WATERPROOFING GROUND CONSOLIDATION, STABILIZATION AND WATERSTOPPING

IN TUNNELING & MINING

BUILDING TRUST

CONSOLIDATION, STABILIZATION AND WATERSTOPPING

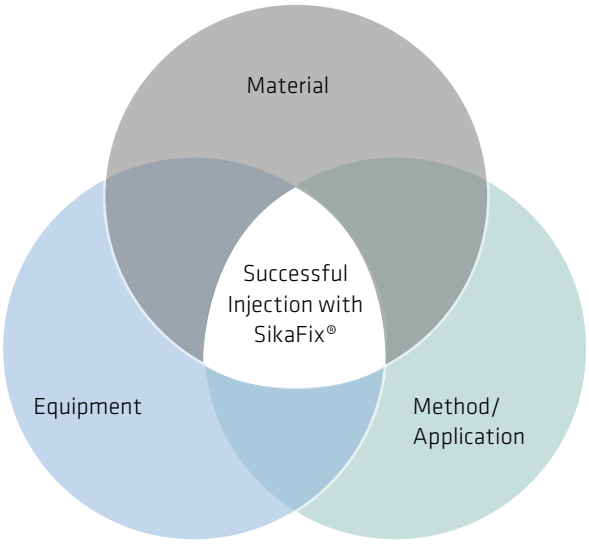
TO COUNTER WATER INGRESS and unconsolidated geology below ground represents a major issue in tunneling and mining operations all around the world: Uncontrolled water ingress can cause severe problems and impact on daily operations. Excess water can greatly influence production cycle times and also reduce the quality of structural elements including shotcrete, mesh and bolts. The whole operation can therefore be at risk, putting not just the structures and machinery, but also the people in severe jeopardy. Unconsolidated ground within fault zones and the ore-body are frequently responsible for costly delays and down-times. Sika provides an extensive and fully integrated range of injection systems for both pre- and post- excavation use in conventional drill and blast drift mining, as well as for TBM tunneling. Sika has more than 100 year's experience in tunnelling and mining worldwide.

THE KEY SUCCESS FACTORS FOR INJECTION SOLUTIONS

There are three key success factors to ensure the effectiveness and durability of injection works: The injection materials, the injection equipment and the injection method. These must all be used in the right combination and this is what Sika provides for Tunneling and Mining applications including:

- Cavity & void filling
- Soil / ground stabilization
- Rock mass stabilization
- Permanent ground consolidation
- Waterstopping – under hydrostatic pressure
- Controlling over-blasting
- Underpinning
- Special systems for earth dams and use with TBM's

SikaFix® injection solutions include pre- and post- excavation solutions.



INJECTION MATERIALS

The selection of the right injection material and the right specific product for the defined project requirements is the first key factor for success. This usually relates to the materials viscosity, strength and its behaviour in contact with water, which can all significantly influence the result.

INJECTION EQUIPMENT

The injection equipment is the second key success factor and this must be suitable for the selected injection product(s), including their correct preparation, mixing and delivery. This means everything from the initial dosage and mixing, through delivery from a pump and injection through the right packers.

INJECTION METHOD / TECHNIQUES

Thirdly, the correct injection method and techniques must be used by trained, competent and experienced contractors.
ALL of this is essential to ensure success and provide complete stabilization, consolidation and permanent waterstopping.

INJECTION TECHNOLOGIES FOR TUNNELING AND MINING

TECHNOLOGY	PRODUCT	
POLYURETHANE FOAM RESINS Polyurethane (PU) foam injection resins are designed to expand by foaming with or without water, in this way they can be injected as a liquid that then foams and expands to fill voids and smaller cavities in rock-structures or loose ground. These materials have good adhesion to the rock and remain firm and rigid after the foaming process has finished. Therefore these polyurethane foam resins are widely used for and stabilizing requirements in both Tunneling and Mining.	**SikaFix®-110** ■ Fast-foaming PU-resin with short reaction times (~45 sec) ■ Foams in contact without and with water, up to 10 to 20 times ■ Strong adhesion, strong foam	**USES:** ■ To stabilize disintegrated rock with a high void content ■ Filling of smaller cavities
POLYURETHANE RESINS Rigid polyurethane (PU) injection resins harden to form a tough injection material that is used to seal water inrushes, or for the consolidation and filling of voids. Their low viscosity ensures good penetration into the rock strata to seal leaks and achieve durable consolidation. Polyurethane resins seal with very good edge adhesion and also have useful water-repelling hydrophobic characteristics. Although not a PU 'foam' resin, these materials will foam slightly in contact with water and so will stop inrushes in a fast and effective way. Rigid PU resins are widely used in both Tunneling and Mining.	**SikaFix®-210** ■ Fast-reacting PU-resin with short reaction times and high final strength (~40 sec) ■ Foams slightly in contact with water, up to 3 times ■ Modular injection system with SikaFix® AC-21 and AC-21 SF ■ In combination with SikaFix® AC-21 and AC-21 SF it reacts as an expanding foam waterstopping system	**USES:** ■ To consolidate unstable ground conditions with fractured geology ■ To stop unexpected high water inrush ■ To effectively stop water infiltration and to seal structures such as shaft linings, primary and secondary linings in tunnels and dams
ACRYLATE RESINS Acrylate resins have a extremely low viscosity (similar to water) and harden to form rigid hydrophilic (water repelling) compounds. They are used for the injection of very low permeability soils due to their ability to penetrate and stabilize them (i.e. sands), by transforming the sand to a rigid high strength soil. The resin reaction (hardening) time is also adjustable and controllable, which allows adaption of the injection material to the conditions on site (e.g. temperature and injection distance etc.). Acrylate resin injection equipment can be cleaned with water.	**SikaFix®-301** ■ Fast-reacting Acrylate resin with extremely low viscosity (~5 Mpa*s) ■ Adjustable reaction times of 2 to 15 min. ■ Slight swelling factor up to 10% ■ Equipment cleaning with water	**USES:** ■ To seal less permeable areas with lower infiltration rates ■ For consolidating soil with low permeability (e.g. for earth dams) ■ To grout cracks, fissures with a high content of small voids e.g diameter below 0.2 mm ■ Filling smaller cavities ■ Umbrella injection in front of TBM's ■ Rockfill dams

