



# CONCRETE SIKA TECHNOLOGIES FOR TUNNELING & MINING

BUILDING TRUST





A perspective view of a large, arched tunnel under construction. The tunnel walls are made of concrete and show signs of excavation. Overhead, there are several parallel cables and support structures. In the distance, a red light is visible at the end of the tunnel. The floor appears to be a concrete base with tracks or rails running down the center.

## CHALLENGING THE LIMITS UNDERGROUND

For more than a century, Sika has been involved in the most challenging tunneling and mining projects around the globe. Looking back and profiting from this wealth of experience, best underground practices are implemented in many regions, bringing Sika underground construction excellence to the far corners of the globe. Today, Sika supplies tunneling and mining solutions for the largest and technically most complex projects everywhere in the world.

From the Atacama Desert in Chile, under which the large Chuquicamata block caving mine is under construction, to the Gotthard base tunnel 2'500 m below the surface of the Swiss Alps; these are both quite different examples of efficient underground construction master classes.

All projects below ground have their own challenges and special requirements. Together with our partners, we take on these challenges and implement tailored solutions for their specific technical requirements, environmental conditions and logistical hurdles.

Sika is at the forefront when it comes to efficiency improvements in tunneling and mining, reducing excavation times with faster shotcrete solutions and optimizing the cost performance of concrete in all underground operations. With a fully integrated and smart, high quality product portfolio, we have become your ideal business partner to continue forging ahead in underground construction.

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# SIKA TECHNOLOGIES FOR TUNNELING AND MINING



## CONCRETE

Over the past 100 years, Sika has made many notable contributions to the development of concrete as a durable and sustainable construction material. Sika meets complex concrete production and construction processes with proven and innovative solutions, to accommodate many challenging demands, such as those encountered in tunneling and mining.

**Sika® ViscoCrete®**  
Superplasticizers

**Sika® ViscoFlow®**  
Slump retainers

**SikaRapid®**  
Accelerators

**Sika® Stabilizer**  
Viscosity control agents

**SikaPump®**  
Pumping aids

**SikaPump® Start-1**  
Lubricant

**SikaFume®**  
Silica fume

**SikaFiber®**  
Micro & macro synthetic and steel fibers

**SikaCare**  
Equipment protection



## SHOTCRETE

Shotcrete is sprayed concrete and today this combines many aspects of concrete technology with admixture chemistry and modern methods of materials handling and delivery. Sika has proven expertise and experience mastering all of the technologies to meet the most demanding requirements. This includes the full range of capabilities using both wet and dry sprayed solutions.

**Sika® ViscoCrete®**  
Superplasticizers

**SikaTard®**  
Shotcrete retarders

**SikaPump®**  
Pumping agents

**FlexoDrain®**  
Water drainage system

**Sigunit®**  
Accelerators

**SikaFiber®**  
Micro & macro synthetic and steel fibers

**Aliva®**  
Sprayed concrete machines

**Sika® Shot**  
Ready mixed gunite



## WATERPROOFING

Modern tunnel structures are designed for a life span of over 100 years. This puts equally high performance requirements on the waterproofing systems, not only in service, but also during the installation and overall construction phase.

**Sikaplan® WT**  
TPO based sheet waterproofing membrane systems

**Sikaplan® WP**  
PVC based membranes

**Sika® WT/WP/Dilatec**  
Preformed, bonded tapes for waterproof connections and terminations

**Sika® Waterbars**  
Joint waterproofing systems

**SikaSwell® P**  
Hydrophilic swelling profile for joint sealing

**SikaFuko®**  
Injectable hoses for joint sealing and secondary / back-up waterproofing

**Sika® Injection**  
Resins for post-applied waterproofing by injection



## INJECTION

Fast cycle times are obviously important for efficient tunneling and mining operations. The SikaFix® range provides effective and innovative injection solutions including cementitious and resin (polyurethane, silicate, and acrylate) based materials for all possible injection and ground stabilization problems.

**SikaFix®**  
Fast, reactive injection products that expand with or without contact with water, mainly injected using a two-component pump. The SikaFix® range is designed for immediate water-stopping under high water flow and hydrostatic pressure conditions.





### TBM SOLUTIONS

Sika offers a wide range of TBM products, covering all types of different TBM types. The products and systems are designed to increase efficiencies throughout the excavation and construction process of fully mechanised tunneling projects.

#### Sika® Foam TBM

Complete range of TBM soil conditioners and polymers

#### Sika® Stabilizers

Special main drive and tail sealants

#### Sika® Set

Accelerators for controlling the set of backfilling grouts

#### Sika® Retarders

For retarding and stabilizing backfilling grouts



### MINE BACKFILL ADMIXTURES

Sika admixtures for paste backfill operations are designed to optimize and significantly reduce the necessary binder consumption and cost. Additionally, these will also help to ensure the rheology and stability of the paste, thereby reducing the backfill line pressure that is required.

#### Sika® Stabilizer MBF

A complete range of paste backfill admixtures for the most cost effective solutions with the variations in tailings from all different types of geological deposits and ground conditions.



