



CONCRETE BACKFILL IN TBMs

BUILDING TRUST



BACKFILLING

Filling the gap in TBM excavation

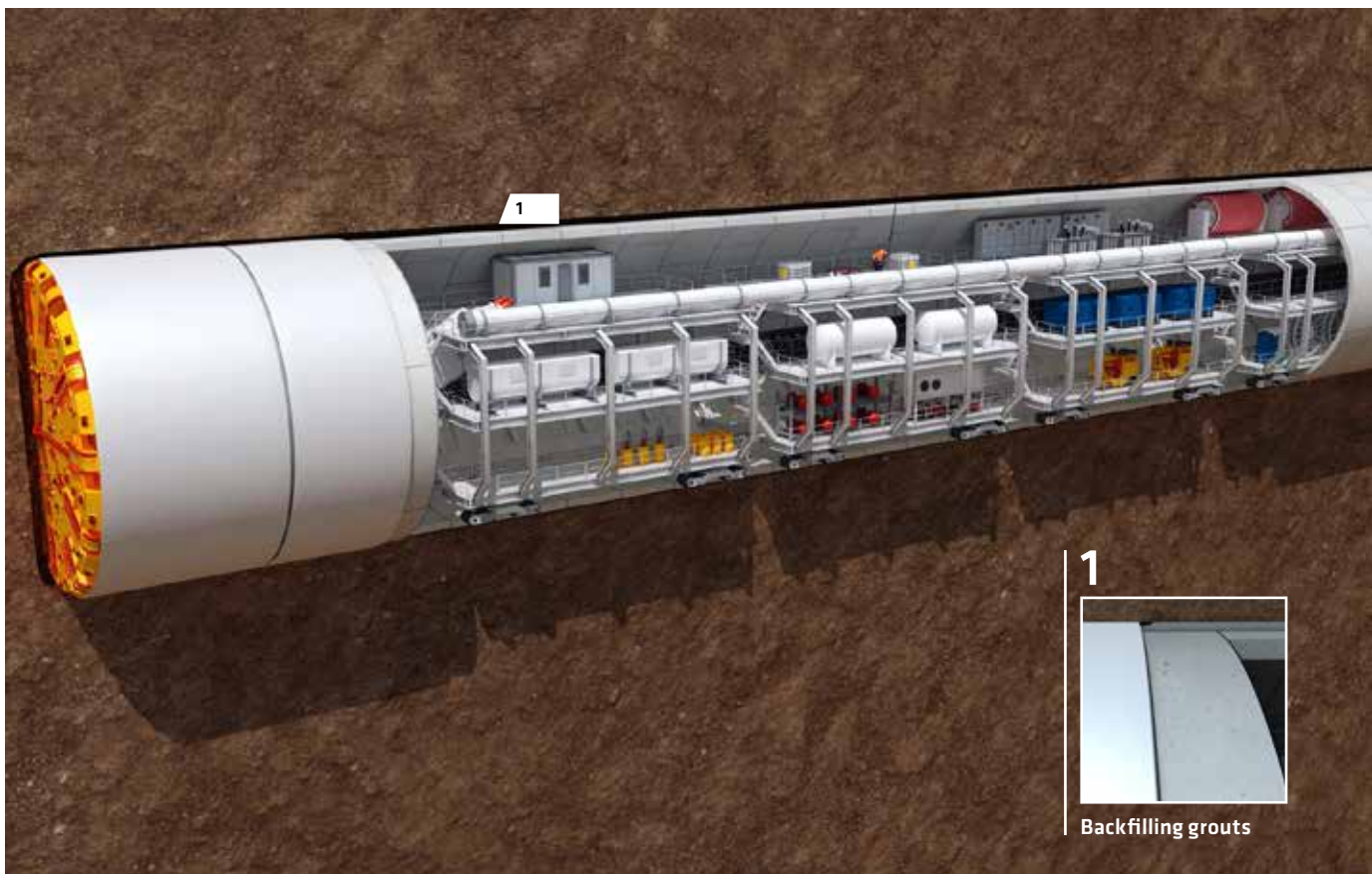
SIKA IS ACTIVELY INVOLVED AROUND THE WORLD in different tunneling projects, providing a wide range of products for TBM backfilling. We present solutions to fulfill specific project requirements.

