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LABORATORY EXPERIMENTS ON SOLUTE TRANSPORT IN A PARTIAL TRANSFIXION SINGLE FRACTURE*

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Abstract: In the study of solute transport in rough single fracture, the contact area is an important factor. The single fracture is defined as two categories in this article: the full transfixion single fracture and the partial transfixion single fracture. The purpose of this article is to research how the contact area affects the solute transport in partial transfixion single fracture. The contact area is generalized as square blocks with three sizes, and contact rate is variable, a series of experiments for solute transport were conducted in a simulation model which can simulate the two types of fractures in the laboratory. Based on the analysis of the breakthrough curves and the experiment phenomena, it is concluded that the difference of breakthrough curves of various contact rates is evident and increases with the increase of contact rate, the relative error curves reflect the difference of block sizes, and the maximum errors increase from smaller than 0.2 to about 0.8 with the increase of contact rate. These phenomena are also explained qualitatively in this article. It is concluded that the contact area strongly affects solute transport, and the research of channels formed by contact area is useful to further understand the rule of solute transport in partial transfixion single fracture.

Key words: contact rate, channels, partial transfixion, single fracture, solute transport

Introduction

Over the past few decades, the environment was polluted by the expansion of human activities. The geological disposal of high-level nuclear waste and the construction of underground storage and underground powerhouse have important impact on the environment[1]. Most of these constructions are related to the fractured media. So researchers have paid more and more attentions to the flow and the solute transport in fractured media.

Since the beginning of study on flow in fractured media, it is gradually going deep into the study from the parallel plate model. Tsang and Tsang[2] put forward and solved the channel model in fractured media, and applied this model to the solute transport, according to the comparison of other studies and prediction of the tracer breakthrough curves in single fracture. It has been proved that the conceptual model is valid, but still needs to be validated by experiments. In fractures the channels are formed by contact area, so it is one of purposes of this article to research the contact area.

For laboratory research of solute transport in fractured media, the fractured media is usually simplified and the anisotropy of fractured media is simulated by porous media materials. A tracer test was performed in a 2-D anisotropic sand tank which is composed of different sizes of sand by Ursino et al.[3], and they discussed the relationship between solute transport and other parameters including saturation, heterogeneity, and anisotropy of unsaturated media. But at high flow rate, there remained two questions need to be answered, and the arrangement of sand was too regular. Jose et al.[4] simulated the natural heterogeneity by several sands in a larger-scale tank, and derived the relationship between effective dispersion and macrodispersion, concluding that the effective diffusion coefficient is about 2/3 of macrodispersion coefficient. And the test results are qualitatively consi-

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