

SLUG TESTS IN PACKER-ISOLATED INTERVALS FOR PLANNING RADIOACTIVE WASTE DISPOSAL (KRASNOYARSK REGION, RUSSIA)

Client: Russian state company

Issue: Determination of hydraulic conductivity changes with depth in fractured gneiss rocks

Solution: Interpretation of slug-tests on packer-isolated intervals

Design of radioactive waste disposals (RWD) in deep horizons requires a detailed understanding of permeability distribution with depth. This is especially important for fractured rocks that are associated with high heterogeneity of hydraulic properties.

To determine hydraulic properties at the RWD site, slug tests were conducted in 22 intervals the borehole. The intervals were of 10 to 50 m length and were isolated by packers. For every tested interval, an instantaneous draw-down of 60 m was created then the hydraulic head was left to recover. Recovery commonly took several days.

ANSDIMAT includes a number of solutions for interpretation of slug tests for water withdrawal (Bredehoeft, Bouwer & Rice, Cooper, Picking, Yeh et al.), injection (Lugeon, Moye, Thiem et al.) and fracture-driven flows (Dougherty & Babu, Gringarten, Wen, Yang et al.).

Interpretation of the tests at the RWD site was conducted using the Cooper solution (see example on Fig. 1).

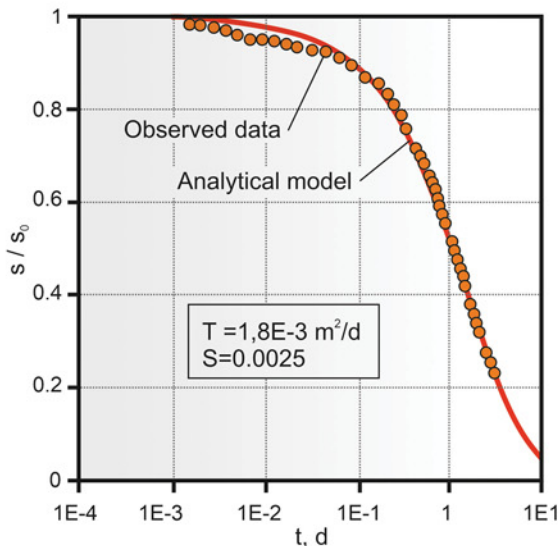


Fig. 1. Interpretation of the slug-test for the depth interval between 200 and 250 m.

The interpretation results were plotted to determine hydraulic conductivity changes with depth. The Fig. 2 displays the strong tendency of hydraulic conductivity to decrease with depth. According to the literature, this is the evolution to be expected for a gneiss formation.

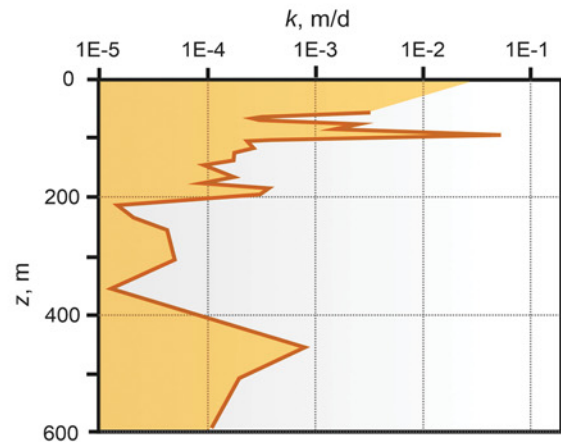


Fig. 2. Variation of the hydraulic conductivity with depth

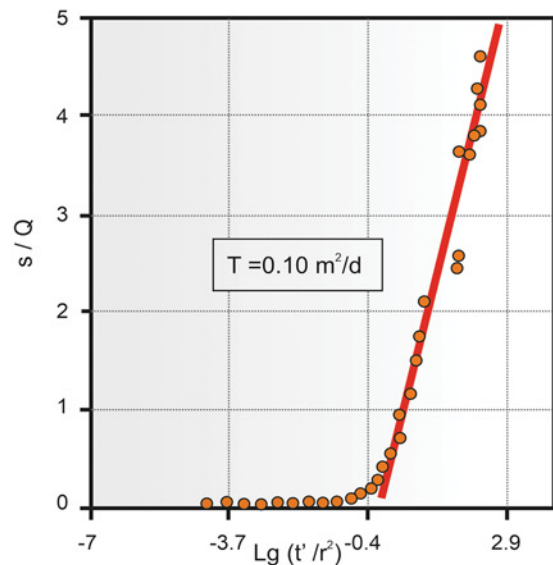


Fig. 3. Interpretation plot for the pumping test in open hole

The interpreted results were validated by comparing the sum of transmissivities for individual intervals to the transmissivity that was determined during a variable rate pumping test from the entire borehole open space. The Fig. 3 presents interpretation results of the test in special coordinates. The interpreted transmissivity, 0.1 m²/day was similar to the sum of interval transmissivities from the slug tests, 0.15 m²/d. This match provided an improved confidence in the determination of the vertical distribution of hydraulic conductivity using interval slug tests.