Excavation with shielded tunnel boring machines (TBMs) requires that precast concrete segments are continuously installed behind the shield to form the tunnel lining.

Allowing movement flexibility to the machine and providing space to install the precast segments – where the advance cylinders push to move forward-, the excavated diameter is bigger than the external diameter of the segments. This difference in the diameters and the space resulting depend on the type of geology to be excavated and the specific TBM design. This space is normally identified as annular gap and generally counts some centimeters.

The filling of this annular gap with a proper material is very important during the excavation process and following goals are considered:

- The filling helps fixing the precast segments into position.
- Keeping the natural state of the ground after excavation, avoiding settlements.
- It ensures homogeneous contact of the precast segments to the ground.
- It transfers the load from the TBM back-up to the ground.
- Together with the precast segments, it helps the water-proofing of the tunnel.



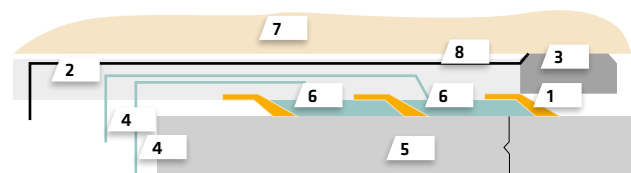


In order to satisfy specific requirements, the filling of the annular gap needs to consider the following aspects during operation:

- The filling material needs to be easily pumped, even over long distances inside the machine or into the tunnel.
- The filling material should allow continuous injection during TBM advance.
- Blockages in the injection lines, damages of the injection pumps and sedimentation in the storage tanks should be avoided.
- The reparation and down-time for the different components of the system needs to be minimized as much as possible.
- The annular gap needs to be fully filled avoiding any space inside the filling material.
- Even by presence of ground water, the pumped material needs to remain in place and cannot be washed.
- Depending on the ground to be excavated, specific requirements for compressive strength and hardening of the filling material may be required.
- Considering possible stops during the excavation of the TBM, the injection of the filling material may be stopped and re-started in short periods of time without affecting the advance of the machine or the quality of the final injection.

Depending on the type of machine and the requirements during the excavation, the type of filling can be classified in three groups:

- **Inert mixes** are based on sand and gravel with the possibility to inject the bottom tunnel section with a mortar in a later stage.
- **Mortar mixes** made with water, cement, fillers, fine aggregates and chemical admixtures.
- **Two component grouts** are very fluid mixes specially stabilized, needing a separated accelerator to start “gelling” in shorter time.



1 Wire brush	2 Tailskin	3 Backfill	4 Grease lines
5 Concrete segment	6 Tail Seal Sealant	7 Ground	8 Grout lines

ONE OR TWO COMPONENT

The right option for your TBM

DIFFERENT SYSTEMS HAVE BEEN SUCCESSFULLY DEVELOPED AND OPTIMIZED trying to improve the excavation of the TBMs. Challenging strength requirements, complex and changing geological conditions in longer tunnels and the growing expectation to save resources have promoted the development of different type of mixes and optimized formulations.

ONE COMPONENT MORTAR

A traditional fluid combination of water, cement and fillers is treated with admixtures to optimize the water/cement ratio and to customize parameters such as workability and setting time.

This mix is fluid and is usually retarded some hours to avoid blocking of the transfer and injection lines in the TBM. The idea is to allow enough time to carry out different activities during TBM excavation before the mix hardens.

The relative higher cement content provides a higher strength value than the surrounding ground.

Sika offers a complete range of Stabilizers and Retarders to prepare these mixes.

TWO COMPONENT GROUT

The two-component grout is based on the called "Component A" which is a mix of water/cement, bentonite and admixtures. This very fluid mix has a high water/cement ratio providing long workability time and making it easier to be pumped over long distances during a relative long period.

The "Component A" transforms from a creamy liquid to a gel in few seconds, after adding an accelerator to the mix just before the outlet of the injection lines at the end of the shield. The accelerator is normally called "Component B". Depending on the working conditions and the geology, the "gel time" can be adapted during excavation.

