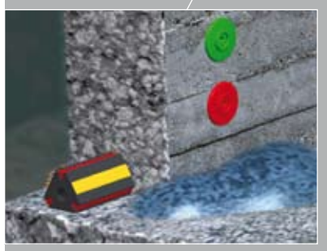
# Sika® Injection Systems for Concrete Structures

# Sika® Injection Systems for Concrete Structures

## Typical Problems in Concrete Structures



### Waterproofing of Construction Joints

Sealing of construction joints in concrete structures.

### Surface Sealing of leaking Concrete Structures

Remedial surface sealing by curtain injection of defects in underground building components.

### Waterproofing of Cracks

Closing, sealing and flexible bridging of leaking cracks in new and existing structures.

### Structural Crack and Void Repair

Bridging and filling of cracks and voids where structural strength is required.

### Waterproofing of damaged Membranes

Repair by injection of damaged water-proofing membranes (single and double layer systems).

### Waterproofing of Foundation Pits

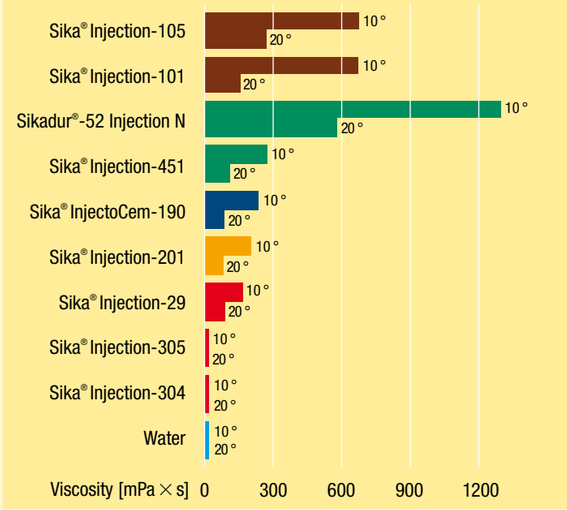
Sealing of water-bearing cracks and joints in retaining walls of foundation pits.

# The Sika® Injection Technology

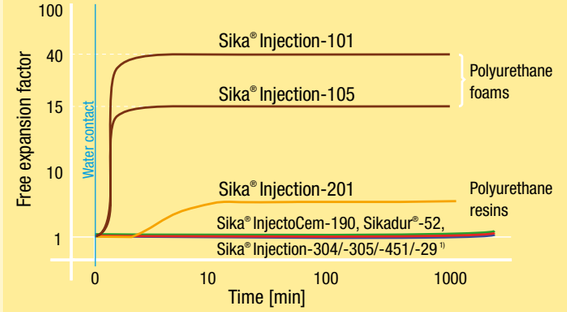
| Injection Material Parameters | Reasons | Injection System Requirements | Sika's Injection Solution |
|---|---|---|---|
| **Viscosity** | ■ Better crack penetration due to low viscosity<br>■ Reduction of high injection pressure due to low viscosity | ■ Different viscosities of injection resins for different crack widths (see table 1)<br>■ Low particle size of microfine binder for fine cracks | **Very low Viscosity**<br>■ Sika® Injection-201<br>■ Sika® Injection-451<br>■ Sika® Injection-29/-304/-305<br>**Low Viscosity**<br>■ Sika® Injection-101/-105<br>■ Sikadur®-52 Injection<br>**Low Particle Size**<br>■ Sika® InjectoCem-190 |
| **Expansion** | ■ Better sealing result due to the self-injecting effect of expansion<br>■ Complete filling of fissures and voids<br>■ Low actual material consumption due to increased volume after expansion | ■ Fast expansion<br>■ High foaming factor<br>■ Stable expansion with no shrinkage later during curing of the system<br>■ Temporary sealing due to high foaming factor | **High and fast Expansion**<br>■ Sika® Injection-101/-105 |
| **Reaction Time** | ■ Short reaction times prevent washing out of the resin<br>■ Short waiting times during the works<br>■ Reaction only takes place when needed | ■ Variable reaction times (see table 2)<br>■ No reaction takes place unless the resin is in direct contact with water or moisture | **Short and variable Reaction Times**<br>■ Sika® Injection-101/-105<br>■ Sika® Injection-AC10/-AC20<br>■ Sika® Injection-304/-305 |
| **Potlife** | ■ Long potlife means as pumpable as single component system | ■ Variable potlife for different requirements (see table 3) | **Long Potlife**<br>■ Sika® Injection-101/-105/-201<br>■ Sika® Injection-29<br>■ Sikadur®-52 Injection and Sika® Injection-451<br>■ Sika® InjectoCem-190 |
| **Flexibility** | ■ Ability to accommodate limited movement | ■ Long-term flexibility after curing<br>■ Permanent sealing | **Flexible**<br>■ Sika® Injection-105/-201<br>■ Sika® Injection-29<br>**High Flexibility**<br>■ Sika® Injection-304/-305 |
| **Adhesion/Bond** | ■ Structural bonding of cracks<br>■ Better sealing due to good adhesion | ■ Excellent adhesion<br>■ Full bond at contact surfaces<br>■ No shrinkage | **High Adhesion**<br>■ Sikadur®-52 Injection<br>■ Sika® Injection-451<br>■ Sika® Injection-201 |
| **Durability/Permanent Sealing** | ■ High durability of the repaired structure<br>■ Little ageing<br>■ Permanent repair | ■ No shrinkage with ageing<br>■ Long-term flexibility<br>■ Permanent sealing | **High Durability**<br>■ Sika® Injection-201<br>■ Sikadur®-52 Injection and Sika® Injection-451<br>■ Sika® Injection-29/-304/-305<br>■ Sika® InjectoCem-190 |
| **Resistance** | ■ High resistance to aggressive chemicals | ■ Injection systems with high chemical resistance | **High chemical Resistance**<br>■ Sika® Injection-201<br>■ Sikadur®-52 Injection and Sika® Injection-451<br>■ Sika® Injection-29/-304/-305<br>■ Sika® InjectoCem-190 |
| **Environmental Hazard/Toxicity** | ■ Allows injection in ecologically sensitive environments<br>■ Non-toxic and non-hazardous in application | ■ Solvent-free systems<br>■ Environmentally friendly raw materials<br>■ Systems tested for ground water contact | **Environmentally friendly**<br>■ Sika® Injection-101/-105/-201<br>■ Sikadur®-52 Injection and Sika® Injection-451<br>■ Sika® Injection-29/-304<br>■ Sika® InjectoCem-190 |

