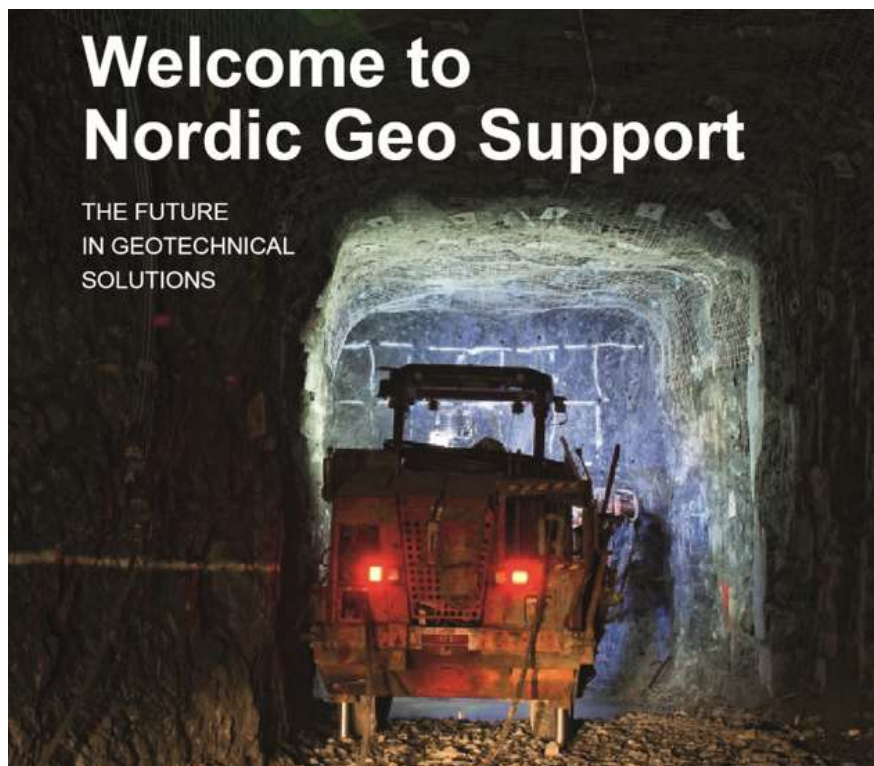




Nordic Geo Support

Sustainable support for your ground

About us

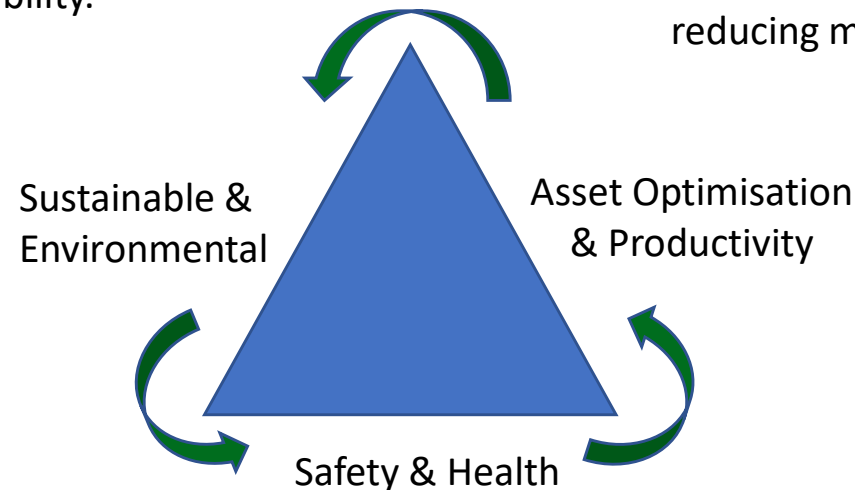


- We specialise in innovative products with an emphasis on improving the environment and project sustainability.
 - Partnering with leading technology companies
- Headquartered in the Sweden for Nordic customers:
 - Nordic Geo Support now has presence in Australia, Canada, South East Asia, Africa and Europe.
- We focus on the following sectors:
 - Drilling
 - Mining
 - Tunnelling
 - Infrastructure and Building construction
 - Asset repair

Reducing Project Impacts

Sustainability & Environmental: Solutions that drastically reduce CO₂ emissions in manufacture and transport and energy usage as well as offering longer life cycles and reusability.

Asset Optimisation & Productivity: Solutions that are faster, more efficient, easier to use and reusable, optimising advance rates and ore recovery as well as reducing maintenance costs.



Safety & Health: Solutions that remove humans and equipment from unsecured ground, faster ground securing, ensuring stability and consolidation, reduce manual operations and weight in manual handling.

Main Solution Areas

Ground Support

- ✓ Resin and cement grouts
- ✓ Injection resin technologies
- ✓ Standard bolting technologies
- ✓ Self Drilling Systems
- ✓ GFRP Bolt
- ✓ Galvanised and Double coated protected bolts
- ✓ Specialised support systems
- ✓ Fibre reinforcement products
- ✓ Mesh and accessories

Ventilation Systems

- ✓ Flexible, robust, low friction, energy saving ducting materials
- ✓ Positive and Negative vent systems
- ✓ Standard ducting
- ✓ Re-usable services hangers

Water Management

- ✓ Resin Injection sealing
- ✓ Specialised cement and additives
- ✓ Resin and cement delivery systems
- ✓ Mechanical water stops and seals
- ✓ Drainage systems
- ✓ Dewatering pumps and Systems
- ✓ Accessories

Drilling and Excavation Consumables

- ✓ DTH
- ✓ Top hammer
- ✓ Blast Hole
- ✓ Rods, shank adapters
- ✓ Pipes
- ✓ TBM cutters
- ✓ High pressure injection systems

Polymer Stabilizing Geoinjection



PSGi®
Polymer Stabilizing Geoinjection

Different Injection materials are suitable for stabilisation, consolidation or sealing of ground.