TECHNOLOGY	PRODUCT	
SILICATE FOAM RESINS Silicate foam resins are organic, rigid materials and designed to expand by foaming. They show high foaming factors, making them ideal for filling large voids. Their low reaction temperature make them very useful in the coal mining industry. Because the cured foam is cuttable and does not stick to the shield of TBM drill heads, Silicate foam resins are used in front of TBM's to stabilize and consolidate loose rock and broken ground.	**SikaFix®-501** ■ Fast-foaming Silicate foam resin with short reaction times (~15 sec) ■ Foams in contact with and without water, up to 35 times ■ Low reaction temperature (important in Mining) ■ Hardening is not water dependent (no change of technical properties) ■ Cured foam is cuttable	**USES:** ■ To stabilize disintegrated rock with a high void content ■ Filling larger cavities ■ To stabilize loose rock in front of TBM Headings ■ For coal mining applications
SILICATE RESINS Silicate resins are non-foaming, organic, rigid injection materials that are used to stabilize dry, damp and wet zones in geological fault zones. Their low reaction temperature allow their use in the coal mining industry. The hardening of silicate resins is not affected by water and the cured resin is cuttable. Depending on the soil conditions, non-foaming silicate resins are used in front of TBM drilling heads for stabilization.	**SikaFix®-601** ■ Non-foaming, non-flammable Silicate resin with short reaction times (~40 sec). ■ Very good adhesion even on damp surfaces ■ Low reaction temperature (important in Mining) ■ Hardening is not water dependent (no change of technical properties) ■ Cured resin is cuttable and can be planed	**USES:** ■ To stabilize fault zones in dry, damp and wet strata ■ For anchor grouting injection ■ Umbrella injection in front of TBM's ■ For coal mining applications
CEMENTITIOUS GROUTS Cementitious grouts are cement based materials containing fine aggregates that can be modified using organic polymers. During hydration of the cement, the grout will harden to a rigid material. Such grouts are available with different particle sizes and granulometry. Special microfine cements are very common for pre- and post- injection use, as they are able to fill and penetrate smaller cracks and voids than ordinary portland cement based grouts. Cementitious grouts usually are a cost effective injection solution and the flowability and curing time can be adjusted by the use of admixtures. However, in case of high water ingress, wash-outs can occur and setting might be delayed or hindered due to the dilution effect in very wet strata.	**SikaFix®-800 SERIES** ■ Locally adjusted to the needs of the customer ■ Workability and flow adjustable ■ Equipment cleaning with water	**USES:** ■ To stabilize disintegrated rock ■ To consolidate loose strata ■ To stop low / limited water infiltration

