



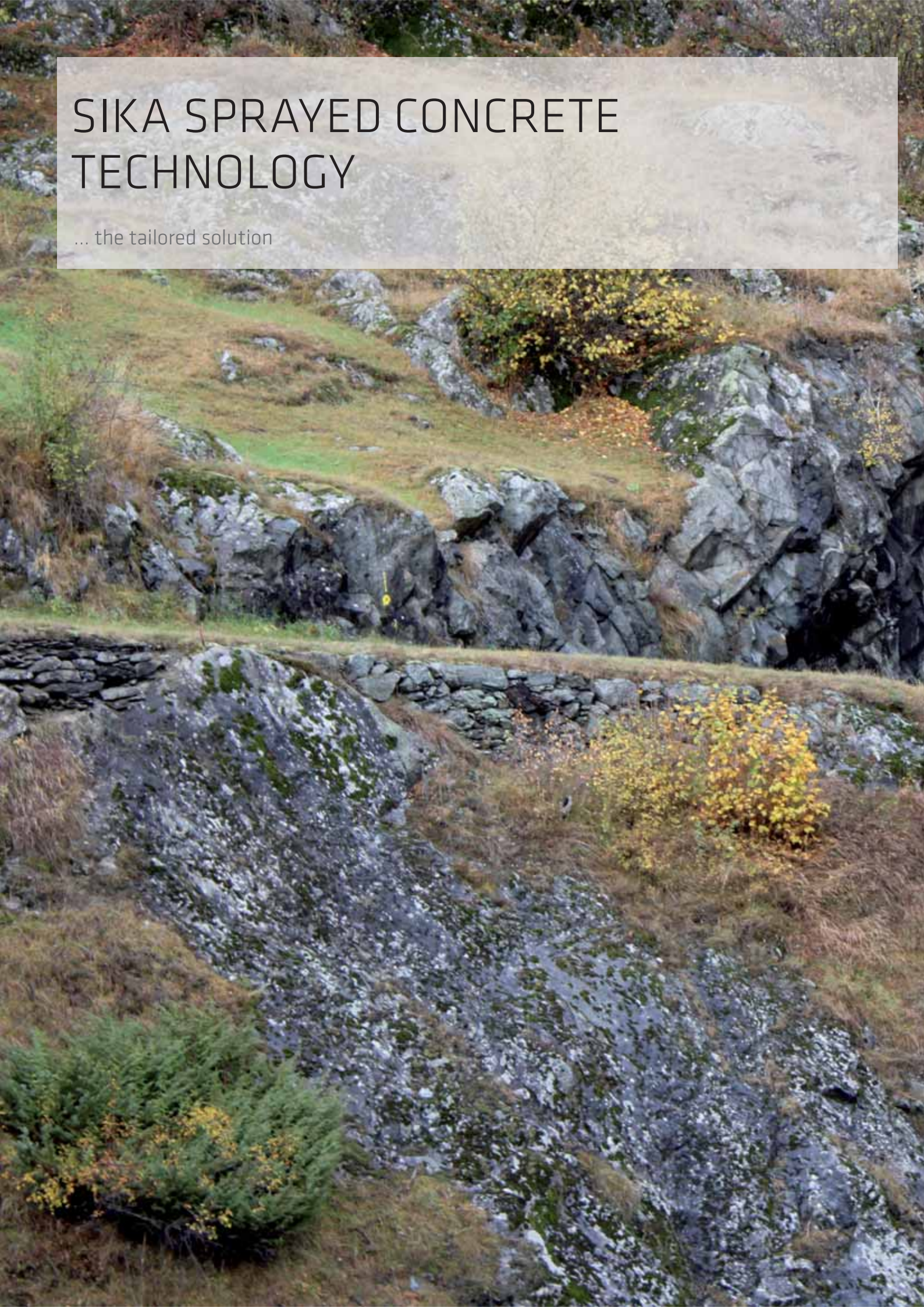
CONCRETE SIKA® SPRAYED CONCRETE TECHNOLOGY

BUILDING TRUST



SIKA SPRAYED CONCRETE TECHNOLOGY

... the tailored solution





SIKA SPRAYED CONCRETE TECHNOLOGY



Sprayed concrete unites many aspects of modern concrete technology with respect to materials handling technology as well as concrete admixture chemistry. Increasing demands on cost-effectiveness, and protection of health and the environment mean that sprayed concrete technology is continuously improving. Sika's sprayed concrete products represent the newest generation of cutting-edge technology. They unify one hundred years of knowledge, economy and quality. Sika provides solutions!

