

## UNDERGROUND SOLUTIONS

COMPREHENSIVE  
RANGE OF SOLUTIONS  
FOR SUSTAINABLE  
TUNNELLING PROJECTS

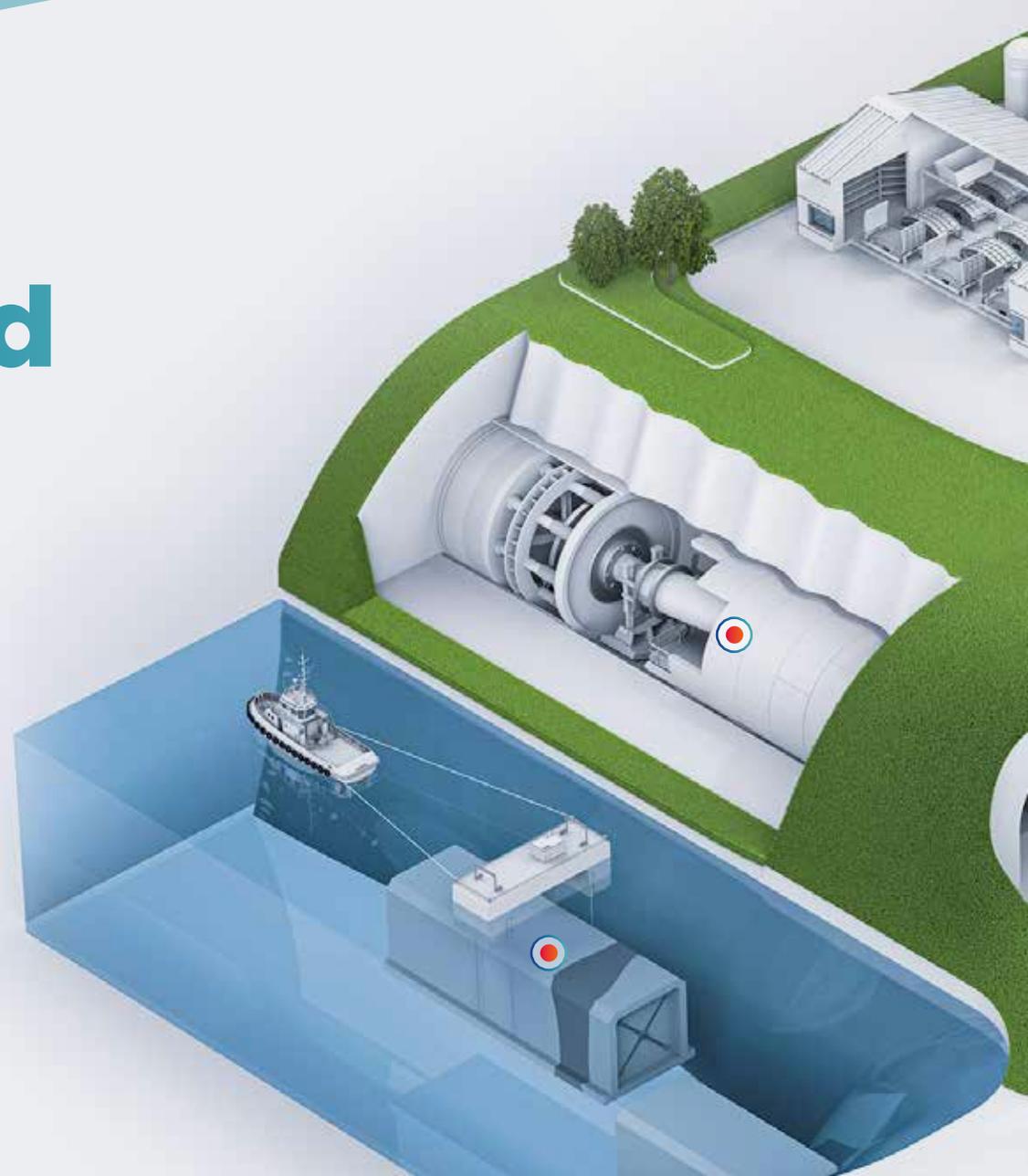
# Underground Solutions

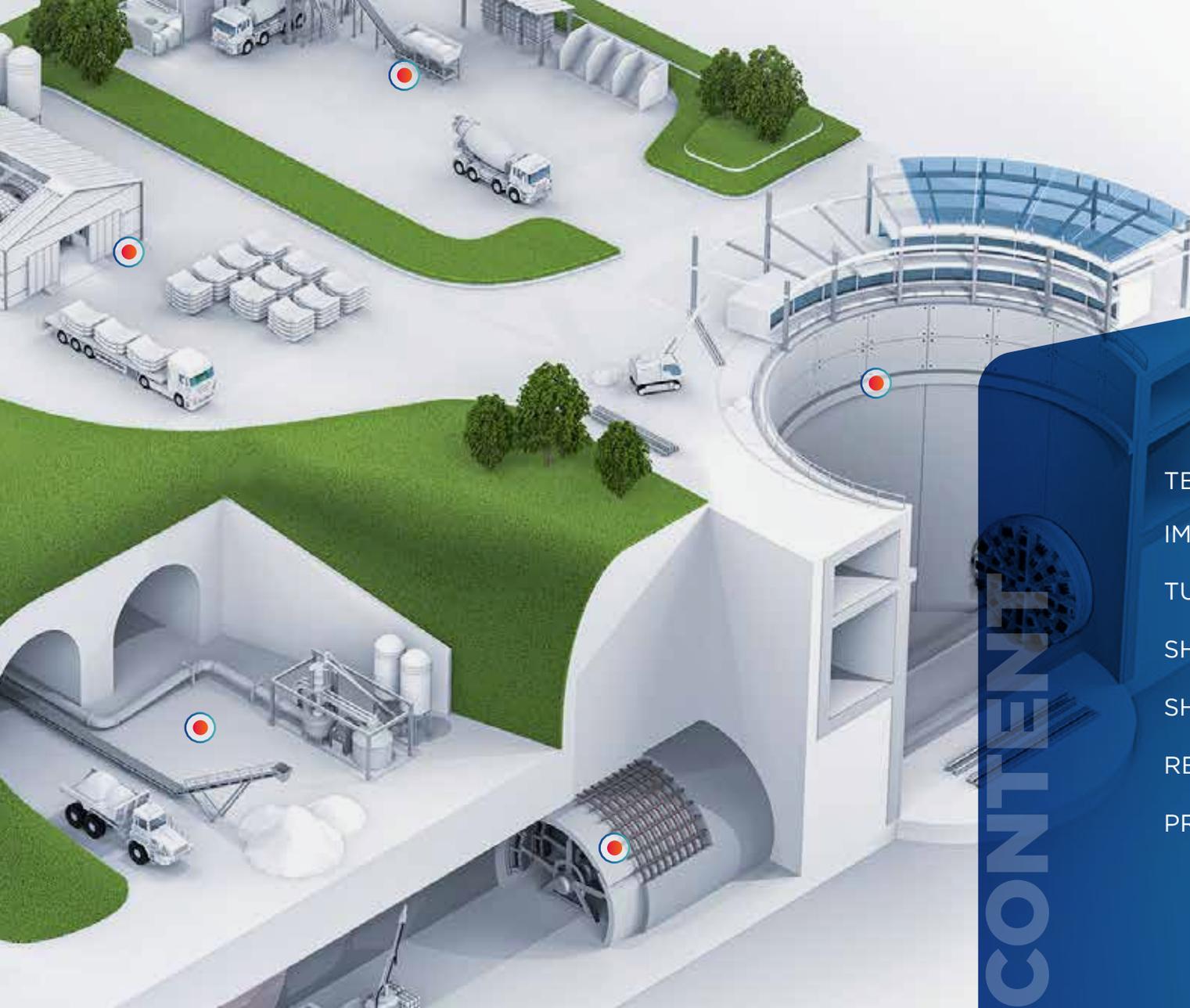
In September 2022, **CHRYSO and GCP** came together to form a new **Construction Chemicals Business Unit** within Saint-Gobain. CHRYSO and GCP offers **over 100 years of experience** in **innovation and technical services**, supporting the construction industry.

