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EXPRESSIONS OF REPRESENTATIVE ELEMENTARY VOLUME FOR A FRACTURED MEDIUM WITH PERCOLATION THEORY

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Several approaches have been employed in attempts to describe flow and transport in fractured media. Among these models an equivalent porous medium model, which is a classical approach that simulates the flow and transport in subsurface, has been used dominantly to describe behaviors of groundwater in fractured media for convenience and quick application. But few appropriate establishments of model domains were provided.

In this study, the relationship between Representative Elementary Volume (REV) and percolation theory was studied. A REV can be related to a correlation length of percolation theory. If conductive fracture units are hydraulically connected, they form a cluster which shows some fractal properties. A correlation length can be defined as some average distance of the connected units belonging to the same cluster. Thus the system shows fractal properties on scales smaller than the correlation length, and homogeneity on scales larger than it. These were proved numerically with a lattice model in this study. REV which was determined by changing effective conductivities on various scales at the given probability of a unit being conductive (p) was well accordance with a correlation length calculated with the density of a percolation cluster. As a result, it is verified that REV can be estimated with the power law. A random fracture network model is related to a lattice model by a parameter which called a connectivity. Numerical experiments were conducted to demonstrate the relationship between a REV and a correlation length in random fracture network system.