■ Polyurethane Foams ■ Microfine Binders ■ Polyacrylic Resins/Gels
■ Epoxy Resins ■ Polyurethane Resins

**1. Viscosity of different Injection Materials at 10 °C and 20 °C**

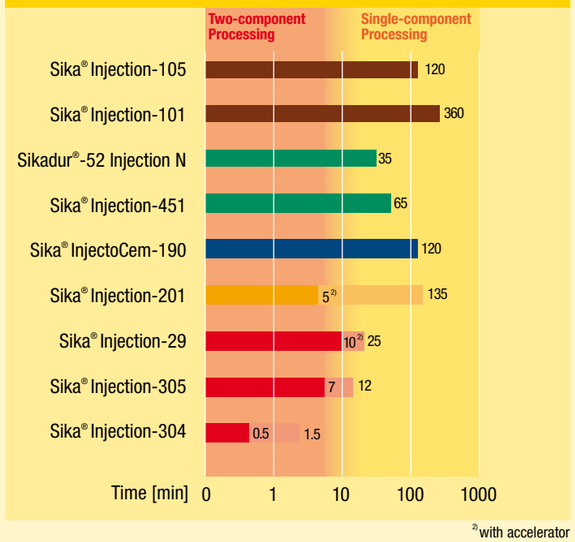



**2. Free Expansion Factor of different Injection Materials**



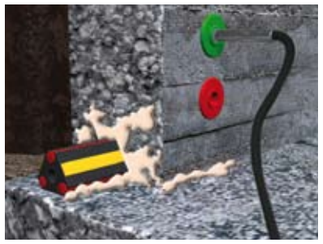

1) Microfine binders, epoxy resins, polyacrylic resins

**3. Potlife in Minutes of different Injection Materials at 20 °C**




2) with accelerator

# The Sika® Injection Systems for the different Applications



## Waterproofing of Construction Joints

**Sealing of construction joints in concrete structures**

**Sika® Injection-29**
Low viscous, flexible and solvent-free polyacrylic injection resin with a high solids content. It is used for the injection of the Sika® Injectoflex Hose System.

**Sika® Injection-201[1)]**
Low viscous, flexible and solvent-free polyurethane injection resin for permanent waterproof sealing of cracks and construction joints. It forms, in contact with water, a uniform, closed and therefore watertight pore structure. The reaction time of Sika® Injection-201 can be accelerated with Sika® Injection-AC20.