With a continued focus on **performance** and **sustainability** goals, we have introduced innovative solutions designed to **reduce the CO<sub>2</sub> footprint of cement and concrete**, as well as **foster the circular economy**.

We have **10 international R&D centers** and an **extensive network of applications labs** to manage and conduct research projects.

With the combination of CHRYSO and GCP expertise our **full tunnelling offering comprises** innovative and proven-effective products and services for concrete, shotcrete, waterproofing and Injection solutions.





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# TBM Solutions

GROUTS, GREASES, INJECTIONS,  
SOIL CONDITIONING POLYMERS  
AND WATERPROOFING INJECTIONS  
FOR TUNNEL BORING MACHINES.

01

## Backfill Grout Solutions

Reliable solutions for A+B grouts, traditional or hybrid Backfill.

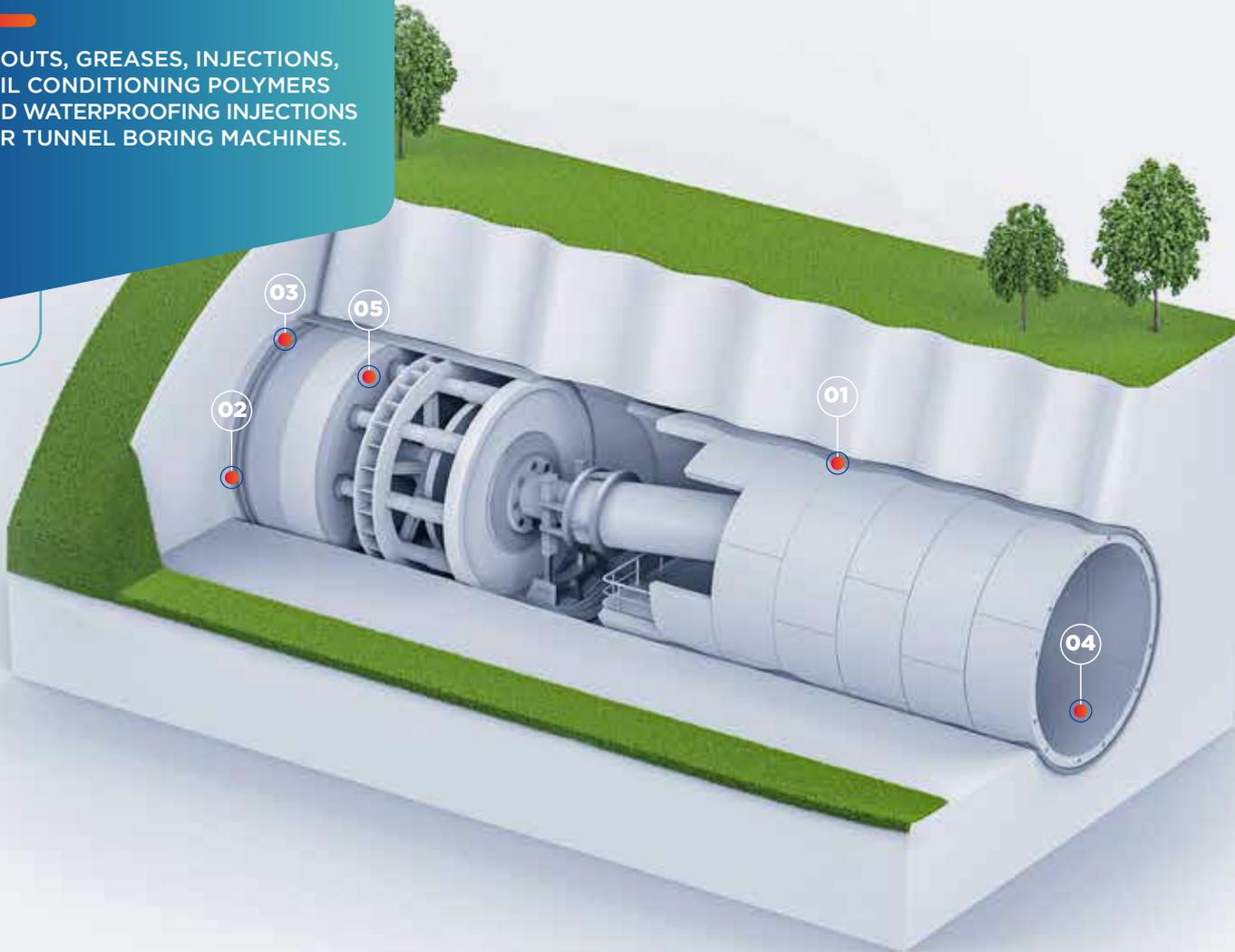
CHRYSO®TBM SGS A+B Backfill Technology is a liquid admixture solution, providing outstanding stability and rapid gelling time to the mortar. It offers superior filling performance and long-distance pumping capabilities while reducing the environmental footprint of A+B grouts.

