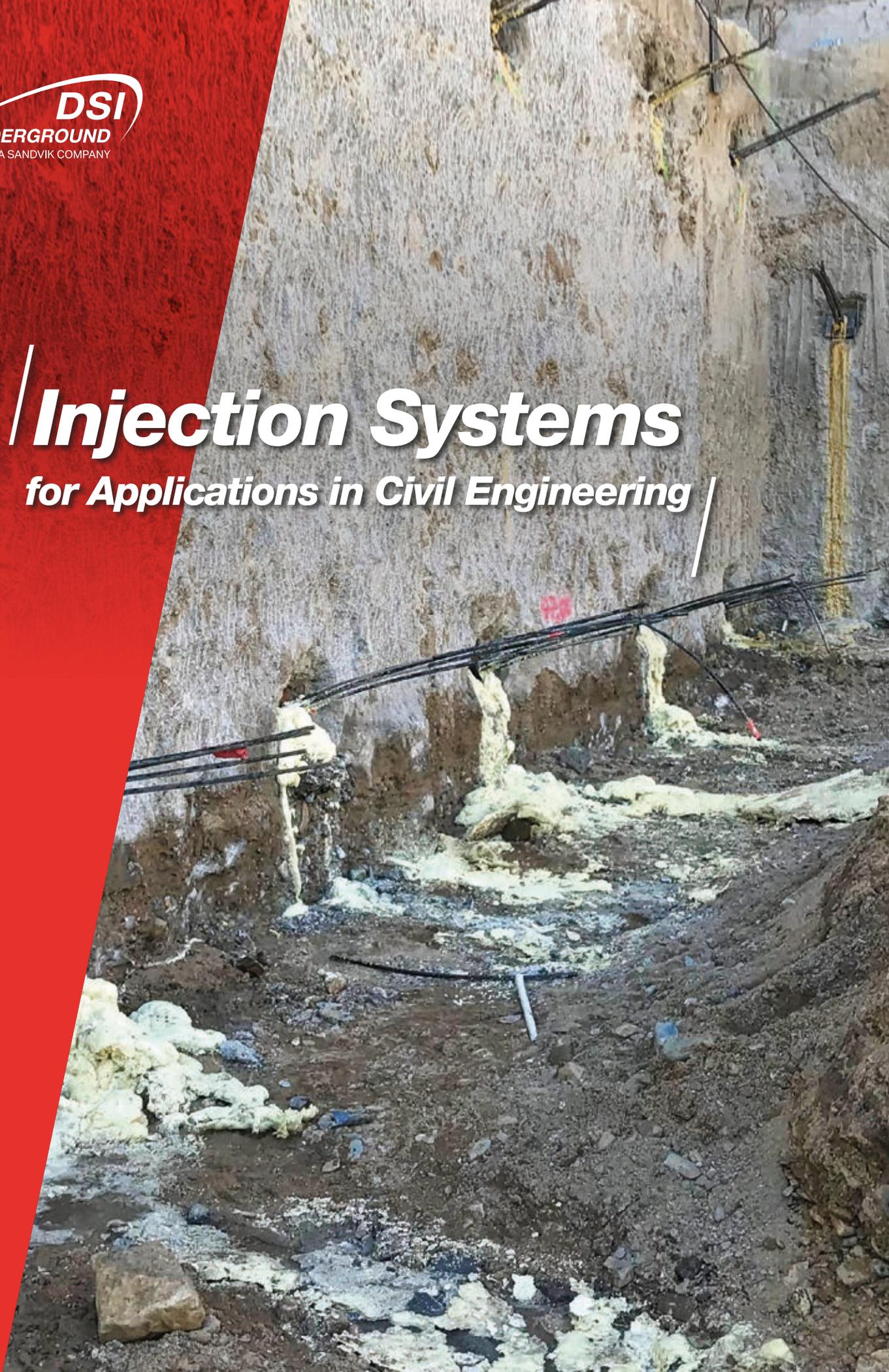




Injection Systems

for Applications in Civil Engineering





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About Us

DSI Underground is the world's leading provider of products, systems, and solutions for all areas of underground and surface construction. We are represented in more than 70 countries with over 2,500 employees, including engineers and technical specialists with many years of experience. Since July 2021, DSI Underground has been part of the Sandvik Group.

DSI Underground offers internationally renown brands for mining, tunneling, and civil engineering. Thanks to our global production locations, we ensure the sustainable and reliable fulfillment of all our customers' requirements. Comprehensive internal quality controls, and international logistical capacities ensure products of the highest quality.

We offer our customers customized, project-specific, durable, and environmentally friendly system solutions with detailed recommendations and comprehensive advice.

In addition to our extensive product portfolio, which ranges from anchor systems to synthetic resin cartridges for mining and tunneling we produce and develop proppants as well as injection resins for civil engineering.

In particular, the DSI Inject resin system developed by DSI Underground covers a wide range of applications in civil engineering.

PUR (2-C): Two-component polyurethane resins, the most versatile injection resin system, are mainly used for sealing and stabilizing all types of structures.

SIL (2-C): Two-component silicate resins, also known as organomineral resins, are mainly used for rock consolidation, cavity filling, and for bonding rock anchors.

PUR (1-C): One-component polyurethane resins are often used for smaller sealing work.

GELE E (3-C): Acrylic injection resins are used for surface sealing against water in the ground or walls or to consolidate floors.

Whether 1-C or 2-C synthetic resin systems based on polyurethanes or 2-C silicate resins, DSI Underground offers comprehensive solutions.

All DSI Inject systems are processed using 1- or 2-component high-pressure injection pumps individually adapted to the respective application. Appropriately used, DSI injection systems meet all ecological and sustainability requirements and can be used without hesitations.



Applications

Type	Product Group	Application							
		Slight Water Ingress	Heavy Water Ingress	Sealing (Gas and Water)	Ground Consolidation	Rock Consolidation	Cavity Filling	Backfilling	Bonding of Rock Anchors
Two-component Resins									
PUR (2-C)	Fast-curing polyurethane resins	+++	+++	+	++	+	----	----	----
	Medium- and slow-curing polyurethane resins	----	----	+++	+++	+++	----	----	+
	Fast-curing polyurethane foam resins	+++	+++	+	++	----	----	----	----
SIL (2-C)	Organomineral silicate resins	----	----	++	+++	+++	----	----	+
	Organomineral silicate resins bonding	----	----	+	++	----	----	----	+++
	Organomineral silicate foam resins	+	----	+	+++	+++	+++	+++	----
One-component Resins									
PUR (1-C)	Fast- and medium-curing polyurethane resins	+	----	+++	++	+	----	----	----
	Slow-curing polyurethane resins	----	----	+	++	++	----	----	----
Multi-component Acrylic Resins									
GELE (3-C)	Acrylic resin	----	----	----	+++	+++	----	----	----
	Acrylic resin injection gel	----	----	+++	++	+	----	----	----

“+” Recommended, “-” Not recommended



The Path to Successful Injection

Step 1: Identification of Task

- Sealing
- Consolidation and stabilization
- Cavity filling
- Crack injection



Step 2: Determination of Injection Material

Three commonly used types of injection materials

- Suspensions
 - Water + cement (for example, micro-cements, fine cement, etc.)
 - Water + cement + fillers (for example, sand, fly ash, etc.)
- Solutions
 - Chemicals diluted in water (for example, water glass + hardener)
 - Polyurethanes (for example, 1-C, one component, 2-C, two components)
 - Acrylic resins
- Emulsions
 - Silicate resins

