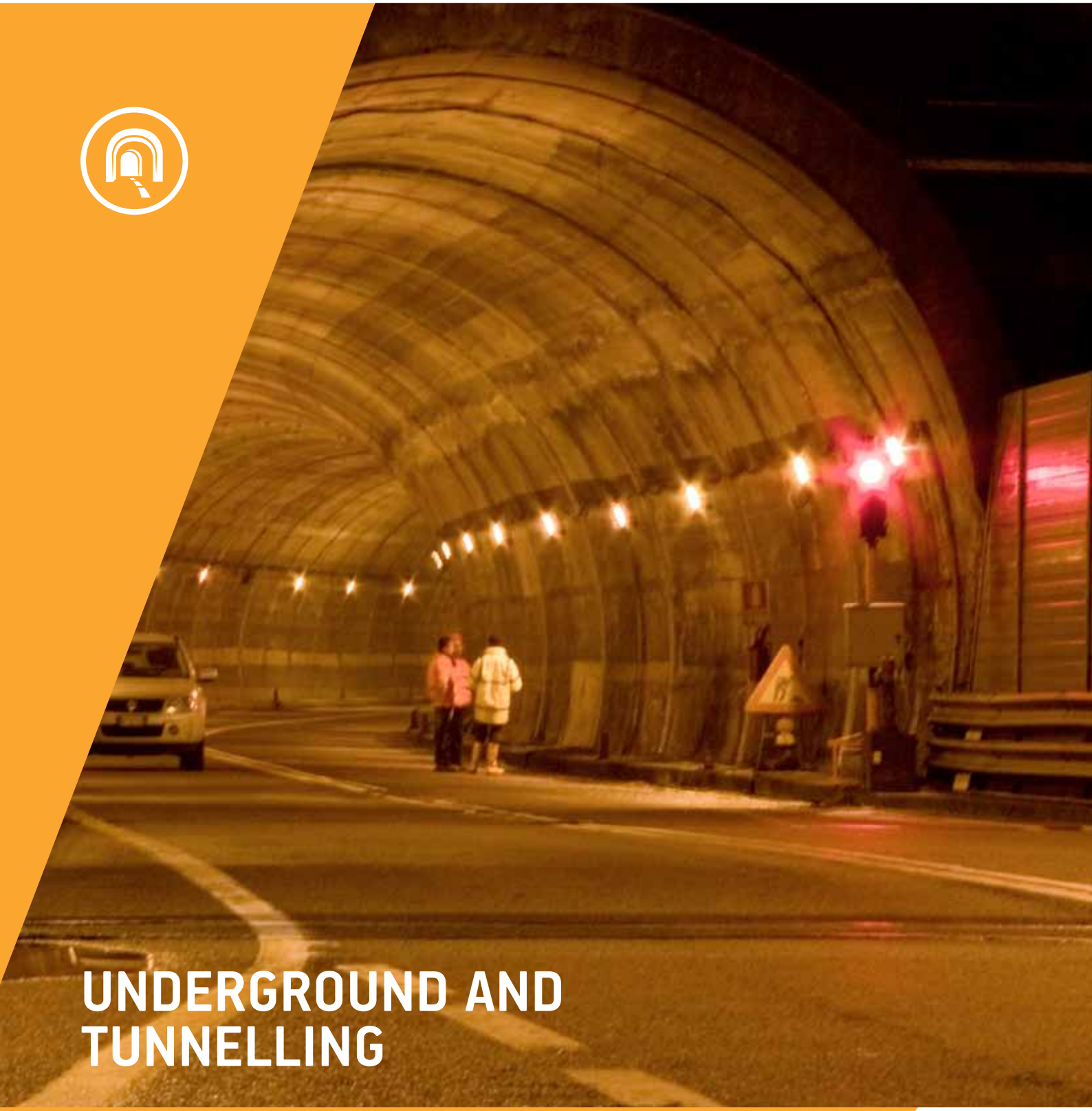

UNDERGROUND AND TUNNELLING

ANALYTICAL FRAMEWORK

OF SYSTEMS FOR SOILS CONSOLIDATION, SPECIAL FOUNDATIONS AND TUNNELLING

draco-edilizia.com

DRACO

QUALITY FOR BUILDING INDUSTRY

DRACO:
QUALITY AND INNOVATION FOR THE BUILDING INDUSTRY

FOR US THE BUILDING SITE IS ALWAYS THE CORNERSTONE

For DRACO, the building site is not just the destination point for our products, it is the building beating heart where we are spurred on to innovation and product development. It is on-site that we collect the most important inputs to develop the very best solutions, and it is on-site that these solutions are tested.

THE COMPANY

PROFESSIONAL TRADITION BUILT OVER TIME

In over 30 years devoted to professional training and practice on the building site, DRACO has established an outstanding tradition based on values to draw with both hands from, to offer excellence in the field of technological solutions for the building site and for constructions at large.

The DRACO range of products provides many solutions but has one single goal in mind: the achievement of top-quality levels in the building site thanks to excellent performances of materials. All products are designed to express their performances in the building site and to make them last over time.

DRACO means assistance and advice from the first design to the final execution of the work.

DRACO, thanks to its flexible client-oriented structure, can provide not only top-quality products but also a service that really makes a difference.

Its personnel, thanks to a continuous training programme, is therefore able to support the client in choosing the most suitable solution to improve the work in the building site.

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CHEMICAL PRODUCTS FOR UNDERGROUND WORKS, TUNNELS AND SPECIAL FOUNDATIONS

WHAT IS ESSENTIAL IS INVISIBLE TO THE EYE

Antoine de Saint-Exupéry

DRACO: the foundations of quality

Since 1982, DRACO has been developing chemical products that would provide the perfect solution for the delicate area of specialist foundations and tunnelling. Decades of experience in the field have provided the company with the valuable and practical knowledge required to create a product line that will make the difference to underground and tunnelling work. You must be expertly aware of the multitude of variables to be considered if you wish to ensure that a product will be truly effective. If you aim high, you need a solid foundation. DRACO technology will help you to build your foundations. There is no doubt that special foundations and tunnelling is the most specialized area in the construction industry. We, at DRACO, have always supported these specialist needs by providing effective solutions that stand the test of time whatever the conditions.

PERMEABILITY OF SOILS

Indicative values of the permeability coefficient k (m/s) according to the type of soil

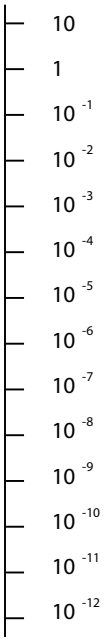
Rock

Coarse gravel
Medium gravel
Fine gravel

Coarse sand
Medium sand
Fine sand
Loam

Clay loam

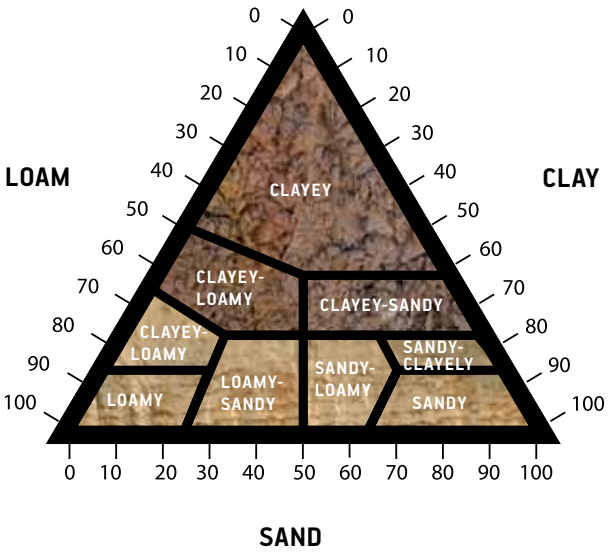
Clay



Permeability coefficient k (m/s)

SOIL COMPOSITION: LOAM, SAND AND CLAY

Diagram to determine the soil texture



SOIL CONSOLIDATION THROUGH INJECTIONS

QUALITY IN DEPTH

In geotechnics there are several treatments to waterproof and/or consolidate rocks and soils. Some of these, such as rock and soil injection and chemical stabilization of the soil, are based on the use of synthetic and additional materials instead of natural and original materials.