### OUR SOLUTIONS

CHRYSO®TBM  
CHRYSO®TBM SGS

### OUR SERVICES

- + Definition of a tailored mix design
- + Grout performance qualification trials
- + On-site dispensing equipment and technical support



02

## Soil Conditioning Polymers

Reliable solutions for high & low permeability soils.

Our range of soil conditioning polymers increases TBM productivity, reduces wear and dust, and improves transport of excavated materials.

Our experts will recommend the most appropriate solution based on your project's geology and the TBM technology.

### OUR SOLUTIONS

CHRYSO® TBM SCF  
CHRYSO® TBM CP  
CHRYSO® TBM AAF



### OUR SERVICES

- + Product selection and application training

03

## Water control and void filling injection solutions

DE NEEF® Leaks Stop Here. Fast, Proven, Durable.

DE NEEF® injection resins are formulated and produced to be not water soluble and have no dilution loss or leaching during and after injection to bring the shortest possible injection cycles and give lasting solutions.

### OUR SOLUTIONS

DE NEEF® 1C • DE NEEF® HA Cut AF  
• DE NEEF® HA Cut CFL AF  
TYTRO® SI 550/660 • TYTRO® DN

DE NEEF®

TYTRO®



### OUR SERVICES

- + Special techniques such as DE NEEF® Combi-Grouting and DE NEEF® Combi-Block supported by our technical experts and extensive test data to deliver a proven and durable result

04

## Leak sealing repair and waterproofing injection solutions

DE NEEF® Leaks Stop Here. Fast, Proven, Durable.

DE NEEF® injection resins are formulated to be not water soluble and have no dilution loss or leaching during and after injection to bring the shortest possible injection cycles and give lasting solutions. Our resins are extensively tested with more than 90% closed cells and a tested service life of up to 120 years for durable and proven results.

### OUR SOLUTIONS

DE NEEF® 1C • DE NEEF® HA Flex LV AF  
DE NEEF® HA Flex SLV AF  
DE NEEF® HA Safefoam NF  
Gelacryl Superflex

DE NEEF®



### OUR SERVICES

- + Technical expertise supporting our applicators and contractors with method statements, technical solutions and extensive test data to deliver a proven and durable result

05

## Tail & Main Bearing seal greases

Safe, reliable and cost-effective solutions for brushes' first or continuous fill.

A wide range of tail seal greases adapted to EPB, slurry or double shield TBM for optimum consumption and reliability. They allow for high sealing performance even under brush stress. They are fire resistant and environmentally friendly.

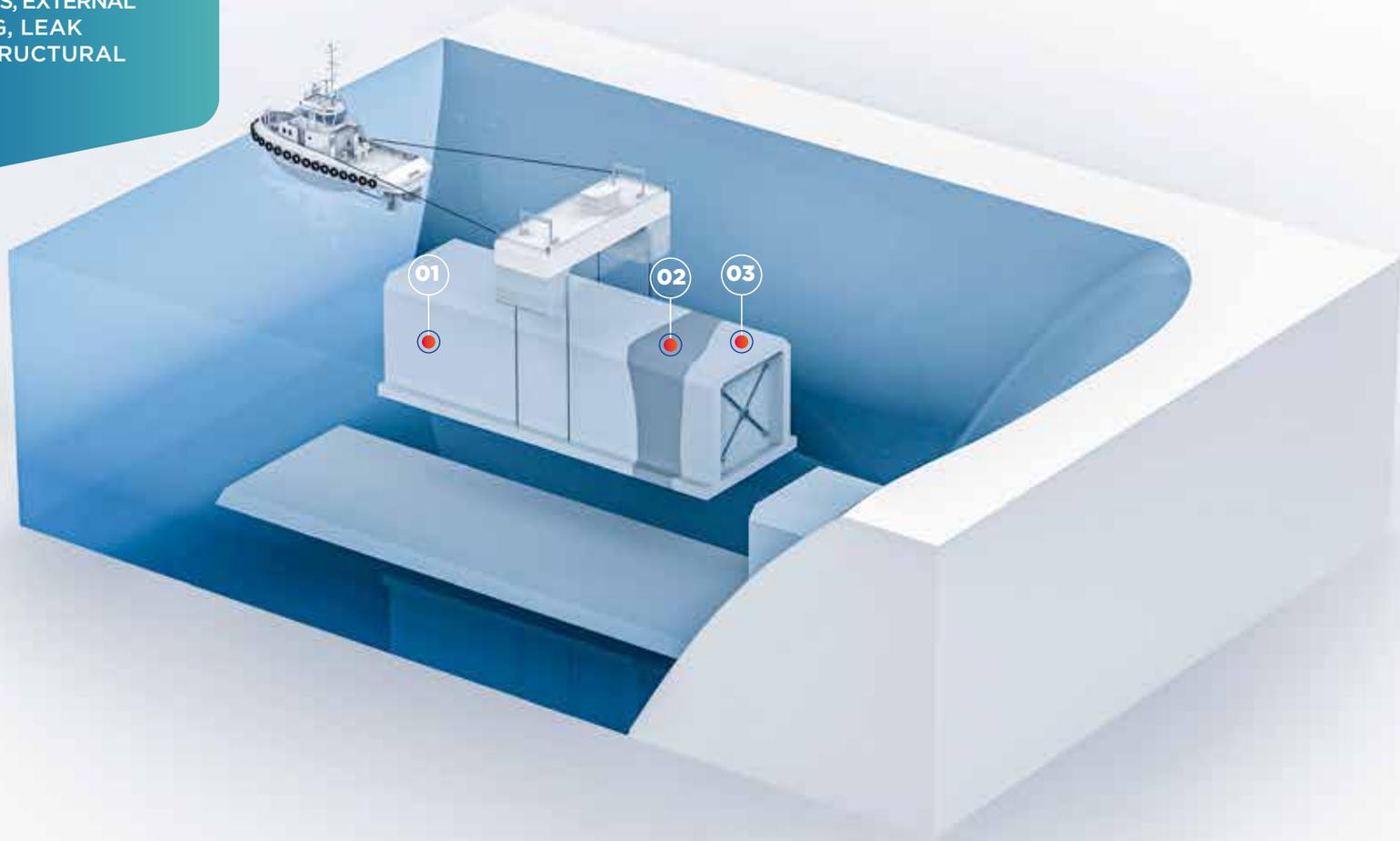
### OUR SOLUTIONS

CHRYSO® TBM GRS 20 & 30  
CHRYSO® TBM F 100 M  
CHRYSO® TBM F 100 L



# Immersed tunnel

ADMIXTURES FOR LARGE  
PRECAST ELEMENTS, EXTERNAL  
WATERPROOFING, LEAK  
SEALING AND STRUCTURAL  
INJECTIONS.