Restrictions with cementitious injection materials

- $\lambda < 1$
- Leaching in general
- Large gaps/cavities
- Permeability less than 10^{-6} [m/s]
- Difficult to use at low temperatures

Application windows for injection resins

Injection resins are used if at least one of the following criteria applies:

- Discontinuities
 - Large gaps/cavities
- Permeability and hydraulic conductivity
 - Lugeon $< 15 - 20$
 - $K < 10^{-6}$ [m/s]
- Water ingress
 - Water speed > 20 [mm/s]
- Water and ground temperature
 - Below $3 - 5$ [°C]

Step 3: Creation of Method Statement – Definition of Injection Target

- By qualified and experienced experts
- Selection of the injection resin taking into account the material properties with a reaction profile
- Definition of the termination criteria for the individual injection points
- Selection of the injection equipment and injection accessories

Step 4: Application and Verification

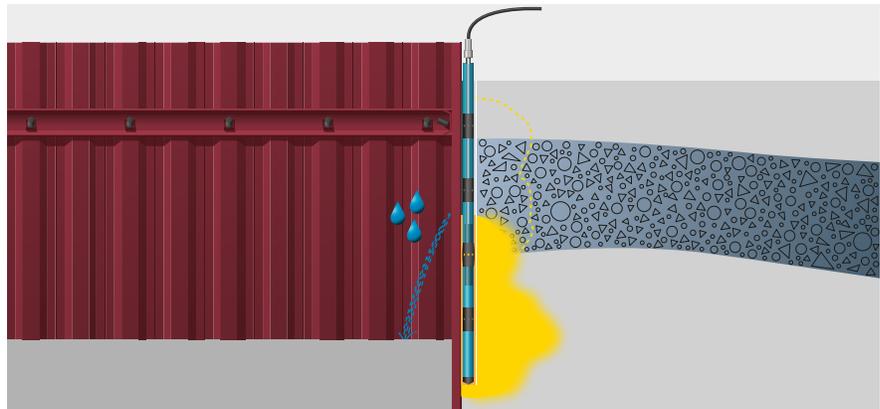
- Execution according to the method statement
- Continuous monitoring of data
- Observance of the predefined termination criteria
- Qualitative and quantitative evaluation of the injection results
- Determination of further steps



Areas of Application

Sealing

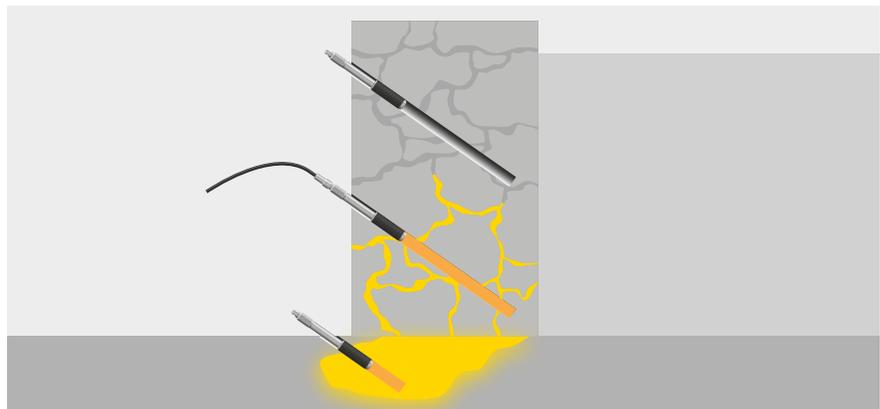
- Water ingress:
 - Temporary or permanent
 - Water quantity
- Pressurizing water:
 - Temporary or permanent
 - Pressure range
 - Water quantity
 - Water temperature
- Escaping gas:
 - Gas type
 - Gas quantity
 - Escape routes
- Product range:
 - PUR quick setting (1-C)
 - PUR foam (2-C)
 - SIL foam (2-C)
 - GELE (3-C)



Stabilization and sealing of a sheet pile wall using the sleeve tube method

Consolidation and Stabilization

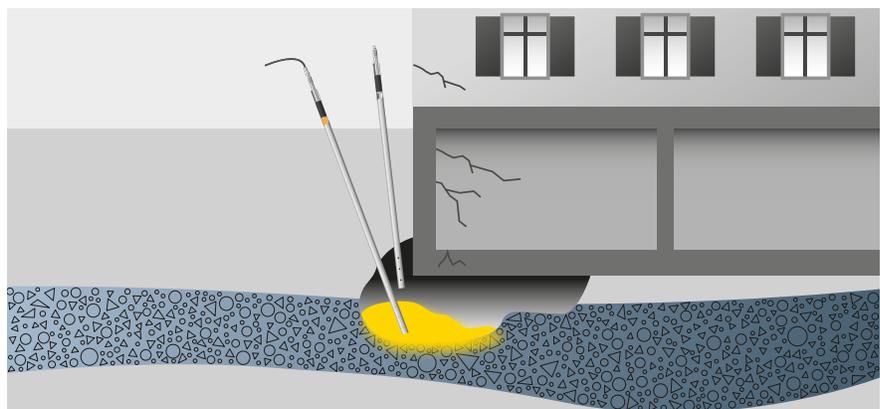
- Consolidation:
 - Soil type
 - Required degree of improvement
- Stabilization:
 - Soil type
 - Temporary or permanent
- Product range:
 - PUR foam (2-C)
 - SIL (2-C)
 - SIL foam (2-C)
 - GELE (3-C)



Cavity filling and consolidation in quarry stone masonry

Filling

- Filling cavities:
 - Cavity size
 - Required degree of improvement
- Backfilling:
 - Gap width
 - Is water present?
- Product range:
 - PUR foam (2-C)
 - SIL foam (2-C)



Cavity filling accessible from the outside (with injection lance)

Competence in the Application

Permeability in Soils and Fractured Rock

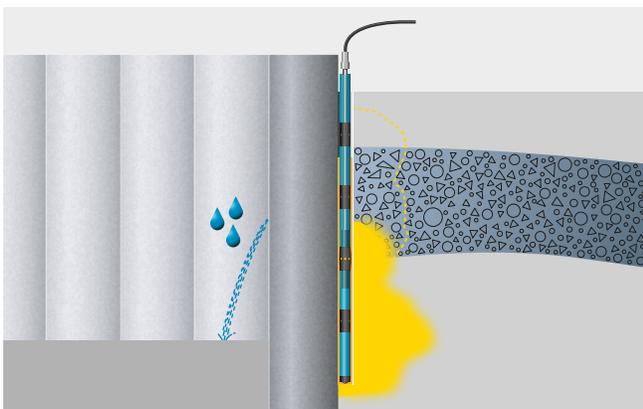
Penetration Capability							
Soil Type							
Gravel	Sand			Silt	Clay		
	Coarse	Medium	Fine				
Particle Size [μm]							
100,000	2,000	500	250	75	5		
Crack Width [mm]							
10	5	1	0.5	0.1	0.05		
Permeability (k) [mm/s]							
10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}	10^{-9}
Grouting Material							
Cementitious Suspensions							
Chemical Solutions							
Injection Resins							

Method Statement

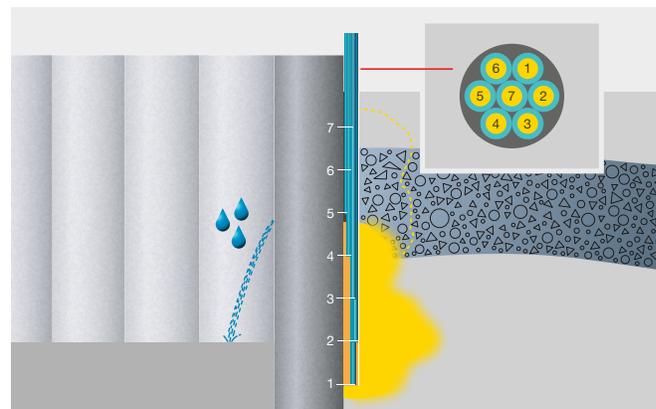
Certain standard applications where access to the future application site, building conditions, and other influencing factors are known – such as the filling of identified cavities or the sealing of segmental linings – can be planned and prepared in advance.