APPLICATIONS OF SIKA INJECTION SOLUTIONS IN TUNNELING AND MINING

1

Stopping water inrush

2

Cavity and void filling

3

Ground consolidation

4

Soil stabilization

5

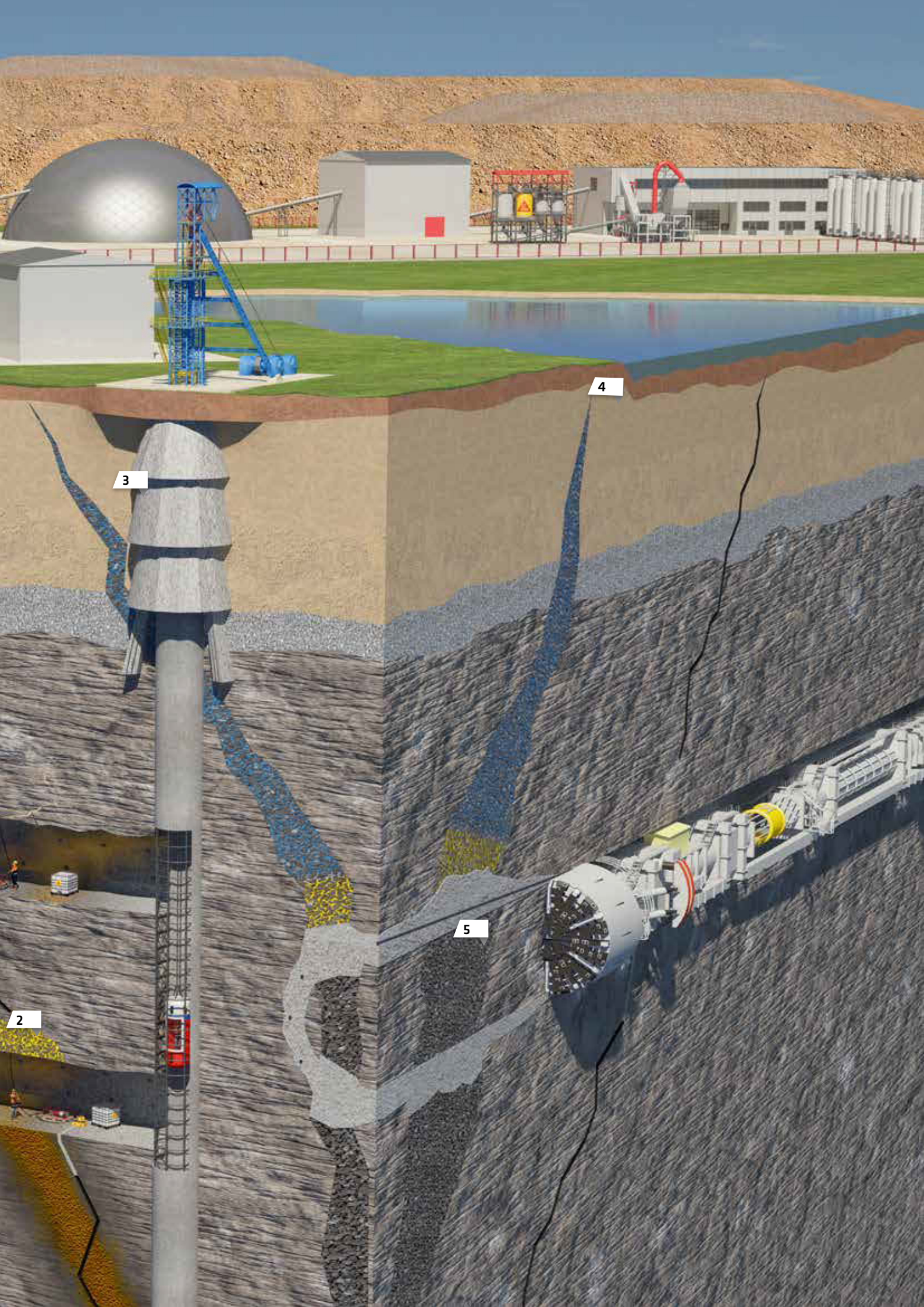
TBM heading injection

6

Control of over-blast

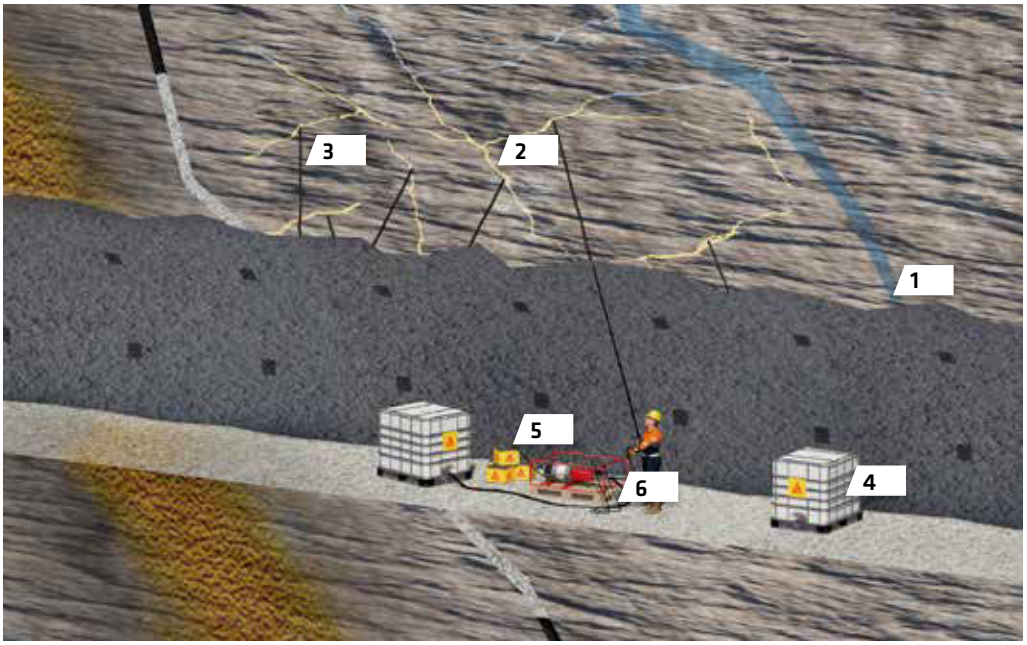
1

6


4
3
5
2

WATER INRUSH UNDERGROUND

WATER INRUSH in tunnel structures and underground mines represent major hazards, also hindering and delaying excavation and drifting processes. Sika® PU-resin injection systems are a powerful solution to consolidate and stabilize the ground to prevent and/or counter any water situations.



1
Water inrush

2
SikaFix®-210 injection material

3
Injection lance incl. packer

4
IBC SikaFix®-210 comp. A or B

5
Pre-mixed accelerated SikaFix®-210

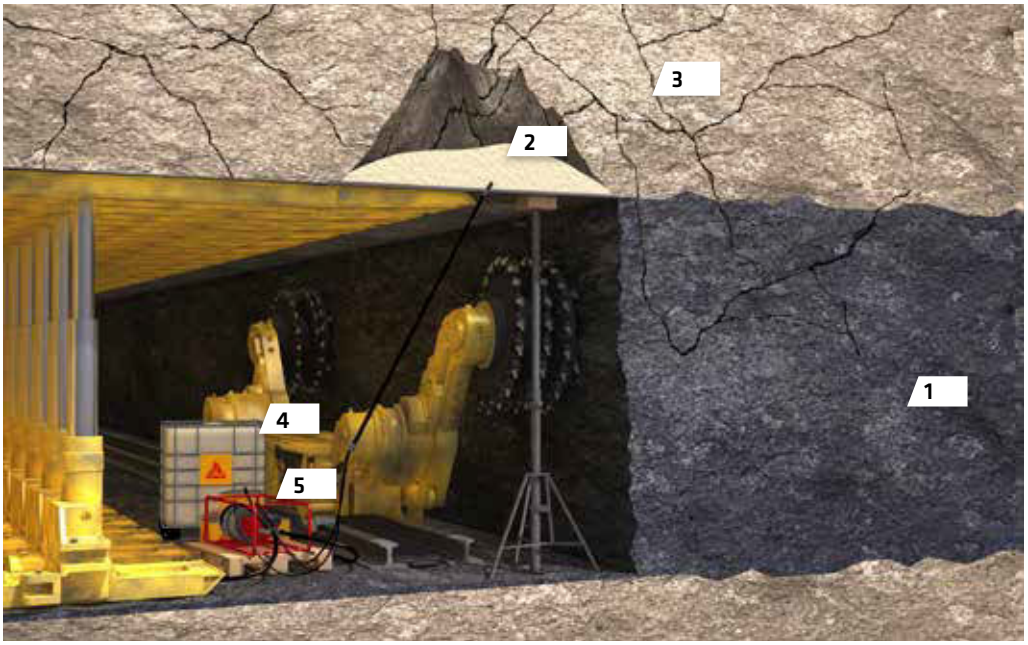
6
2-C injection pump

FAST-REACTING POLYURETHANE RESINS TO STOP WATER INRUSH

SikaFix®-210 is a 2-component Polyurethane resin which penetrates and cures to consolidate and stabilize fault zones. In situations with high water ingress, SikaFix®-210 is a particularly powerful solution due to its special formulation giving slight foaming properties in contact with water to expand and very effectively stop the inrush. This modular system also includes accelerators which can be used to increase the foaming factor and to adjust the time needed for this expansion. During high water inrush, the fast expansion of the foam is a key factor in stopping the water.

CAVITY AND VOID FILLING

CAVITY AND VOID FILLING is used to consolidate the fractured strata and stabilize the ground to ensure a faster, safer development process. The fast foaming Sika® Silicate based injection products have high expansion factors that can fill large cavities and voids in a safe way.