01

## Admixture solutions for large precast elements

Deliver flawlessly the most challenging performances while saving time, money and CO<sub>2</sub>.

Whatever your requirements and production constraints, we meet them with a wide range of high performances products and the support of our specialists from concrete design to project completion.

### OUR SOLUTIONS

CHRYSO®Premia • CHRYSO®Optima 1000  
CHRYSO®Xel • CHRYSO®Dem  
CHRYSO®TurboCast • CHRYSO®Serenis  
CHRYSO®CWA • ADVA® Cast ; PIERI® Clarol  
STRUX® • ECLIPSE®

STRUX®

PIERI®



### OUR SERVICES

- + Definition of a tailored mix design
- + Carbon content optimization
- + Durability testing
- + On-site technical support and training

02

## External waterproofing of immersed tube tunnels

Fully bonded, seamless, tough and durable waterproofing solutions developed to stand the test of time.

INTEGRITANK® is a fully reactive, elastomeric, cold spray-applied liquid waterproofing system designed to outlast the design life of the tunnel. It can be electrically tested to ensure integrity of waterproofing and provide instant quality assurance.

### OUR SOLUTIONS

INTEGRITANK®

INTEGRITANK®



### OUR SERVICES

- + Waterproofing Design support
- + On-site technical support
- + Approved applicator network
- + Installation training
- + Environmental Product Declarations

03

## Leak sealing and structural injection solutions

DE NEEF® Leaks Stop Here. Fast, Proven, Durable.

DE NEEF® injection resins are formulated and produced to be not water soluble and have no dilution loss or leaching during and after injection to bring the shortest possible injection cycles and give lasting solutions. DE NEEF® injection resins are extensively tested with more than 90% closed cells and a tested service life of up to 120 years for durable and proven results.

### OUR SOLUTIONS

DE NEEF® 1C PU  
DE NEEF® HA Flex LV AF  
DE NEEF® HA Flex SLV AF  
Denepox 40

DE NEEF®



### OUR SERVICES

- + Technical expertise supporting our applicators and contractors with method statements, technical solutions and extensive test data to deliver a proven and durable result.

# Tunnel entrance

WATER CONTROL INJECTIONS,  
EMBANKMENT STABILIZATION,  
SPOIL TREATMENT AND  
BACKFILL GROUT SOLUTIONS.



01

## Backfill Grout solutions

Reliable solutions for A+B grouts, traditional or hybrid Backfill.

CHRYSO®TBM SGS A+B Backfill Technology is a liquid admixture solution, providing outstanding stability and rapid gelling time to the mortar. It offers superior filling performance and long-distance pumping capabilities while reducing the environmental footprint of A+B grouts.

OUR SOLUTIONS

CHRYSO®TBM  
CHRYSO®TBM SGS



### OUR SERVICES

- + Definition of a tailored mix design
- + Grout performance qualification trials
- + On-site dispensing equipment and technical support

02

## Stabilized embankment

Consistent high or ultra-high early strengths shotcrete and minimal rebound.

From concrete mix design to on-site technical support, our teams will define with you the best admixture combination for your project. We provide water reducers, shotcrete accelerators, and fiber ranges specifically designed for shotcrete.

OUR SOLUTIONS

CHRYSO®Jet • CHRYSO®Optima  
CHRYSO®Quad • CHRYSO®Fiber Gunita  
EASYSHOT® • TYTRO® • MIRA®

TYTRO®



### OUR SERVICES

- + Mix design and on-site technical support
- + On site shotcreting trials and measurement support
- + Durability studies
- + Temperature regulated storage and dispensing equipment supply
- + Implementation and maintenance on site

03

## Spoil management

Technologies and services to enable circularity.

CLARENA® aggregated treatment solutions, CHRYSO®Quad admixtures and Equalis technology enable the use of certain challenging excavated materials in concrete (within the limitations of local aggregates and concrete standard). High or low fine content, swelling clay, sulphatic aggregates, etc.

OUR SOLUTIONS

CHRYSO®Quad  
CLARENA®



### OUR SERVICES

- + Digital application CHRYSO®Quad App

04

## Tunnel eye water control injection solutions

DE NEEF® Leaks Stop Here. Fast Proven Durable.

DE NEEF® injection resins are formulated and produced to be not water soluble and have no dilution loss or leaching during and after injection to bring the shortest possible injection cycles and give lasting solutions.

OUR SOLUTIONS

DE NEEF® 1C PU • DE NEEF® HA Cut AF  
DE NEEF® HA Cut CFL AF • TYTRO® SI  
550/660 • TYTRO® DN

DE NEEF®

TYTRO®



### OUR SERVICES

- + Special techniques such as DE NEEF® Combi-Grouting and DE NEEF® Combi-Block supported by our technical experts and extensive test data to deliver a proven and durable result.

# Shotcrete solutions

WET SPRAYING, WATER CONTROL & WATERPROOFING, SCL TUNNEL SPRAYED LINING, FORMWORK FILLING & CONCRETE LINING.

01

## Water control and soil consolidation injections

Expertise in underground injections

DE NEEF® and TYTRO® products enable:

- Stabilization, consolidation and void filling
- Pre- and post-grouting
- Umbrella injections
- Combi-Grouting
- Water control
- Rock bolting