### GROUTING

Heavy machinery such as mills, crushers and hoists are key components of large scale mining operations. Grouts play an important role in bedding these to successfully transfer vibration and heavy loads into their structural foundations. Sika solutions include the full range of cement and resin based grouting materials (epoxy, acrylic and polyurethane etc.).

#### SikaGrout®

Complete range of high-performance, cementitious grouting systems

#### Sikadur®

Complete range of epoxy grouting systems

#### Icosit® KC Range

Two-component, polyurethane resin grouts, especially designed for fixing rail tracks and heavy machinery to reduce vibration and noise transmission.



### CONVEYOR BELTS

Mining and tunneling are amongst the largest industrial sectors where rubber conveyor belt systems are widely used. The specially developed SikaBond® range of belt adhesives and repair systems provide excellent cost-performance options for these conveyor belts and many other industrial rubber components that are used for many different applications.

#### SikaBond® R&B-100

High performance, two-component elastomer for fast and durable conveyor belt repairs

#### SikaBond® R&B-200

Structural adhesive with a short open time for bonding rubber materials

#### SikaBond® R&B-210

Structural adhesive with a long open time for bonding rubber materials

# CONCRETE REQUIREMENTS AND APPLICATIONS



## CONCRETE LINING

Fast construction of safe and durable concrete structures is no longer a difficult task with Sika admixture technologies. Good pumpability, flow and compaction, followed by high early strength, then low permeability are the key characteristics for a good tunnel lining concrete.



## HPC CONCRETE

Sika admixtures for high strength and abrasion resistance are used in tunneling for the associated concrete slabs and structures, plus in mining for the drawpoints, extraction levels, haulage drifts and ore pass linings.



## SEGMENTS

In tunnel segment production, high early strengths for rapid demolding, followed by the highest requirements with regards to performance and durability have to be fulfilled.



## SLIKLINE CONCRETE

Sliklines are farthest from the concrete pump and immersed in the concrete for a lot of the time, so the mix design needs the right admixtures for the works to continue without segregation and blocking of the lines.

## THE MAIN REQUIREMENTS FOR CONCRETE IN TUNNELING AND MINING



### High early strengths achieved with SikaRapid® technology

In order to reduce cycle times in underground operations high early strengths are needed to ensure the elements can be demolded, moved or put under load as quickly as possible.



### Extended workability times produced using Sika® ViscoCrete® & Sika® ViscoFlow® technology

In many situations, extending the workability time of the concrete is essential in tunneling and mining applications, especially for pumped concrete, where the transport distances and temperatures can be challenging factors in maintaining the required workability of the concrete.



### Good pumpability with SikaPump®

This pumping agent reduces friction and resistance in the pipes, reduces the wear on the pump and the pipes, which therefore increases the volume output. Initially it is also used to produce a lubricant mix to coat the internal walls of the pipe with a high-fines layer and allow easy pumping, right from the start of the concreting operations.



### In the hardened concrete, a high resistance to abrasion is achieved by using SikaFiber® in the mix.

For many areas of structural concrete the resistance against percussive or striking impact, plus the toughness and flexural strength of the concrete itself, can be very significantly improved by the use of these Sika structural fibers.



### High flow and workability with Sika® ViscoCrete® technology

An efficient way of quickly and easily placing concrete is the use of so-called self-compacting concrete. With the right Sika mix design, this is able to flow under its own weight, completely filling formwork and achieving full compaction without vibration, even around heavily congested reinforcement.



## SIKA PRODUCTS

### **Sika® ViscoCrete®**

Superplasticizers with strong water reduction and extended workability times.

### **Sika® ViscoFlow®**

Special designed admixture for extended workability times under demanding conditions.

### **SikaRapid®**

Accelerators for precise, high early strength development.

### **Sika® Stabilizer**

Admixtures to improve the cohesion of concrete mixes and compensate for the variations that occur in raw materials (sands and aggregates).

### **SikaPump®**

Special concrete pumping aids to improve pumpability in difficult circumstances such as temperature variations and long transport distances.

### **SikaPump® Start-1**

A start-up lubricant for the pipes, which also helps to reduce the wear and tear on the pumping equipment and increase the output.

### **SikaFume®**

Fine silica fume, which is added to significantly improve the performance and extend the durability of the concrete.

### **SikaFiber®**

Sika micro and macro fibers can significantly improve the ductility, impact resistance and the tensile strength of concrete.

### **SikaCare**

An easily applied solution for the protection of metal equipment against rust and also to prevent concrete spills sticking to them.



# SPRAYED CONCRETE – SHOTCRETE APPLICATIONS



## SLOPE STABILIZATION

Shotcrete is ideal for slope stabilization, especially when dealing with steep slopes and pit wall angles, in order to protect men and machinery in portals, galleries and on ramps.



## ROCK SUPPORT

Rapid early strength development of the shotcrete is critical in order to enable short cycle times and ensure efficient rates of progress in both mining and tunneling.



## SHOTCRETE EQUIPMENT

Sika Aliva® is a market leader when it comes to shotcrete equipment for both wet and dry spray applications.



## SIKA SERVICE

Sika provides support from pre-testing, right through with continuous on-site support, to the completion of operations, in order to realize ongoing efficiencies.

