnant pool on solute tracer and the corresponding change of transport character are discussed especially. Random tracer particle method is adopted，which considers convection and diffusive steps. Numerical experiments are conducted in a homogeneous conductivity field. Simulations with different degrees of diffusion are used to compare their effect on solute transport result，i.e. character of breakthrough curves. The effects of geometric shape of fracture in stagnant pool and relative molecular diffusion degree on the solute transport are analyzed according to the characters of different breakthrough curves. Results indicate that，in the single fracture without stagnant pool，the solute pours out almost at the same time；for the same diffusion scale，the peak value of the breakthrough curves of the fractures with a deeper or wider stagnant pool decreases obviously and the tail of the curve increases. The results also demonstrate that the breakthrough curves have similar characters under the condition of higher scale of molecular diffusion.

Key words　numerical analysis；fracture；stagnant pool；solute transport；heterogeneous medium

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