### OUR SOLUTIONS

DE NEEF® 1C PU  
TYTRO® 2C PU

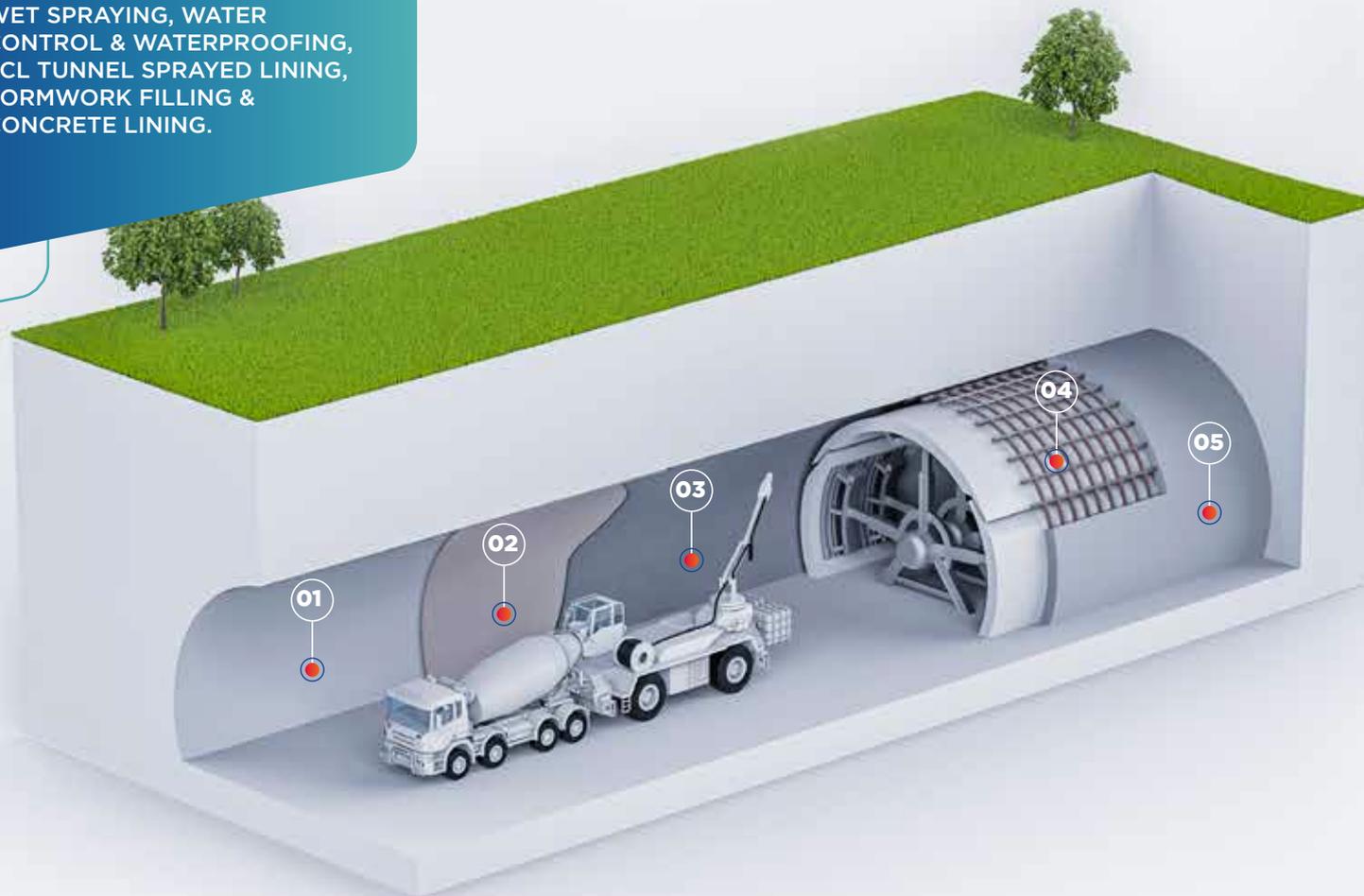
DE NEEF®

TYTRO®



### OUR SERVICES

+ Technical support and special techniques such as DE NEEF® Combi-Grouting and DE NEEF® Combi-Block



02

## SCL tunnel spray-applied waterproofing system

Fast-curing, seamless and fully bonded liquid, spray-applied system specially designed to provide superior bond to shotcrete and accelerate project schedules by allowing shotcrete to be used as a final lining. Robust, spray applied system, which forms a seamless, intimate bond with the concrete so water cannot penetrate through the membrane and circulate behind it.

### OUR SOLUTIONS

TYTRO® SL 500

TYTRO®



### OUR SERVICES

- + Waterproofing Design support
- + On-site technical support
- + Approved applicator network
- + Installation training

03

## Wet spraying shotcrete solutions

Consistent high or ultra-high early strength shotcrete and minimal rebound.

From concrete mix design to on-site technical support, our teams will define with you the best admixture combination for your project. We provide water reducers, shotcrete accelerators, and fiber ranges specifically designed for shotcrete.

### OUR SOLUTIONS

CHRYSO® Jet • CHRYSO® Optima  
CHRYSO® Quad • CHRYSO® Fiber Gunita  
TYTRO® • MIRA® • EASYSHOT®

TYTRO®



### OUR SERVICES

- + Mix design and on-site technical support
- + On site shotcrete trials and measurement support
- + Durability studies
- + Temperature regulated storage and dispensing equipment supply
- + Implementation and maintenance on site

04

## Formwork filling & concrete lining

Our comprehensive range of solutions enables you to:

- Maintain workability at will
- Achieve superior pumpability and finish while offering high early strengths
- Significantly reduce the carbon footprint of concrete
- Use complex local aggregates
- Improve the lifespan of your formwork

### OUR SOLUTIONS

CHRYSO® Optima 1000 • CHRYSO® Quad  
CHRYSO® Equalis • CHRYSO® EnviroMix  
CHRYSO® Dem • CLARENA® • ECLIPSE®  
PIERI® Clarol • STRUX®

PIERI®



### OUR SERVICES

- + Mix design and on-site technical support
- + Fiber-reinforced concrete structural study
- + Challenging aggregates study (Clear Test)
- + Durability studies
- + Concrete CO<sub>2</sub> footprint optimization
- + Pumpability simulator
- + Release agent application equipment and training

05

## Cut & cover tunnel external waterproofing

Category creating, fully bonded, high-performance waterproofing solutions that provide continuous and durable protection preventing lateral water migration as well as ensuring full overlap compatibility.

PREPRUFE® pre-applied waterproofing membranes combined with INTEGRITANK® or BITUTHENE® post-applied membranes provide a fully integrated solution to achieve completely dry underground spaces.