The unknown parts of any civil engineering project are unpredictable soil and groundwater conditions that can potentially lead to an emergency situation and require the immediate application of injection measures. For an emergency application, project-specific method statements must be prepared.

The parameters for drawing up the method statement include the extent (size) of the application area, the soil and rock conditions, the ambient and water temperatures, the water inflow volume, and the water pressure. Collecting of further project-specific data is necessary to obtain a comprehensive emergency method statement.



Stabilization and sealing of a bored pile wall using the sleeve tube method



Stabilization and sealing of a bored pile wall with a graded injection tube bundle



Technology

Over the last few decades, injection materials for use in civil engineering have been continuously developed and improved.

The applications and requirements have become more specific. The portfolio has been expanded regarding developing new products and systems to enable an optimized solution for targeted injection applications.

The composition of today's injection resins also shows improved performance characteristics thanks to the further development of raw materials and components.

State-of-the-art injection resins are characterized by an improved mode of action and increased environmental compatibility, such as groundwater and drinking water, etc.

However, the injection equipment and the entire application technology have been continuously improved. Injection equipment, hoses, fittings, and valves have been adapted to current and future requirements. Well-matched mixing products ensure the ideal mixing of the individual components. Standardized processing procedures guarantee a safe and reliable working process.

Equipment and Accessories

- Project-specific design and dimensioning
- Supply of complete solutions
- Wide range of injection technology



Selection and Design Criteria

Product Properties

Introduction

Several parameters define the properties and assess the suitability of injection resins regarding their correct application. These parameters include reactivity, viscosity, reaction time, mechanical strength, adhesion, foam factor, and water miscibility, to name just the most important parameters. They determine the range of applications of a particular resin system and the success of the application. Without a doubt, a detailed analysis of the parameters must be an integral part of any case study to ensure the successful application purpose, i.e., sealing, stabilizing, filling, or bonding.

Setting Time

The setting time is the system parameter that indicates the material's reactivity, for example, the point at which the reacting liquid stops flowing. After this time, the material begins to cure, that is, the hardening process begins.

The setting time can vary from seconds to hours. In practice, the systems are divided into quick, medium, and slow.

The setting time mainly influences injectability in relation to the application.

Another common term for the setting time is tack-free time, which defines the state at which the surface of the reacting resin is no longer sticky.

Thixotropy

The thixotropy of injection resins describes aggregate states, which are fluid during the injection process at a high speed of movement and stiffen immediately after the injection device is switched off or the movement greatly reduced.

Thixotropic behavior is necessary in any overhead application, for example, when bonding rock anchors, to prevent an uncontrolled outflow of the material during and after injection. The same applies to the application of injections in Karst formations.

Water Reactivity

The presence of water during the application always influences the effectiveness. When selecting the appropriate material, the presence of water must be considered with regard to several aspects:

- Chemical reactivity with the components
- Physical modification of the material
- Water leakage
- Water pressure
- Mechanical properties

Viscosity

Viscosity is the physical parameter characteristic of the individual components and the reaction mixture. The higher the components' viscosity, the higher the flow resistance. Therefore, this factor is important for correctly selecting injection equipment and accessories in terms of injection pressure.

Viscosity is also important when considering the relationship between crack size, injection pressure, and penetration depth. There is a direct relationship between viscosity and injection pressure.

Foaming Properties

For polyurethane and silicate resins, the foaming ability is the characteristic feature of the injection system.

Special formulations allow the foam factor and cell structure to be controlled, in order to produce open-cell or closed-cell foam. The following rules of thumb apply: The higher the foam factor, the lower the mechanical strength and the lower the cost per unit of filling volume. The higher the content of closed cells, the better the waterproofing properties of the foam.

Miscibility of Components

The vast majority of injection materials are two-component systems. The two components are delivered separately by means of a 2-C injection device. At the end of the delivery line, they are brought together in a mixing head and then homogeneously mixed by a static mixer element. The effectiveness of mixing the components determines the final material properties and reaction parameters. Static mixers work on the flow division principle. The higher the flow velocity, the more intensive the close mixing of the individual components. The design of the mixing element can be different for different injection agents. Therefore these static mixers are carefully tested and selected. The manufacturer's recommendations must be strictly observed.

Mechanical Properties

Mechanical properties are specific characteristics of injection materials, for example, compressive, flexural, or tensile strength. Solid products are very strong compared to foamed materials. As the foam factor increases, the mechanical properties decrease.

If the purpose of the injection is consolidating the injection zone (rock, soil, concrete, or masonry), the mechanical parameters are decisive.

Areas of Application

Once the application (or several applications) is defined as an injection project, selecting the appropriate injection resin types for a given application is critical. **PUR (1-C)** resins are used for small injection work under mainly known, manageable conditions. **PUR (2-C)** and **SIL (2-C)** injection resins can be used for a wide range of applications.

DSI Underground offers products with different properties to ensure an optimal injection result.

Adhesion to Surfaces

Adhesion is an important factor in ground consolidation and surface application. It can significantly influence the outcome of the application – improvement, ground consolidation, and anchoring in the ground are good examples.

In mechanized tunneling, injection resins **SIL (2-C)** or **GELE (3-C)** may be the preferred choice for mechanized tunnel lining due to their properties. Consolidated or filled areas can be passed through by the tunnel boring machine (TBM) without any problems.

An initial estimate of a suitable product range can be made based on the water pressure conditions and the amount of loosening.

Application areas

Product	Type	Water Presence				Ground Fracture Magnitude				
		Dry	Moist	Wet	Pressurized	Crack Width [mm]				
						0.05	0.1	0.5	5	10
PUR (2-C)	W	■				■				
	WF	■					■			
	WT	■						■		
	S	■				■				
	LV	■				■				
	HF		■					■		
SIL (2-C)	Bond	■				■				
	Bond T	■					■			
	Fill	■					■			
PUR (1-C)	1C-50	■				■				
	1C-100		■			■				
	1C-400		■				■			
GELE (3-C)	SR	■				■				
	E		■				■			

Abbreviations

PUR (2-C) Two-component polyurethane resin
SIL (2-C) Two-component organomineral resin
PUR (1-C) One-component polyurethane resin
GELE (3-C) Multi-component acrylic resin