1
Coal seam

2
SikaFix®-501
injection material

3
Unstable strata

4
IBC SikaFix®-501
comp. A or B

5
2-C injection pump

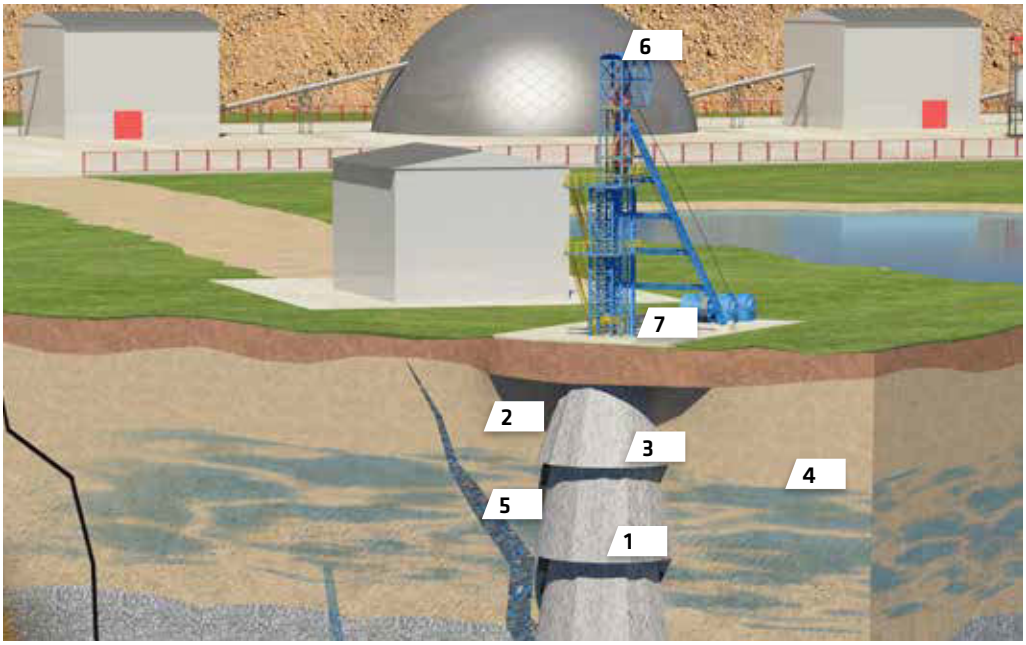
CAVITIY AND VOID FILLING WITH FOAMING RESINS

SikaFix®-501 is a silicate based injection resin that is designed with a high expansion factor (~35 times). This helps to fill and stabilize large voids and to give additional support to the roof and ribs of the excavated structure. In addition to stabilizing disintegrated rock and faults with a large volume of voids. SikaFix®-501 is used in coal mines to consolidate collapsed / broken-down sections of the hanging wall above the coal seam. The product has a low reaction temperature and makes it suitable for the coal mining industry.

SikaFix®-110 is a polyurethane foam resin which is designed for the filling and stabilization of smaller voids and smaller cavities. Due to its high reaction temperature it is not recommended for use in the coal mining industry. SikaFix®-110 has the added advantage that it will start to foam and expand both with and without the presence of water.

GROUND CONSOLIDATION

AN EFFICIENT WAY TO STABILIZE UNCONSOLIDATED geological masses, fractured rock-strata or permeable soils is by using cementitious injection grouting materials. The SikaFix®-800 range provides excellent penetration and consolidation properties. These systems are based on specially blended cements and microfine cements with Sika® admixtures that are used to adjust the viscosity and to accelerate the materials set and hardening.



1
Umbrella like injection prior to shaft sinking

2
Quaternary cover above hard rock

3
Pre-injected with SikaFix®-800 series

4
Ground water horizon

5
Fault zone

6
Head frame

7
Shaft collar

WATERPROOF AND STABILIZE UNCONSOLIDATED LOOSE GROUND

The most cost effective method, of consolidating and stabilizing loose ground conditions is injection with cement/microfine cement based grouts. Due to the clear cost advantages this is also the most commonly used method. Local differences in cement chemistry and quality, local adjustments are made with Sika® admixtures to control the workability, flow and set to meet the project requirements.
Microfine cement based grouts are used for sealing and stabilization to prevent water ingress. However, depending on the ground situation and the water pressure, chemical resin injection may be required.
An effective ground consolidation system can often be achieved by the use of Sika® cementitious injection grouts in combination with Sika® chemical resin injection systems such as SikaFix®-210, SikaFix®-301 or SikaFix®-601.

SOIL STABILIZATION

SIKA PROVIDES THE FULL RANGE OF INJECTION PRODUCTS AND SYSTEMS to fill, stabilize and consolidate the ground in different geological conditions. In situations where the ground has relatively low permeability, Sika® Acrylate based injection resins with their low viscosity, water-like consistence and penetration ability, will give superior performance over the other chemical resins and cementitious grouting solutions.

1
Tailings pond dam
(Rock-filled dam)

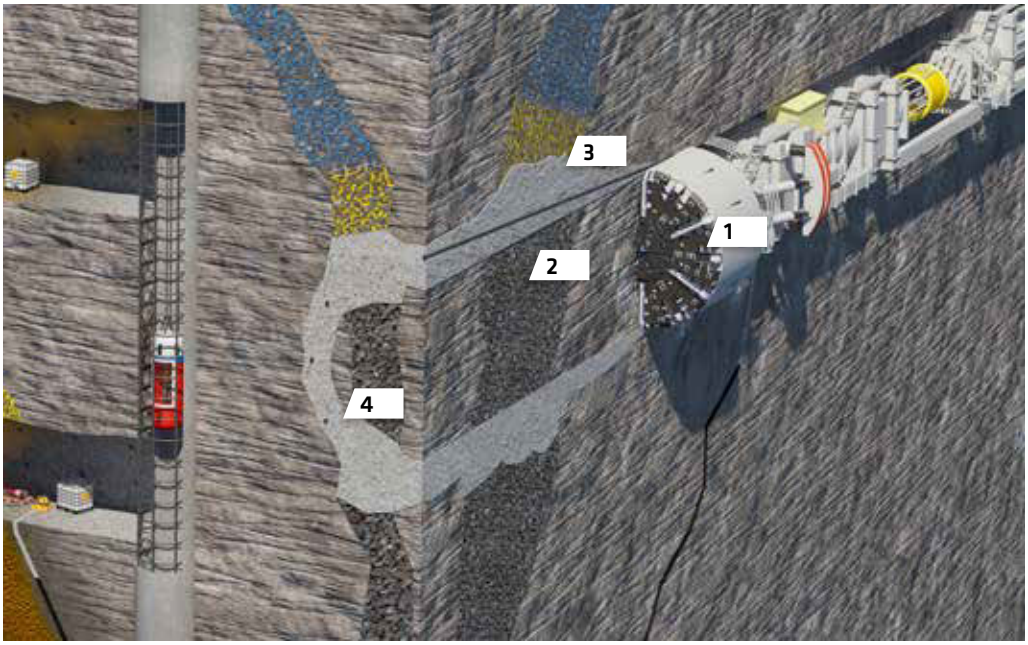
2
Clay liner

ROCKFILL DAMS

Rock-fill dams are embankments of compacted granular fill with low permeability. Such structures are used for tailing embankments and hydropower dams. As the viscosity of SikaFix®-301 Acrylate resin is extremely low and very similar to that of water, the product can be injected into the fine voids of such low-permeable structures. SikaFix®-301 even penetrates into fine sands and the polymerisation process starts during the application, which results in a highly resistant waterproofing system and stabilizes the soil. Other injection materials such as Cementitious grouts, or the Polyurethane and Silicate resins are not able to penetrate into such very fine voids and low-permeable structures.