### OUR SOLUTIONS

PREPRUFE® • BITUTHENE® • INTEGRITANK®

PREPRUFE®

BITUTHENE®

INTEGRITANK®

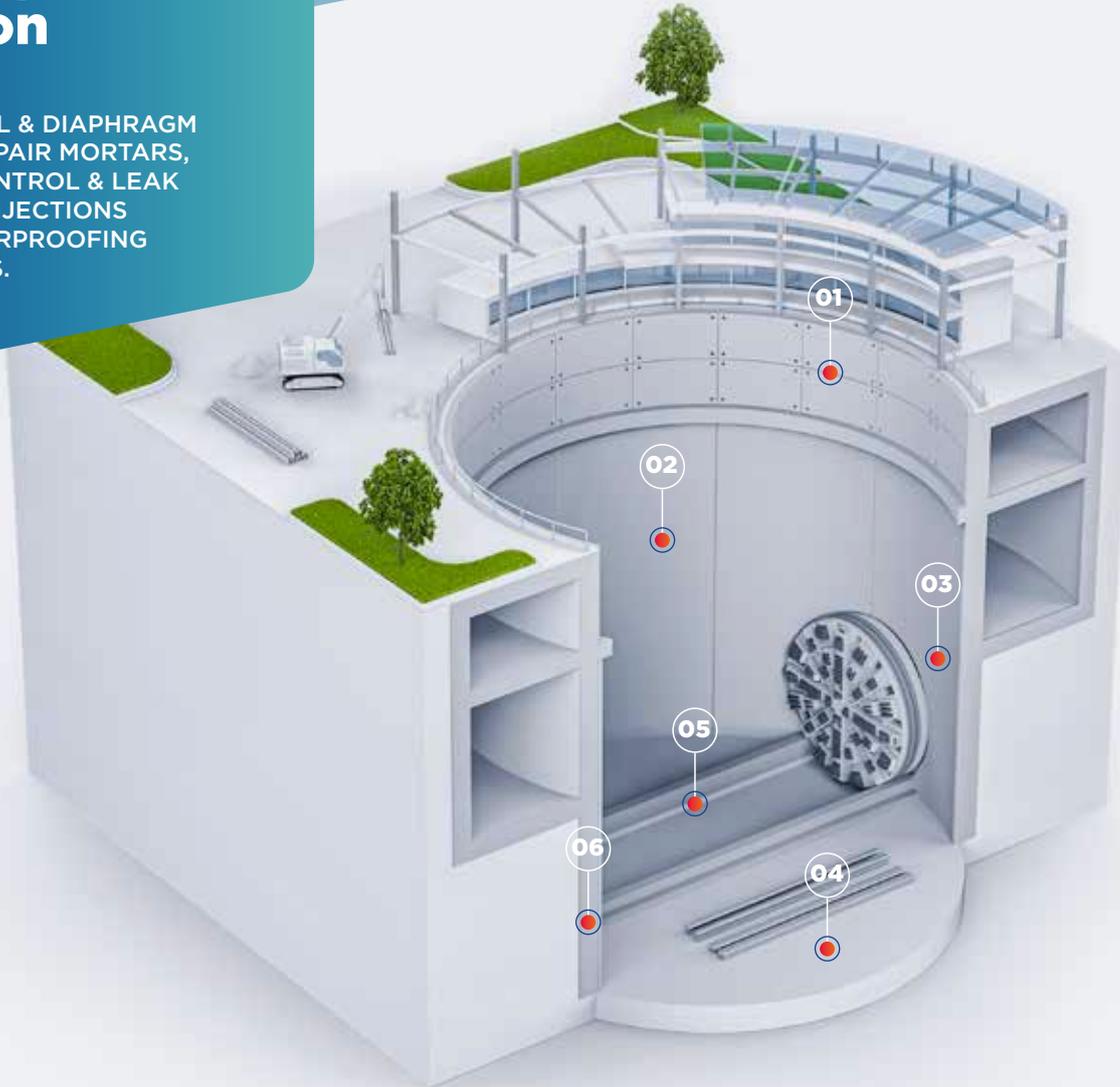


### OUR SERVICES

- + Waterproofing products and systems
- + Waterproofing Design support
- + On-site technical support
- + Installation training
- + EPD

# Shaft / metro station

SEGMENTAL & DIAPHRAGM WALLS, REPAIR MORTARS, WATER CONTROL & LEAK SEALING INJECTIONS AND WATERPROOFING SOLUTIONS.



01

## Segmental walls

High-performance proven solutions for precast wall segments:

- Enhanced placeability, low permeability and high early strengths concrete
- Lab testing program for optimized productivity
- Increase formwork shelf life
- Enhanced concrete durability in harsh environment
- Drastic reduction of your project's carbon footprint

### OUR SOLUTIONS

CHRYSO®Premia • CHRYSO®Turbocast  
CHRYSO®Xel • CHRYSO®EnviroMix • CHRYSO®Tera  
CHRYSO®Dem • CHRYSO®Serenis • CHRYSO®CWA  
ADVA® Cast • PIERI® Clarol • STRUX® • ECLIPSE®

PIERI®

STRUX®

ECLIPSE®



### OUR SERVICES

- + Concrete mix design and on-site technical support
- + Carbon content optimization
- + Durability testing
- + Release agents spraying equipment and training

02

## Diaphragm walls

Record-breaking technology. Diaphragm walls require long workability retention concrete, excellent pumpability and no bleeding.

CHRYSO®Optima 1000 Technology enables the production and placement of concrete meeting all these requirements.

OUR SOLUTIONS

CHRYSO®Optima 1000 Technology



### OUR SERVICES

- + Concrete mix design and on-site support
- + Durability testing
- + Pumping simulator

03

## Water control and leak sealing injection solutions

DE NEEF® Leaks Stop Here. Fast Proven Durable.

DE NEEF® injection resins are formulated and produced to be not water soluble and have no dilution loss or leaching during and after injection to bring the shortest possible injection cycles and give lasting solutions.

OUR SOLUTIONS

DE NEEF® 1C PU • DE NEEF® HA Cut AF  
DE NEEF® HA Cut CFL AF  
TYTRO® SI 550/660 • TYTRO® DN

DE NEEF®

TYTRO®



### OUR SERVICES

- + Special techniques such as DE NEEF® Combi-Grouting and DE NEEF® Combi-Block supported by our technical experts and extensive test data to deliver a proven and durable result.

04

## Waterproofing solutions

Category creating, fully bonded, high-performance waterproofing solutions that provide continuous and durable protection preventing lateral water migration as well as ensuring full overlap compatibility.

PREPRUFE® pre-applied waterproofing membranes combined with INTEGRITANK® or BITUTHENE® post-applied membranes provide a fully integrated solution to achieve completely dry underground spaces.

OUR SOLUTIONS

PREPRUFE® • BITUTHENE®  
INTEGRITANK®

PREPRUFE®

BITUTHENE®

INTEGRITANK®



### OUR SERVICES

- + Waterproofing products and systems
- + Waterproofing Design support
- + On-site technical support
- + Installation training
- + EPD

05

## Repair mortars

Certified high-performance mortars and grouts.

Specifically engineered to comply with the highest industry standards and guidelines, BETEC® mortars and grouts bring solid, reliable, and consistent performance & application.

A full range of normal and cold temperature products are available to allow year round grouting and repairs. BETEC® mortars and grouts have a proven track record of consistent high quality and performance in technically demanding applications.