W Water stopping
LV Low viscosity
F Fast
S Slow

T Thixotropic
HA High adhesion
HF Controllable foaming factor
HS High strength

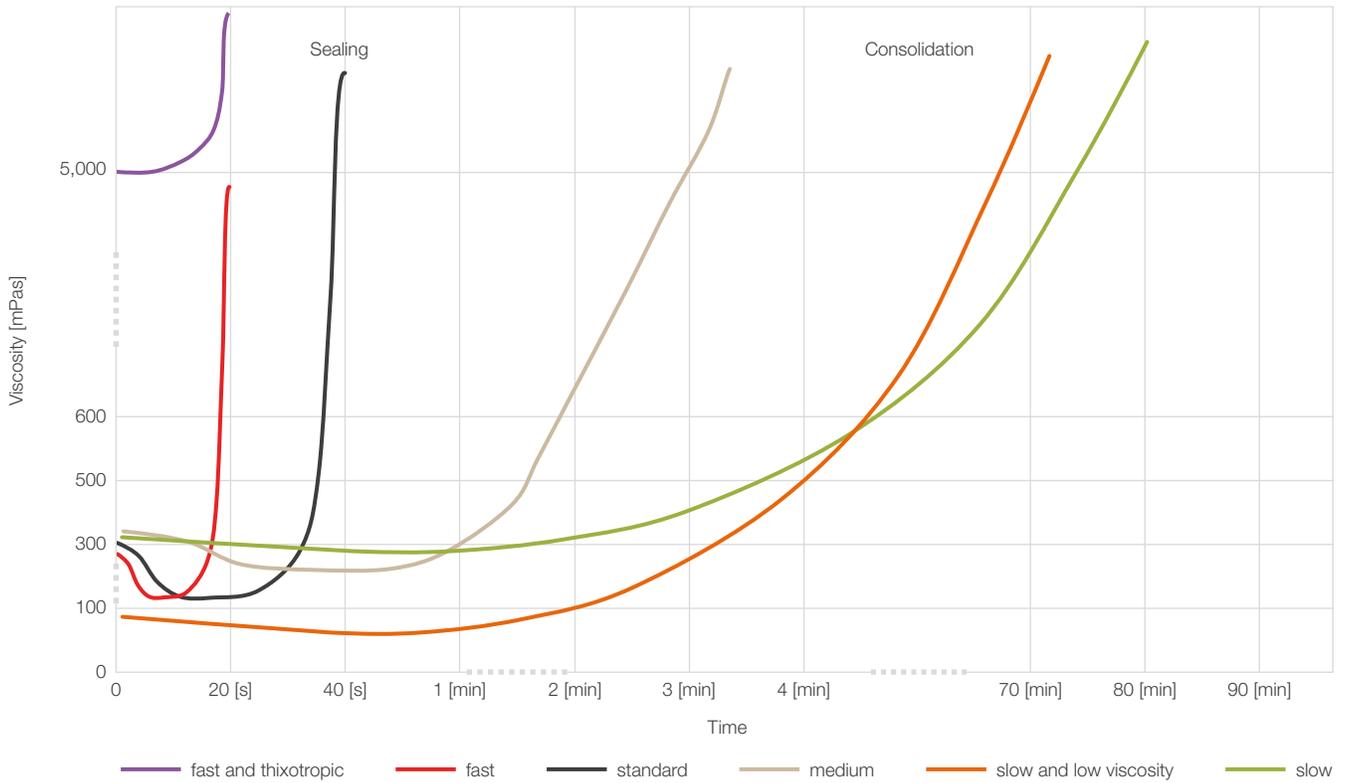
E Elastic
SR Semi-Rigid

Polyurethane Resins PUR (2-C)

Product Range

Product Designation	Product Name	Product Description
Fast-setting polyurethane resins	PUR W	<ul style="list-style-type: none"> - Fast-setting resin - 100% solid system - Balanced and adapted viscosity of the components - Low initial viscosity - Easy miscibility - Outstanding mechanical properties - Good adhesion to the substrate in wet and dry conditions - Environmentally friendly
	PUR WF	- Faster version of PUR W
	PUR WT	- Thixotropic version of PUR W
	PUR HS	<ul style="list-style-type: none"> - Very fast-setting resin - 100% solid system - Balanced and adapted viscosity of the components - Outstanding mechanical properties - Good adhesion to the substrate in wet and dry conditions
Medium- and slow-setting polyurethane resins	PUR HA	<ul style="list-style-type: none"> - Medium fast-setting resin - 100% solid system - Balanced and adapted viscosity of the components - Easy miscibility - Good mechanical properties - Good adhesion to the substrate in wet and dry conditions - Good resin flow properties
	PUR S	<ul style="list-style-type: none"> - Very slow-setting resin - 100% solid system - Balanced and adapted viscosity of the components - Low initial viscosity - Easy miscibility - Outstanding mechanical properties - Good adhesion to the substrate in wet and dry conditions - Environmentally friendly
	PUR LV	<ul style="list-style-type: none"> - Very slow-setting resin - Balanced and adapted viscosity of the components - Extremely low initial viscosity - Easy miscibility - Easy to mix at different temperatures - Adaptable mechanical properties - Good adhesion to the substrate in wet and dry conditions
Fast-setting polyurethane foam resins	PUR HF-2, 5, 10, 15	<ul style="list-style-type: none"> - Fast-setting resin - 100% solid system - Easy miscibility - Good adhesion to the substrate in wet and dry conditions - Environmentally friendly - System with implemented foaming up to 15 times
Additives for two-component polyurethane resins	Add Fast	<ul style="list-style-type: none"> - Additive for two-component polyurethane resin - Is used when a faster reaction is required due to high water ingress or low temperatures
	Add Thix	<ul style="list-style-type: none"> - Additive for two-component polyurethane resin - Increases initial viscosity after mixing which can be useful for reducing resin loss in highly permeable ground or where there is massive water ingress

Properties: Viscosity and Setting Time



Specifications

Product	Properties / Unit ¹⁾			
	Viscosity after Mixing	Reaction Start Time	Time until Tack-free	Foam Factor
[-]	[mPas]	[s]	[s]	[1]
PUR W	280	5	35	≈ 1
PUR WF	280	5	20	≈ 1
PUR WT	> 5,000	5	35	≈ 1
PUR HS	600	15	25	≈ 1
PUR HA	225	8	70	≈ 2
PUR S	280	240	2,400	≈ 1
PUR LV	100	1,800	3,600	≈ 1
PUR HF-2	325	50	80	≈ 2 - 3
PUR HF-5	350	60	120	≈ 4 - 5
PUR HF-10	350	60	120	≈ 10
PUR HF-15	350	60	120	≈ 15

1) The specified values are laboratory values and may deviate on-site. 20 [°C] (68 [°F]).

Store in the original packaging and protected against moisture at temperatures between 5 [°C] and 30 [°C] (41 [°F] and 86 [°F]).

Data on other mixing ratios and application-relevant information can be found in the DSI Underground technical data sheets.

