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学　位　論　文　内　容　の　要　旨

博士の専攻分野の名称　　博士（工学）　　氏名　A.K.M. Badrul Alam

学　位　論　文　題　名

Temperature and confining pressure effects on the permeability of rocks under triaxial compression
(三軸圧縮下における岩石の浸透率に対する温度と封圧の影響)

To clarify the permeability behavior of rock during deformation and failure, and the influences of confining pressure and temperature on that behavior, triaxial compression tests were carried out for Shikotsu welded tuff, Kimachi sandstone, and Inada granite under confining pressures of 1-15 MPa at 295 K and 353 K. Main findings are as follows.

(1) Effects of confining pressure:

For Shikotsu welded tuff, the permeability monotonously decreased with axial compression. The decrease ratio increased with confining pressure; the main cause of the decrease was attributed to pore collapse.

For Kimachi sandstone, the permeability first decreased with increasing axial stress, but then began to increase when the total lateral strain recovered its value before the application of confining pressure, and finally showed an almost constant value in the post-peak region. The minimum and final permeability decreased with confining pressure. Compared to the permeability before axial compression, the final permeability became larger under small confining pressure but smaller under high confining pressure. The main cause of the decrease was attributed to either compaction or large plastic deformation of clay cementing materials.

For Inada granite, the permeability behavior during axial compression was almost the same as that for the Kimachi sandstone. Compared to the permeability before compression, the final permeability was larger, and it decreased with smaller confining pressures. The main causes of the decrease were attributed to a decrease in the number and width of rupture planes and a decrease in the axial cracks from biotite; however, the permeability increased under larger confining pressures because of the formation of subrupture planes due to high stress concentration at the rough and stiff rupture plane.

(2) Effects of temperature:

For all types of rock, the permeability at 353 K was lower than at 295 K, and the influence of the confining pressure was less at 353 K than at 295 K. The principal mechanisms causing the permeability decrease were enhancement of pore collapse for the Shikotsu welded tuff, plastic deformation of the cementing material for Kimachi sandstone, and viscous deformation of mineral particles for Inada

granite by thermal activation.

The flow velocity of the fractured specimens with the unit pore pressure gradient at 353 K was slightly lower under low and moderate confining pressures but higher under high confining pressures for the Shikotsu welded tuff, slightly higher for the Kimachi sandstone, and obviously less for Inada granite compared to values at 295 K.

Change in sealabilty of underground openings due to the progress of EdZs and EDZs were also inferred by considering the rupture plane in the triaxial compression tests analogous to a fracture in a rock mass.