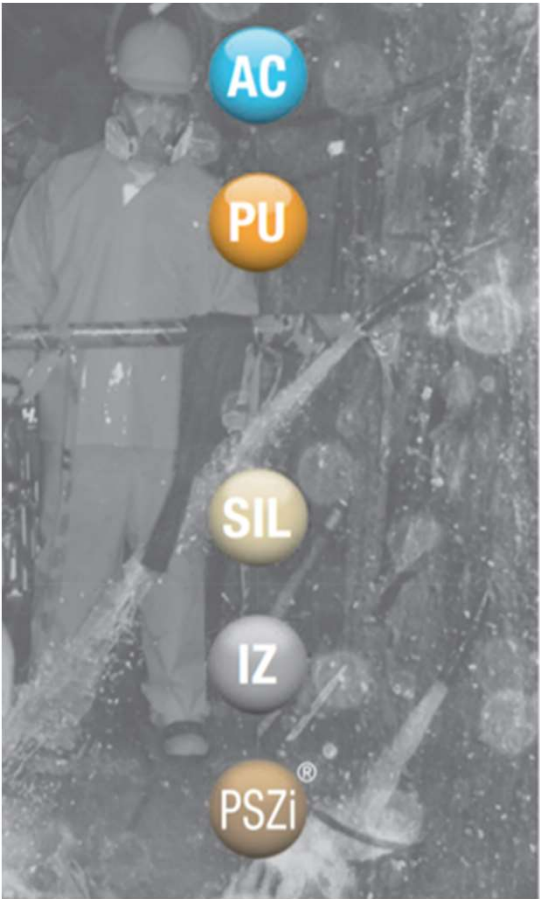
The injection procedure uses packers or lances into the targeted area.

The hardened result if the mixture gives different characteristics, such as rigidity, elasticity or sealing effect.

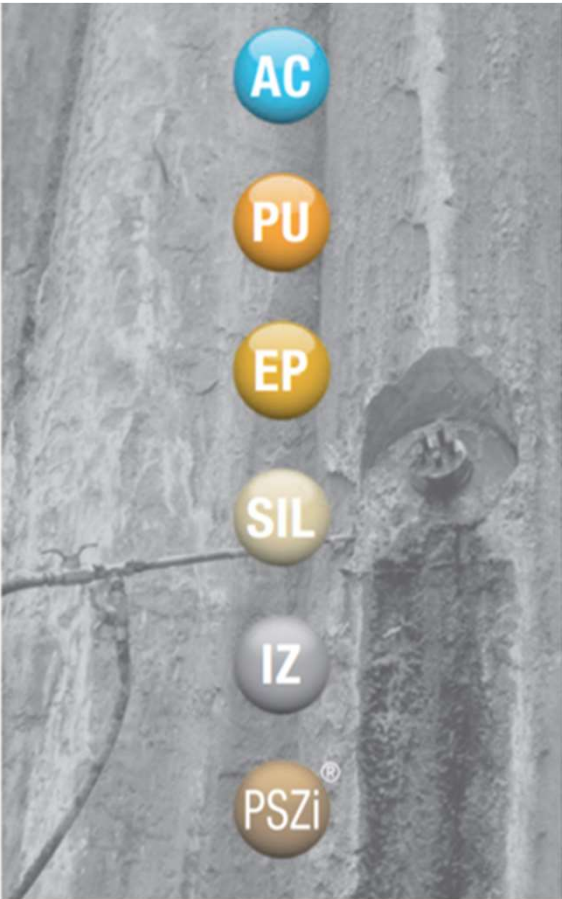
AC Acrylate Resin	PU Polyurethane Resin	
EP Epoxy Resin	SIL Silicate Resin	IZ Injection Cement
PSzi® Polymer Stabilised Cements		