Organomineral Resins SIL (2-C)

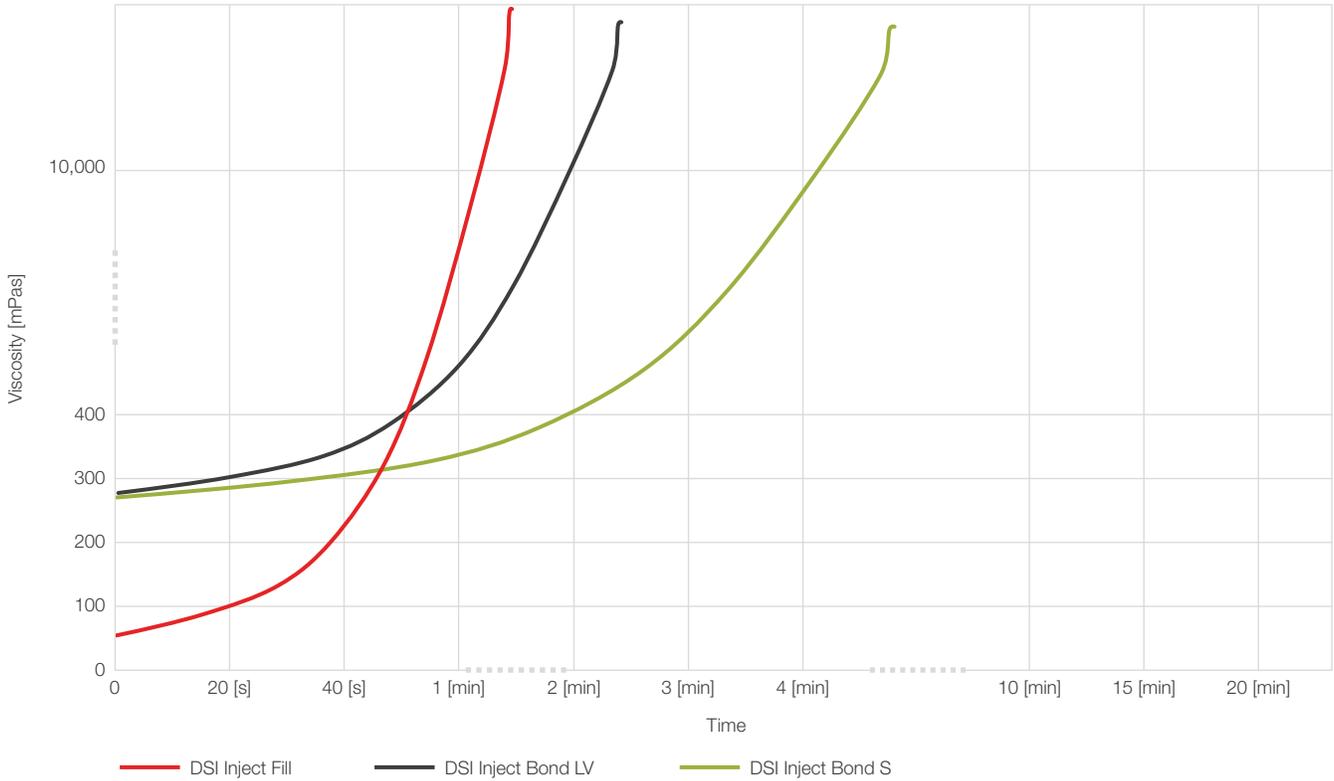


Typical flow pattern of a thixotropic organomineral resin

Product Overview

Product Designation	Product Name	Product Description
Organomineral resins	Bond LV	<ul style="list-style-type: none"> – Medium fast-setting resin – Low viscosity of the components – Relatively low initial viscosity – Good mechanical properties – Very good adhesion to the substrate in wet and dry conditions – Does not react with water. Water does not influence material's properties. – Outstanding corrosion resistance – Environmentally friendly
	Bond S	– Slower version of Bond LV
	Bond T	<ul style="list-style-type: none"> – Thixotropic version of Bond LV – System with increased initial viscosity after mixing – Excellent for use in highly friable substrates
Organomineral resin foams	Fill	<ul style="list-style-type: none"> – Highly foaming injection resin – Very low viscosity of the components – Very low initial viscosity – Cured resin is easy to cut and drill through – Does not react with water and water has no influence on the material properties – Outstanding corrosion resistance
	Fill S	– Slower version of Fill
Organomineral anchor resin	Bolt MI	<ul style="list-style-type: none"> – Specially developed thixotropic behaviour of the reaction mixture for mechanical anchor installation – Easy overhead installation of the anchors possible – High final strength and immediate load-bearing capacity after installation – Outstanding mechanical and adhesive properties – Hydrophobic system, for example, Mineral Bolt does not react with water and water has no influence on the material properties – Lower exothermic reaction temperature compared to PUR systems – Not combustible – Environmentally friendly
	Bolt F	– Fast-setting
	Bolt M	– Medium fast-setting
	Bolt S	– Slow-setting
	Bolt US	– Ultra slow-setting

Properties: Viscosity and Setting Time



Specifications

Product	Properties / Unit ¹⁾			
	Viscosity after Mixing	Reaction Start Time	Tack-Free Time	Foam Factor
[–]	[mPas]	[s]	[s]	[1]
Bond LV	300	120	180	1.0
Bond S	300	240	400	1.0
Bond T	450 - 10,000	120	180	1.0
Fill	75	15	45	≈ 35
Fill S	75	40	135	≈ 35

Product	Properties / Unit ¹⁾			
	Viscosity after Mixing	Reaction Start Time	Tack-Free Time	Foam Factor
[–]	[–]	[s]	[s]	[1]
Bolt MI	Very high viscosity liquid	20	60	1.0
Bolt F	High viscosity liquid	50	80	1.0
Bolt M	Normal viscosity liquid	105	240	1.0
Bolt S	Normal viscosity liquid	180	540	1.0
Bolt US	Normal viscosity liquid	285	660	1.0

1) The specified values are laboratory values and may deviate on-site. 20 [°C] (68 [°F]).

Store in the original packaging and protected against moisture at temperatures between 5 [°C] and 30 [°C] (41 [°F] and 86 [°F]).

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Polyurethane Resins PUR (1-C)

