Laboratory axisymmetric diffusion test for cylindrical specimens

Mikio Takeda[1]; Ming Zhang[1]; Tsuyoshi Hiratsuka[1]

[1] AIST

http://unit.aist.go.jp/georesenv/

Precise knowledge concerning transport and retardation of contaminants in engineered and natural barriers is necessary to perform safety assessments of the geological disposal of hazardous wastes, including radioactive nuclear waste. When groundwater flow is very slow, typically in low-permeability environments, diffusion and sorption are the dominant processes for contaminant migration, and thus evaluation of the diffusive and sorptive properties of barrier materials is of fundamental importance.

The diffusion of substances in geological media is known to depend on the geometric orientation of the pore structure. In particular, preferentially layered pore structures due to sedimentation in sedimentary rocks may cause anisotropic diffusion in directions perpendicular and parallel to the bedding plane. Therefore, the investigation of directional diffusivities is necessary for evaluating diffusion phenomena in the anisotropic geological media.

For measurement of diffusion properties of porous media, many types of laboratory diffusion tests are available; however, most tests are designed for determining diffusivity in the axial direction of cylindrical specimens cored from boreholes or molded in laboratories. To evaluate the diffusivities in both the axial and radial directions of cylindrical specimen, an experimental method and an associated semi-analytical solution are developed in this study. In this experimental method, a cylindrical specimen is located in a solution reservoir, and a tracer is allowed to diffuse into the specimen from lateral and end surfaces. The transient variations of tracer concentrations are measured and interpreted by using the semi-analytical solution. In order to examine the feasibility of the proposed method, practical experiments are performed using sedimentary rocks and potential problems related to test interpretations are discussed.