INTERPRETATION OF PACKER TESTS IN FRACTURED SCHISTS, OLIMPIADA OPEN PIT IN THE KRASNOYARSK REGION (RUSSIA)

Client: Polyus Gold

Objective: Determination of hydraulic conductivity in low-permeable schist formations

Method: Lugeon test tool in Hydrogeologist Workbench

The Lugeon test (or Packer Test) is an in-situ testing method widely used to determine the permeability of low-permeable fractured rocks.

The tests are performed in a borehole with water injected into a packer-isolated section. The pressure head for water injection is maintained constant at each pressure stage (normally 4 to 6 pressure stages). Pressure is commonly increasing from stage to stage and then decreasing to the same values. This process allows verifying, whether testing was conducted under laminar or turbulent conditions and also reveals any change in geomechanical conditions (e.g. pressure-induced fracture opening).

Both, pressure, and flow rate of injected water are measured during injection and both are required for interpretation.

The hydraulic conductivity is determined in Lugeon units, where 1 Lugeon is defined as the hydraulic conductivity corresponding to a flow rate of 1 l/min under a water pressure of 10 bar applied for a 1 m test interval.

The current study was carried out at the olimpiada gold deposit in the Krasnoyarsk region. Hydraulic properties of schists were required to quantify their response to depressurisation measures during the open pit development. In total, 98 packer tests were conducted in 8 hydrogeological boreholes. The length of tested intervals varied between 60 m and 70 m, the intervals were isolated using packer equipment IPI SWIPS. The interpreted hydraulic conductivities were varying between 0.000001 and 0.25 m/day and presented a significant negative correlation with interval depths.

The **figure** below illustrates the ANSDIMAT interpretation for testing interval 339.3-378.8 m below ground level with five pressure stages (dP) in one of the boreholes. The pressure for different stages was changing from 330.5 m to 432.6 m of water column (see the **Table**) and back.

The **figure** presents the Lugeon tests dialog window, where calculations of hydraulic conductivity are performed, and presents the diagnostic diagram to determine testing conditions.

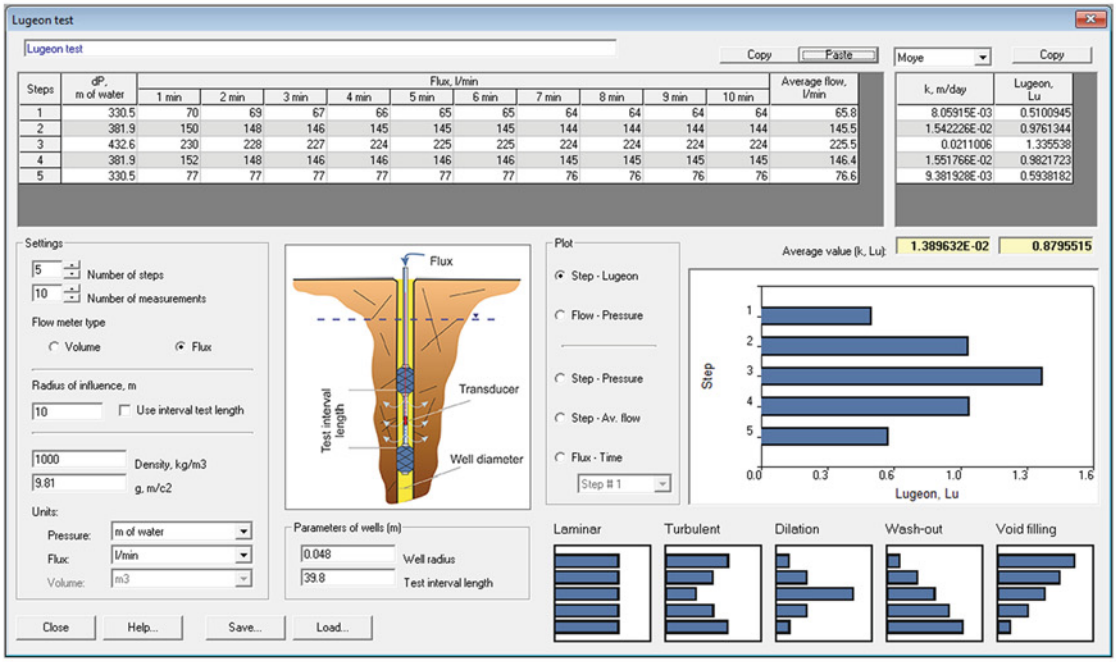

Figure - The Lugeon tests dialog window in ANSDIMAT

Specifically, the diagram shows that Lu values were increasing as pressure increased, indicating fractures were opening as a result of excessive pressure. It is generally recommended that water pressure is sufficiently high during a test to inject water into the formation but not excessive, to preserve the mechanical integrity of the tested formation.

Hydraulic conductivities were calculated using the solutions of **Thiem**[1] and **Moye**[2]. Both resulted in similar values, as presented in the **Table**.

Table. Interpreted hydraulic conductivities for pressure stages

Step	Pressure step dP, m	Hydraulic conductivity, m/day		Lugeon, Lu
		Method		
		Thiem	Moye	
1	330.5	6.1E-03	8.1E-03	0.51
2	381.9	1.2E-02	1.5E-02	0.98
3	432.6	1.6E-02	2.1E-02	1.34
4	381.9	1.2E-02	1.6E-02	0.98
5	330.5	7.1E-03	9.4E-03	0.59
Aver.		**1.1E-02**	**1.4E-02**	**0.88**

[1] Thiem G. Hydrologische methoden. Leipzig. 1906
[2] Moye D.G. Diamond drilling for foundation exploration. Civil Eng. Trans., Inst. Eng. Australia. 1967, pp 95–100.