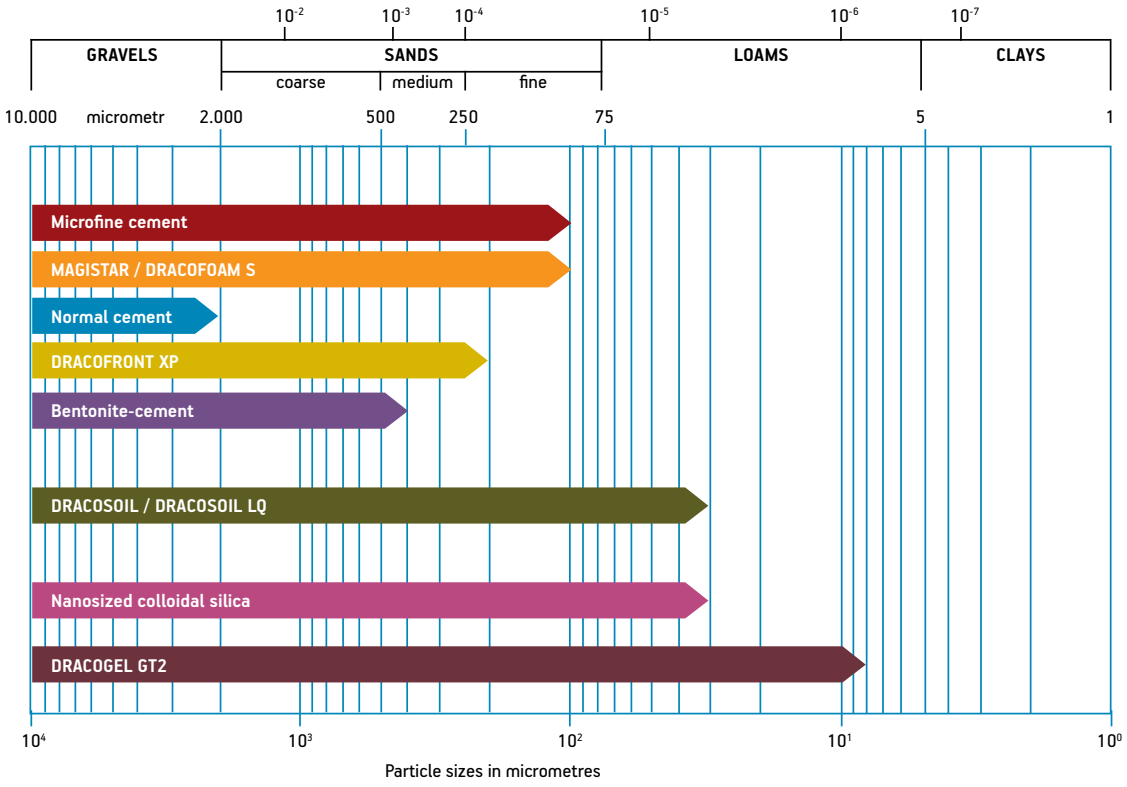
The consolidating and waterproofing effect often consists in simply filling the existing voids or cracks with synthetic material and to a lesser extent in a more complex interaction between additional and original material. In both cases between original natural material (rock/soil) and additional synthetic material (cement, resin, etc.) an interface contact is established, which is more ore less widespread according to the system to be waterproofed or consolidated and also to the specific technique adopted. The differences between them will be analysed more in detail later in this analytical framework.

However it is clear how the main driver of technical differentiation consists in the attitude of the mixture/technology adopted in proposing its own consolidating and waterproofing action on a soil of a specific particle size and water permeability coefficient.

OVERVIEW OF THE INJECTION SYSTEMS FOR CONSOLIDATION PURPOSES

	REACTIVITY	EXPANSION	FLEXIBILITY	COMPRESSIVE STRENGTH	PERMEATION CAPACITY
MAGISTAR	++++	++++	++	++++	++
DRACOSOIL	+	+	+	+	+++
DRACOGEL	++++	++	++++	+	++++
DRACOFOAM	+++	++++	+	+++	++
DRACOFRONT XP	+	+++	+	+++	++
DRACO DR 1	+	++	+	++	++

OVERVIEW OF THE INJECTION MIXTURES USED IN SOILS CONSOLIDATION



ANALYTICAL FRAMEWORK OF SYSTEMS FOR SOILS CONSOLIDATION, SPECIAL FOUNDATIONS AND TUNNELLING

Ancipa Dam, Enna - Hydroelectric plant of Troina

Restoration of 'Allacciante-Cutò' hydraulic tunnel by injecting DRACOFRONT XP expansive cement mortar into the pipes

PRE-MIXED EXPANSIVE PRODUCTS FOR INJECTIONS

The expansive premixes for consolidation injections and reduction of water permeability of soils are a very innovative solution in pre- and post-excavation operations, compared to the traditional systems of chemical grouts, resins or traditional cement injections. The benefits are both connected with durability features and with technical efficacy, but also with environmental reversibility and compatibility.

The matrix developed by the expansive cement slurries for injection is mechanically strong. Yet, having micro-aired structure, it permits easy excavation and demolition/removal, by means of regular mechanical diggers without using demolition hammers.

These offer a higher permeability to the gases normally circulating in the soil, thus reducing the biological impact of soil treatment, as it normally happens with compact cementitious mixtures, polyurethanes and resins at large.

DRACO DR1

CONSUMPTION:
300 to 380 kg of product per m^3 of cavity to be filled

PACKAGING:
The product is available in 20 kg bags

ECO-FRIENDLY PRE-MIXED EXPANSIVE CEMENT BINDER FOR REINFORCEMENT INJECTIONS INTO SOILS AND FILLINGS

DRACO DR1 is a cellular pre-mixed expansive cement-based binder designed to clog the soil cracks directly in-situ, thus reducing water permeability, playing a cohesive and aggregating action and increasing the angle of friction.

IDEAL FOR

- Clogging soil cracks thus reducing water permeability
- Reinforcing escarpments and landslide slopes
- Reinforcing building foundations
- Filling shoring and piling systems

BENEFITS

- Eco-friendly
- Low cost
- Great injectability
- Good waterproofing and expansion properties

DRACOFRONT XP

CONSUMPTION:
550 to 650 kg of product per m^3 of cavity to be filled

PACKAGING:
The product is available in 20 kg bags

ECO-FRIENDLY EXPANSIVE CEMENT SLURRY FOR REINFORCING AND WATERPROOFING EXCAVATIONS, SOILS AND FOUNDATIONS

DRACOFRONT XP is an eco-friendly pre-mixed expansive binder for reinforcing and waterproofing excavations, soils and foundations. When simply mixed with water, it produces lightweight cellular cement slurry with micro-diffusion and expansion properties.

IDEAL FOR

- Reinforcing tunnel excavation fronts
- Reinforcing slopes and soils
- Filling shoring and piling systems
- Reducing water permeability of soils
- Filling cavities or cavity walls with auxiliary function of static compaction

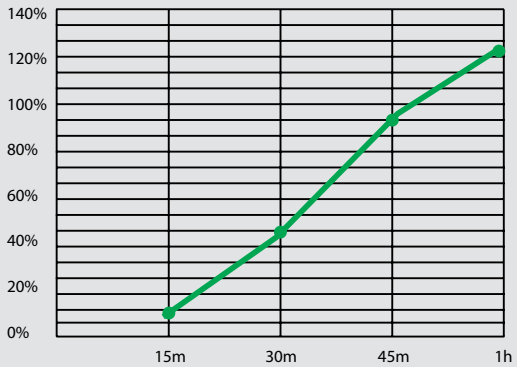
BENEFITS

- Eco-friendly
- Low cost
- Great injectability even into loose-textured soils
- Excellent expansion and consolidating properties

VOLUMETRIC EXPANSION

Expansion % V/V

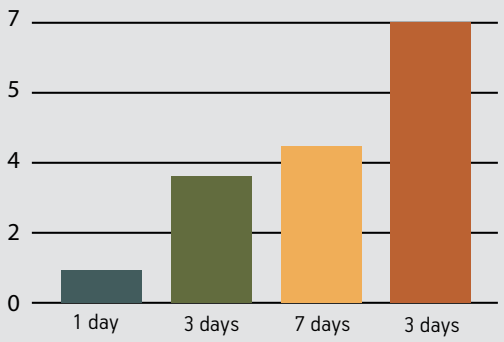
(+20°C - Water/Product ratio = 0,47)



MECHANICAL STRENGTH

Mechanical compressive strength in MPa

according to EN 196 in free expansion
(+20°C - Water/Product ratio = 0.47)



Venerocolo dam, Adamello, Brescia

Strengthening and repairing of the dam's walls by injecting DRACOGEL GT2, the hydroactive elastic resin with controllable gel time

HYDRO ACTIVE RESINS FOR INJECTIONS

Hydro active resins for injections represent the most advanced technology and a decisive one in more complex situations in the field of underground and "soil conditioning". The DRACO range of hydro active resins resolves a variety of situations through the use of multiple technologies such as polyurethane resins, organic and mineral resins, and our non-toxic gel resin DRACOGEL GT2.