## THE MAIN REQUIREMENTS & SIKA SOLUTIONS FOR SHOTCRETE



### High early strengths achieved using Sigunit® accelerators

Early setting of the shotcrete lining is critical in order to enable rapid underground development with short cycle times.



### Extended slump retention achieved with Sika® ViscoCrete® SC technology

Depending on the location and the complexity of the project, long haulage distances can require extended slump life of the concrete and in all manner of environmental conditions.



### Laboratory testing

Sika has developed unique testing equipment known as “MiniShot” where local raw materials (e.g. different binders, accelerators, admixtures and additives etc.) can all be quickly and reliably tested locally and in an efficient way to optimize the shotcrete mix designs.



### On site testing

After the pre-evaluation and mix selection of the shotcrete-system using the Sika MiniShot, the mix-design is tested under real conditions. The well trained Sika shotcrete teams will then implement the best cost performing solutions.



### Trouble-free applications

Safe application, consistent speeds and uninterrupted spraying are critical factors for efficient in cycle shotcreting. This is achieved with Sika support to master the sprayed concrete operations with efficient equipment, mix designs, admixtures and skilled operators.





## SIKA PRODUCTS

### **Sigunit®**

Shotcrete accelerators for high early strength requirements. Sigunit® solutions are available as liquid and powder solutions to suit challenging logistics and different operational requirements.

### **Sika® ViscoCrete®**

Superplasticizers for high water reduction and extended workability times.

### **SikaTard®**

Slump retention admixtures, especially formulated for shotcrete, to control workability times in all different temperature conditions.

### **SikaFiber®**

Sika micro and macro fibers significantly improve the ductility, impact resistance and the tensile strength of shotcrete.

### **SikaPump®**

Special concrete pumping aid to improve pumpability under difficult circumstances such as temperature variations and long transport distances.

### **FlexoDrain®**

An easy to use drainage system to channel water ingress underground.

### **SikaTell®**

A shotcrete admixture designed to reduce rebound and improve the cohesion of the shotcrete.

### **Sika® Shot**

A pre-bagged, ready mixed gunite for dry spraying that is cement based and powerfully accelerated.

### **Aliva rotary spray machines and pumps**

Universal machines for the application of dry and wet shotcrete.

# STRUCTURAL WATERPROOFING



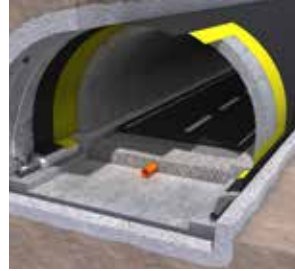
## DRAINED

Used in drill and blast tunnels and hard rock TBM excavations where single shell shotcrete or a double shotcrete lining is installed. Liquid applied membranes and Sika FlexoDrain® form the waterproofing system.



## WATERTIGHT CONCRETE

For conventional excavations and Hard Rock TBM's, watertight concrete is used in a "white-box" concept, using engineered joint sealing solutions. For tunnels with limited water pressure resistance requirements.



## UMBRELLA SYSTEM

For road and railway tunnels with high overburden. The "umbrella system" provides a cost effective solution, based on a full arch barrier in combination with a drainage system to keep the tunnel and its structure dry.



## HYDROSTATIC BARRIER

Loose-laid membrane system, PVC or FPO based, including compartments and integrated injection back-up ports. The membrane is applied as a single or double layer system for the highest watertightness requirements (NEAT system).

## SIKA HAS THE WIDEST RANGE OF WATERPROOFING SOLUTIONS



### Loose-laid synthetic sheet membranes

For more than 50 years, Sika's loose-laid synthetic membranes have been the below ground waterproofing system of choice where high performance is required. This technology has been continually developed and the service life of Sika membranes remains unchallenged and their leading position is maintained by the most comprehensive materials testing.



### Fully bonded sheet membranes

An alternative evolution of Sika's advanced polymeric sheet membranes are these systems designed to form a full surface bond with the structural concrete. These Sika systems also use the FPO materials that fulfil the highest durability as the loose-laid membranes.



### Sika 'white box' concept with watertight concrete

The integral waterproofing of concrete structures makes this a very convenient and attractive approach for contractors with Sika concrete admixtures and jointing systems. However durability also depends on the groundwater, especially where this is salt water, or it contains other aggressive influences that can attack the concrete and its steel reinforcement.



### Waterproofing mortars

Sika waterproofing mortars are easy to use to protect both large and small areas of concrete surfaces, and can be applied by hand or spray. These can provide good durability and a long service life in contact with fresh water, however with increasing salt and chemical content this can be reduced and additional protection may be required.



### Liquid applied membranes (LAM) based on reactive resins (PUR/PUA)

Sika provides a complete range of liquid applied membranes, primarily designed for spray application, but they can also be hand applied, which is useful for complex detailing solutions. Sika LAM are therefore ideal for waterproofing surfaces with a lot of penetrations and/or difficult access for the application works.



## SIKA PRODUCTS

### **Sikaplan® WP**

Homogeneous, plasticized PVC sheet membranes for waterproofing tunnels, plus cut and cover structures.