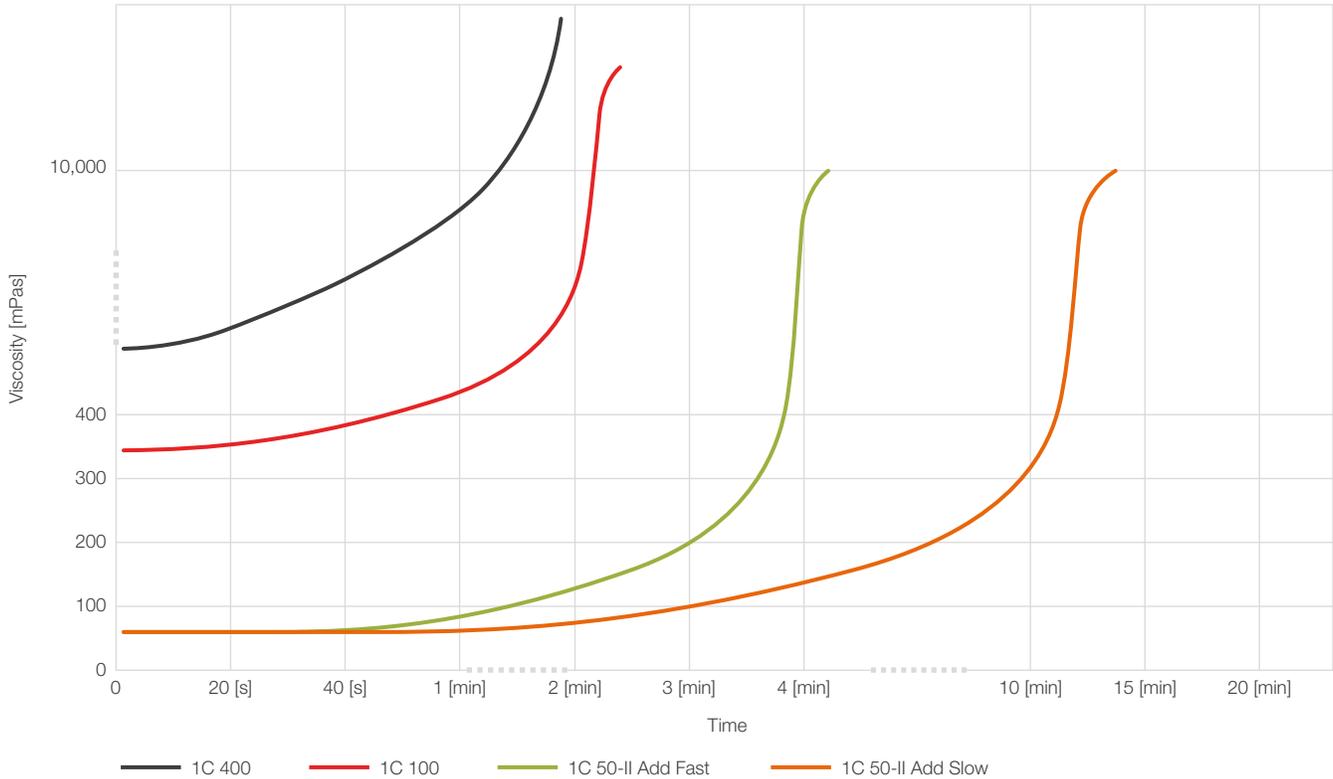


Injection for sealing on an anchor head

Product Overview

Product Designation	Product Name	Product Description
One-component resins PUR (1-C)	General	<ul style="list-style-type: none"> – Slow to fast-setting resin with adjustable reaction time – Phthalate-free – Good mechanical properties of consolidated ground – Environmentally friendly
	PUR 1C 50-II	<ul style="list-style-type: none"> – Slow-setting resin – Very low initial viscosity – Product developed for fine sand injection
	PUR 1C 100	<ul style="list-style-type: none"> – Rigid and medium fast-setting resin – The setting time can be shortened with Add Fast 1C – Solvent-free – Can be used in a wide temperature range – Environmentally friendly
	PUR 1C 100-II	<ul style="list-style-type: none"> – Based on PUR 1C 100 – Faster start time – Significantly faster foam formation
	PUR 1C 100-II-R	<ul style="list-style-type: none"> – Based on PUR 1C 100 – “R” for “ready for use”, genuine 1C system
	PUR 1C 400	<ul style="list-style-type: none"> – Elastic and medium fast-setting resin – The setting time can be shortened with Add Fast 1C – Solid system – Solvent-free – Environmentally friendly
Accelerator for one-component resins	Add Fast 1C Add Slow 1C	<ul style="list-style-type: none"> – Additives for one-component resins – Used when faster or slower reactions are required to cope with high water ingress or low temperature conditions.

Properties: Viscosity and Setting Time



One-component PUR Resins

- Easier use of PUR (1-C) systems
 - Injection using 1-C equipment
 - Quick and easy cleaning of the equipment and hoses
- Special integrated accelerator on request tailor-made to project requirements
- Limitations of PUR (1-C) systems
 - Short reaction times
 - Generally, low flow rates

Specifications

Product	Properties / Unit ¹⁾				Foam Factor
	Reaction Start Time [s]		End of Foaming [s]		
[-]	10 [°C] (50 [°F])	20 [°C] (68 [°F])	10 [°C] (50 [°F])	20 [°C] / 68 [°F]	[1]
PUR 1C 50-II ²⁾	80	55	350	180	≈ 5
PUR 1C 100	45	13	230	150	≈ 35
PUR 1C 100 - II	20	15	50	45	≈ 30 ³⁾
PUR 1C 100 - II-R	35	25	185	120	≈ 30 ³⁾
PUR 1C 400 ⁴⁾	55	20	300	180	≈ 20

1) The specified values are laboratory values and may deviate on-site. 20 [°C] (68 [°F]).

Store in the original packaging and protected against moisture at temperatures between 5 [°C] and 30 [°C] (41 [°F] and 86 [°F]).

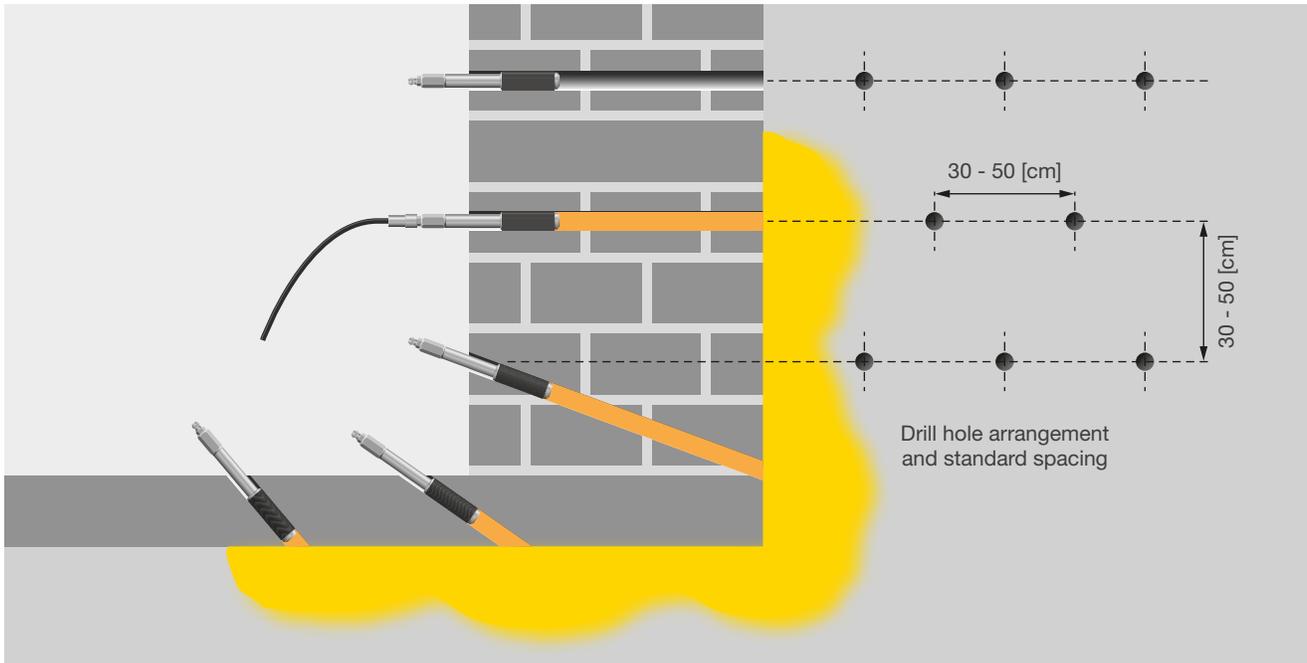
Data on other mixing ratios and application-relevant information can be found in the DSI Underground technical data sheets.

2) Reaction times with the addition of 0.5% Add Fast 1C and 10% water.

3) Free foaming.

4) With the addition of 2% DSI Inject ADD Fast 1C.