The Purpose

Sealing



Consolidation

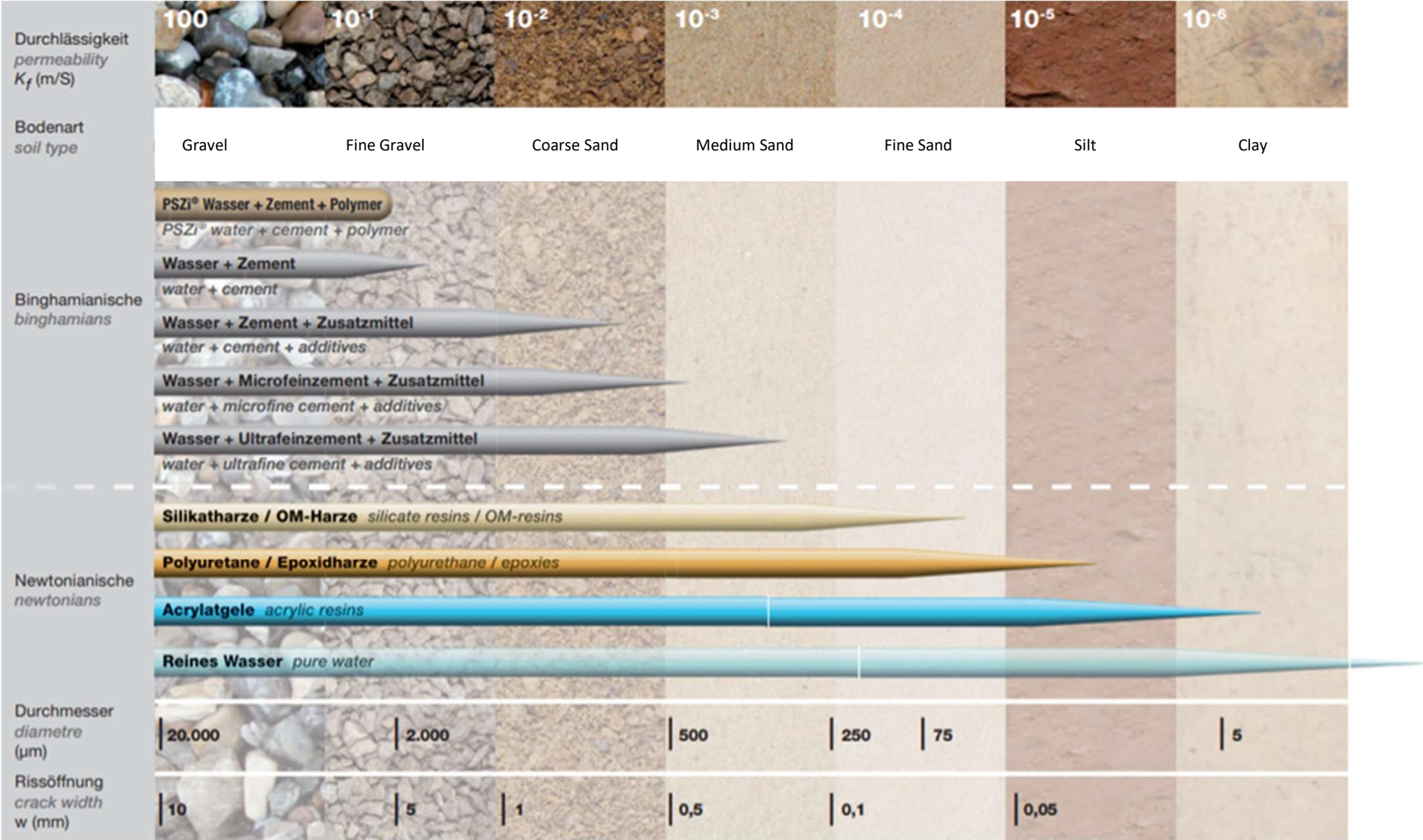


Filling



Injection resins are also used in specialist bolting applications

Solution & Application



Ground Water Conditions

Wasserverhältnisse water conditions	Dry	Moist	Standing Water	Lightly Flowing Water	Heavily Flowing Water
Acrylatgel Acrylate gel	AC	AC	AC	AC	AC
Polyurethanharz Polyurethane resin	PU	PU	PU bei Kontakt mit Wasser schäumend foam up in contact with water	PU	PU
Silikatharz Silicate resin	SIL schäumend / nicht schäumend foaming / non-foaming	SIL	SIL vermischt sich nicht mit Wasser no reaction in contact with water	SIL	SIL
Epoxidharz Epoxy resin	EP	EP	EP	EP	EP
Injektions- Zement Injection cement	IZ	IZ	IZ	IZ	IZ
Polymerstabilis. Zementinjektion Polymer Stabilized Cement Inj.	PSZi [®]	PSZi [®]	PSZi [®]	PSZi [®]	PSZi [®]

Other key inputs

Project Goals:

- Stabilisation
- Sealing
- Filling

Durability:

- Permanent
- Temporary

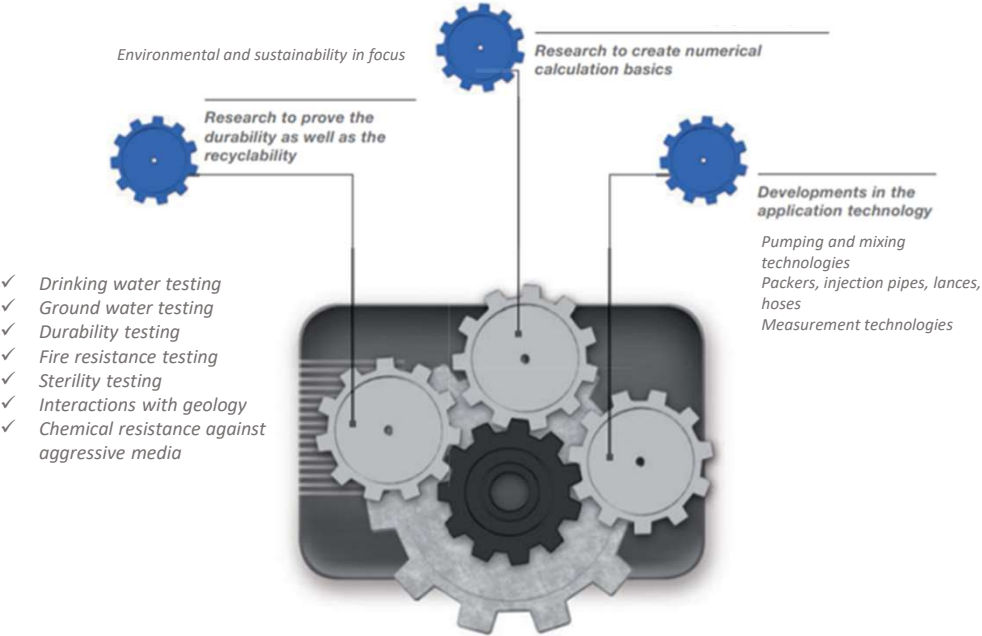
Environment

Carbon footprint



Research & Development

Getting the right solution



Our R&D Partners

Working with the global industry and educational leaders



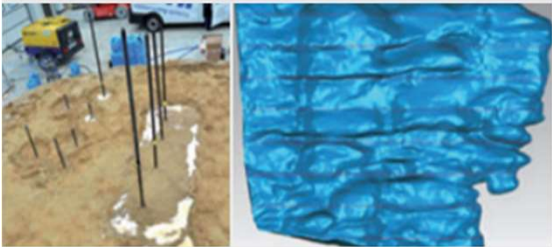
Project:
Geological solidification as well as sealing to damaged dams and dykes.



Project:
Production of load bearing and sealing bodies using new bases for calculations.



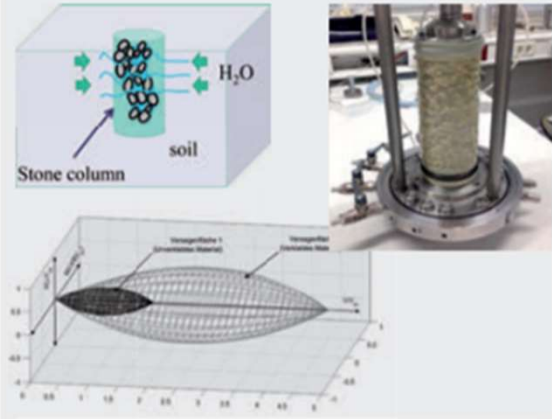
Project:
Resin stabilised permeable vibrated stone columns



Project Partners:
Lead – TPH
Technical University, Dresden
IWD Institute of Hydraulic Engineering and Technical Hydromechanics
IGT Institute of Geotechnics



Project Partners:
Lead – TPH
Technical University, Dresden
IWD Institute of Hydraulic Engineering and Technical Hydromechanics
IGT Institute of Geotechnics
GGL Geophysics and Geotechnics Leipzig GmbH



Project Partners:
Lead – TPH
University of Kiel / Geophysics & Geotechnics
IAB Weimar, DMI Special Injection, TU Vienna
University of Innsbruck
Vienna Consulting Engineers
Keller, Austria

Stopping High Water Flow

Project:

Stopping High water flow and ingress.

Due to geological conditions, driving water with pressure of 6 bar was encountered.

The directional water permeability in the local area around the tunnel excavation had to be filled, sealed and solidified



Efforts to use 1-component PU resin systems failed under high water pressure.

Additionally, the very low water temperature negatively affected reaction.

Two Component (2C) NordicPUR resins systems met the challenging conditions

Leaks During Construction



Heavy water ingress in the tunnels of a metro line construction project. To stop the water flow behind the segment lining a two step procedure was implemented. The first step was to have a compartment injection resin barrier behind the segments at 10 meter intervals followed by a curtain grouting procedure behind the existing lining.

Waterproofing work was performed over a length of 4.8 kilometres. The curtain grouting filled gaps and where needed crack injections were added to complement the solution. Compared to a new inner lining with waterproof concrete which would decrease tunnel cross sections, the injection system was less expensive, faster and less time consuming, furthermore injection resins did not compromise tunnel design.

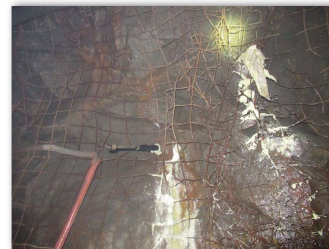


Sealing In Front of the Face

Case Story: Sealing in the front face of a Gallery

Main Problems:

- Leakages:
 - **Flow:** 350 gpm = 27 l/s
 - **Pressure:** 80 psi = 5,5 bar
 - **Temp. Water:** 40°C
- 15 days stopped the advancing works.
- Previous treatments with cement grouting:
 - Grouting 360 cement bags. (11.000 Kg)
 - No decrease in flow was achieved.
- A bypass was planned to do 40 meters further back.



Sealing In Front of the Face

Results:

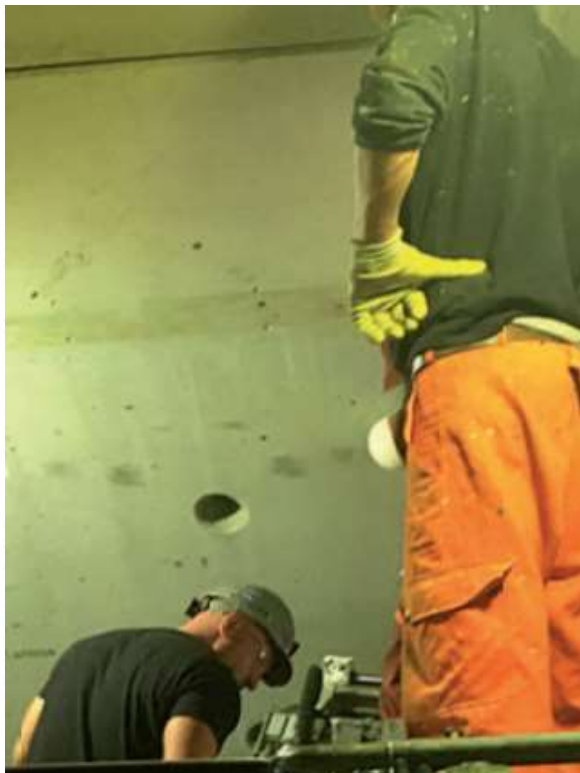
- It was sealed 95 % of the income water, the air temperature decreased
- After the blasting of the front no more water entered
- It was appreciated that the resin fully consolidated the fault
- Consume: 450 Kg Structural Polyurethane PUR-O-STOP FS-F
- Total working time: 4 hours



Consolidating brittle and fractured rock

In some geological conditions various fault zones are encountered. Excavation works can create instability and collapse at the face.