Before the mix gels, it can fill every gap behind the tunnel lining. After hardening, it has comparable compressive strength to the surrounding ground.

For the required flow and retarded effect of the "Component A", as well as to control the hardening with the "Component B", Sika admixtures are used.





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SUPPORTING YOUR PROJECT

Our technologies around the world

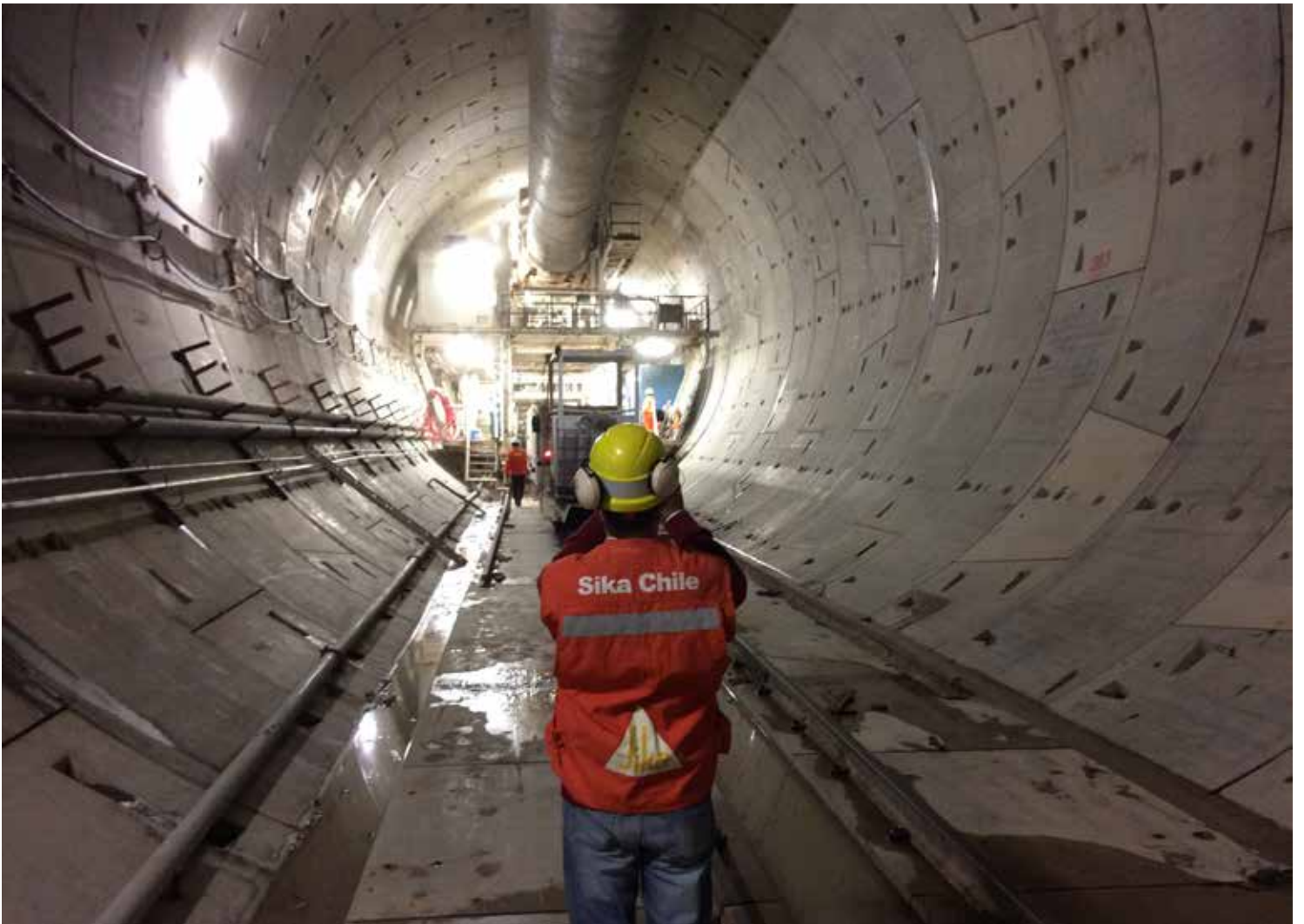


Sika counts with a wide range of products for the excavation with TBMs.