DRACOGEL GT2 certainly represents one of the flagships of our portfolio of solutions for underground work and is the result of years of research and field testing. The end result is a totally non-toxic and hydro active flexible gel capable of being decisive in all those cases in which traditional technologies display their limits.

DRACOFOAM S

PACKAGING: the product is available in 23 kg can + 23 kg can = (A+B) 46 kg

HIGHLY REACTIVE TWO-COMPONENT ORGANIC-MINERAL RESIN FOR FILLING CAVITIES AND VOIDS EVEN IN THE PRESENCE OF WATER SEEPAGE

DRACOFOAM S is an injectable two-component product based on polyurethane resins and silicates. DRACOFOAM S is a highly reactive, organic mineral resin that is specially formulated to be injected for rapid filling of voids and cavities to consolidate soil and excavation fronts even where there is moderate water seepage. The action of DRACOFOAM S takes place in 2 stages: first the hydrophilic polyurethane component reacts and increases in volume, and later the mechanical strength increases thanks to the reaction of silicates, thus ensuring a waterproofing and consolidating action.

IDEAL FOR

- Blocking water seepage in concrete structures even if subject to movement
- Consolidating and filling cavities even in the presence of water
- Injections of large volumes where the mass effect involves risks
- Consolidating and filling cavities even in the presence of water

BENEFITS

- Self-extinguishing, non-flammable
- Great expansion
- Low cost
- High waterproofing and consolidating action

MAGISTAR

PACKAGING: The product is available in 25 kg pails.
2.5 kg can of accelerator

PERMANENT SEALING TECHNOLOGY BY INJECTION FOR JOINTS AND CRACKS EVEN IF SUBJECT TO MOVEMENT AND IN THE PRESENCE OF WATER

Concrete structures are often subject to infiltration due to inadequate, degraded or poorly executed waterproofing. The solution is MAGISTAR, a low viscosity hydrophilic injection system with adjustable times of reaction to water. It penetrates the cavities, sealing joints and cracks permanently and blocking seepage even when the water is under pressure. Once it has reacted, MAGISTAR forms a flexible seal with strong bonding that is resistant to chemical attack.

INJECTABLE ONE-COMPONENT SEMI-FLEXIBLE HYDROPHILIC POLYURETHANE RESIN

MAGISTAR is a compound based on synthetic hydro-expansive polymers that are resistant to environmentally aggressive agents. It consists of a polyurethane resin and an accelerator that reduces setting time with adjustable proportions for effective regulation of mixture reaction time. When MAGISTAR is injected into a joint or crack, it expands when it comes into contact with water thus creating a semi-flexible seal that permanently waterproofs the structure.

IDEAL FOR

- Blocking water infiltration with high flow rate and high hydrostatic pressure
- Sealing cracks and joints in underground parking lots, structures below the water table, tunnels
- Sealing cold joints with water seepage
- Backfilling grouting behind tunnel segments through injections
- Waterproofing intervention in case of water penetration and dripping in existing tunnels or during construction work
- Consolidating and filling cavities even in the presence of water

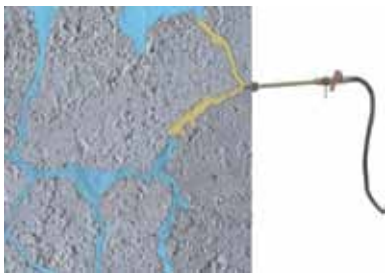
BENEFITS

- High expansive power (it expands up to 4-8 times its volume)
- It produces a dense foam with a closed-cell structure
- Semi-flexible consistency
- High consolidating action

HOW IT WORKS

STEP 1 : EXPANSION

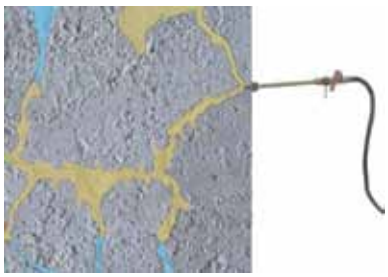
■ When MAGISTAR comes into contact with water and moisture it develops an expansive foam with a closed-cell structure. The reaction also produces an inert gas which generates additional pressure thus increasing the diffusion of the product into the structure.



STEP 2 : WATERPROOFING AND CONSOLIDATION

■ Once the expansion phase is completed, MAGISTAR solidifies thus waterproofing and consolidating the structure.

MAGISTAR is available in different versions, with specific flexibility features according to the requirement.



PERMANENT SEALING OF WATER SEEPAGE IS FAST AND PRACTICAL THANKS TO THE SPECIAL STARJET INJECTORS

■ STARJET AC

Steel injectors for injecting MAGISTAR into concrete. Diameter Ø 16 mm Specifically designed for high pressure (> 3 bar).

■ STARJET PC

Plastic injectors for injecting MAGISTAR into concrete. Diameter Ø 18 mm.

DRACOGEL GT2

PACKAGING: the product is available in
- 20 kg Can + 2 kg Pail + 2 kg Pail = (A+B+C) 24 kg

- 200 kg Drum + 20 kg Pail + 20 kg Pail = (A+B+C) 240 kg

THREE-COMPONENT NON-TOXIC ACRYLIC GEL FOR CONSOLIDATING AND BLOCKING WATER SEEPAGE IN SOILS AND BUILDING STRUCTURES BY INJECTION

DRACOGEL GT2 is an aqueous-phase acrylic resin that through polymerization turns into an hydrophilic and elastic gel with controllable gel time. Since it uses water as permeation medium and it is a single-phase product, it shows very high permeation capacity that, supported b low surface tension and very low viscosity, allows for the soil consolidation even in loamy ground having particles with diameter equal to 0.01 mm. Cracks and porosities are filled with DRACOGEL GT2 which solidifies in a solid gel that prevents water ingress or the washing out by water from the surrounding environment.

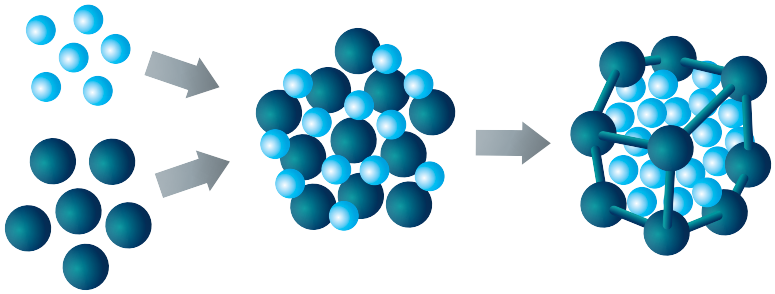
IDEAL FOR

- Blocking water seepage in concrete structures even if subject to movement
- Sealing and repairing tunnels, dams, tunnels and underground pipelines
- Structures in contact with drinking water
- Blocking moderate and high water infiltration in concrete, masonry, stone, tuff and soils even if loamy

BENEFITS

- Infinite possibilities to reactivate the swelling process
- Before the reaction the product has a viscosity similar to water in order to ensure an excellent permeation even in micro-cavities
- As a solid gel the product is flexible and breathable
- Controllable gel time from a few seconds up to 1 hour
- Completely non-toxic and eco-friendly
- The hydrophilic properties last over time and during wet/dry cycles