Non-load bearing fractured rock was filled and consolidated with high foaming silicate resin in front of the working face.



The foaming silicate resin creates a support to prevent the rock ahead of the advance from collapsing.

Ideal in cyclic excavations and TBM operations. Securing the face through consolidation and stabilisation of the rock mass being excavated.

- ✓ High foaming factor
- ✓ Fast setting times
- ✓ Minimised downtime
- ✓ Process is less expensive than cement based face stabilisation operations



Economic comparison



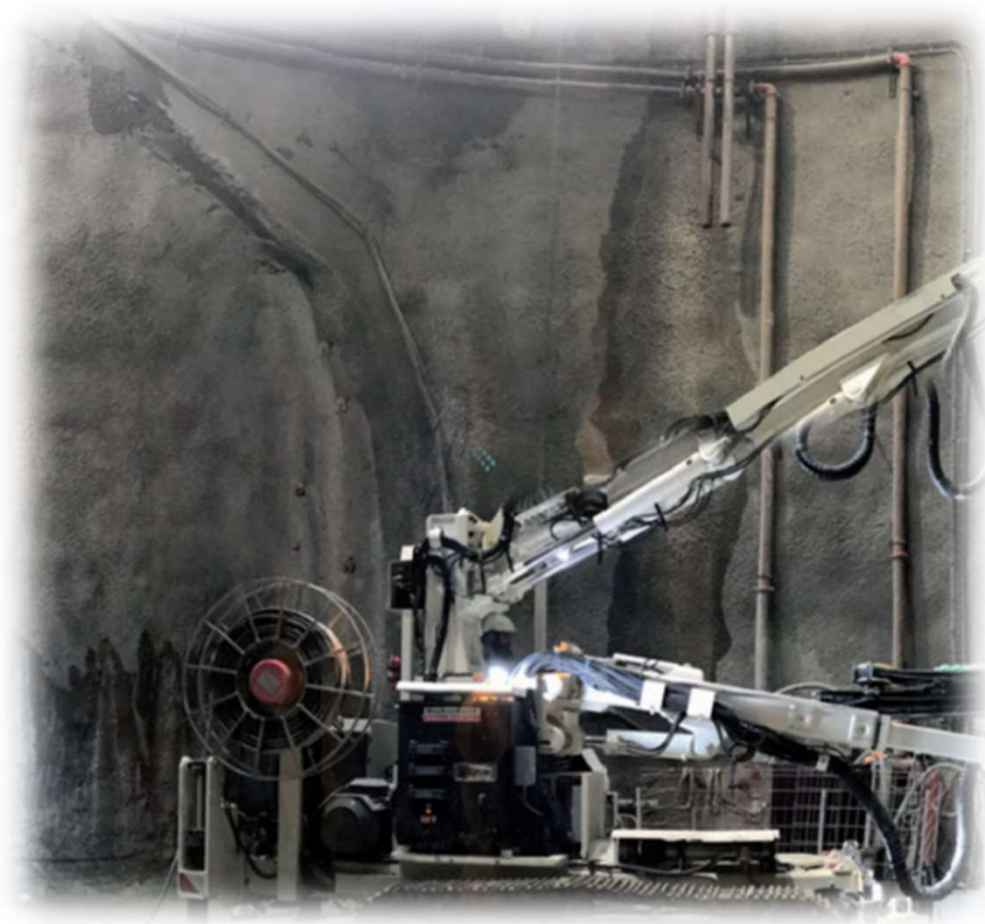
Concrete vs. Foaming Resin for cavity fillers

FILLING CAVITY of 100 m3		Filling with concrete	Filling with foaming resin NordicSIR FOAM
Logistics	Energy	Electric	Compress Air
	Material	Concrete trucks of 2 m ³	NordicSIR Foam in 25 l-plastic canisters
	Transporte	From cement factory to Tunnel.	Stock in jobsite
	Injection System	Large capacity and heavy pump, hoses over D= 2", mixer, water, etc.	Pneumatic pump (100 Kg), 1/2 "DN10 hoses. Light and small equipment
	Staff	6-8 workers	3-4 workers
Material	Density material	Approx. 2,3-2,5 tons/m ³ – total 250 tons Concrete.	Approx. 50 kg/m ³ – total: 5.000 kg
	Material Costs	100,00 €/ton approx.	Approx. 15 €/Kg
		Transport en 10-11 camiones cuba	10 pallets of 500 kg
		Concrete truck of 2 m ³	Transport ¼ container or in 2 pick-up trucks
Time	Working Time	2-3 weeks	2-3 days
Costs	Material	10,000.00 €	75,000.00 €
	Transport	30,000.00 €	1,000.00 €
	Time (approx 5.000 €/day)	100,000.00 €	10,000.00 €
	Total	140,000.00 €	86,000.00 €

Ground water approved
Drinking water approved

This example used our drinking water approved resin for sensitive applications

Faster Bolting Solutions



Bolting in mining and tunnelling projects is costly in time and productivity, as well as a key safety consideration.