### **Sikaplan® WT**

Glass fabric reinforced, FPO sheet membranes for waterproofing tunnels and other structures, particularly against salt water and aggressive ground conditions.

### **Sika Waterbar WP/WT**

External waterstops, heat welded to the installed Sikaplan® membranes to form compartment systems.

### **Sikaplan® WP/WT Tapes & Sika Dilatec ER/E Tapes**

Adhesive sealing tapes based on PVC or FPO, bonded with Sikadur®-31 CF or other adhesives for sealing details and perimeter terminations.

### **SikaProof® A**

Pre-applied FPO sheet waterproofing membrane system, applied below base slabs and on formwork for poured-walls.

### **SikaProof® P**

Post applied in-situ adhered FPO sheet waterproofing membrane, specially designed for roof slabs and walls.

### **Sikalastic® LAM**

Highly flexible, fast curing, two component (PUR / PUA) spray applied, membranes for concrete surfaces.

### **Sika® WT 100/200**

Pore blocking and active crystalline concrete admixtures for producing watertight concrete. The utmost in waterproofing technology for concrete mix design.



# GROUND INJECTION AND ROCK CONSOLIDATION



## STOPPING WATER

Uncontrolled water intrusions in tunnels and mines represent major hazards often responsible for long downtimes and expensive pumping campaigns. The SikaFix® injection range includes powerful solutions to stop and then block this water, to regain hydrological control.



## VOID FILLING

Cavity and void filling is used as and when necessary to consolidate fractured strata and to stabilize the ground, therefore ensuring a faster and safer excavation process.



## GROUND STABILIZATION

An efficient way to stabilize unconsolidated geological perimeters, fractured rock-strata or permeable soils is by injecting them with specially formulated grouts (normally cementitious).



## INJECTIONS FOR TBM'S

Water bearing fault and shear zones can represent a major risk for TBM's. These risks can be managed by using Sika pre-injection systems to consolidate and stabilize the ground ahead of the TBM.



## Sika Injection expertise

Site inspection for selection of the appropriate concept, as well as the correct material and application method, is critical for a successful injection approach. Sika experts provide assistance on site and in the laboratory to select the most suitable and cost-effective materials and methods. We also provide the necessary detailed documentation and training for successful product application.

Injection Material	Clay	Silt	Sand			Gravel	Pre-injections	Water stopping	Ground consolidation
			fine	medium	coarse				
Cement						days	X		X
Micro-cement						hours	X		X
SikaFix®-110 (PU)						45 seconds	X	X	
SikaFix®-210 (PU)						10 seconds		X	
SikaFix®-501 (Silicate)						15 seconds	X	X	X
SikaFix®-601 (Silicate)						40 seconds	X		X
SikaFix®-301 (Acrylate)						2 - 15 minutes	X	X	X
Grain size (in mm)	0.001	0.01	0.1	1	1.5	10			
Permeability K (m/s)	10 <sup>-7</sup>	10 <sup>-6</sup>	10 <sup>-5</sup>	10 <sup>-4</sup>	10 <sup>-3</sup>				

This table: Different Sika injection technologies for use based on substrate permeability and reaction times required.



## SIKA PRODUCTS

### **SikaFix®-110**

Polyurethane foam injection resin designed to foam with or without water.

### **SikaFix®-210**

Rigid polyurethane injection resin hardens to form a tough material that is used to seal high water inrushes.

### **SikaFix®-301**

Acrylate resin based with low viscosity – similar to water – but hardens to form a rigid, hydrophilic and water repelling compound. Ideal for injection to low permeability soils.

### **SikaFix®-501**

Silicate resin based, designed to expand to a rigid material by foaming. Its high foam expansion factor makes it ideal for filling large voids.

### **SikaFix®-601**

Silicate resin based, non-foaming, rigid injection material that has excellent adhesion to damp surfaces. It is used for demanding rock consolidation to stabilize damp and wet geological fault zones.

### **SikaFix®-800 series**

Cementitious grout range, modified using organic polymers. During hydration of the cement, the grouts will harden to a rigid material as required.

# SPECIAL SOLUTIONS FOR TBM'S



## POLYMER FOAMS

The use of soil conditioning foams extends the possibility of cost-efficient TBM excavation to a wider range of ground conditions. These systems allow EPB TBM's to achieve better advance rates even in mixed ground with gravels, sand and water, as well as other difficult geological conditions.

### **Sika® Foam TBM 101 FB**

Universal foaming agent for ground with high to low permeability.

### **Sika® Foam TBM 102 GP**

Foaming agent giving exceptionally high stability.

### **Sika® Foam TBM 301 HP**

Concentrated foaming agent for permeable and highly fractured soils.

### **Sika® Foam TBM 401 LC**

Universal foaming agent for medium permeability to dry soils.

### **Sika® Foam TBM 501 LS**

Foaming agent for highly cohesive soils.



## POLYMER LIQUIDS & POWDERS

Typical applications of Sika polymers in the TBM excavation process are for the

- Reduction of "stickiness"
- Reduction of adhesion to metal surfaces
- Reduced segregation in the mixing chamber
- Drying out the ground and de-watering

### **Sika® Foam TBM 220 P**

Water absorbing powder admixture, which reduces the risk of filling the pressure chamber with liquefied soil.