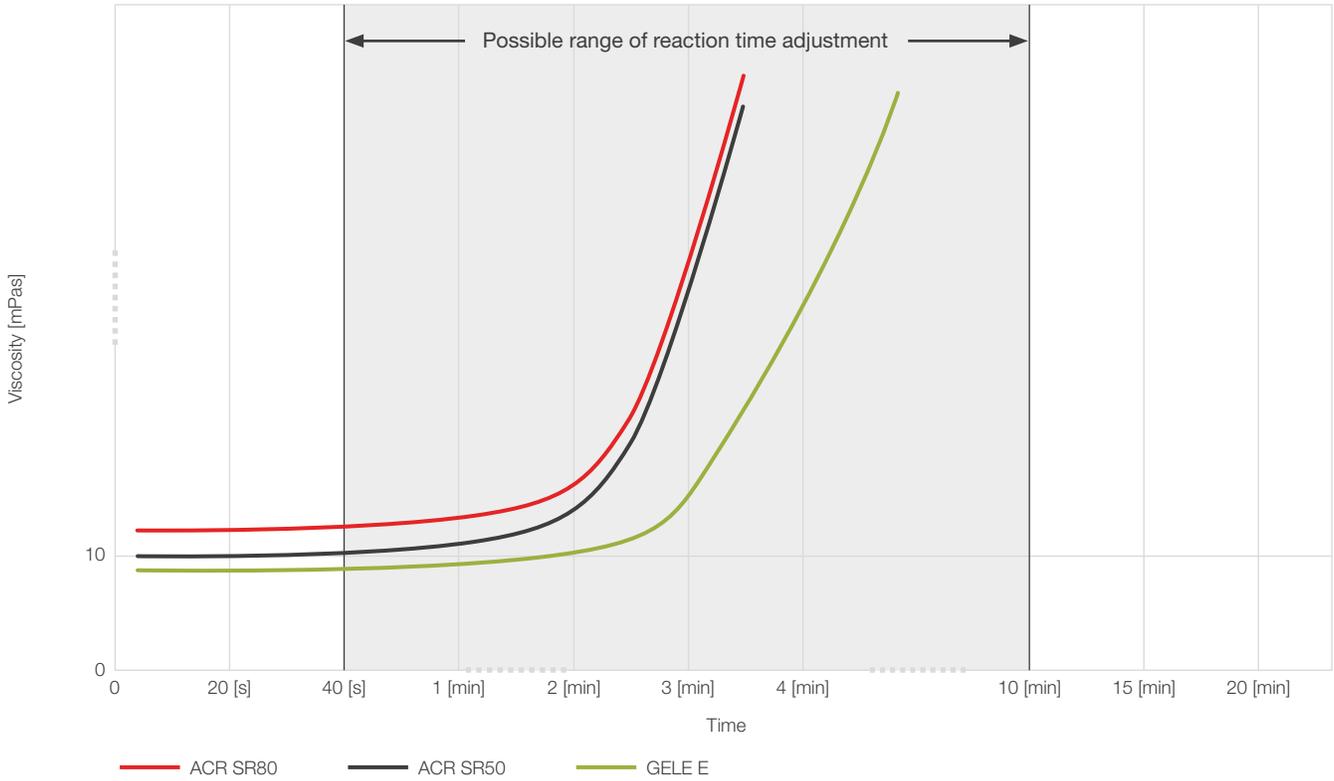
Acrylic Resins GELE (3-C)



Product Overview

Product Designation	Product Name	Product Description
Acrylic Resins GELE (3-C)	General	<ul style="list-style-type: none"> - Low viscosity aqueous solutions of acrylic monomers - Extremely low initial viscosity of the mixing components ~10 [mPas] - Easy to mix at different temperatures - Environmentally friendly - Outstanding penetration and good adhesion
	ACR SR 80	<ul style="list-style-type: none"> - 4-component system - High strength resin with easily controllable gelation - Outstanding mechanical properties - Suitable for the injection of fine sands
	ACR SR 50	<ul style="list-style-type: none"> - 3-component system - Medium strength with easily controllable gelation - Good mechanical properties - Suitable for the injection of fine sands
	GELE E	<ul style="list-style-type: none"> - 3-component system - Flexible, rubber-like acrylic resin - Suitable for ground stabilisation and water sealing

Properties: Viscosity and Setting Time



Special Features

- 3-component acrylic resin GELE (3-C)
- Efficient sealing against groundwater
- So-called “curtain injections / surface injection”: Sealing by forming an impermeable sealing layer in the ground
- Constant foam factor: 1

Specifications

Product	Properties / Unit ¹⁾				
	Viscosity after Mixing	Reaction Start Time ²⁾	Mixing Ratio: Parts per Volume	Foam Factor	Compressive Strength ³⁾
[-]	[mPas]	[s]	[-]	[1]	[Mpa]
ACR SR 80	12	30 - 360	1 : 1	1	≈ 20
ACR SR 50	10	60 - 300	1 : 1	1	≈ 10
GELE E	9	300	1 : 1	1	N/A

1) The specified values are laboratory values and may deviate on-site. 20 [°C] (68 [°F]).

Store in the original packaging and protected against moisture at temperatures between 5 [°C] and 30 [°C] (41 [°F] and 86 [°F]).

Data on other mixing ratios and application-relevant information can be found in the DSI Underground technical data sheets.

2) Start of gelling.

3) With sand.

Injection Technology

The selection of suitable technology for the economic implementation of the injection task and the optimal achievement of the injection aim depends on various factors.

DSI Underground has decades of application experience worldwide and supports you in your selection. Many of our products, possible special products depending on the task, and cooperation with the leading suppliers in the injection market form a reliable product portfolio.

Injection Equipment and Accessories

Our single- and multi-component injection devices are available in different drive types. Mainly air-driven pumps are used. Depending on the injection material and the application, electric or electro-hydraulic pumps can also be used. We supply you with the job-specific equipment package with the associated mixing devices, high-pressure hoses, measuring instruments, and desired connections.



1-C injection pump – electrically driven



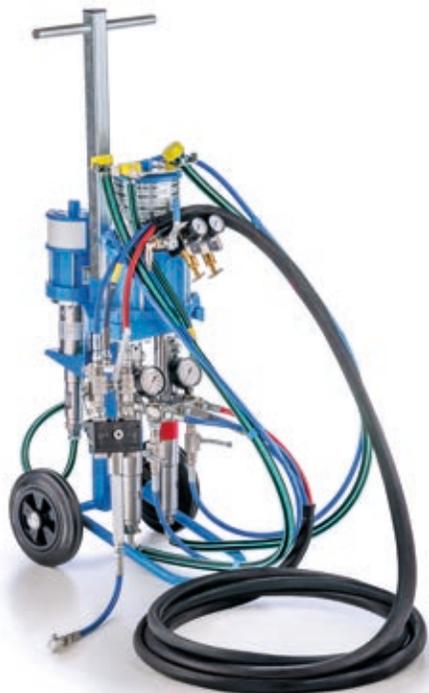
1-C injection pump compact – air-driven



2-C injection pump – air-driven



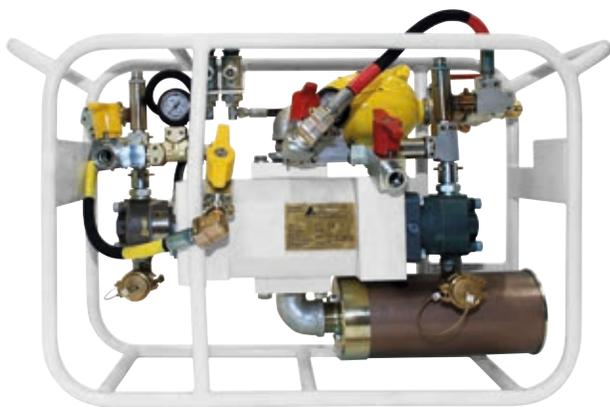
2-C piston pump with material containers – air-driven



2-C piston pump with additional flushing pump – air-driven



2-C mixing head with separate flushing function



2-C gear pump – air-driven



2-C piston pump – air-driven

Recording Device

The increased requirements for documentation imposed on the building contractor may require an electronic recording of the injection processes. For this purpose, recording devices are used, which, for example, record the injection quantity, injection pressures, and many other data.