**Sika® InjectoCem-190**
Two-component injection grout for sealing and structural strengthening of cracks and construction joints, based on microcement with added admixtures and corrosion inhibitors. It is also used for the injection of the Sika® Injectoflex Hose System.

## Surface Sealing of leaking Concrete Structures

**Remedial surface sealing by curtain injection of defects in underground building components**

**Sika® Injection-304**
Flexible, very low viscous and very quick-gelling polyacrylic injection gel for permanent watertight sealing of leaking surfaces. The material reacts to form a waterproof, flexible but solid gel with good adhesion to both dry and wet substrates.

## Waterproofing of Cracks

**Closing, sealing and flexible bridging of leaking cracks in new and existing structures**

**Sika® Injection-101**
Fast foaming, low viscous and solvent-free water-reactive polyurethane injection foam resin for temporary waterstopping. The material cures to a very dense hard-elastic foam with a very fine cellular structure. The reaction time of Sika® Injection-101 can be accelerated with Sika® Injection-AC10.

**Sika® Injection-201[1)]**
Low viscous, flexible and solvent-free polyurethane injection resin for permanent waterproof sealing of cracks and construction joints. It forms, in contact with water, a uniform, closed and therefore watertight pore structure. The reaction time of Sika® Injection-201 can be accelerated with Sika® Injection-AC20.

## Structural Crack and Void Repair

**Bridging and filling of cracks and voids where structural strength is required**

**Sikadur®-52 Injection[2)]**
Low viscous, solvent-free, high strength epoxy resin for structural bonding of cracks and voids in dry and damp concrete structures.

**Sika® Injection-451**
Ultra low viscous, solvent-free, high strength epoxy resin for structural bonding of cracks and voids in dry and damp concrete structures.

**Sika® InjectoCem-190**
Two-component injection grout for sealing and structural strengthening of cracks and construction joints, based on microcement with added admixtures and corrosion inhibitors.

## Waterproofing of damaged Membranes

**Repair by injection of damaged waterproofing membranes (single and double layer systems)**

**Sika® Injection-305**
Flexible, very low viscous and quick-gelling polyacrylic injection gel for permanent watertight sealing of damaged membranes (single and double layer systems). The material reacts to form a waterproof, flexible but solid gel with good adhesion to both dry and wet substrates.

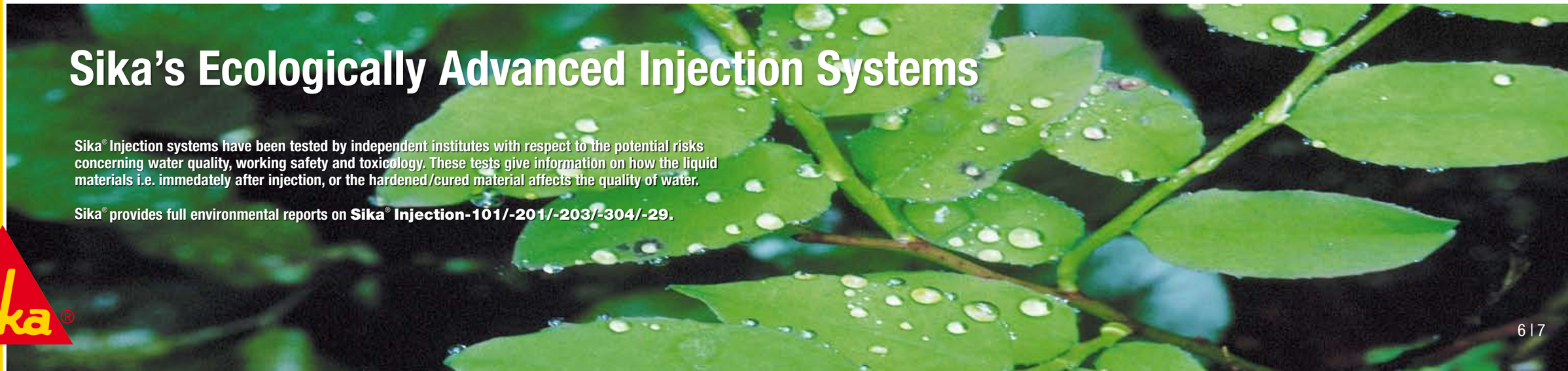
## Waterproofing of Foundation Pits

**Sealing of water-bearing cracks and joints in retaining walls of foundation pits**

**Sika® Injection-105**
Fast foaming, low viscous and solvent-free water-reactive polyurethane injection foam resin for flexible waterproof sealing of leaking foundation pits. The material cures to a very dense flexible foam with a very fine cellular structure.