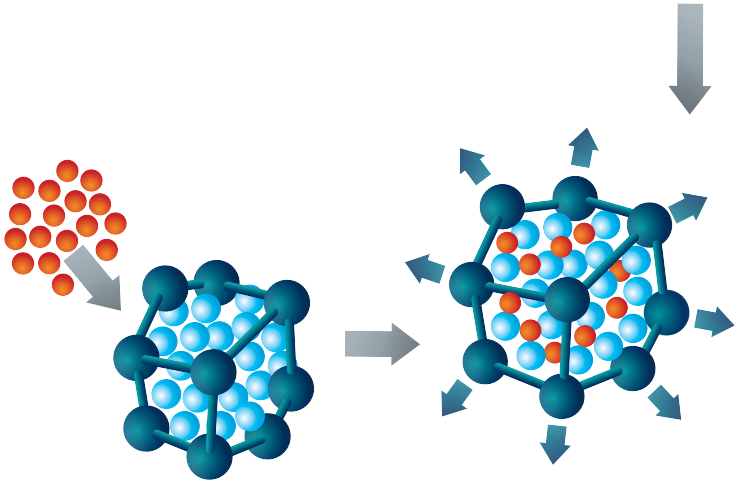
DRACOGEL GT2 in action



Liquid-state injection in the areas affected by water seepage

Diffusion of DRACOGEL hydrophilic monomers in the infiltration water

Immobilisation of the water seepage molecules in the DRACOGEL lattice that then forms a solid gel thus producing a consolidating action



WATER MOLECULE

DRACOGEL MONOMER

WATER RESULTING FROM SUBSEQUENT INFILTRATION

AS A SOLID GEL DRACOGEL GT2 IS:

- **ADHESIVE**: being a polymer, it adheres like a glue to the weave of the permeated element.
- **ELASTIC**: the gel has an elastic-plastic structure and therefore it ensures hydraulic sealing even in case of structural settlement.
- **BREATHABLE TO WATER VAPOUR**: the gel is acrylic and promotes a decrease in moisture in the treated structure.
- **HYDRO-EXPANSIVE**: the elastic structure of DRACOGEL is hydrophilic; hence when osmotic pressures vary, it will acquire the water molecules in its polymer lattice, leading to an increase in volume of the gel.

As a solid gel **DRACOGEL GT2** remains elastic easily adapting to any structural movement.

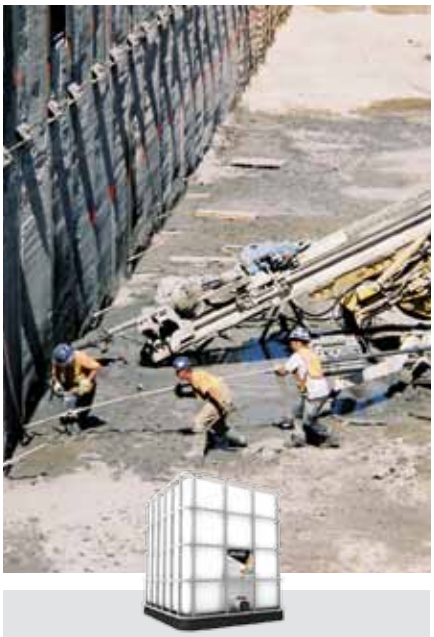
Palmanova-Cervignano spur route, Udine

Consolidation of the soil below the railway sections Trieste-Venice and Cervignano-Udine by injecting DRACOSOIL and REAGENTE SILICATICO

SILICATE BINDERS BY INJECTION

The most modern technology in the field of silicates for the consolidation of foundation soils. DRACO silicates for injection are the result of many years of research and field testing and are products that make a difference by ensuring a quality and performance of the highest level.

DRACOSOIL



CONSUMPTION:
150 to 300 l/m³ of consolidated soil

PACKAGING: the product is available in
- 1350 kg IBC
- bulk

SILICEOUS BINDER FOR CONSOLIDATING AND WATERPROOFING SOILS BY CHEMICAL INJECTIONS

DRACOSOIL is an aqueous-phase solution of polysilicon acid. It should be used in combination with REAGENTE SILICATICO as a binder for single-phase reinforcement injections.

IDEAL FOR

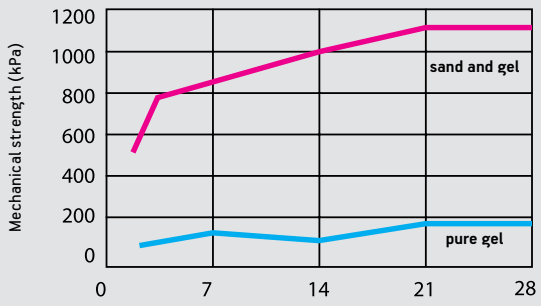
- Consolidating soils and reducing their water permeability
- Injections in loamy and sandy soils that are difficult to treat with binary and ternary mixtures

BENEFITS

- High consolidating action at a mixture's competitive cost
- Antifouling action
- Adjustable gelation/hardening time

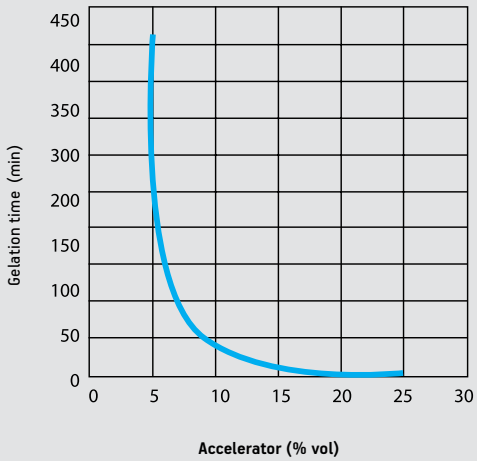
MECHANICAL STRENGTH

Mechanical strength's diagram in relation to time (days)



GELATION TIME

Gelation time diagram in relation to the accelerator percentage (t= 20°C)



REAGENTE SILICATICO

CONSUMPTION:
1% to 4% of the silicate mixture volume

PACKAGING: The product is available in
- 250 kg Drum
- 1200 kg IBC

REAGENT FOR CHEMICAL INJECTIONS WITH DRACOSOIL

REAGENTE SILICATICO is an aqueous solution of aluminous salts used as reagent for reinforcement injections with DRACOSOIL.

IDEAL FOR

- Using as a hardener and solidifier for chemical mixtures with an amorphous silicate, polysilicon or nanosilicon matrix
- Using in combination with DRACOSOIL

BENEFITS

- High consolidating action at a mixture's competitive cost
- Antifouling action
- Adjustable gelation/hardening time

Venice Arsenal
Consolidation and reducing water permeability of soil by injecting DRACOSOIL and REAGENTE SILICATICO

ADMIXTURES FOR INJECTION MIXTURES

Injection mixtures based on cement, concrete and bentonites are still the most widespread soil consolidation methodologies with a predominant use in injections with methodology for permeation but also in the creation of plastic diaphragms walls for the containment of excavation trenches affected by significant water flow. Binary or ternary injection mixtures are simple conglomerates but of non-trivial preparation and development. A proper mix design activity is fundamental to carrying out effective intervention by adapting to the characteristics of the soil also within its stratigraphy and to changes in hygrometric conditions. The most modern additive technology allows you to always obtain effective mixtures thanks to specific water reducers and chemical activators for bentonite which allow for simplification of a construction site layout by eliminating bentonite mud pre-activation tanks and also preventing ion exchange phenomena.

The use of the DRACRIL B.C. admixture eliminates the need for bentonite pre-activation tanks.

DRACRIL 771

CONSUMPTION:
0.1 to 0.3% by weight of cement

PACKAGING: The product is available in
- 25 kg cans
- 230 kg drums
- 1000 kg IBC
- bulk

PLASTICIZER FOR INJECTABLE CEMENT MIXTURES TO CONSOLIDATE SOILS AND FOUNDATIONS

DRACRIL 771 is a special dispersing admixture based on synthetic water-soluble polymers with high molecular weight. DRACRIL 771 is specifically formulated to interact with fine and ultrafine grained materials, such as cement, micro-cement, bentonite mixtures and microfine hydraulic binders thus increasing the diffusive and consolidating action of binary, ternary and quaternary injection mixtures.

