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D3.23 POPLU Experiment

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PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the partners of the DOPAS project	
CO	Confidential, only for partners of the DOPAS project	

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		Appendices	0
Title	D3.23 POPLU Experiment	Articles:	

ABSTRACT:

This Deliverable shows the POPLU Experiment, which has been emplaced in the demonstration area in ONKALO, Olkiluoto, Finland.

RESPONSIBLE:

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COMMENTS:

POPLU Experiment is reported in detailed in several DOPAS Deliverables and at DOPAS public website.

http://www.posiva.fi/en/dopas/wp_3/experiment_4_poplu

APPROVED FOR SUBMISSION:

Johanna Hansen 31.8.2016

The POPLU full-scale concrete tunnel end plug was cast in two sections during July and September 2015. Prior to this, the construction preparation work has included installation of 3 metres length of tunnel backwall, the 1.2 metre thick filter layer of pervious concrete blocks, and three lead-throughs for instrumentation, pressurization and water release. Construction efforts also included building of the formwork, installation of grouting tubes and bentonite tape, followed by installation of stainless steel reinforcement. The DOPAS project has covered aspects of the instrumentation and monitoring system (by VTT) and some of the concrete quality assurance. The construction work has included many subcontractors to Posiva which were not covered within the scope of DOPAS funding, including Hartela Oy for construction, Rudus Oy for concrete delivery and quality control, Vesi-Vasa Oy assisting with the pressurization system, IS Works Oy assisting with metal works and Lännen Kaivuu ja Louhinta Oy for rock works.

For each plug section casting, there were 20-25 truckloads of $4m^3$ each delivered at 20 minute intervals over a 10 hour period to 420 m underground. A total of 172 m^3 low-pH concrete was used, comprised of 94 m^3 in the first plug section and 78 m^3 in the second section. The concrete was placed by pumping at increasing height intervals in the plug. No mechanical vibration was used, as the material was self-compacting. The uppermost or last hole in the formwork had concrete pumping or casting with an applied pressure of 0.5 bars maintained for 30 minutes (Figure 1). No problems were encountered during the casting procedure, with very uniform self-compacting concrete achieved having a very low water-content and meeting demanding conditions for casting. The formwork from the plug was removed in October 2015 (Figure 2).

Prior to placement, air content, density and temperature and slump flow of the concrete were measured at both the factory and on-site to ensure consistency and quality (Figure 3). The average slump flow of the concrete during quality control testing underground was 600mm and air content 2.0%. The formwork pressure was also measured during emplacement. The plug sections were instrumented with 67 sensors to measure early age and long-term performance, including temperature, relative humidity, stress, pressure and displacements. The maximum temperature of the plug after casting was 43°C at approximately 3 days. Concrete samples were taken for measurements of compressive strength, watertightness and pH leachate at 28, 91 and 365 days after casting. 1 m^3 quality control cubes were also cast underground beside the plug to be used for further quality control sampling for each mix (16 and 32 mm aggregate sizes, for both plug section castings) (Figure 3). For the first concrete plug section, the 91 day average results were: compressive strength 85.8 MPa, 3.2 mm watertightness, and pH of 10.8 in groundwater.

In December 2015 the plug-rock interface was injected with low-pH grout to enhance the watertightness. The plug was then pressurized to 4.1 MPa in spring 2016, to simulate the loading expected over the 100 year service life. The performance monitoring is on-going, including measurement of any potential leakage and response in the near field tunnel environment. The interpretation of results from construction and pressurization response are being used to evaluate the feasibility and performance of the plug. The evaluation contributes to the further development of Posiva's end plug design.

DOPAS Deliverable D4.5 POPLU Experiment summary report compile more detailed information.

A short film about POPLU field work and installation phases is available at http://www.posiva.fi/en/dopas

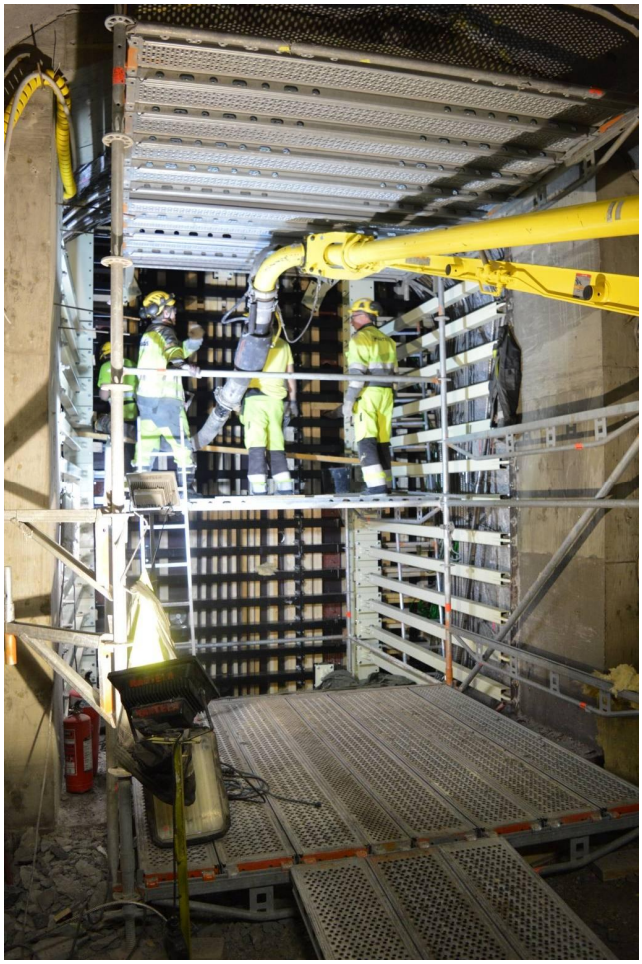

Figure 1. Emplacement of the plug concrete.

Figure 2. Plug appearance after formwork removal (prior to contact grouting and pressurization).

Figure 3. Quality control testing of the plug (left =cubes for quality control, right= slump flow test).