[1)] other formulation available (Sika® Injection-203) that is tested and approved according to ZTV-ING (RISS) and registered with the BASt-List

[2)] other formulation available for underwater injection (Sikadur®-53)



## Sika's Ecologically Advanced Injection Systems

**Sika® Injection systems have been tested by independent institutes with respect to the potential risks concerning water quality, working safety and toxicology. These tests give information on how the liquid materials i.e. immedately after injection, or the hardened/cured material affects the quality of water.**

**Sika® provides full environmental reports on Sika® Injection-101/-201/-203/-304/-29.**

# Criteria for Selection of the Sika® Injection Systems

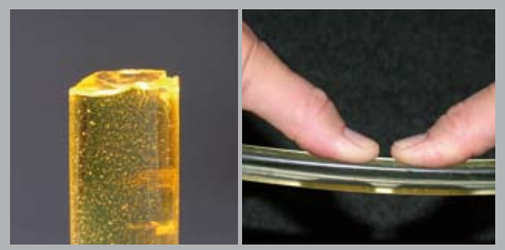
## Selection Criteria for Injection Systems to be used in the Repair and Waterproofing of Concrete Structures:

| | | Polyurethane Foams | | Polyurethane Resins | Epoxy Resins | | Polyacrylate Resins/Gels | | | Microfine Binders |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Sika® Injection-101* | Sika® Injection-105 | Sika® Injection-201/-203* | Sikadur®-52 Injection | Sika® Injection-451 | Sika® Injection-29 | Sika® Injection-304 | Sika® Injection-305 | Sika® InjectoCem-190 |
| 1 | **Structural strengthening = S  Durable elastic sealing = E  Temporary sealing = T**<br>The rheological properties of the injection system and damaged concrete structures determine the most suitable application system. | T | T | E | S | S | E | E | E | S |
| 2 | **Can accommodate movement after curing**<br>Non-elastic injection systems can cause subsequent cracking elsewhere. | | X | X | | | X | X | X | |
| 3 | **Durable waterproof sealing**<br>Long-term effectiveness and reliable protection against ground water pressure. | | | X | X | X | X | X | X | X |
| 4 | **Improvement in matrix quality**<br>The injection system strength is appropriate for repairs to weaker concrete and mortar. | | | X | X | X | | | | X |
| 5 | **Penetrates into fine cracks (e.g. >0.2 mm)**<br>The low viscosity of the injection material determines the crack penetration and reduces the injection pressure. | X | X | X | X | X | X | X | X | X |
| 6 | **Not durable**<br>Suitable for temporary waterproofing against water under pressure. | X | X | | | | | | | |
| 7 | **Reacts only in contact with water**<br>The reaction only takes place when needed. | X | X | | | | | | | |
| 8 | **For watertight compartment injection**<br>Repair by injection of waterproofing membranes (single and double layer systems). | | | | | | | X | X | |
| 9 | **Pumpable as a single component system**<br>Injection systems with long potlifes (>20 min) can be pumped with a single-component pump. | X | X | X | X | X | X | | | X |
| 10 | **Only suitable for low pressure injection (<10 bar)**<br>Low injection pressure prevents separation of microfine cement suspensions. | | | | | | | | | X |
| 11 | **Drinking water approval**<br>Allows injection in ecologically sensitive environments. | X | | X | | | X | X | | |
| 12 | **Can be accelerated**<br>Acceleration of the reaction time reduces waiting times during works (especially at cold temperatures) and prevents washing out of the resin. | X | X | X | | | X | | | |

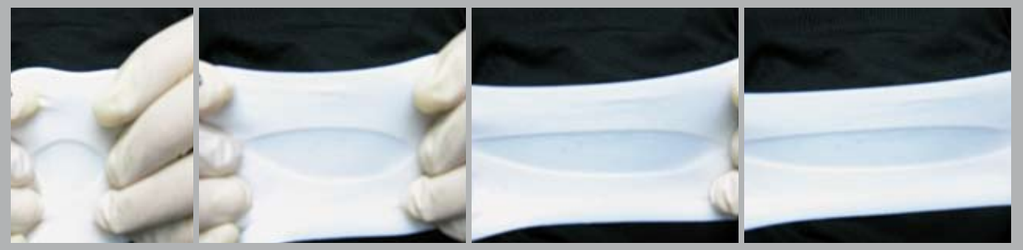
* tested and approved by ZTV-Riss and registered with the BASt-List

The free expansion rate of **Sika® Injection-101** is up to 40 times.

