3-3 Challenges of Seepage Control at a Repository for Radioactive Waste

−Applicability of a Grout Penetration Model−

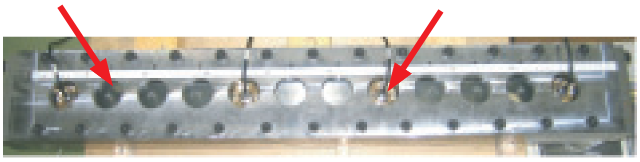

Fig.3-9 Flat parallel plate apparatus (top view)
Two flat parallel plates form a narrow aperture. Infiltration distances of the injected grout from the inlet were observed through acrylic windows and infiltration pressures were monitored by pressure gauges.

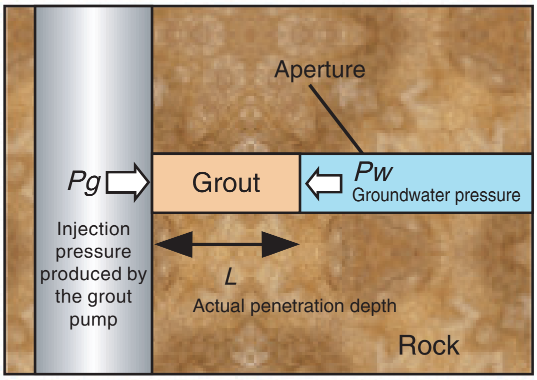

Fig. 3-10 Grout flow in an aperture
Grout is injected into apertures in the rock with injection pressures higher than groundwater pressure. Penetration distance of the injected grout is referred to as *L* .

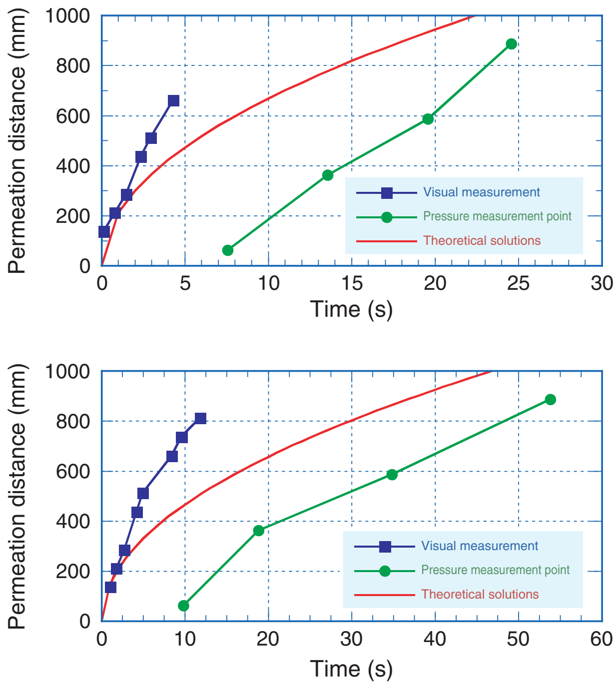

Fig.3-11 Results of modeling and laboratory tests of penetration
The modeling is in agreement with the results of laboratory tests: the penetration fronts were solved theoretically according to the model plot close to the averages of those acquired by observation and from the pressure gauges in the laboratory tests.

Grouting open apertures in a rock mass improves the strength of the rock mass and limits the ingress of groundwater during the construction and operational phases of facilities for the geological disposal of radioactive waste. Ordinary Portland cement is conventionally used for grouting, but which can generate a high pH plume that has generally uncertain effects on the performance of other facility components and of the rock mass. A low pH cement grout material and appropriate grouting techniques are therefore being developed to mitigate these effects. Assessments of penetration depth are particularly important because they can be used to provide information for long-term safety assessment.

In the current study, the grout penetration depth of a low pH cementitious material was tested in the laboratory using 1D flat parallel plate apparatus and compared with predictions using the Gustafson & Stille model (Fig.3-9). Fig.3-11 shows that the modeling predictions are in agreement with the results of the laboratory tests: the evolution of the penetration distance solved theoretically according to the model was approximately consistent with that of the average distance measured visually and by pressure gauges at the observation points.

The model provides the average distance of injected grout in the aperture (Fig.3-10). Grout material is simulated as a Bingham fluid, which exhibits a nonzero (i.e. positive) yield strength on the stress vs. rate of strain relationship. Bingham fluids exhibit heterogeneous flow velocity distributions in the cross section of the aperture; in particular, the flow velocity is slower closer to the wall of an aperture.

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Reference

Fujita, T. et al., Fundamental Study on a Grout Penetration Model for a HLW Repository, Journal of Energy and Power Engineering, vol.6, no.8, 2012, p.1191-1203.