OUR SOLUTIONS

BETEC®

BETEC®



### OUR SERVICES

- + Technical expertise to assist in choosing the best product and solution

06

## Concrete Monitoring

Maturix® is an intelligent real-time concrete monitoring digital system.

It enables concrete quality to be monitored and traced, construction times to be guaranteed and optimised according to the worksite environment, and the use of new low-carbon binders to be optimised.

OUR SOLUTIONS

CHRYSO®Maturix



### OUR SERVICES

- + Training in the use of the software
- + Study of Mix-Design

# Ready mix plant

WATER REDUCERS,  
SLUMP EXTENDERS AND  
FIBERS FOR READY MIX  
CONCRETE



01

## Water reducers

A wide range of solutions for the most challenging projects, covering a wide range of concrete performance requirements:

- Long & ultra-long slump retention
- High pumpability and cohesion for diaphragm wall or remote deliveries
- Drastic carbon content reduction and use of local challenging aggregates

### OUR SOLUTIONS

CHRYSO®Optima • CHRYSO®Quad  
CHRYSO®EnviroMix • MIRA®



### OUR SERVICES

- + Concrete mix design and on-site support
- + Durability testing, Pumping simulator
- + Dispensing equipment (installation & maintenance)
- + Inventory management
- + Digital services: CHRYSO®EnviroMix app and CHRYSO®Quad app

02

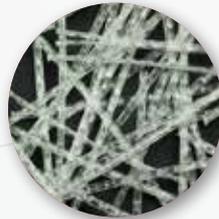
## Fibers

Our wide range of solutions for Fiber-reinforced concrete enables:

- Time and cost savings
  - Lower pump wear vs. steel fibers
  - Shorter project completion time (labor savings)
  - CO<sub>2</sub> footprint reduction
  - Enhanced durability vs. corrosion
- Because each project is specific, our experts will recommend the right fiber and dosage rate.

### OUR SOLUTIONS

CHRYSO®Fiber Gunita  
SINTA® • STRUX®



### OUR SERVICES

- + Structural dimensioning and dosage recommendations, in-field support and training

03

## Slump extenders

Slump retention at will.

Our slump extenders range allows for adjusting workability retention with minimum impact on rheology properties or setting time.

Combined with our superplasticisers, they provide superior workability retention and pumpability, excellent cohesiveness to prevent any bleeding and best in class early strengths.

### OUR SOLUTIONS

CHRYSO®Equalis  
CHRYSO®Jet THC

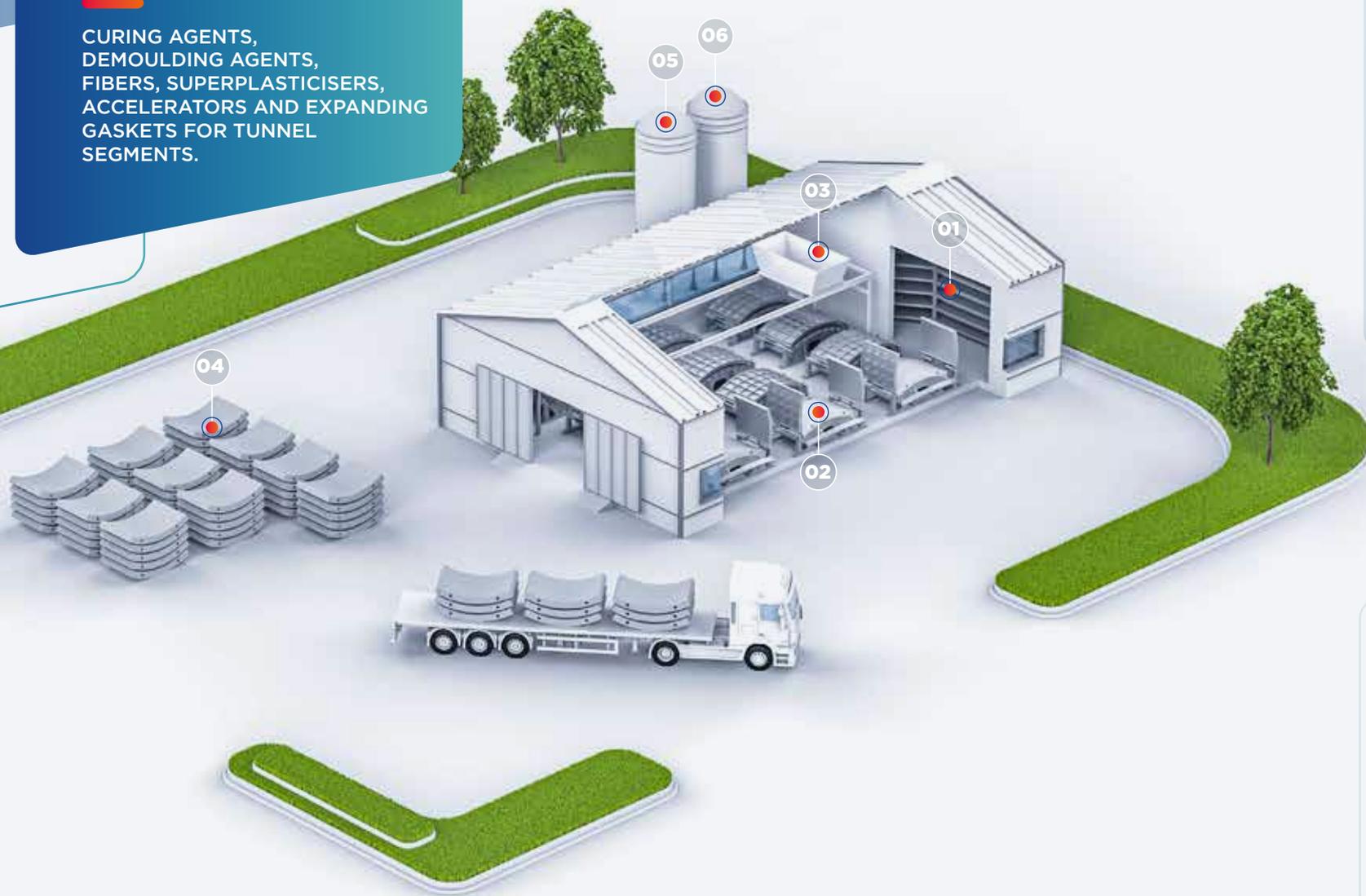


### OUR SERVICES

- + Concrete mix design and on-site support
- + Durability testing
- + Pumping simulator
- + Dispensing equipment
- + Inventory management

# Precast plant

CURING AGENTS,  
DEMOULDING AGENTS,  
FIBERS, SUPERPLASTICISERS,  
ACCELERATORS AND EXPANDING  
GASKETS FOR TUNNEL  
SEGMENTS.