IDEAL FOR

- Adding to water-cement-bentonite mixtures
- Reinforcement and waterproofing injections into soils and rocks even with low permeability
- Producing very fluid injection mixtures

BENEFITS

- High plasticizing action
- It increases the diffusive action even in low permeable soils
- It prevents the formation of lumps even with microfine cements
- Plasticizing effectiveness

DRACRIL B.C.

CONSUMPTION:
approx. 1% by weight on the basis of the total weight of the solids

PACKAGING: The product is available in 15 kg bags

ACTIVATING DISPERSING ADMIXTURE FOR BENTONITE AND CEMENT-BASED MIXTURES

This admixture is specifically designed for activating and plasticizing bentonite mixtures used for consolidation. DRACRIL B.C. allows to obtain fluid and uniform mixtures with reduced water/binder ratios. Double action: it plasticizes the mixture and activates the bentonite.

IDEAL FOR

- Adding to water-cement bentonite mixtures
- Eliminating the need for pre-activation tanks
- Increasing mixtures' fluidity and cohesion for consolidation

BENEFITS

- High plasticizing action
- It increases the diffusive action even in low permeable soils
- It prevents the formation of lumps even with microfine cements
- Plasticizing effectiveness
- It activates the bentonite
- Stabilizing effectiveness against the ion exchange
- Anti-flocculation effect

Trans-Adriatic Pipeline (TAP), Albania
Consolidation of the Albanian pipeline slopes carried out through the application of shotcrete prepared with DRANITE AF, DRACRIL 605, FILLCRETE e FIBERFLEX S

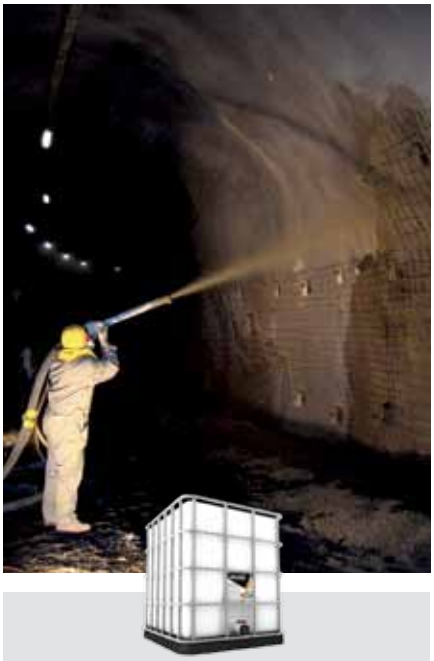
SHOTCRETE ACCELERATORS

Shotcrete is mainly used in underground construction for protection in the progress of the excavation into rock and for protection from falling stone or even to block water seepage coming from the walls of the excavation. It is also used to protect foundation excavations, to consolidate slopes and embankments as well as to execute restoration works of degraded concrete constructions in stone and/or brick; it grants endless possibilities to structures with complex geometric configurations and can be applied wherever traditional cement powering presents difficulty in execution such as on ceilings or on walls behind pipes or other mechanical obstacles.

There are two types of accelerators: those with a sodium silicate (5÷15% by concrete) base and those called **alkali-free which are based on aluminium sulphates** (4÷8% by concrete). Sodium silicate based accelerators reach, within a few hours, higher compression resistance levels than alkali-free accelerators. By contrast, sodium silicate based additive mixes, in the long run, demonstrate a lower mechanical performance than those achieved with alkali-free accelerators.

The reduction of the mechanical performance of mixes with sodium silicate additives can also reach 50% when compared to no additive conglomerates. Alkali-free accelerators instead determine reductions of predictable mechanical resistance estimable at about a 10% compared to a mix without accelerators. For this reason, **sodium silicate-based accelerators are used to create temporary coatings while alkali-free ones are used to produce mixes intended for the production of definitive structural coatings.** Sodium silicate-based accelerators, on the other hand and thanks to a quicker setting, are preferred to alkali-free ones when there is substantial water seepage on the walls of an excavation. In this context, in fact, alkali-free mixes may be subject to washing out due to their lower setting speed.

DRANITE L



CONSUMPTION:
approx. 2 to 6 kg per 100 kg of cement

Packaging: The product is available in
- 270 kg drums
- 1350 kg IBC
- bulk

LIQUID SETTING ACCELERATOR FOR SHOTCRETE

DRANITE L is a liquid alkaline setting accelerator admixture with hydrophobic effect for preparing moderately resistant shotcrete, even in case of high dampness, seepage and slight water infiltration.

IDEAL FOR

- Preliminary phase coatings for tunnels made by shotcrete application
- Restoring existing tunnels
- Restoring and reinforcing bulkheads, dam faces, canal walls etc.

BENEFITS

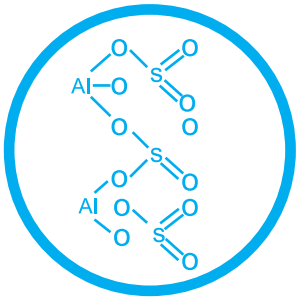
- Good mechanical strength, good resistance to the chemical aggressiveness of the environment and low concrete permeability
- Reduced application time
- Low scrap quantity
- Possibility of varying the dosage depending on the specific use
- High thixotropy which increases shotcrete adhesion and allows to reduce the number of coating layer
- A thickness up to 25 can be achieved in a very short time (*)
- Rapid development of the cement hydration heat so as to facilitate application even at low temperatures
- It protects exposed reinforcements and prevents corrosion

(*) For best results, add FIBERFLEX or FIBERMIX fibres

THE DRANITE AF PROJECT

A new generation of accelerating admixtures for shotcrete is the fruit of years of experimentation in DRACO laboratories. Research to overcome the traditional focus on dosages and 'flash time' involving more global performance targets that are able to guarantee quality that is truly global for executors, clients and users of the work.

A new concept of performance that sees parameters such as stability of the mixture at low temperatures, reduced scrap quantity, characteristics of mixture durability, adhesion to the substrate even in the case of thicknesses that require more 'coats' all to guarantee a high development of mechanical strength even for medium and long periods of time.



COMPARISON TABLE OF DRANITE AF ALKALI-FREE SHOTCRETE ACCELERATORS

	DRANITE AF 880	DRANITE AF 890	DRANITE AF 900	DRANITE AF 1000
Colour	**Neutral clear**	**Neutral clear**	**Neutral clear**	**Pale yellow clear**
Density kg/l +/-0,03 ISO 758	1.262	1.313	1.382	1.372
Dry solids content 105°C +/-2% EN 480-8	33.26	37.92	44.52	45.03
Alkalis (Na_2O)	< 1%	< 1%	< 1%	< 1%
pH +/- ISO 4316 1:0	3.16	2.77	3.49	2.1
Chlorides % 1:1	< 0.1	< 0.1	< 0.1	< 0.1
Setting start time 8%	1	1	1	1
Setting end time 8%	11	5	5	4
Dosage (% cement)	8/10	7/9	6/8	5/7
Bulk price	0.68	0.76	0.84	0.90
1500 kg IBC price	0.85	0.94	1.00	1.10

DRANITE AF 880

CONSUMPTION:
8 to 10 % by weight of cement.

PACKAGING: The product is available in
- 250 kg drums
- 1250 kg IBC
- bulk

ALKALI-FREE SETTING ACCELERATOR SPECIFICALLY DESIGNED FOR SHOTCRETE

Multifunctional version for cold and temperate climates

DRANITE AF 880 is a liquid alkali-free setting accelerator for shotcrete and sprayed mortar. DRANITE AF 880 will ensure very short setting times, minimal scrap quantity and superior mechanical strength.

IDEAL FOR

- Preliminary phase coatings for tunnels made by shotcrete application
- Restoring existing tunnels
- Restoring and reinforcing bulkheads, dam faces, canal walls etc.

BENEFITS

- Good mechanical strength
- Good resistance to the chemical aggressiveness of the environment
- Low concrete permeability
- Low scrap quantity
- Thixotropic: it increases shotcrete adhesion and allows to reduce the number of coating layers
- Rapid development of the cement hydration heat so as to facilitate application even at low temperatures
- It protects exposed reinforcements and prevents corrosion

DRANITE 890

CONSUMPTION:
7 up to 9 % by weight of cement

PACKAGING: The product is available in
- 250 kg drums
- 1250 kg IBC
- bulk

ALKALI-FREE SETTING ACCELERATOR SPECIFICALLY DESIGNED FOR SHOTCRETE

High-yield version for medium-high thicknesses

DRANITE AF 890 is a liquid alkali-free setting accelerator for shotcrete and sprayed mortar. DRANITE AF 890 will ensure very short setting times, minimal scrap quantity and superior mechanical strength.

