

Innovative TDR applications for nuclear waste disposal sites

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Topic:

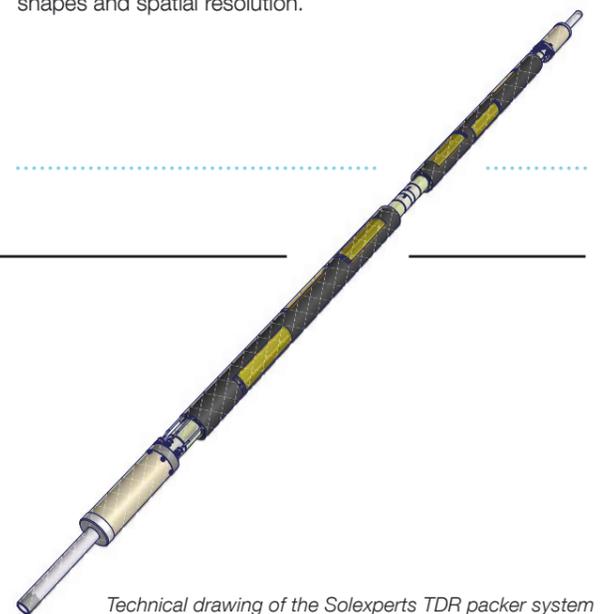
Solexperts AG is a provider of measurement technique for geo-technical and hydrogeological applications and in-situ experiments.

Solexperts produces and sells precision measurement instruments and complete monitoring systems including data logging, alarming and web-visualization for civil engineering risk management of projects with difficult ground conditions. For many projects customized solutions are developed.

In the framework of research projects on nuclear waste disposal sites, Solexperts has specialised in planning, instrumentation and performing tests for in-situ and large scale experiments at the Grimsel test site (CH), the Mont Terri rock laboratory (CH), the Laboratoire souterrain de Meuse/Haute-Marne (F), Tournemire (F) and for many other test sites in Europe, Korea and Japan.

For the determination of moisture and of water and gas transport through sealings and barriers, the TDR (time

domain reflectometry) method was found to be most suitable. Recently, for different research experiments Solexperts has been developing specialized TDR probes to meet demanding requirements, e.g. borehole application, high pressures, electrically conductive materials, particular shapes and spatial resolution.



Technical drawing of the Solexperts TDR packer system

The Solexperts TDR Packer - System:

- Developed for measuring water content in rock
- Designed for installation in boreholes (86 mm)
- TDR probe has direct contact to rock surface (no filling material in gap necessary)
- Pressure to rock surface can be controlled and measured (swelling pressure can be monitored)
- 3 TDR probes per packer element (positioned one above another with a 120° offset)
- TDR signal generator acquisition and signal processing unit are integrated in packer system
- System is retrievable from the borehole
- Multiple probes / packer elements can be installed in a single borehole
- Combined solutions with additional instruments that can be installed in the same borehole through the packer mandrel (e.g. pore pressure monitoring)
- Coated waveguides and optimized TDR technology for measuring in electrically conductive materials, such as clays or mudstones



Double element Solexperts TDR packer (6 sensors), approx. 3 m system length

TDR Sensors for special Applications / Custom Sensors:

Line sensors for moisture measurement and gas migration studies in a bentonite barrier

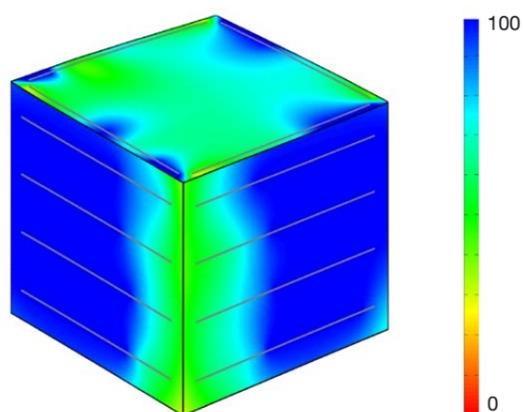
- Custom lengths between 90 cm and 140 cm (tailored to experiment)
- Allows measurements with spatial resolution in highly conductive material
- High water and gas pressure tightness (up to 30 bars)

Coated 3-rod sensors for use in highly conductive materials

- high water and gas pressure tightness (up to 30 bars)
- Coaxial measurement line in pressure resistant metallic tubes
- Robust design to withstand compaction of matrix material



Insulated TDR rod probe for high conductive materials



Saturation of the surface area of a bentonite barrier (analysis in co-operation with Schlaeger Mathematical Solutions)

Ring shape sensors

- Special shape for detection of lateral water and gas flow along the wall of a cylindrical container
- Coated sensor lines
- Special conductor measurement cable leading outside of the experiment set-up



Ring shape TDR sensor for barrier experiment (schematic)



Gas tight TDR line sensor for gas migration experiment