Likewise, abort criteria can be set to avoid uncontrolled or incorrect injection. Possible settings are achieving a certain pressure or quantity, and the mixing ratio deviations.



Recording device for injection processes

Static Mixer Mixing Device

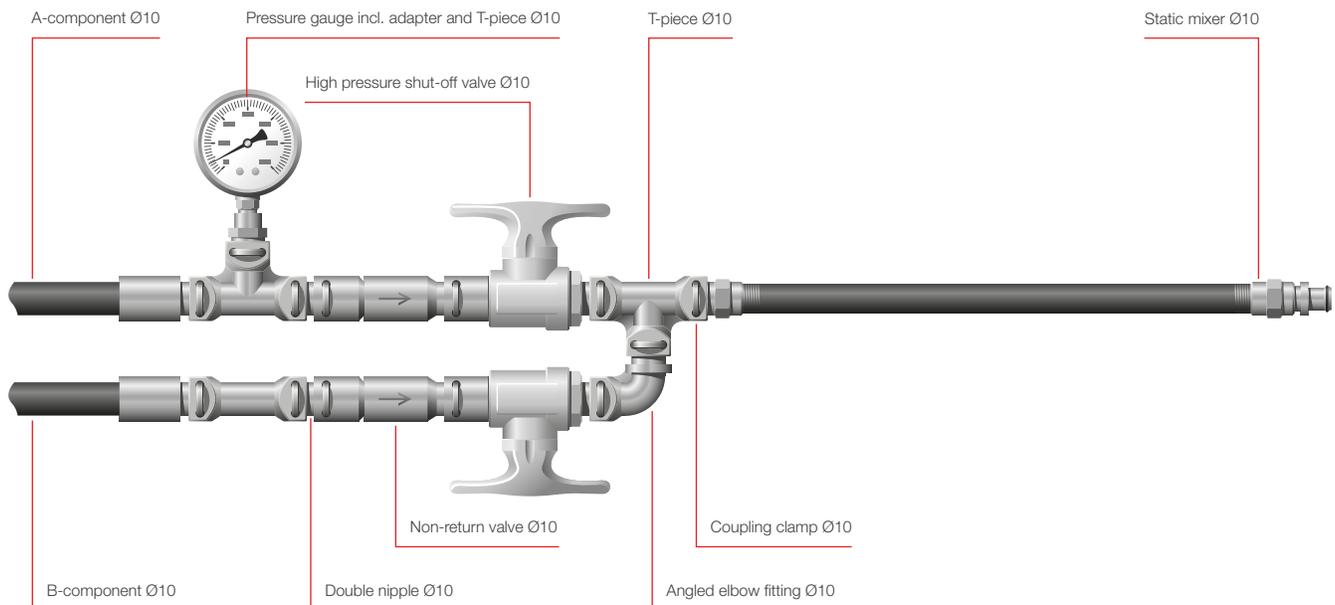
A stationary or static mixer is a device for mixing fluids that do not have moving elements and in which the flow movement alone causes the mixing.

It consists of flow-influencing elements in a pipe. These alternately divide the material flow and then bring it together again, through which the mixing is achieved.

Static mixers are suitable for combinations of liquid/liquid, gaseous/gaseous and liquid/gaseous, under certain circumstances, also for bulk materials.



Mixing Unit DN10 with Static Mixing Pipe



Products for the Insertion of Injection Materials

Every injection job has its standard but also its individuality. We supply an extensive range of mechanical injection packers, from the small injection packer for crack injection to the cavity filler packer in larger dimensions.

Inflatable hydraulic packers, for example, for umbrella injection, are also part of the range. Self-drilling hollow bar anchors made of steel/GRP or ram lances for ground consolidation and many other products are included in our extensive

range as a manufacturer of injection solutions. Individual tailor-made solutions to your requirements can also be produced cost-effectively and within a short time.



Adhesive packer Ø 50 [mm] with zerk fitting



Steel packer Ø 13 x 110 [mm] with zerk fitting



Lamella packer Ø 14 x 95 [mm] with external thread



Steel packer Ø 18 x 150 [mm] with external thread



Steel packer Ø 10 x 110 [mm] with button head fitting



Ram lance Ø 13 x 1.000 [mm]

Tip



Connection coupling for button head fitting



Steck-O connectors

Products for the Insertion of Injection Materials



One-way inflatable packer Ø 40 [mm]



One-way inflatable packer Ø 40 [mm] expanded



Mechanical packer Ø 90 x 500 [mm] with ball valve



Screw-on nipple Steck-O on R32 injection drill anchor



Injection connection for cement injections



Inflatable hydraulic packer - double packer Ø 56 x 1,000 [mm]



GRP hollow bar injection drill anchor



Steel hollow bar injection drill anchor

Inspection, Test, and Packaging

Quality & Service

Our products are subject to permanent quality control in all processes, undergo inspections and tests and have the corresponding approvals from external cooperation partners, such as

MFPA Leipzig GmbH, DMT GmbH Essen and Hygiene Institut Gelsenkirchen, etc.

Other country-specific inspection and testing bodies partner with us on all

continents in order to meet all performance and quality requirements and to guarantee the sustainability and reliability of our products.

Packaging

We supply our products in various types and sizes of packaging. The standard packaging types can be found in the technical data sheets. IBC containers for large applications, rectangular plastic canisters in black or transparent in various sizes. Metal drums and metal canisters are available in different designs and sizes.

- Rectangular or round metal canisters in various sizes
- Metal drums 200 [l]
- IBC containers 1,000 [l]



Application and Virtual Reality Training

In addition to the standard documents, such as safety and technical data sheets, we also provide you with detailed information on the processing, cleaning and disposal of our products.

Furthermore, our application team will be happy to assist you with any challenges, personally on-site or via the option of Virtual Reality Training (VRT).

Together with EDVIRT®, a DSI Underground company, we can guide you into the future of injection training.

EDVIRT®

EDVIRT® is a Swedish company providing products and training based on its advanced virtual reality training technology to mining and tunneling customers worldwide. The team is made up of experienced tunneling engineers, trainers, and software developers who are dedicated to improving training standards.

Since the spring of 2021, the company has been owned by DSI Underground SMART, a wholly-owned subsidiary of DSI Underground.

The service and product portfolio are gradually being expanded to include several areas of underground mining operations. The VR Training for installing the AT – Pipe Umbrella has been implemented successfully.

Solutions are also being planned and prepared in the field of foundation engineering, hydraulic engineering, and also in rehabilitation. The VR solutions enable cost reductions, and at the same time, deliver a great improvement in quality and safety. The globally unparalleled, virtual, simulator-based training offer and the corresponding certification programs are sustainable, fast and efficient.



www.edvirt.com



Screenshots from VR injection training

Notice:

This brochure is only intended to provide basic information about our products. The technical data and information contained herein are expressly non-binding in character and are subject to change without prior notice. We shall not accept any liability for damages in connection with the use of the technical data and information contained herein or due to the improper use of our products. Please contact us directly for further information on specific products.

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