### **Sika® Foam TBM 230 L**

Water absorbing liquid admixture.

### **Sika® Foam TBM 800 C**

Liquid polymer to stabilize foams and modify the viscosity.

### **Sika® Foam TBM 900 Bio**

Natural viscosifying polymer and stabilizer for foams and other water dispersed fluids.

### **Sika® Foam TBM 1000 Bio**

Natural powder viscosifying polymer and stabilizer for foams and other water dispersed fluids.



## ADDITIONAL ADDITIVES

Foams are the most commonly used ground conditioning systems during EPB TBM tunneling. However, a range of other additives may also be considered in order to improve the excavation process in difficult ground conditions.

### **Sika® Foam TBM 20**

Disc cutter cleaner and clay remover, used for faster progress through clays.

### **Sika® Foam TBM 200**

De-foaming agent used in tunnel excavation with clay and muds before disposal.

### **Sika® Foam TBM 700 WR**

Clay based, friction reducing agent used to keep steel surfaces clean and free from clay.



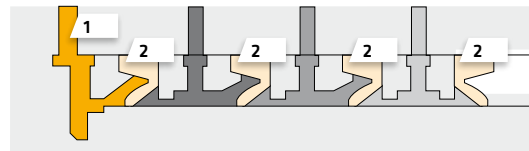
## MAIN DRIVE SEALANTS

One of the most important and expensive components of the TBM is the main bearing. In order to keep it in good condition, proper sealing and lubrication is required.

Experience has shown that failures of TBM main bearings are related to a loss of lubricant, or to the entry of contaminants. For this reason it is necessary to have and keep the system working with reliable products. Sika® Stabilizer TBM H protects the main bearing from water, mud, dust and foam.

### Sika® Stabilizer TBM H

Is ideal as a main bearing sealant with its strong grab to metal surfaces and high wash-out resistance. It also has good lubrication and pumping properties.



1 Sika® Stabilizer TBM H | 2 Seals



## TAIL SEAL SEALANTS

Tail shield sealants are injected between the rows of brushes along the gap between the tailskin and the lining segments to prevent water, soil and backfilling grout entering the TBM. Sika® Stabilizer TBM TS1/TS2/TS3 are specifically designed to be safe for use in urban areas and elsewhere that the ground water could be in contact with TBM excavations, in order to prevent pollution of the environment

### Sika® Stabilizer TBM TS1

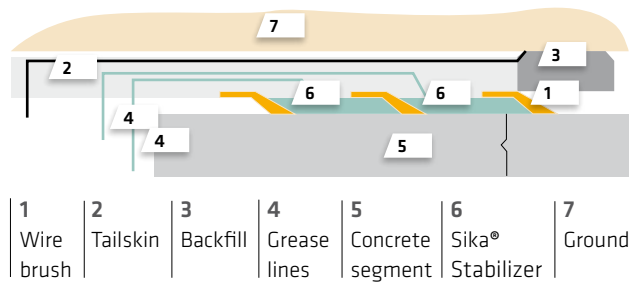
First-fill tail seal sealant.

### Sika® Stabilizer TBM TS2

Tail seal sealant for TBM's.

### Sika® Stabilizer TBM TS3

Non-flammable tail seal sealant for TBM's.



1 Wire brush | 2 Tailskin | 3 Backfill | 4 Grease lines | 5 Concrete segment | 6 Sika® Stabilizer | 7 Ground



## TWO COMPONENT GROUTS

Two component injection grouts are used to backfill the annulus between the wall-rock and the TBM segments.

They are prepared by mixing water, cement, bentonite and a retarder, plus an accelerator is added at the tailskin injection point which transforms the injected slurry to a gel in around 10 – 20 seconds.

The final mix has comparable compressive strength to that of the surrounding ground and can fill the gap and voids before it sets and hardens. For the required flow and retarded set effects, SikaTard® and Plastiment® products are used. SikaSet® or Sigunit® accelerators are then used to control the setting and hardening time.