The many demands placed on sprayed concrete today mean there are no longer standard solutions. Depending on the application process and the structure, varying conditions effect the sprayed concrete. In tunnel construction sprayed concrete is normally employed for excavation stabilization, in open mining and on major construction sites for the fixation of slopes in the foreground and in bridge refurbishments sprayed concrete is used specifically because formwork can therefore be dispensed with, resulting in significant savings. Through decades of activity in the area of construction,

Sika understands the difficulties of building. Sika provides solutions that surmount these challenges.

Sika masters all the technologies of sprayed concrete, from wet to dry spray applications. Thanks to the development of our own sprayed concrete application machine Aliva, research and production of concrete admixtures such as Sigunit and Sika ViscoCrete and years of experience in tunnel construction and in major construction projects, Sika is the ideal partner for principal owners, planners and contractors. Innovation is the most critical property of Sika products, since only innovation masters the high demands for environmental protection, cost-effectiveness and quality. Our great success speaks for itself. Major projects such as the Gotthard Railway Base Tunnel or Karahnjukar are being built with Sigunit and Sika ViscoCrete technology. These products are subject to the requirements of the worldwide environmental management system "Responsible Care", which requires continuous performance improvement in the areas of health, safety and environmental protection.



SPRAYED PROCESSING

Thin stream and dense stream processes



Sprayed concrete can be processed as dry or wet mix. Two different procedures are used. The choice of the spraying procedure is dependant on the particular application, construction methodology, conveying volume and distance.

In the “dense” stream process, concrete is fed through hoses by means of pumps, whereas in the “thin” stream process the concrete is conducted through hoses by means of compressed air.

Both processes are characterized by specific advantages.

Thin stream process

- High flexibility
- Simple operation
- Lower requirements for mix design.

Dense stream process

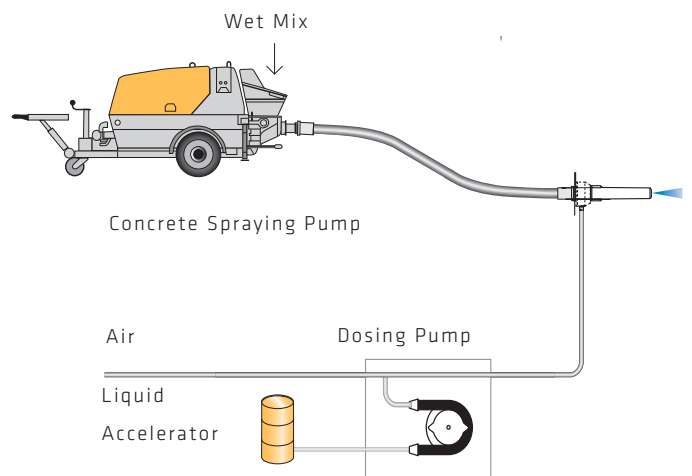
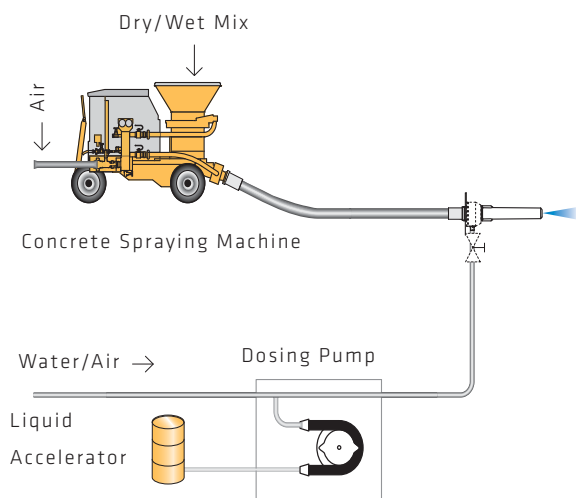
- High spray output
- Low air demand
- Low dust generation.