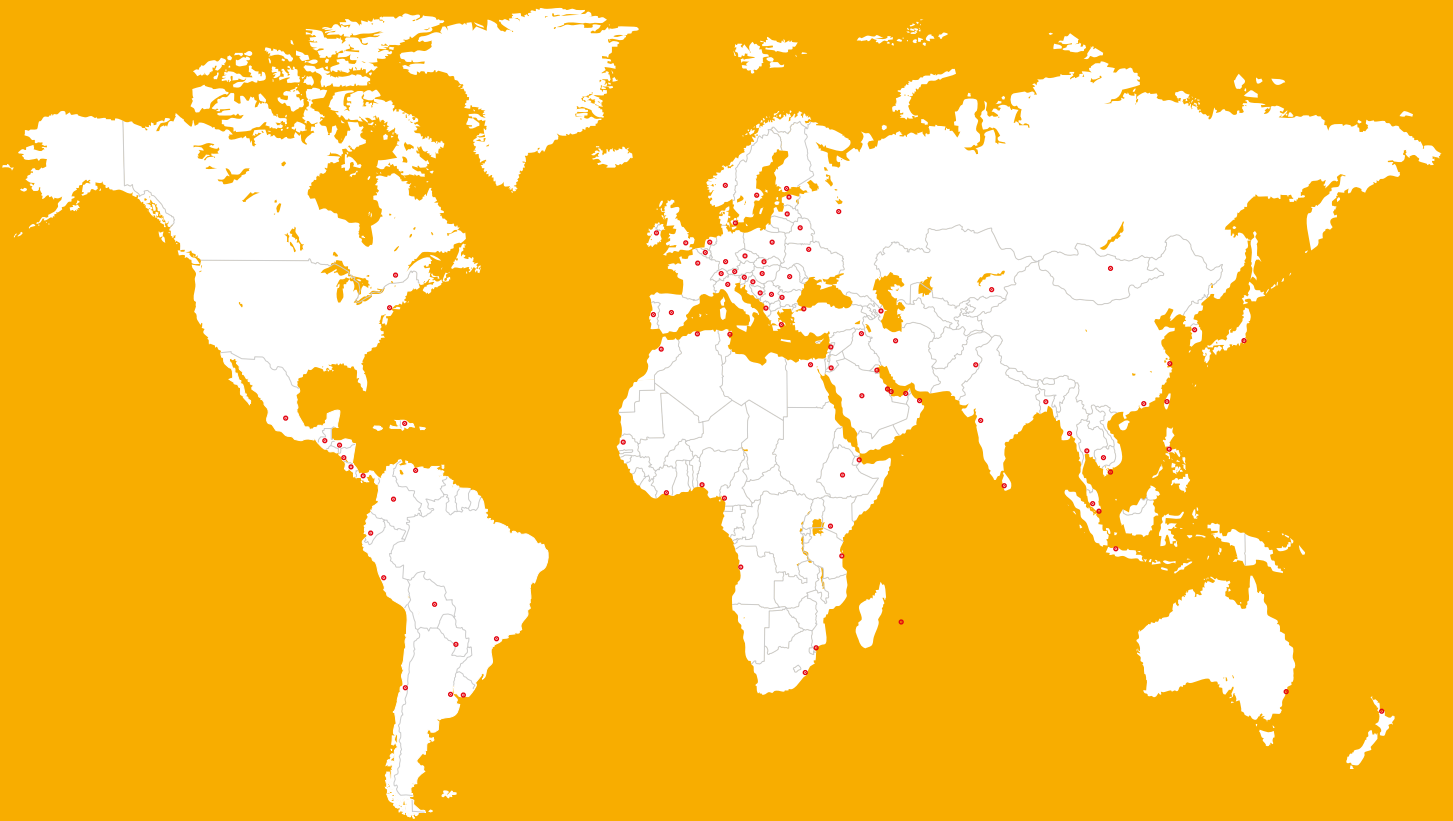
Our concrete admixtures help reaching the required technical expectations.

With global expertise and local support, Sika is constantly supporting the excavation team during all the phases of the project.





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, industrial 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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