Due to the low viscosity of **Sika® Injection-201** it can penetrate into cracks >0.2 mm in width.



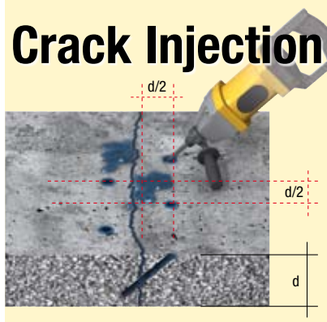
**Sikadur®-52 Injection** achieves a strength of up to 50 N/mm².



**Sika® Injection-304** reacts to form a waterproof, flexible but solid polyacrylic gel.

# Application of the Sika® Injection Systems

## Crack Injection with Mechanical Packers




1. Drill packer holes at a 45° angle to the concrete surface as shown in the figure. ∅ of drill hole = ∅ of packer + 2 mm.

2. Install the mechanical packers. Tighten the mechanical packers so that they can withstand the maximum injection pressure.

3. Fix the non-return valve on the first packer and start the injection process.

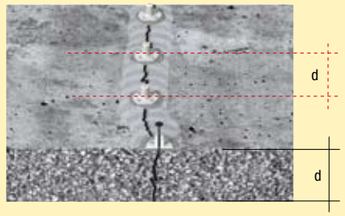
4. When the injection material flows out of the second packer during the injection process, fix the non-return valve on it as quick as possible. Stop injection at the first packer and continue at the second packer.

5. Repeat this procedure from packer to packer.

6. If necessary, a secondary injection procedure is carried out to ensure the crack is completely filled and sealed.

## Crack Injection with Surface Packers

1. Prepare the substrate by blast cleaning or mechanically by grinding etc., then clean by brush and vacuum.




2. Place a steel nail through the packer into the crack to prevent the injection canal from being blocked by the **Sika® Injection-490** adhesive and then install the surface packers as shown in the figure.

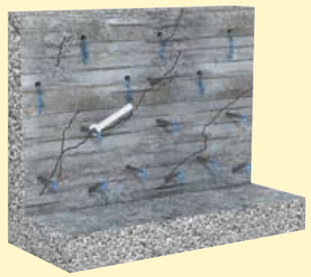
3. Patch the surface of the crack with **Sika® Injection-490**. Ensure that the packer and the crack on the surface are fully covered by the adhesive filler.

4. As soon as the adhesive has cured, remove the nail and fix the button head fittings (non-return) on the first packer and start the injection process.

5. Continue the injection procedure as for crack injection with mechanical packers (points 4, 5 and 6).

## Curtain Injection

1. Drill holes for the mechanical packers through the leaking building component at a distance of 30–50 cm apart as shown in the figure.



2. Install the mechanical packers. Tighten the mechanical packers so that they can withstand the maximum injection pressures.

3. Fix the button head (non-return) fittings on the first packer and start the injection process at the lowest row of drill holes.

4. When the injection material flows out of the second packer during the injection process, fix the non-return valve on it as quickly as possible. Stop injection at the first packer and continue at the second packer.

5. Continue the injection procedure as for crack injection (points 5 and 6).

## Important Notes for the Application of Sika Injection Systems:

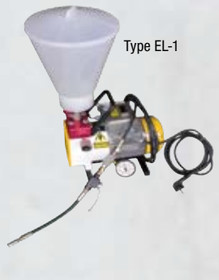
- Make sure that there is no drainage pipe in or behind the surface
- Always start injection with low pressure
- The surfaces of voids and cracks need to be clean
- Always work from the bottom to the top

# Injection Pumps and Packers for Sika® Injection Materials

## Injection Equipment for Sika® Injection Resins and Microfine Cement Suspension

### Single-component Pumps for Polyurethane, Polyacrylate and Epoxy Resins

Sika® single-component injection pumps are universal injection devices suitable for a wide range of applications. They are designed for professional use in crack and Sika® Injectoflex-System injection. **Sika® Injection Pump EL-1, EL-2, Hand-1 and Hand-2** are suitable for Sika polyurethane, epoxy and polyacrylate resins.


Type EL-1

### Two-component Pumps for Polyacrylate Gels

**Sika® Injection Pump PN-2C** is specially designed for curtain injection. A two-component pump is required for these fast reacting polyacrylate gels. The individual components are introduced to the mixing head separately. The actual mixing process takes place in a static mixer located in the mixing head.