THIN STREAM PROCESS

Rotor machines convey concrete pneumatically by means of air (thin stream). The advantage of this method is that both wet and dry spray concrete can be applied in this manner. Since spray machines for the thin stream process are considerably smaller than those for dense stream processing, this technique is ideally appropriate for applications in the area of refurbishments, in which spatial limitations often impede work.

DENSE STREAM PROCESS

When substantial quantities must be applied the concrete is pumped through pipelines in a dense stream to the nozzle, where it is dispersed by compressed air. Accelerator is mixed into the concrete with the compressed air. The nozzle turns the concrete-accelerator mixture into a spray jet. Thanks to the large output capacity this method is generally employed for excavation stabilization in tunnel construction and for the stabilization of large building pits.



PRODUCT TECHNOLOGY

Selective solutions with admixtures and application technology for Sika

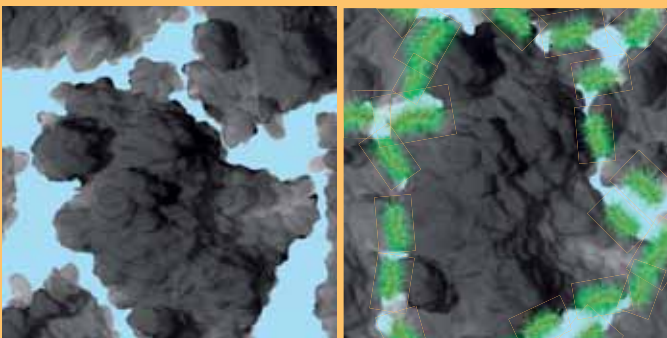
WITH SPRAYED CONCRETE ADMIXTURES AND APPLICATION TECHNOLOGY FROM SIKA, INDIVIDUAL CHALLENGES ARE OVERCOME IN A TARGETED MANNER.

Sprayed concrete must demonstrate a sufficient workability and exhibit an extremely rapid strength development. Occupational safety and environmental protection have grown to be definitive factors in the development of admixtures for sprayed concrete. Products must therefore conform to international standards and be economical in use. By using high-quality Sika admixtures for sprayed concrete, processes can be optimized and durability is significantly improved.

SUPERPLASTICISERS

Sika ViscoCrete technology controls the workability and increases the durability of sprayed concrete. Due to outstanding water reduction, Sika ViscoCrete reduces the water demand of the concrete and increases its workability at the same time. Sika ViscoCrete products are designed to work with Sigunit; the strength development of the sprayed concrete is positively influenced by the coaction of the superplasticiser and accelerator.

- High water reduction
- Better workability
- Time controlled workability.

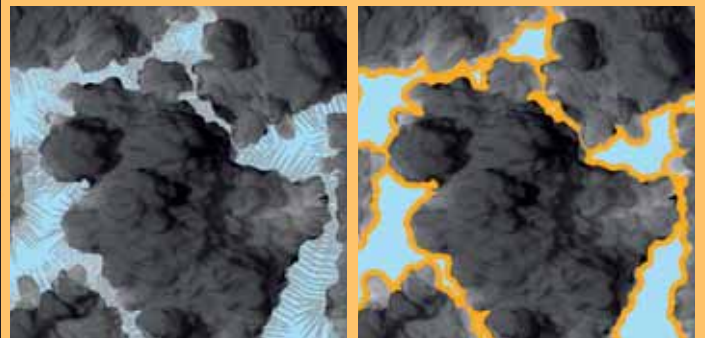


The cement grains are repelled from each other by Sika ViscoCrete through electrostatic and steric forces. So the concrete can be processed optimally at a low w/c ratio.

SET RETARDING ADMIXTURES

SikaTard regulates the hydration of sprayed concrete. This enables extension of the sprayed concrete's workability, so that freshly mixed sprayed concrete can be worked (without difficulty) throughout periods of time from just a few hours to up to 72 hours.

- Adjustable workability
- No cleaning of pumps and hoses necessary during the retarding phase
- Proven interaction with Sigunit and Sika ViscoCrete High water reduction



SikaTard retards the crystallization and allows a long workability of the concrete.