01

## Curing agents

Improved concrete hydration and durability.

PIERI® Easy Cure and Curing includes high-performance curing agents that are easy to apply and user and eco-friendly. Some of these products also significantly reduce the porosity of concrete surfaces over the long term.

### OUR SOLUTIONS

PIERI® Easy Cure  
PIERI® Curing TP 2002

PIERI®



### OUR SERVICES

- + Spraying equipment
- + Concrete monitoring with CHRYSO®Maturix

02

## Demoulding agents

Forms shelf-life, flawless facing and safety while respecting the environment.

To further increase the shelf-life of your forms, take advantage of integrated corrosion inhibition technology and reduce your environmental footprint through the use of vegetal and biodegradable release agents.

### OUR SOLUTIONS

CHRYSO®Dem Oleo • PIERI® Clarol  
PIERI® Decobio

PIERI®



### OUR SERVICES

- + Spraying equipment
- + Application Audit and Training (Adequadem program)

03

## Fibers

Save time, money, and CO<sub>2</sub>, prevent spalling, and increase durability of concrete.

Our wide range of solutions for Fiber-reinforced concrete enables:

- Time and cost savings vs. traditional steel mesh solutions
- Facilitate labor and training
- Reduce elements weight and save on transportation
- CO<sub>2</sub> footprint reduction & Enhanced durability vs. corrosion

### OUR SOLUTIONS

CHRYSO®Fiber S  
STRUX® • SINTA®

STRUX®



### OUR SERVICES

- + Structural dimensioning and dosage recommendations
- + In-field support and training

04

## Expanding gaskets for segments

Our hydro-swelling rubber strips are available in a wide range of shapes and sections for sealing smooth construction joints and joints between precast concrete segments. It can be applied to most common construction materials and has a delayed initial expansion to allow installation in rain or inclement weather conditions.

### OUR SOLUTIONS

Swellseal® 3V and 8V



### OUR SERVICES

- + Expertise to develop sizes and sections according to project design and requirements

05

## Superplasticisers for tunnel segments

Optimization of tunnel segments production.

CHRYSO®Tera is a solution to answer specific challenges of tunnel segments production. The innovative approach of CHRYSO's teams focuses on 3 performance indicators specific to the production of tunnel segments:

- Proper placing of the concrete
- Concrete levelling
- Finishing quality

### OUR SOLUTIONS

CHRYSO® Tera



### OUR SERVICES

- + CHRYSO®TeraLab:  
The CHRYSO®Tera offer stands out in its customised support, from the diagnostics phase to project completion.

06

## Accelerators

Shorter production cycles, lower energy consumption and reduced CO<sub>2</sub> footprint.

CHRYSO®TurboCast patented technology reduces or eliminates hot curing, while Enviromix® accelerators are specifically designed for the production of low- and ultra-low-carbon concrete.

### OUR SOLUTIONS

CHRYSO®Xel • CHRYSO®TurboCast  
• DARACCEL®



### OUR SERVICES

- + Concrete mix design and on-site support
- + Durability testing
- + Dispensing equipment
- + Inventory management

# Nurdağı High speed train tunnel

TURKEY

SOLUTIONS

CHRYSO®TBM AAF 100



# Tramo AVE Madrid - Galicia

SPAIN

SOLUTIONS

- CHRYSO®Optima
- CHRYSO®Fluid AG
- CHRYSO®Plast



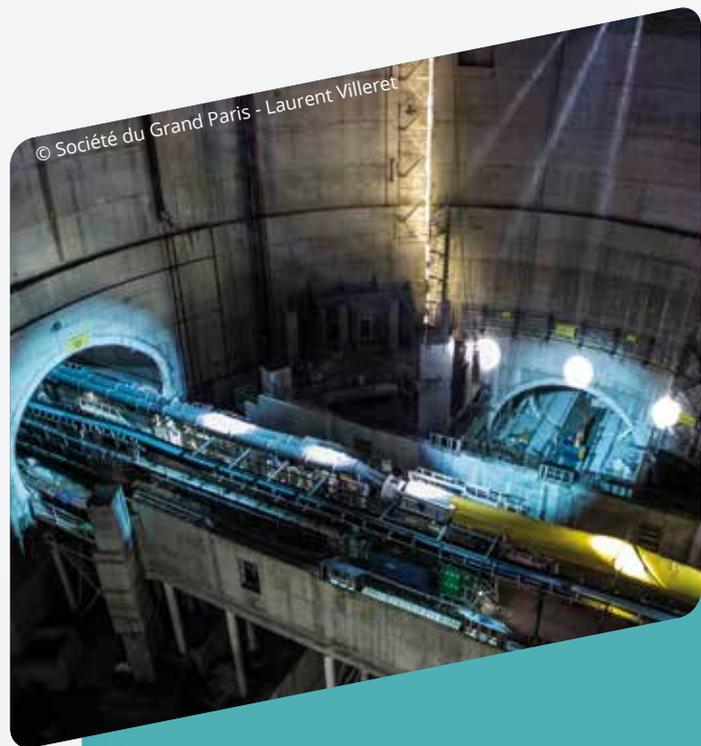
# AVRASYA (EURASIA) TUNNEL

TURKEY

SOLUTIONS

- CHRYSO®Optima
  - CHRYSO®Air
- +100 years of durability  
guaranteed concrete





## Grand Paris Express

FRANCE

### SOLUTIONS

- CHRYSO® Optima 1000 Technology
- CHRYSO® Tera
- DE NEEF® HA CUT AF
- DE NEEF® HA Cut CFL AF
- DE NEEF® Gelacryl Superflex AR
- DE NEEF® HA Flex LV AF
- DE NEEF® HA Safeoam NF



## HS2 Project

UNITED KINGDOM

### SOLUTIONS

- CHRYSO® Optima 1000 Technology
- CHRYSO® Tera
- CHRYSO® Omega
- CHRYSO® Tard
- CHRYSO® RMD
- CHRYSO® Serenis
- VERIFI®
- ELIMINATOR®
- BETEC®
- PREPRUFE®

# References



**STRONGER  
TOGETHER**  
SAINT-GOBAIN CONSTRUCTION CHEMICALS

### **CHRYSO Southern Africa (Pty) Ltd.**

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Kenya | Tel: +254 725 041 526