TBM HEADING INJECTION

THE USE OF TBM'S FOR TUNNEL CONSTRUCTION in highly populated areas such as cities and urban areas is now well established, but there is always an increased risk factor when dealing with fault zones and unconsolidated geology. Potential collapses and water inrush must all be avoided as the potential cost of losing control during the tunneling process is very high. This risk can be safely mitigated by using Sika® pre-injection systems to consolidate and stabilize the ground ahead of the TBM's.



1
TBM

2
Fault zone

3
SikaFix®-501
injection material

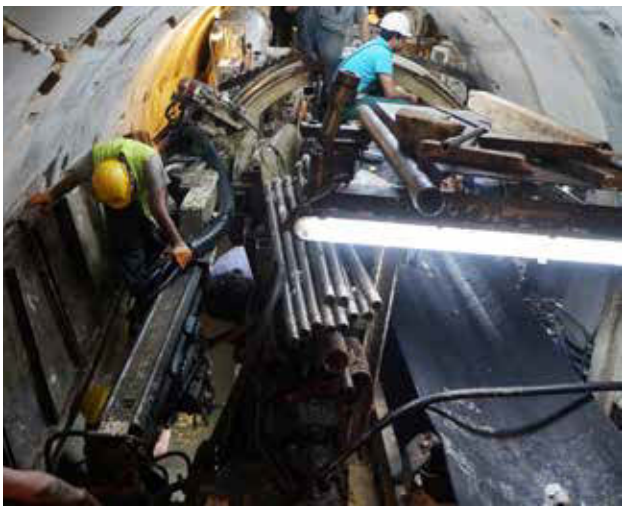
4
Cementitious
pre-injection

INJECTION PRODUCTS FOR USE WITH TBM'S

SikaFix®-501 has the ideal properties to fill voids and stabilize loose strata in front of the TBM Heading. Furthermore, once hardened, this silicate foam resin will not have any negative effects on the cutting head of the TBM while subsequently drilling through the injected area.

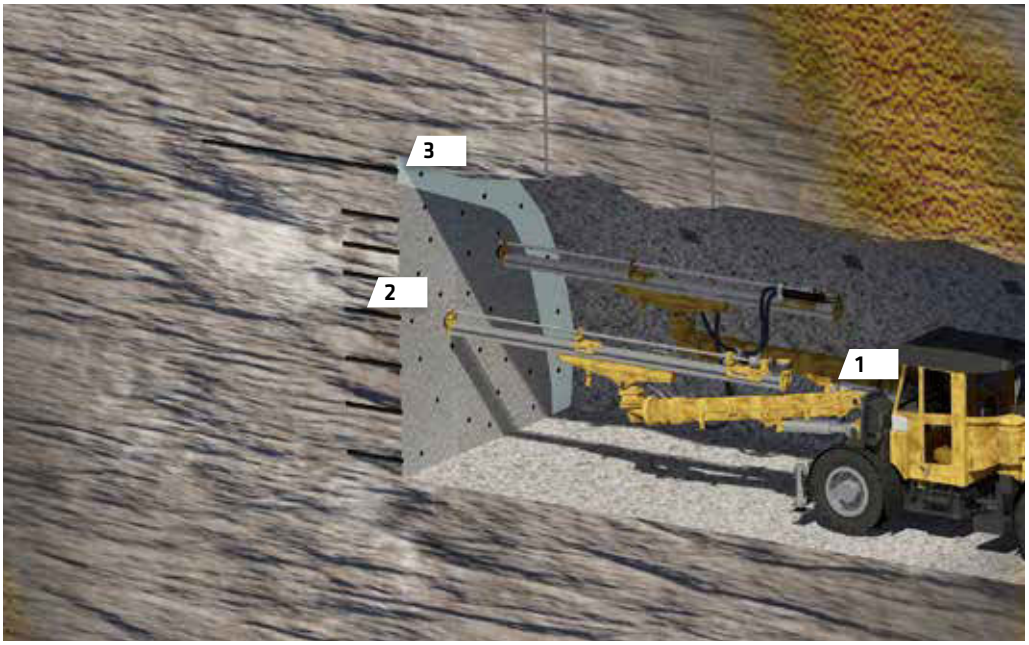
SikaFix®-301 is designed to be used for pre-injection ahead of the cutting head in conditions with loose ground and deeply wheatered sections in front of the TBM including EPB shield machines.

These SikaFix® resins assist efficient and fast injection and drifting cycles.



CONTROL OF OVER-BLAST

OVER-BLASTING REPRESENTS A MAJOR issue when it comes to external ore-dilution in underground, high grade, narrow vein mines. This problem from frequent over-breaking of the roof and ribs of the excavated stope can be significantly reduced and controlled by stabilizing the production face with Sika® Silicate resin injection systems. The injection of the resin takes place before a new round is blasted.