SPRAY MORTARS

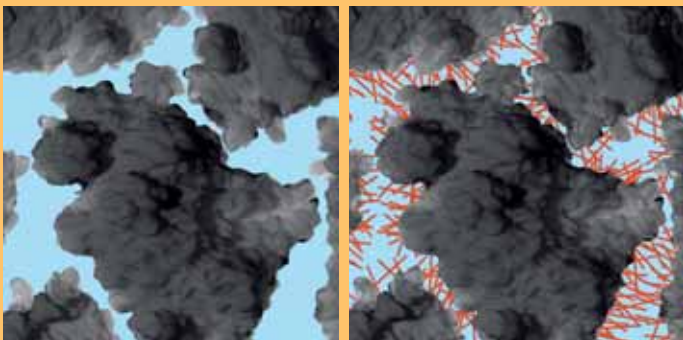
Sika spray mortar products are ready to use for specialist applications such as refurbishments, waterproofing or fire protection. Ready to use mortars provide flexibility on construction sites, since materials can be warehoused for long periods and can be sprayed with comparatively small machines.



ACCELERATORS

Sigunit causes a rapid setting of the sprayed concrete and accelerates the strength development in the first hours. Sigunit technology includes a broad palette of setting accelerators that are tailored to the various spraying processes and construction procedures.

- High early strength development
- Safe working
- High durability
- Low rebound.



The concrete matrix sets due to the reaction of Sigunit with the cement solution causing an augmented formation of ettringite.

CONCRETE SPRAYING EQUIPMENT

Aliva rotor systems are robust, low-wear concrete spraying machines. Thanks to the modular system design, individual units can be combined that are adapted to the respective, object-specific requirements.

- Aliva rotor machines
- Aliva dosing units
- Aliva TBM spraying robots.

Sika-PM are large-scale systems employed in mid-sized to major projects. These spraying devices are equipped with a rotor or a concrete pump and convey exclusively wet spray concrete. These systems offer a high degree of flexibility for mechanised concrete spraying.

- Sika-PM407 concrete spraying system
- Sika-PM500 concrete spraying system.



REQUIREMENTS

The optimal interplay of application technology and mix design increases cost-effectiveness.



There are many requirements placed on sprayed concrete. Depending on the location of use; a long duration of workability, a high spraying output or an adapted quality are demanded. Cost-effectiveness, environmental protection and occupational safety are constantly in the forefront.

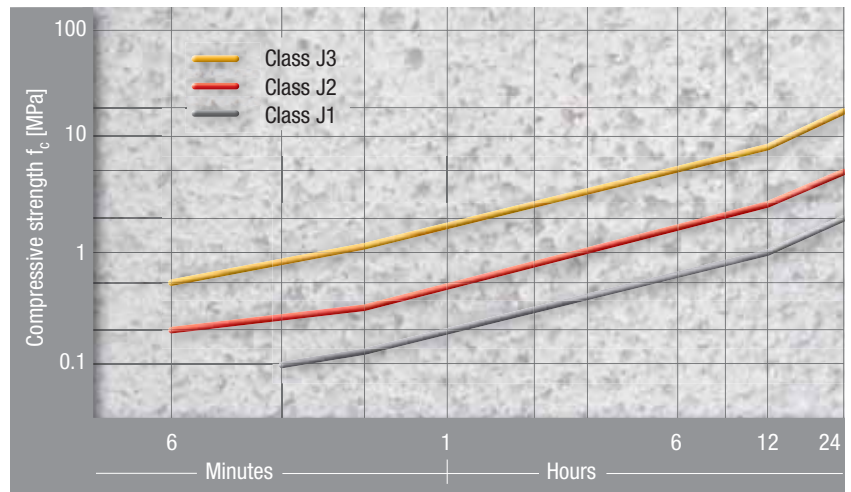
Sika sprayed concrete technology unites all these needs and makes possible a targeted adjustment of the sprayed concrete to the requirements of the building owner, the planner and the contractor.

The bulk of sprayed concrete is employed today in tunnel and mining construction. In underground constructions, early strength development plays a central role. Sprayed concrete should be applied quickly in thick layers, including overhead. As a result the strengths of freshly-applied sprayed concrete are divided into three classes: J1, J2 and J3 (EN 14487).