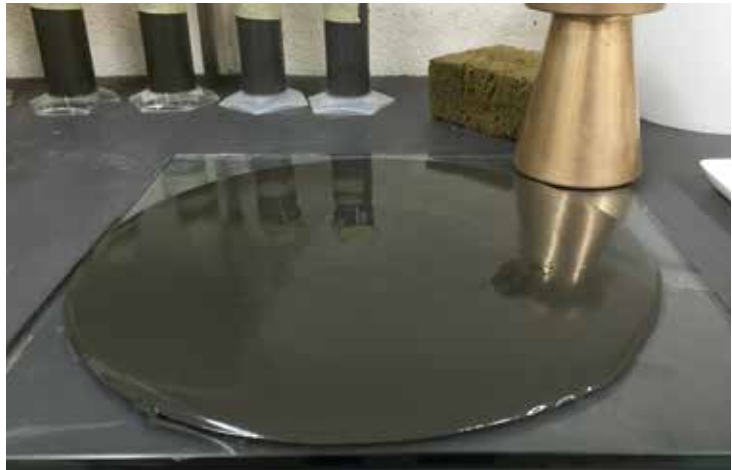


# MINE BACKFILLING

## PASTE WITH NO ADMIXTURE



## THE SAME MIX WITH Sika® Stabilizer MBF

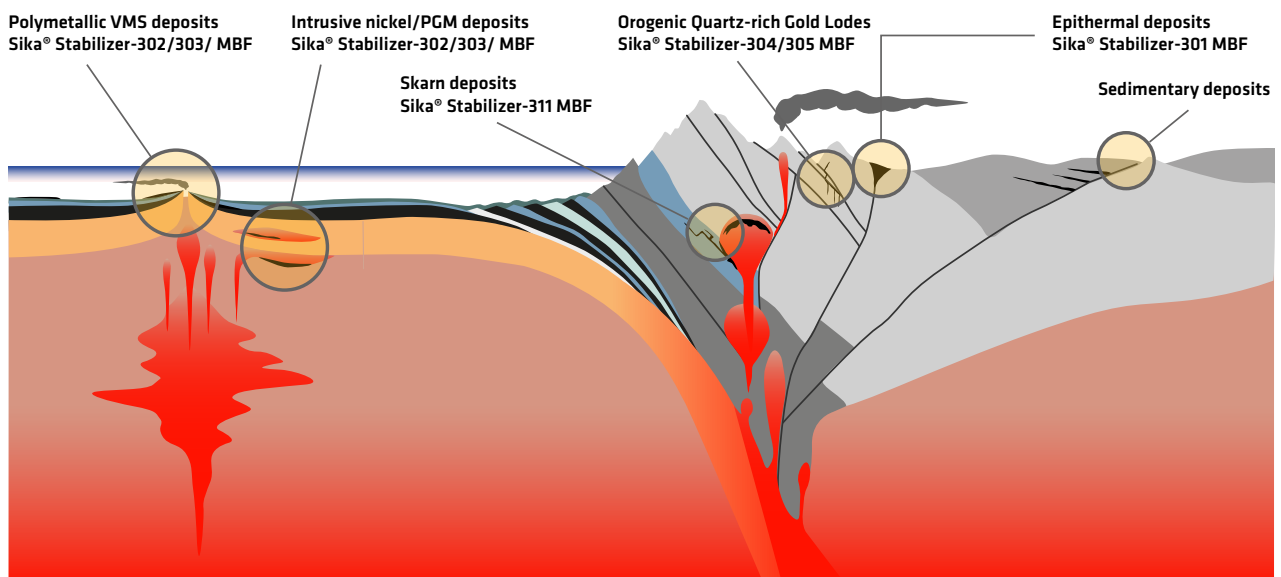


Paste-mix design without admixtures (left side), and with Sika® Stabilizer MBF admixture (right side), note the very significant increase in slump.

Using backfill admixtures allows engineers to adjust and modify the many variables of backfilling materials. The following parameters can all be modified in order to obtain the required properties and cost performance from the backfill:

- Reducing the binder content
- Increasing the strengths
- Increasing the solids content of the paste mix and hence increase fill efficiencies
- Improving the rheological properties of the cement based fill during the mixing, pumping and backfilling process
- Reducing yield stress whilst enhancing workability
- Reducing pumping pressures
- Reducing wear and tear on machinery and equipment
- Minimizing segregation and bleed
- Improving consistency of fill rates and compressive strengths
- Reducing the risk of line blockages
- Preventing liquefaction

Sika has developed a powerful range of mine backfilling admixtures to modify the paste mixes from all of the main ore deposit types. The most suitable admixtures can be selected on each individual project for maximum cost efficiency.



Sika backfill admixture range for different deposit types.



## SIKA PRODUCTS

### **Sika® Stabilizer-301 MBF**

Paste backfill admixture for Epithermal, polymetallic deposits.

### **Sika® Stabilizer-302 /-303 MBF**

Paste backfill admixture for polymetallic volcanic hosted massive sulphide deposits (VMS).

### **Sika® Stabilizer-303 /-302 MBF**

Paste backfill admixture for intrusive hosted nickel/PGM deposits.

### **Sika® Stabilizer-304 /-305 MBF**

Paste backfill admixture for orogenic, greenstone hosted quartz-gold lodes.

### **Sika® Stabilizer-311 MBF**

Paste backfill admixture for intrusion related skarn deposits.

### **Sika® Stabilizer-306 /-311 MBF**

Admixture for limestone replacement deposits, carlin-style or skarn deposits.

### **Sika® Stabilizer-401 MBF**

A special admixture to prevent high water bleeding.



# GROUTING



## Sikadur® EPOXY BASED GROUTS

Sika's epoxy resin based grouts are widely used for load bearing plate and direct equipment fixing, especially those under dynamic load and subject to vibration, such as generators, crushers, rolling mills and other special machinery. The correct application of these products is critical to ensure a durable outcome. Sika provides extensive guidance and assistance, including onsite support for complex grouting procedures.



### Sikadur®-42 Range

Pre-batched, epoxy resin based, chemically resistant, high flow grouts for precision grouting of structural components and machinery.