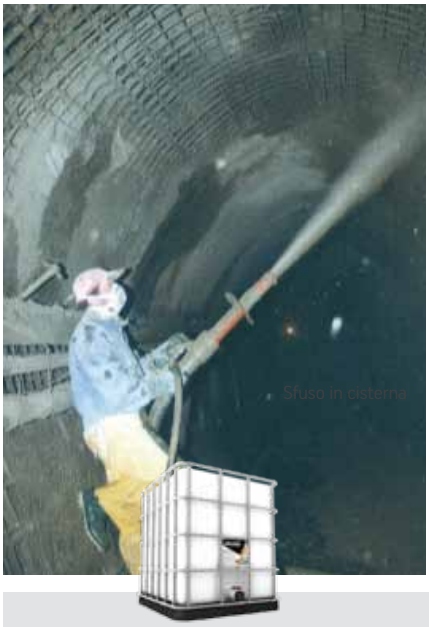
IDEAL FOR

- Preliminary phase coatings for tunnels made by shotcrete application
- Restoring existing tunnels
- Restoring and reinforcing bulkheads, dam faces, canal walls etc.

BENEFITS

- Good mechanical strength
- Good resistance to the chemical aggressiveness of the environment
- Low concrete permeability
- Low scrap quantity
- Good thixotropy which increases shotcrete adhesion, allows to achieve medium-high thicknesses and reduces the number of coating layer
- Rapid development of the cement hydration heat so as to facilitate application even at low temperatures
- it protects exposed reinforcements and prevents corrosion

DRANITE AF 900



CONSUMPTION:
8 up to 10 % by weight of cement

PACKAGING: The product is available in
- 250 kg drums
- 1250 kg IBC
- bulk

ALKALI-FREE SETTING ACCELERATOR SPECIFICALLY DESIGNED FOR SHOTCRETE

High-yield version for cold climates

DRANITE AF 900 is a liquid alkali-free setting accelerator for shotcrete and sprayed mortar. DRANITE AF 900 will ensure very short setting times, minimal scrap quantity and superior mechanical strength.

IDEAL FOR

- Preliminary phase coatings for tunnels made by shotcrete application
- Restoring existing tunnels
- Restoring and reinforcing bulkheads, dam faces, canal walls etc.

BENEFITS

- Good mechanical strength
- Good resistance to the chemical aggressiveness of the environment
- Low concrete permeability
- Low scrap quantity
- Excellent thixotropy which increases shotcrete adhesion and allows to reduce the number of coating layer
- Rapid development of the cement hydration heat so as to facilitate application even at low temperatures
- It protects exposed reinforcements and prevents corrosion

DRANITE AF 1000

CONSUMPTION:
5 to 7 % by weight of cement

PACKAGING: The product is available in
250 kg drums
1250 kg IBC
bulk

ALKALI-FREE SETTING ACCELERATOR SPECIFICALLY DESIGNED FOR SHOTCRETE

Version for low temperatures and high thicknesses

DRANITE AF 1000 is a liquid alkali-free setting accelerator for shotcrete and sprayed mortar. DRANITE AF 1000 will ensure very short setting times, minimal scrap quantity and superior mechanical strength.

IDEAL FOR

- Preliminary phase coatings for tunnels made by shotcrete application
- Restoring existing tunnels
- Restoring and reinforcing bulkheads, dam faces, canal walls etc.

BENEFITS

- Good mechanical strength
- Good resistance to the chemical aggressiveness of the environment
- Low concrete permeability
- Low scrap quantity
- Excellent thixotropy which increases shotcrete adhesion and allows to reduce the number of coating layer
- Rapid development of the cement hydration heat so as to facilitate application even at low temperatures
- It protects exposed reinforcements and prevents corrosion

BACKFILLING SYSTEM

TWO-COMPONENT SYSTEM FOR BINARY AND TERNARY CEMENT INJECTIONS FOR BACKFILL GROUTING IN TUNNELLING

BACKFILLING SYSTEM is a two-component system for preparing bentonite-cement mixtures used to backfill grouting behind the precast segments in tunnels excavated by means of TBM (Tunnel Boring Machines).
BACKFILLING SYSTEM consists of two components:

BACKFILLING RETARDER

Superplasticizer with high workability retention, specifically designed for cement and cement-bentonite injectable mixtures.

BACKFILLING SK (SLUMP KILLER)

Setting activator admixture and consistency modifier for cement and cement-bentonite mixtures.

BACKFILLING SYSTEM DRACO

Two-component system for the admixture preparation and application through injections in order to backfill grouting behind segments in tunnels excavated by means of TBM

BENEFITS

BACKFILLING SYSTEM is a two-component system for the admixture addition in injectable cement-bentonite mixtures to backfill grouting behind tunnel segments. It provides the following benefits:

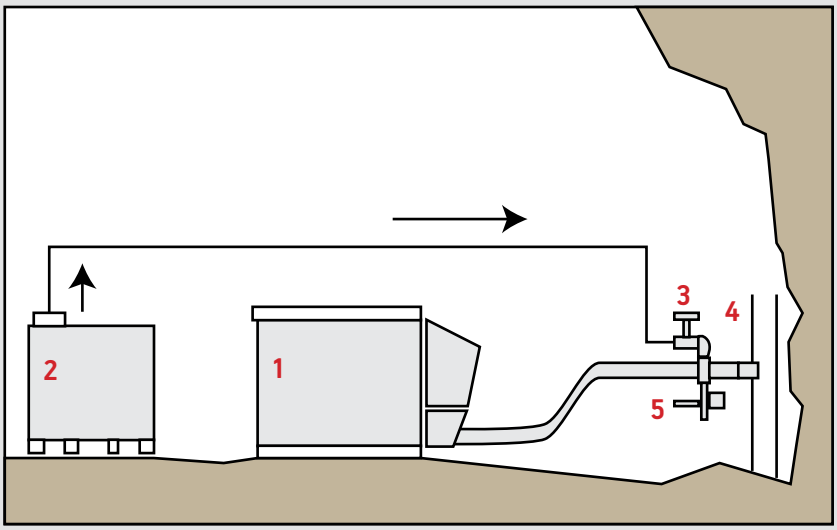
- The combined action of the two components maintains the workability and pumpability over time, thus allowing, at the same time, to predict the loss of workability and the fluid grout's setting time.
- Great injectability of the mixture.
- Excellent cohesion and anti-washout effectiveness.
- It ensures the actual filling of the spaces between segments and rock thus improving cohesion.
- It promotes production by reducing the formation of deposits in the injection pipes
- It Increases the sodium bentonite dispersing action thus helping to stabilize syneresis phenomena.

IDEAL FOR

BACKFILLING SYSTEM is a two-component system for preparing injectable cement-bentonite mixtures to backfill grouting behind tunnel segments. It is used for:

- Backfilling injections behind precast segments in tunnels.
- Ensuring the support and filling of segments in tunnels excavated by means of TBM.
- Reducing water permeation in the excavation surrounding soil.

