Numerical and approximate solutions for solute transport in a fractured rock for dispersion in fractional dimension

*Ye-Chen Lin[1], Chia-Hsin Yen[1], Shaw-Yang Yang[2], Fu-Kuo Huang[3], Hund-Der Yeh[1]

1. National Chiao Tung Univ., 2. Vanung Univ., 3. Tamkang Univ.

The groundwater flow in the fractured formation may be in fractional dimension; however, the problems of solute transport in such a flow system have not been studied yet. This study develops a transport model to investigate the solute transport in a fractured rock with dispersion in fractional dimension. The finite-difference method is used to solve the model and the result is compared with existing analytical solutions. In addition, an approximate solution is also developed based on the steady-state transport equation and a moving boundary condition. The results show that the approximate solution gives very good prediction in the concentration distribution well under the conditions of short observed location, large dispersivity, and long operating time. The sensitivity analysis indicates that the solute concentration is very sensitive to the parameters such as retardation, injection rate, and flow dimension. We also find that a larger dispersion dimension would lead to solute concentration arriving the observation point earlier. Meanwhile, a smaller dispersion dimension yields more transfer mass near? the source.

Keywords: fractured rock, solute transport, finite-difference method, approximate solution