CLASS J1 sprayed concrete is appropriate for application in thin layers on a dry substrate. No structural requirements are placed on the sprayed concrete within the first few hours following application.

CLASS J2 sprayed concrete is used for tasks in which application must occur quickly in thick layers. It is appropriate under circumstances of slight water afflux and directly following work steps such as drilling and blasting.

CLASS J3 sprayed concrete is employed with highly fragile rock mass and strong water afflux. Due to rapid setting, more dust and rebound is generated, for which reasons class J3 sprayed concrete is only used in special cases.



Early Strength Classes (EN 14487-1)

REQUIREMENTS

REQUIREMENTS AND SOLUTIONS FOR OWNERS, DESIGNERS AND CONTRACTORS.

OWNER - REQUIREMENTS

Depending on the method of excavation stabilization, different requirements are placed on the sprayed concrete. Temporary protective layers require a lower durability than permanently sprayed concrete shells. Cost-effectiveness is considered in regard to the application technology for the situation and to the sprayed concrete tailored to the method. To ensure sustainability and safety the highest quality demands are placed on man and material.

This implies:

- High durability and quality with low maintenance
- Overall sustainable construction
- Cost-effectiveness
- Reliability
- Safety.



OWNER - SOLUTIONS

In order to reach the above listed aims, a well adjusted system is essential. A fast setting, alkali-free accelerator combined with a highly durable concrete will ensure these needs.

Sika Sprayed Concrete Technology offers the following possibilities:

- High durability due to a low w/c ratio with Sika ViscoCrete
- Safe and gentle application with Sigunit
- Resistant repair and protection with Spray Mortars
- Sustainable application due to a proven application system.



DESIGNER - REQUIREMENTS

The planner places high demands on the mix design of the sprayed concrete. On one hand rapid strength development is expected to ensure good tunneling performance, while on the other high ductility (steel fibres) are also required. Resistance to frost and freeze/thaw, sulphates, watertightness and high final strength are also evaluated as indicators for durability. Economic aspects thereby include low rebound, high output and the fulfillment of requirements with the thinnest possible layer.

Furthermore importance is attached to:

- Design freedom and compliance with standards
- Sustainability
- Durability and quality
- Mechanical behavior
- Technical functionality

DESIGNER - SOLUTIONS

The resistance of the structure against all the influences which can occur in an underground construction is a challenging task for the designer. Further economical and environmental requirements demand sustainable system solutions.

To achieve the aims listed, Sika Sprayed Concrete Technology offers solutions to this challenge:

- Impermeability of the hardened concrete facilitated by the high water reducing capability of Sika ViscoCrete
- Outstanding strength development due to the use of Sigunit accelerators
- Spray Mortars for durable repair and protection of the structure
- Proven systems with respect to standards and the environment.

CONTRACTOR - REQUIREMENTS

The contractor strives to fulfill requirements in the most cost effective method. Work safety is emphasized to protect employees and to avoid costly work interruptions. Highest early strength, large machine output and at the same time minimal rebound increase cost-effectiveness from the view of the applicator. Long periods of workability, thick spray layers with optimized mix design, easy handling and storage raise the quality of sprayed concrete.

This means:

- Quality workable concrete
- Fast and easy application of sprayed concrete
- Good finishing behavior
- Cost effective sprayed concrete systems
- Safe working conditions

CONTRACTOR - SOLUTIONS

The contractors focus regarding a sprayed concrete application is on fast strength development in an early stage, and the cost efficiency of the system.

In order to meet these requirements, Sika Sprayed Concrete Technology supports your application:

- High initial strength by using Sigunit
- Long workable concrete due to the addition of SikaTard
- Improved processing of the concrete thanks to Sika ViscoCrete
- Fast and easy repair and protection with ready to use Spray Mortars
- Aliva & Sika-PM Robust and low-wear concrete spraying machines for an efficient application
- Approved system solutions which fulfill the technical requirements with respect to health and safety.