In many cases bolting is applied in fractured ground, requiring bore hole consolidation.

NordicSIR Fast Bolt solution combines the resins capability of high early strength and setting times with the right bolting, cabling or other securing element solutions.

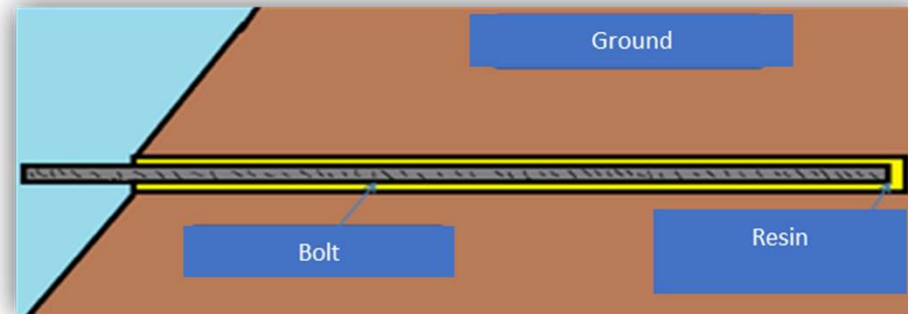
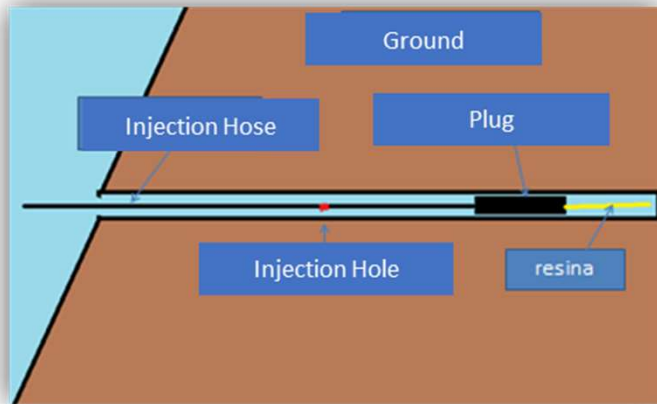
NordicSIR Fast Bolt can be applied under running water conditions that may prevail with no washout or other

Adjustable for low to high ambient temperatures.

- ✓ **Final compressive strength 21MPa**
- ✓ **High early strength**
- ✓ **Ductile, excellent for managing of blast shock waves or ground movement.**