1
Drill boomer

2
Boreholes for blasting

3
Boreholes for over-blast injection

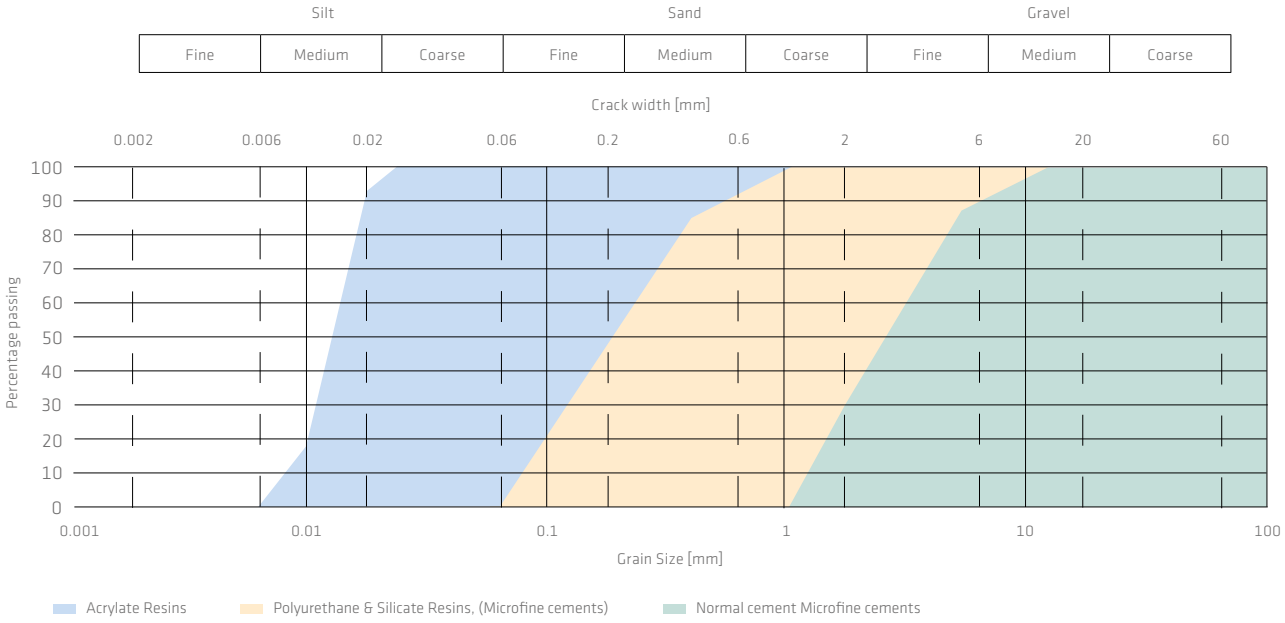
INJECTION PRODUCTS TO CONTROL OVER-BLAST

Due to the brittle and unstable nature of rock masses in many hard rock underground mines, overbreaks are a common feature during drilling and blasting of the stopes. Such overbreaks increase dilution and hence unit production costs of the mine. Pre-excavation injection with the SikaFix®-601 silicate resin system presents a viable option to stabilize the strata and significantly reduce over-breaks in the ribs and roof of the stopes. The injection holes are drilled and the two component resin is injected prior to blasting. The resin penetrates and then hardens, filling the fractures and voids effectively. This injection is carried out using standard 2-component injection resin pumps.

SikaFix® INJECTION RESIN MATERIALS SELECTION CHART

THIS SELECTION CHART is intended to give an indication of which type of injection product best applies for use in different ground conditions. The different injection technologies will also have different cost performance dependent on the rock characteristics present. This is mainly a factor of the grain size, the rock quality rating and the presence of water. The table below therefore indicates the most appropriate resin technology that can be used for different grain sizes, which is generally the controlling factor when it comes to the ground permeability and resin penetration rates.

Selection chart for Ground consolidation / Soil stabilization



DIFFERENT GROUND, DIFFERENT TECHNOLOGIES

Due to their relatively low cost, cementitious slurries are often used to stabilize unconsolidated ground and stop minor water inflow. Smaller fissures and cracks in the rock strata can usually not be filled successfully with a cement injection grout and a microfine cement grout has to be used. Chemical resin based injection materials generally have much better penetration rates due to their low viscosity. In situations with fast flowing water and / or high hydrostatic pressures, the fast reacting chemical resins, such as PU's and Silicates, represent the only viable options to stop water underground and consolidate loose or finely fractured rock strata. Furthermore, the risk of wash-out is greatly reduced when using fast setting and in particular, the expanding Sika reactive resin injection systems.

ADVANTAGES WITH SIKA

SINCE SIKA WAS FOUNDED IN 1910, the company has been involved in the largest and most challenging underground construction projects around the globe. Delivering reliable and innovative solutions for the world's mines and tunnels has been amongst the top business priorities ever since. Today there are local Sika companies in more than 90 countries with more than 160 production facilities supporting our global service and distribution network. Sika brings more than 100 years of underground construction expertise to your project – Building trust.

SIKA'S INJECTION EXPERTISE

- Site inspection and selection of the appropriate concept
- Selection of the correct material and application method
- Selection of the most cost-effective materials and methods to maximize our customers benefits
- Detailed product and application documentation

GLOBAL PRESENCE AND LOCAL SUPPORT

- Local presence in more than 90 countries with 160 production facilities and regional technical service support centres
- Providing the most efficient logistics and supply routes
- Specialised tunneling and mining teams in all regions

ON SITE SUPPORT

- Local Sika Expert teams
- On site testing & support
- Quality control procedures and check-lists

TECHNICAL AND PRACTICAL TRAINING

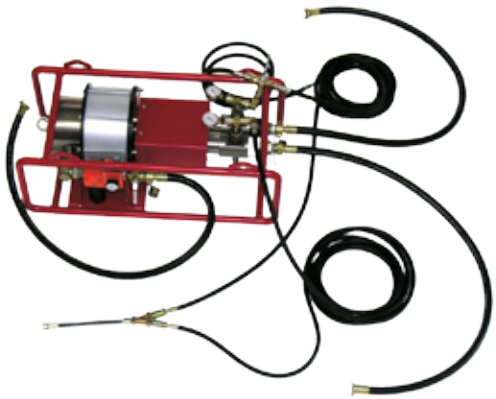
- Sika provides local training sessions at your site, specifically to enhance and optimize the full benefits of using Sika® materials technologies and application systems.

EQUIPMENT AND ACCESSORIES FOR SUCCESSFUL INJECTION WORKS

INJECTION PUMPS FOR SUCCESSFUL INJECTION AND CONSOLIDATION

The chemical resin injection materials used in tunneling and mining are generally two-component (2-C) products, which are designed to have fast-reaction times in order to consolidate the ground and stop or prevent water ingress and therefore to allow the construction or mining works to continue as soon as possible. As high volumes of these products are necessary, 2-C pumps are used to deliver the two individual components so that they are only mixed together at the last minute in the nozzle at the point of injection into the ground.
Sika provides a variety of injection lance and packer systems. A 2-C pump for the resins is also necessary to minimize any issues with wastage or exothermic heat generation, plus the equipment cleaning and maintenance is easier. For the cementitious injection products, alternative types of pumping equipment are used.

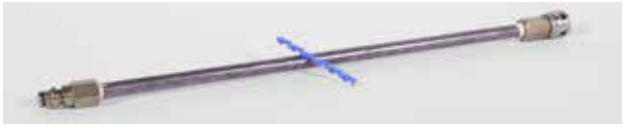
TWO-COMPONENT AIR-DRIVEN PUMPS FOR SIKA PU- AND SILICATE BASED INJECTION PRODUCTS
These 2-C piston pumps are robust and specially designed for demanding underground conditions. The pumps allow for high volume output under elevated pressure.



TWO-COMPONENT PUMPS FOR SIKA ACRYLATE BASED INJECTION PRODUCTS
The SikaFix®-301 acrylate resin injection system requires special pumping equipment due to its (relatively) long reaction time and the high volumes of the product which are required.