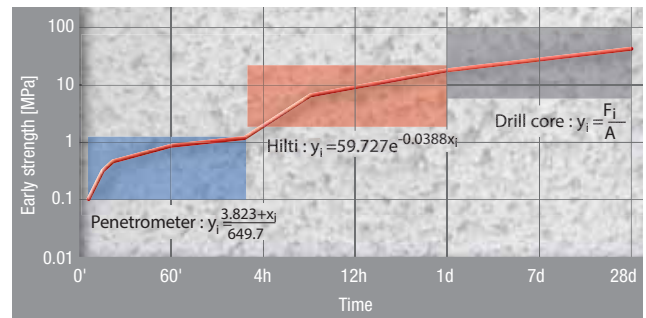


TECHNICAL SUPPORT

Tailored solutions for every application

IN ORDER TO ADJUST THE PROPERTIES OF SPRAYED CONCRETE in a targeted manner for the complex challenges met in tunnel construction, Sika maintains regionally its own sprayed concrete laboratories and a worldwide network of sprayed concrete experts.

The optimal adjustment of the admixtures to the cement can be determined in the spray laboratory; this guarantees high cost-effectiveness on the construction site. With their detailed knowledge in application technology, quality assurance and sprayed concrete admixtures the sprayed concrete specialists help planners and contractors to adjust the mix design according to the requirements.



Determination of early strength

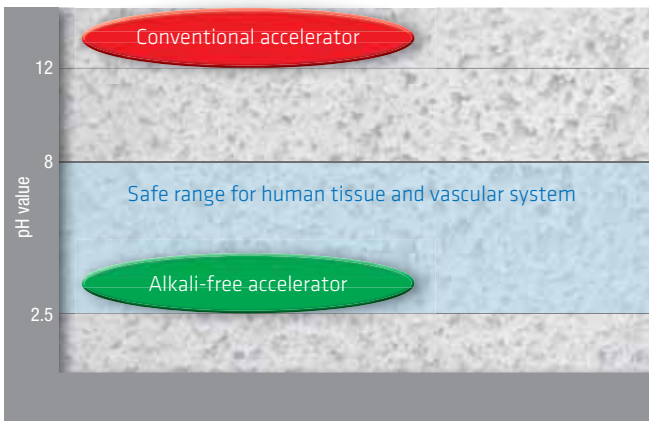


SUSTAINABILITY

Safety, environment and health

SIKA'S NEWEST GENERATION OF SPRAYED CONCRETE admixtures conform to the international "Responsible Care" standard, which establishes basic principles regarding safety, health and environmental protection. Products are subject furthermore to strict testing. These newest developments are thus classified according to European guidelines (EFCA Seal) as neither harmful to health nor environmentally dangerous.

The non-toxic and alkaline-free accelerators have a low pH value. In contrast to older generation accelerators they exhibit a lower risk for people and the environment in transport, storage and use. The atomized spray contains no caustic accelerator aerosols, thus avoiding injury to skin, eyes or mucous membranes.



SPRAYED CONCRETE WORLDWIDE

KAREBBE HYDROELECTRIC POWER PROJECT, INDONESIA

PROJECT

Third Hydroelectric Plant to supply electric power to PT INCO, largest nickel mine in Indonesia.

Main Contractor: Kajima-PP

Consultant: SNC LAVALIN

Owner: PT International Nickel Indonesia

REQUIREMENTS

40-MPa strength sprayed concrete with use of steel fibre specified as structural reinforcement.

Wet mix sprayed concrete with workability up to 60 minutes using locally available cement and aggregates.

SIKA SOLUTIONS

Use of Sika ViscoCrete SC-305 yields the desired workability and high water reduction to achieve high strength sprayed concrete. Sigunit L53-AF MY is used as an accelerator. Aliva-503 is used to spray on narrow areas and some slopes while modified Aliva-285 is used in the diversion tunnel.



NEW RAIL LINK THROUGH THE ALPS, GOTTHARD RAILWAY BASE TUNNEL, SWITZERLAND

PROJECT

As of 2017, the new flat trajectory railway through the Swiss Alps will link Europe's high-speed railway networks. The core of the new link is the Gotthard Base Tunnel with a length of 57km. Sika was a significant participant in the excavation stabilization and expansion of this structure.

REQUIREMENTS

The high demands placed on the interior work, which should guarantee a durability of 100 years, also required high performance from the sprayed concrete. With the processed excavation material and high durable cements, a strength development of class J2 was expected to be achieved. Despite the long transport distances and high temperatures the workability of the sprayed concrete had to be guaranteed for more than three hours.