### Sikadur®-42 HE

Proven effective as the crusher backing mortar for gyratory crushers.

### SikaTop® Armatec® EpoCem®

For use in highly corrosive environments in combination with all Sika repair systems.

### SikaWrap®/ Sika Carbodur®

Carbon based, structural strengthening material for concrete.



## SikaGrout® CEMENTITIOUS BASED GROUTS

Sika is a market leader in high quality cement based grouts. These cementitious SikaGrout's are available all over the globe and widely used within the tunneling and mining industry for many different applications and requirements. From high strength concrete repairs through to grouting structural columns, base plates and heavy equipment – The SikaGrout® range covers it all.



### SikaGrout®-200 series

The standard cement based, multi-purpose grouting products for many different applications. These grouts are pourable and self-leveling. They are compensated against shrinkage and quickly develop high compressive strengths of 50 – 60 MPa.

### SikaGrout®-300 series

The advanced, cement based, multi-purpose grouting products for grouting applications that require large thicknesses. These grouts are all pourable and self-leveling, compensated against shrinkage and rapidly develop compressive strengths up to 80 MPa.



## Sika® REPAIR MORTARS

Refurbishing deteriorated or damaged concrete structures and upgrading them for the future is one of Sika's core competencies. Our extensive product range provides a system or product as the ideal solution for every concrete repair job you will ever encounter anywhere in the world!



### Sika MonoTop® Range

Pre-bagged, one component, polymer modified, cement based, concrete repair mortars for many applications.

### Sika MonoTop®-610

Primer for reinforcement protection and also a bonding bridge for the MonoTop® concrete repair mortars to steel and concrete surfaces.

### Sika Gunit®

Dry spray mortar for large volume repairs using Aliva® spray equipment.

### Sikacrete® SCC

Pre-bagged, silica-fume enhanced, self-compacting concrete mix.

# CONVEYOR BELT REPAIR AND BONDING

**THE TUNNELING AND MINING INDUSTRY** are amongst the largest industrial sectors where rubber conveyor belt systems are widely used. Sika's expertise can provide superior cost-performance for the bonding and repair of rubber belts and associated components for many different applications.

## BELT REPAIRS

### SikaBond® R&B-100

This two-component, high-performance, elastomeric, synthetic resin based system is specially designed for the repair of textile and steel reinforced rubber conveyor belts. The material is primarily used to repair typical non-structural damages such as holes, cuts and ripped edges that are part of normal wear and tear. These durable repairs can then significantly extend the service-life of the conveyor belt. The SikaBond® R&B-100 system develops outstanding mechanical properties and is ideal for fast repairs and a rapid return to service.



## BONDING RUBBER COMPONENTS

### SikaBond® R&B-200/210

The vulcanization of rubber is always time-consuming and expensive with a lot of hardware and special know-how involved. Therefore, Sika has developed unique, patented solutions for "cold-splicing" rubber components in a very simple, fast and safe way without the use of power and heavy equipment. SikaBond® R&B-200/210 are fast curing, flexible adhesive systems, designed to replace mechanical fixings, such as rivets and screws, or welding as well as hot vulcanizing itself.





# TUNNELING AND MINING

Project references





## THE GOTTHARD BASE TUNNEL, SWITZERLAND

At the heart of the new transalpine rail route in Switzerland is the Gotthard Base Tunnel and with a length of 57 km it is the world's longest and also the deepest rail tunnel. It opened to traffic and became operational at the end of 2016 after more than 15 years of design and construction works.

Sika was involved in this project from the beginning, providing assistance to the project team from their global expertise and experience, including many previous tunneling projects in the Alpine regions of Europe. Sika's support was particularly valuable in developing all of the concrete and sprayed concrete systems, as well as for the complete waterproofing concept.

### Sika Solutions:

<b>Sika® ViscoCrete®</b>	Superplasticizers
<b>Sigunit®</b>	Shotcrete accelerators
<b>SikaTard®</b>	Set retarders
<b>Sika®-PM</b>	Shotcrete spraying systems
<b>Aliva®</b>	TBM Spray robots
<b>Sikaplan®</b>	Tunnel waterproofing system

## THE KIRUNA MINE

Since 2008 Sika has been the main supplier of concrete admixtures and underground concrete construction technologies at Kiruna. Located in Swedish Lapland, north of the Arctic Circle, the challenges in terms of concrete production and logistics are manifold. Sika, together with its partner LKAB took on these challenges and today the LKAB operations are a showcase of 'Mining Best Practice' for other large, block cave mining projects around the world.

Kiruna is also now one of the world's largest underground sub-level block cave operations. Fast mining-cycle times are the key to maintain high productivity and ore throughput rates. Hence, an efficient in-cycle shotcrete set-up is required, providing fast re-entry times into the blasted areas once their perimeters are secured.