SPECIAL INJECTION RESIN MIXING HEADS
Sika provides special injection resin mixing heads to ensure optimal performance with all of the different injection resin technologies. These include mixing tubes with a compulsory static mixer to ensure correct mixing of the two components.

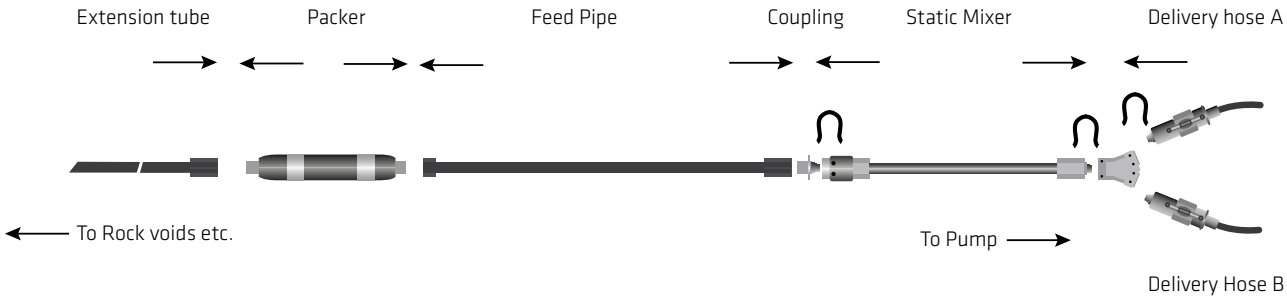
Mixing tube with the static mixer for Sika PU injection resins
The Sika PU resin mixer is shorter overall and has a larger outer diameter then the Sika Silicate resin mixer.



Mixing tube with the static mixer for Sika Silicate resins
Silicate resin mixing requires more energy therefore the mixing tubes are longer and the static mixers of smaller diameter.

SIKA INJECTION LANCE AND PACKER SYSTEMS

Sika provides a variety of injection lance and packer systems. These are usually assembled and connected as indicated:



SikaFix® INJECTION EQUIPMENT / PUMP CLEANING SYSTEM

Sika® Injection Cleaning System includes a full range of cleaning and pump conservation agents for the efficient and reliable use, storage and re-use of all types of injection pumps with the SikaFix® product ranges. All of these Sika cleaning and conserving agents are produced free of CFC's, FC or chlorine/chlorides.

	Polyurethane Foams	Polyurethane Resins	Silicate Resins	Acrylate Resin	Cement based products
	SikaFix®-110	SikaFix®-210	SikaFix®-501/-601	SikaFix®-301	Sika® InjectoCem®-190
Inter-mediate Cleaning	Sika® Injection Cleaner C1	Sika® Injection Cleaner C1	Comp. A: Water, Comp. B: Sika® Injection Cleaner C1	Water	Water
Final Cleaning	Sika® Injection Cleaner C 1	Sika® Injection Cleaner C 1	Sika® Injection Cleaner C 1	Water + standard dishwashing liquid	Water
Cleaning of cured material	Sika® Injection Cleaner C 2	Sika® Injection Cleaner C 2	Sika® Injection Cleaner C 2	Sika® Injection Cleaner C 2	Mechanically
Conser-vation of pumps	Sika® Injection Conservator	Sika® Injection Conservator	Sika® Injection Conservator	Sika® Injection Conservator	Sika® Injection Conservator

CASE STUDIES

MINE WATER INRUSH

MINING PROBLEM

In this mine, a decline is constructed to access the ore-body by conventional drilling and blasting. The gneiss rock has good strengths, but is strongly fractured, and this allows, a large amount of water ingress to the mine infrastructure. The tunnel broke into a problematic area with high water ingress in the range of 200 m^3/hour, with the main water inrush of approximately 100 m^3/hour, coming from one specific location. The pumping capacity of the mine was limited to about 400 m^3/hour and so urgent measures had to be taken.

PROJECT REQUIREMENT

- Rapid waterstopping under high hydrostatic pressure using post-excavation injection methods
- Reduce the pumping capacity of the mine

SIKA SOLUTION

- Waterstopping using SikaFix®-210 fast-reacting polyurethane resin with short setting times, and using SikaFix® AC-21 accelerator and SikaFix® AC-21 SF accelerator to further shorten reaction time and to prevent wash outs

INJECTION EQUIPMENT

- A two-component injection pump with special PU-resin mixing heads, tubes and lances

MINE OVER-BLAST

MINING PROBLEM

This mine was experiencing frequent problems in trying to maintain the profile of the tunnel when drilling and blasting the orebody. The mining contractor was also unable to keep ore dilution under control due to heavy overbreak from the roof and ribs. This resulted in excessive use of structural steel supports and timber beams.

PROJECT REQUIREMENT

- Rapid stabilization and strengthening of the strata
- Achieve at least 20 mpa within 1 hour
- Withstand further blasting
- Environmentally friendly as the excavation was done at relatively shallow levels

SIKA SOLUTION

- SikaFix®-601 silicate resin
- High strengths after short curing time
- Injection to a depth of 10 m

INJECTION EQUIPMENT

- Two component piston pump with special mixing heads for silicate resins
- Injection through an inflatable packer system

TBM HEADING INJECTION

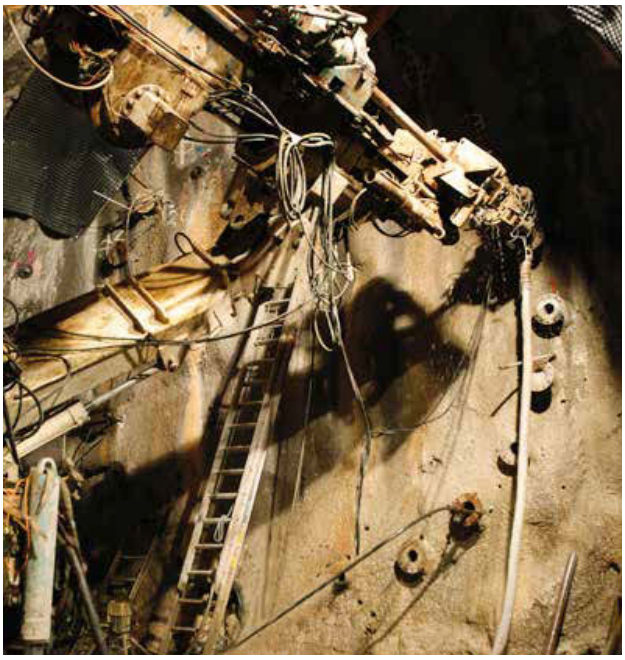
TUNNELING PROBLEM
Twin high-speed railway tunnels ~6.8 km long were excavated by a TBM and supported by placing precast concrete segments after the excavation process. In some sections, due to soft soil and the resulting high pressure on the cutting head of the TBM, the excavation process was delayed.