DIAGRAM FOR THE APPLICATION OF BACKFILLING SYSTEM



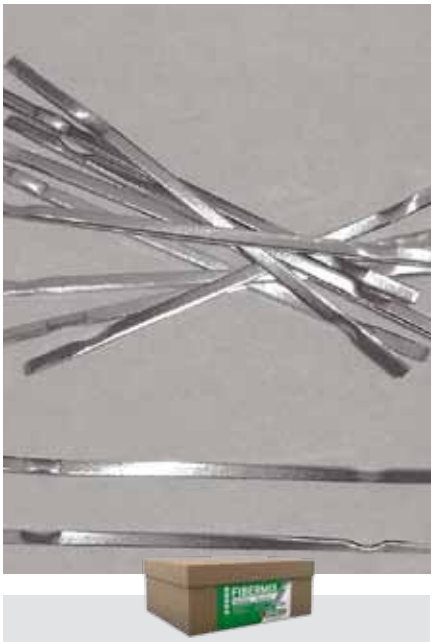
1. Pump for mortar or fluid grout prepared with BACKFILLING RETARDER
2. Pump for BACKFILLING SK liquid accelerator
3. Accelerator flow control valve
4. Spiral mixer tube (Ø =50mm, Length =30-40 cm)
5. Connector for cleaning (compressed air or water)

Monte Giglio tunnel, Calusco d'Adda, Bergamo
Tunnel shotcrete prepared with FIBERFLEX S and DRANITE AF

STRUCTURAL FIBRES FOR SHOTCRETE

The technique of shotcrete has known since its birth a huge evolution which has seen great importance also in the development of the technology of the fibre reinforced concrete. Initially with a predominant use of metallic fibres and today with the use of a growing number of structural polymers, various spraying mixtures have been obtained and these are all characterized by features of reduced hairline cracking due to plastic shrinkage, ductility, toughness and impact resistance of concrete. FIBERFLEX S structural synthetic fibres and FIBERMIX FLOW metal ones are highly effective solutions in terms of application in a plastic state and in mechanical terms in a hardened phase.

FIBERMIX FLOW SPRITZ



CONSUMPTION:
30 - 70 kg/m³ of concrete

SIZE:
Length 30-35 mm

PACKAGING: The product is available in 25 kg bags

HIGH STRENGTH STEEL FIBRES FOR STRUCTURAL AND NON-STRUCTURAL REINFORCEMENT OF CONCRETE AND MORTARS

FIBERMIX FLOW SPRITZ is a cold-drawn low-carbon steel fibre for structural and non-structural reinforcement of concrete and mortar under high stress that provides high ductility and mechanical resistance to impacts. The special hooked shape of the fibre facilitates mix pumping and guarantees strong anchoring to the concrete matrix.

IDEAL FOR

Acting as a cement matrix reinforcing agent, FIBERMIX FLOW SPRITZ improves the physical and mechanical properties of aggregates and it is particularly used as secondary reinforcement and protection against cracking. It is ideal for:

- Preparing shotcrete
- Shotcrete in tunnels and other types of structures
- Pouring of structures exposed to high static and dynamic loads
- Pouring of decks, slabs and thin section structures

BENEFITS

- The special geometry ensures an exceptional bonding to the cement mix also during the plastic phase, thus avoiding dispersion of the fibres during application
- It enables a uniform distribution in the mix, thus avoiding concrete bleeding
- It controls shrinkage during the plastic phase and during drying shrinkage thus reducing cracks
- Thanks to its uniform distribution in the mix and its special geometry, it ensures great workability and pumpability
- Thanks to its energy absorbing capability, the concrete fibre-reinforced cement conglomerates are highly resistant to impacts
- Increased concrete ductility
- Significant increase in tensile strength by flexure

FIBERFLEX S

CONSUMPTION:
2.5 to 5 kg/m³ of conglomerate
shotcrete: 5 kg/m³ (recommended consumption)

SIZE:
Length 20- 30 - 55 mm / Thickness 0.45 mm

PACKAGING: available in
5 kg bag on 500 kg pallet

STRUCTURAL SYNTHETIC FIBRE FOR CONCRETE REINFORCEMENT

Polyethylene terephthalate (PET)

FIBERFLEX S is a structural fibre made of polyethylene terephthalate (PET) for the reinforcement of concrete. The fibre is contoured and knurled on both sides to improve its adhesion and this permits excellent bonding with all cementitious binders thus avoiding dispersion of the fibres during application. The contoured shape of FIBERFLEX S also enables a uniform distribution in the mix, thus the concrete can be pumped more easily while avoiding the formation of blockages.

IDEAL FOR

Acting as a cement matrix reinforcing agent, FIBERFLEX S is particularly suitable as a secondary reinforcement and protection against cracking of:

- Shotcrete
- Pouring of structures exposed to high static and dynamic loads
- Pouring of decks, slabs and thin section structures

BENEFITS

- The high bonding to the cement matrix, the exclusive geometry and the "three-dimensional profiling" ensure an exceptional bonding to the cement mix
- Increased flexural-tensile strength of the cement
- Conglomerate uniform distribution in the mix with consequent reduction of concrete bleeding phenomena
- It controls shrinkage during the plastic phase and during drying shrinkage thus reducing cracks
- Thanks to its uniform distribution in the mix and its special geometry, it ensures great workability and pumpability
- Chemical resistance, not affected by corrosive phenomena
- Increased concrete ductility

EXPO 2015, West Gate, Milan

Consolidation of the gates' soil with Dracosil and creation of piling systems in concrete supplemented with FLUIBETON 982

CONCRETE ADMIXTURES FOR PILES AND DIAPHRAGM WALLS

Technology in concrete used in the preparation of mixtures for pouring piles and diaphragm walls is at this time well-established and essentially standard. There are special conditions, though, in which the use of special admixtures can solve specific problems that may occur in a construction site.

FLUIBETON 982

CONSUMPTION:
approx. 0.8 to 1.5 kg per 100 kg of cement

PACKAGING: The product is available in
- 25 kg can
- 230 kg drum
- 1000 kg IBC
- bulk

SUPERPLASTICIZER FOR CONCRETE WITH A LOW W/C RATIO

FLUIBETON 982 is a superplasticizer ideal for the production of all types of concrete prepared throughout the winter period, especially where a rapid strength development in short and medium curing is required. It is well-suited to application in prefabricated units in reinforced concrete and pre-stressed reinforced concrete.

IDEAL FOR

- FLUIBETON 982 is particularly suitable for all types of concrete throughout the winter period, especially for the pouring of slabs, industrial and airport flooring to be installed also at low temperatures
- Production of durable concrete for piles, secant piles, diaphragm walls, etc.

BENEFITS

- It increases the concrete mechanical strength, waterproofing capacity and durability. It ensures concrete with a W/C ratio reduced by 20-25%
- The concrete thus obtained is not subject to segregation and will be more homogeneous and cohesive
- It provides a better "fair-faced" finish
- It provides superior adhesion between concrete and iron
- By improving pumpability, it allows you to use the pump with a lower operating pressure

RAPIDCRETE

CONSUMPTION:
approx. 1 to 2.5 kg per 100 kg of cement

PACKAGING: The product is available in
- 5-10-25 kg cans
- 250 kg drums
- 1000 kg IBC
- bulk

SETTING ACCELERATOR FOR CONCRETE AND LIGHTWEIGHT INSULATING CONGLOMERATES

RAPIDCRETE is an accelerator admixture ideal for the preparation of non-reinforced concrete where rapid formwork removal is required. RAPIDCRETE is also used in lightweight concrete conglomerates (cellular, polystyrene, clay, etc.) particularly in cold climates.

IDEAL FOR

- Concrete pouring at low temperatures and with washing-out water
- Depending on RAPIDCRETE dosage, it is possible to pour concrete and remove formworks in order to meet work schedules

BENEFITS

- High initial strength
- Faster formwork removal and faster reuse
- Higher work completion rate during the cold season
- Compatibility with all the ordinary types of cement

ARTIC OCF

CONSUMPTION:
approx. 1 to 4 kg per 100 kg of cement

PACKAGING: The product is available in
- 5-10-25 kg cans
- 250 kg drums
- 1000 kg IBC
- bulk

ANTI-FREEZE ADMIXTURE FOR ACCELERATING SETTING AND HARDENING TIMES

ARTIC OCF is a plasticizer that accelerates setting and hardening times and has an anti-freeze effect. It is used in all types of concrete. ARTIC OCF is particularly suitable for preparing concrete in cold climates thanks to its plasticizing effect.

IDEAL FOR

- ARTIC OCF is used in all types of concrete: ordinary, reinforced, precast, and in concrete transported by truck. Being a chloride-free product, it is widely used in the precast industry and for pre-stressed concrete. ARTIC OCF is particularly suitable for preparing concrete in cold climates.