SIKA SOLUTIONS

In order to fulfill the high requirements, intensive pre-qualifying tests were conducted in the Testing Gallery Hagerbach in



Switzerland. Among other characteristics optimized for excavation stabilization were sulphate resistance, early strength, workability, and for the vertical, 800m long access shaft at the Sedrun construction site, the fire resistance of the sprayed concrete.

Sika ViscoCrete -	Superplasticiser
Sigunit L AF -	Sprayed concrete set accelerator
SikaTard -	Set retarder
SikaPump Start 1 -	Lubrication agent for dense stream pumping
SikaPump -	Stabiliser and pumping agent
SikaFume -	Silica fume
Sika-PM -	Concrete spraying systems
Aliva -	TBM-Robots
SikaPlan -	Tunnel sealing membranes.



HYDROPOWER PROJECT KÁRAHNJÚKAR, ICELAND

PROJECT

In East Iceland an immense hydropower station is being developed that will generate 690 MW of power. The project includes several large dams and a tunnel system more than 60km in length. The core consists of a 190m high rubble dam with a concrete surface.

REQUIREMENTS

The long transport distances and very low temperatures demanded special logistical solutions for the sprayed concrete admixture. The concrete spraying machines also had to fulfill special needs, since they are used in caverns as well as in cramped galleries.

SIKA SOLUTIONS

Due to the very tough climatic conditions, accelerators in powder form were employed that could be dissolved in water just-in-time on site. Logistics costs could thereby be reduced and storage times considerably increased. Concrete spraying systems of modular design were used, with elements such as the sprayed concrete pump Sika-PM 702 and telescopic spray boom Aliva-302 being mounted on railway cars.

Sika ViscoCrete-	Superplasticiser
Sigunit AF -	Sprayed concrete set accelerator
Sika-PM -	Concrete spraying systems
Aliva -	Concrete spraying systems
SikaPump -	Stabiliser and pumping agent
SikaAer -	Air entrainer
SikaFiber -	Steel fibres.



JOHNSTONE'S HILL TWIN TUNNELS, NEW ZEALAND

PROJECT

The Twin tunnels at Johnstone's Hill north of Auckland are part of a four lane motorway extension to improve transport infrastructure and support the economic and social well-being of the areas to the north. Construction of the tunnels started in January 2006 and was completed in 2009. The tunnels run a total length of 640m and the design includes two cross-passages, lighting, ventilation and fire protection. The tunnels are constructed through a steep ridge line clad with native forest.

REQUIREMENTS

The tunnels had several engineering challenges including the site's location within a steep mountainous area high in ecological value. The initial tunnel support was to be sprayed concrete incorporating steel fibres, and the shotcrete mix had to meet the specified compressive and flexural strength tests. The batching plant was approximately 30 minutes away from the site, and it was the preference of the tunnel engineer that the mix was not to be dosed with admixtures on site.



SIKA SOLUTIONS

Construction of concrete:

Sika ViscoCrete
Sigunit L53AF
Formol
Rugasol
SikaFillm
Separol WB-230
SikaTard-930

Sealant:

Sikaflex-11 FC
Sikaflex MS
Sika Firerate & Firerate PU
Sikaflex Construction
Sikaflex Tank
Sika Boom

Waterproofing:

SikaProof Torch-on 3P & 4P Mineral
Sikaplan FPO

Grouting:

Sika Grout-212,-215
Sika Grout-212HP
Sika Grout GP
Sikadur-31
Sikadur-41
Sikadur-42

Concrete Repair:

MonoTop Primer
MonoTop Structural Mortar
MonoTop High Build Mortar
MonoTop Micro Concrete
Nitokit LV
Nitokit TH





FOR MORE CONCRETE INFORMATION:



WHO WE ARE

Sika AG, Switzerland, is a globally active speciality chemicals company. Sika supplies the building and construction industry as well as manufacturing industries (automotive, bus, truck, rail, solar and wind power plants, façades). Sika is a leader in processing materials used in sealing, bonding, damping, reinforcing and protecting loadbearing structures. Sika's product lines feature high quality concrete admixtures, specialty mortars, sealants and adhesives, damping and reinforcing materials, structural strengthening systems, industrial 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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