PROJECT REQUIREMENT
- It was necessary to quickly consolidate the ground and allow the tunnels to be dug, and the precast concrete segments to be safely and securely placed in position. This required a solution that could be injected in front of the TBM and:
- Allow the ground to be excavated easily by the TBM
- Seal and fill the voids in the zones of weakness
- Be fast-reacting and curing
- Which was available in substantial volumes for fast delivery

SIKA SOLUTION
- SikaFix®-501 Silicate foam resin supplied in bulk IBC's
- Local supply chain set-up with SikaFix®-501 in IBC's
- Delivery of the first 3 truckloads of materials within one week

INJECTION EQUIPMENT
- Two component injection pump with special mixing heads for silicate resins, plus additional Silicate resin mixing tubes

PRE-GROUTING ROCK STABILIZATION



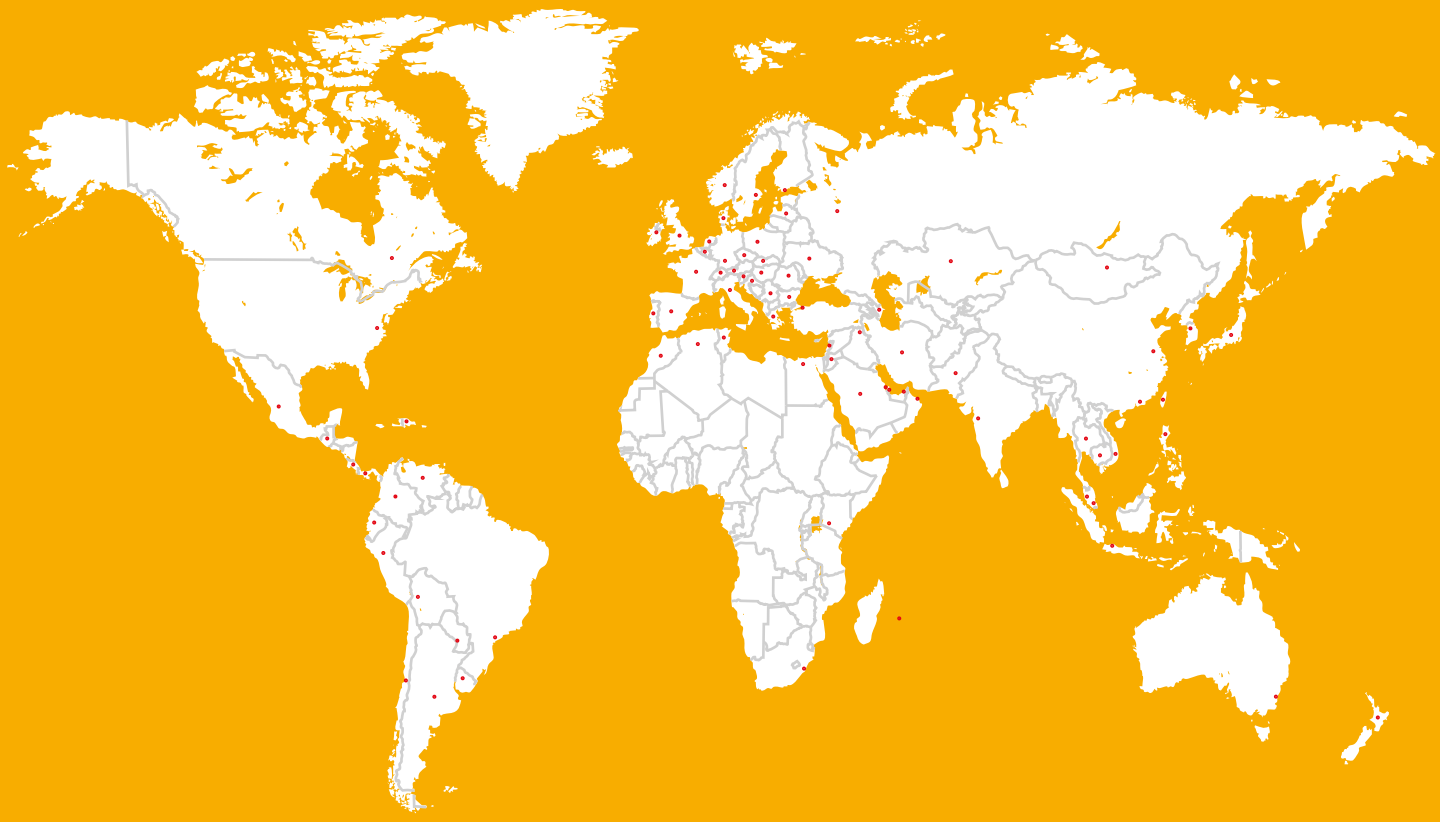
TUNNELING PROBLEM
A lot of information about the geological conditions was received from the TBM drilling the first tunnel out of a twin tunnel project. The likelihood of high water ingress and areas of unstable strata ahead of the TBM was identified. To increase the efficiency of the TBM working for the second tunnel, pre-excavation injection of the rock was undertaken using a micro-fine cement grout. The objective was to significantly reduce water ingress from the anticipated 250 – 300 litres / second to less than 50 litres / second, especially through 840 m of very unstable rock. This would enable the TBM excavation rate to be increased and allow a faster and safer working process.

PROJECT REQUIREMENT
- Consolidation of the unstable rock strata
- Significant reduction in the rate of water ingress
- High environmental requirements for materials within the water table and ground water protection area

SIKA SOLUTION
- Cementitious injection grout adjusted to local requirements
- Use of microfine cements (low-alkali) with Sika® accelerators, stabilizers and plasticizers to achieve the required high flow

INJECTION EQUIPMENT
- Cementitious mixing and pumping station

GLOBAL BUT LOCAL PARTNERSHIP



FOR MORE WATERPROOFING INFORMATION:

WE ARE SIKA

Sika is a specialty chemicals company with a leading position in the development and production of systems and products for bonding, sealing, damping, reinforcing and protecting in the building sector and the motor vehicle industry. Sika's product lines feature concrete admixtures, mortars, sealants and adhesives, structural strengthening systems, flooring as well as roofing and waterproofing systems.

Our most current General Sales Conditions shall apply.
Please consult the Data Sheet prior to any use and processing.

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