BENEFITS

- Possibility of pouring the concrete during the cold season when temperatures are expected to drop below -10°C
- It anticipates the development of concrete strength at low temperatures thus facilitating formwork removal and protecting it by possible damages caused by frost

VISCOBETON

CONSUMPTION:
approx. 0.5 to 1 kg per 100 kg of cement

PACKAGING: available in
10 kg bag on 600 kg pallet

ANTI-WASHOUT ADMIXTURE FOR UNDERWATER CONCRETE POURING

VISCOBETON is an anti-washout powder admixture for underwater concrete pouring. VISCOBETON makes it possible to prepare concrete that resists washing out and segregation phenomena for concrete pouring in free or moving water. VISCOBETON ensures excellent pumpability.

IDEAL FOR

- Pouring piles and diaphragm walls under hydraulic head
- VISCOBETON is used to prepare homogeneous, non-segregable, bleeding-free and easy-pumpable concretes used for underwater works, piers, foundations, riverbanks, bases, etc.

BENEFITS

- It allows to obtain homogeneous and compact concrete with improved mechanical and waterproofing properties
- It does not exhibits bleeding phenomena
- The concrete prepared with VISCOBETON is cohesive and does not exhibit bleeding or segregation phenomena

DRACRIL 605

CE EN 934-2 | EN 206 | UNI 11104

CONSUMPTION:
approx. 0.6 to 1.5 kg per 100 kg of cement

PACKAGING: The product is available in
- 20 kg cans
- 200 kg drums
- 1000 kg IBC
- bulk

HIGH PERFORMANCE POLYCARBOXYLATE SUPERPLASTICIZER FOR READY-MIX CONCRETE WITH A LOW W/C RATIO

DRACRIL 605 is an admixture particularly suitable for the production of ready-mix concrete characterised by a low water-cement ratio, high mechanical strength with both short and long curing and good workability time.

IDEAL FOR

- Preparation of wet shotcrete
- Preparation of concrete for piles and diaphragm walls
- High-strength ready-mix concrete with the possible addition of silica fume, fly ash, blast-furnace slags, etc.
- Elements made of reinforced concrete with a very low water-cement ratio, resistant to aggressive agents (chlorides, sulphates, carbon dioxide)

BENEFITS

- It allows the production of high-performance concrete with a very low water-cement ratio (0.4) and S5 super-fluid consistency, thus increasing its durability
- Consistency is maintained for 90 minutes, depending on the w/c ratio and the type of cement
- The high dosage by weight of cement allows to obtain special HPC or RRPC by adding FILLCRETE (silica fume) or fly ash

REFERENCES

The products in the UNDERGROUND and TUNNELLING DRACO line can boast many successful applications in high level Italian and European shipyards. Below is a selection of our references.

1. **Trans-Adriatic Pipeline (TAP), Albania**
   Consolidation of the Albanian pipeline slopes carried out through the application of shotcrete prepared with DRANITE AF, DRACRIL 605, FILLCRETE and FIBERFLEX S
2. **Enel Dam - Valgallina, Belluno**
   Reinforcement injections with DRACOGEL GT2, the hydrophilic acrylic elastic resin with controllable gel time, and spillway restoration with FLUECO 175 T CR FR anti-wear mortar
3. **Palmanova-Cervignano spur route, Udine**
   Consolidation of the soil below the railway sections Trieste-Venice and Cervignano-Udine by injecting Dracosoil and Reagente Silicatico
4. **Artificial barrier, Guillemore, Aosta**
   Strengthening and repairing of the dam's walls by injecting DRACOGEL GT2, the hydro active elastic resin with controllable gel time
5. **EXPO 2015, West Gate, Milan**
   Consolidation of the gates' soil with Dracosil and creation of piling systems in concrete supplemented with FLUIBETON 982
6. **Venerocolo dam, Adamello, Brescia**
   Strengthening and repairing of the dam's walls by injecting DRACOGEL GT2, the hydro active elastic resin with controllable gel time
7. **Venice Arsenal**
   Consolidation and reducing water permeability of soil by injecting DRACOSOIL and REAGENTE SILICATICO
8. **Gilgel Gibe III dam, Ethiopia**
   Structural epoxy resin injections for consolidating the dam's wall
9. **Bastia Dam, Lago di Santa Croce, Belluno**
   Strengthening the dam's walls by injecting DRACOGEL GT2, the hydro active elastic resin with controllable gel time
10. **Tunnel, Cernobbio, Como**
    Consolidation of the tunnel vault by coating with FLUECO 80 T2 fibre-reinforced mortar and inserting a mesh between layers
11. **Power plant, Nus, Aosta**
    Waterproofing and strengthening the substrate ballast by injecting DRACOGEL GT2, the hydro active elastic resin with controllable gel time

1 Trans-Adriatic Pipeline (TAP), Albania

2 Enel Dam, Valgallina, Belluno

3 Palmanova-Cervignano spur route, Udine

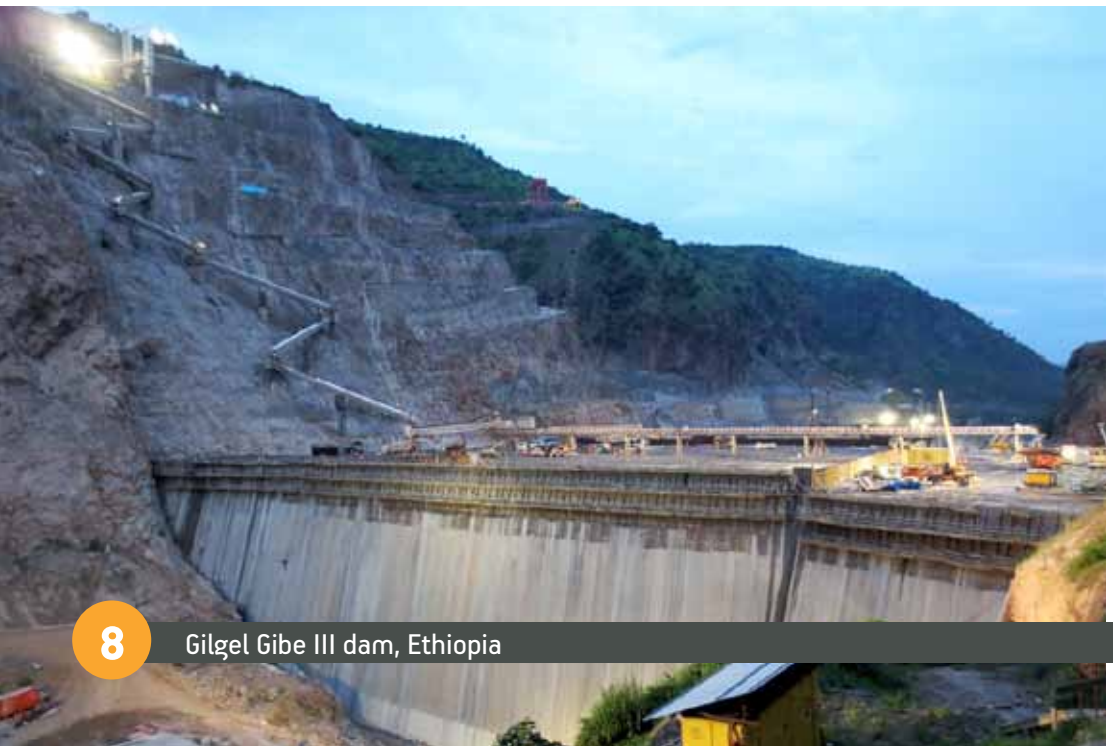
Trans-Adriatic Pipeline (TAP), Albania

Artificial barrier, Guillemore, Aosta 4

EXPO 2015, West Gate, Milan 5

6 Venerocolo dam, Adamello, Brescia

7 Venice Arsenal



8 Gilgel Gibe III dam, Ethiopia

Bastia Dam, Lago di Santa Croce, Belluno 9

Tunnel, Cernobbio, Como 10

Power plant, Nus, Aosta 11

FIND OUT MORE ABOUT DRACO BUILDING SOLUTIONS:

- **CONCRETE** LINE
- **FLOORING** LINE
- **WATERPROOFING** LINE
- **REFURBISHMENT AND PROTECTION** LINE
- **UNDERGROUND AND TUNNELLING** LINE
- **RENOVATION AND BIOARCHITECTURE** LINE

draco-edilizia.com

DRACO

QUALITY FOR BUILDING INDUSTRY

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