### Sika Solutions:

<b>Sikament®</b>	Superplasticizers (HRWR)	<b>Sigunit® AF</b>	Shotcrete accelerator	<b>Sika Control®-50</b>	Shrinkage reducer
<b>SikaTard®</b>	Consistency stabilizers	<b>Sika FastMix</b>	HRWR (powder)	<b>Sika Crackstop</b>	12 mm Fibers w
<b>Sika Aer®</b>	Air entrainers	<b>Sika Intrapast-A</b>	Expansion aid	<b>SikaFix®</b>	2-comp. injections
<b>Sika Retarder</b>	Retarders	<b>Sika Antifreeze S</b>	Antifreeze		
<b>SikaRapid®</b>	Concrete accelerators	<b>Sika NeatCrete</b>	Concrete remover		

## THE EMISOR ORIENTE TUNNEL, MEXICO

Mexico City, and its metropolitan area has developed and expanded over the years in an area that was once an area of swamp and lakes. As the city grew, more and more construction took place on the ancient swampland, the city was faced with increased risk of flooding. At present, a 62 km drainage tunnel is under construction, with 24 shafts and an output capacity of 150 cubic meters of water per second, making this a landmark in the Latin America infrastructure landscape. Sika has been involved with the project design and construction since the beginning, providing concrete admixture technologies for the precast segments to build the tunnel by TBM techniques. Sika also supplies many other materials to support the TBM's progress.

### Sika Solutions:

<b>Sika® ViscoFlow®</b>	Superplasticizers
<b>SikaFoam TBM</b>	Foaming agent for EPB - TBM excavation
<b>Sigunit®</b>	Shotcrete accelerators
<b>Sika®Separol</b>	Mould release agents

# TUNNELING AND MINING

Project references



## THE GRASBERG MINE, INDONESIA

The Grasberg mine, operated by Freeport McMoRan and jointly owned by Freeport and Rio Tinto, is one of the largest mining clusters on the globe. The mine is located in the very remote highlands of the Sudirman mountain range in the province of Papua, Indonesia. Freeport McMoRan and its main contractors are long standing partners of Sika.

Sika supplies large quantities of materials to the Grasberg operation including concrete admixtures for self-compacting, shaft lining concrete and shotcrete, plus shotcrete accelerators, injection resins and additional concrete refurbishment products. For example, to ensure rapid underground progress, the high performing Sika Sigunit® AF shotcrete accelerators are used to achieve high early strength of the shotcrete that allows cost efficient, short cycle times.

### Sika Solutions:

<b>Sika® ViscoCrete®</b>	Superplasticizers	<b>Sikacrete®</b>	High performance, dry sprayed gunite
<b>Sika ViscoFlow®</b>	Slump retainers	<b>Sikafloor®</b>	Industrial floors
<b>Sigunit®</b>	Shotcrete accelerators	<b>SikaFix®</b>	2-comp. injections
<b>SikaTard®</b>	Consistency stabilizers		

## THE METRO IN DOHA, QATAR

An extensive metro system is under construction in Doha, Qatar, with a total length of 358 km. The Doha Metro system will be one of the most extensive metro systems in the region. Phase 1, to be completed in 2018, comprises tunnels with a total length of 49 km, excavated using EPB-TBM machines. Elevated and at grade sections feature for approximately 30 km of this length.

Sika is the main supplier of concrete admixtures to produce the fire resistant precast concrete segments with a design life of at least 120 years. Sika is also supplying Sika membrane waterproofing solutions for all of the cross passages, plus concrete hardening accelerators and synthetic macrofibers, as well as Aliva wet spray machines, for the sprayed concrete lining. Elevated sections are assembled using the same SikaDur® structural adhesive as originally developed for the equally demanding requirements of segmental bridge construction.

### Sika Solutions:

<b>Sika® ViscoCrete®</b>	Superplasticizers	<b>Sika® Separol</b>	Mould release agents
<b>SikaFoam TBM</b>	Foaming agent for EPB – TBM excavation	<b>Aliva®</b>	Shotcrete machines
<b>SikaFiber®</b>	Synthetic microfibers for concrete	<b>Sikaplan®</b>	Waterproofing membranes
<b>Sigunit®</b>	Shotcrete accelerators	<b>Sikadur®-31 SBA</b>	Segmental bridge adhesive
<b>SikaFiber®</b>	Synthetic macrofibers for shotcrete		

## THE ESCOBAL MINE, GUATEMALA

Since the Escobal project in Guatemala broke ground, Sika has been involved as the main supplier for concrete admixtures and many other specialty chemicals. In order to achieve the ore throughput levels of 4'500 tons per day, of which half will be put back underground in the form of cemented paste backfill, the mine needs an efficient in-cycle support installation for rapid development rates. From the very beginning, one of the main challenges was to provide enough underground production headings in order to source enough ore feed for the mill on surface. Hence, multiple ore development headings are driven simultaneously, in sometimes difficult ground conditions, which require expert shotcrete support in mix design and spray application that is all fully integrated into the mining cycle.

### Sika Solutions:

<b>Sika® ViscoCrete®</b>	Superplasticizers
<b>Sika® ViscoFlow®</b>	Slump retainers
<b>SikaTard®</b>	Consistency stabilizers
<b>Sigunit® Alkali-free</b>	High performance shotcrete accelerators
<b>Sika®-PM</b>	Shotcrete spraying system



# GLOBAL BUT LOCAL PARTNERSHIP



## FOR MORE 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 most current local Product Data Sheet prior to any use.



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