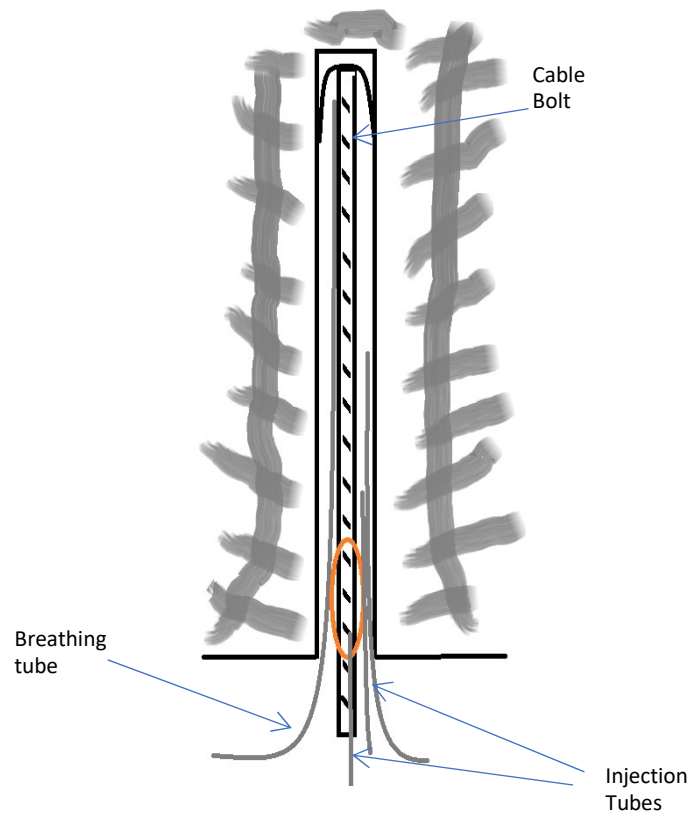
Fast Bolt Anchoring Solid Bolts

Thixotropic consolidation resin NordicSIR Fast Bolt



Anchoring Cable Bolts

Thixotropic consolidation resin NordicSIR Fast Bolt

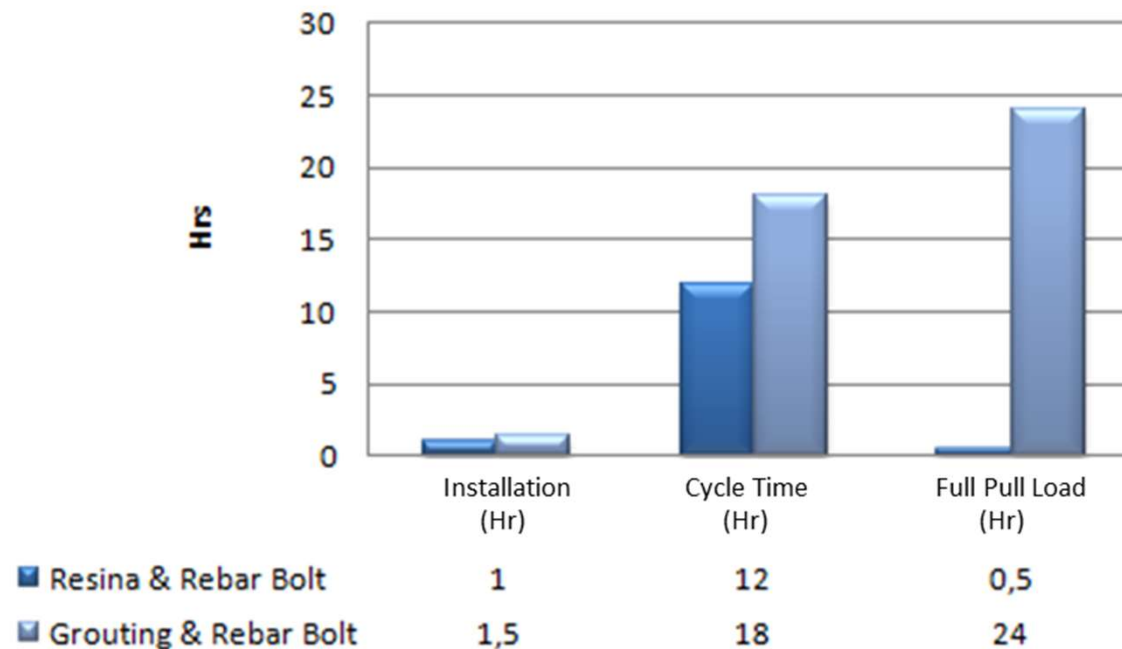


- Improved production times on sublevel stopping
- PULL TEST:
 - Trial time: 30 min
 - Bolt pull: 20 Tons
 - Bolt displacement: 1,5 mm



Anchoring bolts

Resin Injection vs Grouting



10% Installation time savings

35% Cycle time savings

98% Greater effectiveness in Pull Test and anchorage security

Slope Stabilisation



A slope stabilisation project using 25m long anchors in highly fissured zone. It was feared that conventional cement suspensions would flow from the cracks in an uncontrolled manner and not fully secure anchors. Additives were used to modify characteristics and bring about a thixotropy to the injection cement by using polyurethane based mito prevent any loss of material

Ground Consolidation

Ground Consolidation of poorly permeable sandy soils

Acrylic Gels

- Highly flexible
- High ground penetrability
- Slope consolidation (tailings)



Consolidation of tunnel face

Tunnel length 705m
Excavator driven
160m below built up area

Geology: Tertiary soils of gravels, sands, silts and clays in varying composition with different distribution over the targeted excavation area. Ground water was also present.

Project required consolidation, sealing against water and prevent surface settlements.

Solution: Rammed lances approximately 4 meters long with perforations in umbrella shape and inject with acrylate gels. The injection material was injected into lances via mechanical packers.



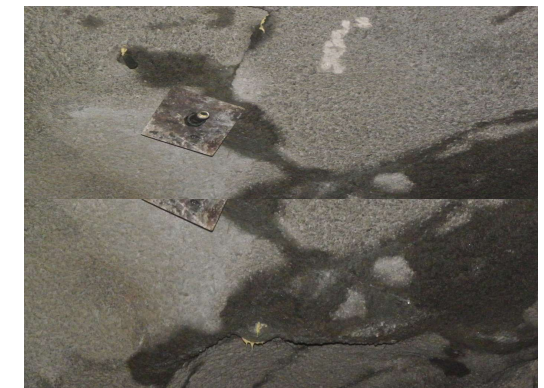
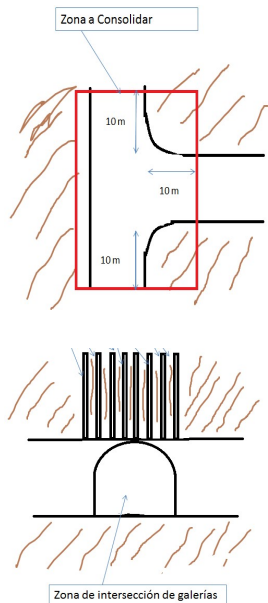
Ground Consolidation

Intersections of Galleries

Comparative cost between resin injection + self-drilling bolt and steel arches					
Section of Gallery		Reinforcement with steel arches	Reinforcement with resin + self-drilling bolts	Safe Money	
Width (m)	High (m)				
4.5	4.2	\$ 18,894	\$ 8,082	\$ 10,812	
3.5	3.5	\$ 11,385	\$ 5,910	\$ 5,475	

