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Analysis of chemical transport in a vertical circulation flow field

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Vertical circulation well (VCW) technique is a promising innovative technology for cleanup of the contaminated aquifer. In this study, we present a mathematical model for describing chemical transport in a vertical circulation well. In developing the mathematical model, a steady-state analytical solution for drawdown distribution is derived and used to calculate radial and vertical components of the pore velocity. The two-dimensional advection-dispersion equation in cylindrical coordinates is used to account for chemical transport in a vertical flow field. The Laplace transformed finite difference technique is applied to solve the two-dimensional advection-dispersion equation in cylindrical coordinates with variable-dependent coefficients. The developed mathematical model is applied to investigate the temporal evolution of chemical concentration contour in the aquifer. Results show that the differences in velocity and transport distance among streamlines result in extra spreading of solute. Additionally, increasing anisotropy will cause the chemical traveling through the upper part of the extraction screen interval. The mathematical model presented herein provides a tool for describing the transport regime resulting operation of a vertical circulation well, and can be useful in designing in situ groundwater contamination treatment systems.