Mesh 2 x 2 m of Self-Drilling Bolts L= 3 – 4m

Injection of consolidation resin through them



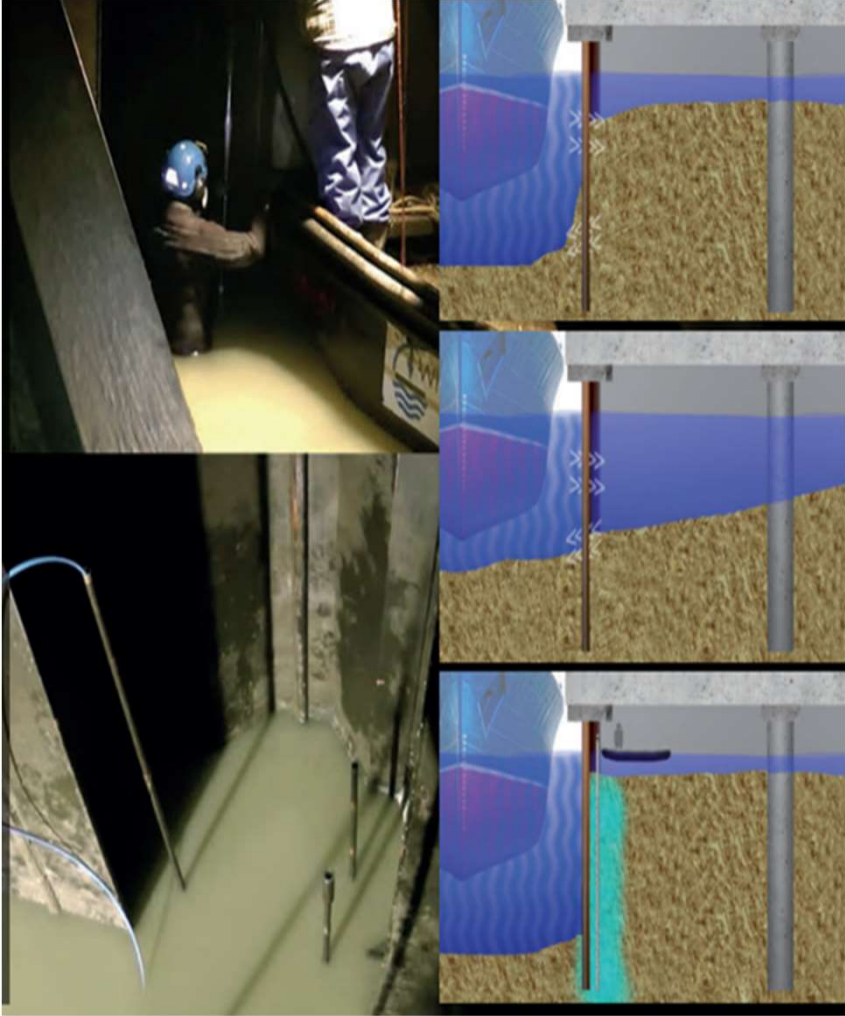
Consolidation of sands



Dredging of a harbour basin after challenges during installation of 40 meter rammed sheet pile elements revealed failures at the joint locks. Over time the effects through tidal movements and waves, created openings that allowed sand to be flushed out from behind. The washed out sand continued to gather in front of the sheet pile wall causing problems to shipping and requiring permanent dredging. Securing the stability of the sheet piling system, as well as the upper concrete slab became increasingly compromised.

Due to challenges of accessibility the injection was through 18 meter pipes. For complete sand saturation and consolidation 3 manchette tubes per leaking joint were situated. Additionally, the environmental hygiene was in focus. The selected injection material was an extremely low viscosity polymethacrylate gel with environmental approvals for curtain injection.

The project successfully consolidated the sands along the 1725 meter long quay wall, preventing sand to be washed out and permanently closing the gaps by a rubber-elastic acrylic gel through injection.



Sealing against ground water



Ground Stabilisation

- For an extension tunnel, the initial requirement was to bring the soil body to a strength of 4 Mpa.
- Acrylate gels we used for grouting into small crevices and cavities as well as layers of sands and silts.
- Piling lances were used for the application work, The acrylate gels were forced in under a 20 bar pressure via the lances. The lances were withdrawn in sections to create a stabilisation of the targeted ground. The area was later successfully excavated.



Product range

Drilling Consumables

High Performance rock drilling tools and consumables:

- DTH Hammers
- Bits
- Shanks
- Rods
- Drill Pipes
- Adapters
- Augers, Accessories

Injection Grouts

Leading edge resin injection technology for demanding cases:

- Water Stopping
- Sealing
- Ground Consolidation
- Ground Stabilisation
- Construction and structural repairs

Anchoring & Bolting Grouts

Grouting technologies offering ease of use, clean and fast setting:

- Capsules
- Cartridges
- Pumpable grouts
- Additives

Anchoring & Bolting

A broad range of rock bolting and anchoring technologies:

- Double and single coated protected steel
- Steel Self Drilling Anchors
- GFRP bolrs of all types
- Standard bolts and meshes

Cement-Based Additives

Cement based admixtures and additives:

- Concrete Repair
- Admixtures
- Modifiers
- Waterproofing
- Joint Sealants

Pumps & Accessories

Cement and resin mixing and pumping technologies:

- Cement Pumps
- Resin Pumps
- Transfer systems
- Dataloggers
- Hoses, lances, packers

Water control

Waterproofing, drainage and pumping:

- TunnelDrain innovative strip drainage system
- Drainage pipes
- Waterproofing grouts, additives and sealants
- A broad range of dewatering pumps

Ventilation

Air quality, ventilation and safety solutions:

- Ventilation bags and systems, including Mecanicad's rigid ducts
- Fans & inline coolers
- Water atomisers

Re-usable Hangers

Developed in the Nordics, fast, easy to use & reuse:

- Services Hooks for ventilation systems, water and pneumatic lines, electrical cables and distribution boards
- Blasting hooks

Other products

A range of other products:

- Coatings & sealants
- Personal protective products
- Mining accessories