Type PN-2C

### Mixing and Pumping Equipment for Microfine Cement Suspension

The colloidal mixer **Sika® Injection Mixer C-1** is needed for the complete and thorough mixing of Sika® microfine cement suspensions. **Sika® Injection Pump MFC-1** is used for the pumping of Sika® microfine cement suspensions. It provides continuous pumping without separation of the suspension.

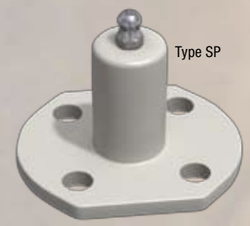

| Sika Injection Pump/Mixer | Polyurethane Foams | Polyurethane Resins | Epoxy Resins | Polyacrylate Resins/Gels | | Microfine Binders |
|---|---|---|---|---|---|---|
| | Sika® Injection-101/-105 | Sika® Injection-201/-203 | Sikadur®-52 Injection<br>Sika® Injection-451 | Sika® Injection-29 | Sika® Injection-304/-305 | Sika® InjectoCem-190 |
| EL-1/-2 | X | X | X | X | | |
| Hand-1/-2 | X | X | X | X | | |
| PN-2C | | | | | X | |
| C-1 | | | | | | X |
| MFC-1 | | | | | | X |
| Equipment Cleaning | Sika® Colma® Cleaner | | | Water | | |

## Sika® Injection Packers for different Applications

**Sika® Injection Packers are filler necks used as connection pieces between the injection pump and the structure. Sika provides a full range of injection packers. There are two different types of packers:**

### Mechanical Packers
**for high and low pressure injection where hole drilling is possible**


### Surface Packers
**for low pressure injection, where drilling is not possible**


Type SP

| Application | Concrete Quality | Injection Pressure | Sika® Injection Packer | | | |
|---|---|---|---|---|---|---|
| | | | Mechanical | | | Surface |
| | | | MPS | MPR [1] | MPC [2] | SP |
| Crack and Void Injection | Drilling not possible (steel reinforcement) | 1 – 10 bar | | | | X |
| | Good and poor quality (drilling possible!) | | X | X | X | X |
| Injectoflex Injection | | | X [3] | X [3] | X [3] | |
| Curtain Injection | Good and poor quality (drilling possible!) | 10 – 200 bar | | X [4] | | |
| Crack and Void Injection | | | X | X | | |
| Injectoflex Injection | | | X [3] | X [3] | | |

[1] Recommended for high pressures and high flow rates [2] Specially designed for injection with microfine binders [3] Just 13 mm diameter [4] Only with button head (non-return) fitting

# Case Studies

## Surface Sealing of a Leaking Shaft

**Problem**
An inadequate waterproofing system had been selected for a concrete shaft standing in groundwater. Water was infiltrating the shaft from several construction joints and damaging the electrical installations.

**Injection Material Requirements**
- Very fast reacting injection material
- Able to form a new permanent watertight sealing surface
- Environmentally friendly

**Sika Solution**
Curtain injection with
- Fast reaction polyacrylate gel **Sika® Injection-304**

**Injection Equipment**
- **Sika® Injection Pump PN-2C** and **Sika® Injection Packer MPR** with button head fittings

## Sealing of Cracks in a Basement

**Problem**
A basement garage which is built up of watertight concrete with waterbars, suffered settlement cracks in the structure after construction. Water was infiltrating because the garage was exposed to groundwater pressure.

**Injection Material Requirements**
First phase:
- Fast foaming injection foam
- Reacts only in contact with water

Second phase:
- Low viscosity
- No shrinkage in subsequent dry conditions
- Good adhesion to concrete
- Environmentally friendly and chemically resistant

**Sika Solution**
Crack injection with
- Fast reacting polyurethane foam **Sika® Injection-101** for temporary waterstopping
- Elastic polyurethane resin **Sika® Injection-201** for permanent waterproof sealing

**Injection Equipment**
- **Sika® Injection Pump EL-2** and **Sika® Injection Packer MPS**

## Sealing of Damaged Membranes in an Open-cut Tunnel

**Problem**
An open-cut tunnel below groundwater level was sealed with sheet waterproofing membranes and waterbars. Damage occurred during the construction period and went unnoticed until the tunnel began leaking. Fortunately the damage location was easily identified as the membrane and waterbars were formed into compartments.

**Injection Material Requirements**
- Permanently elastic
- Able to form a new permanent watertight sealing surface
- Gel time able to be adapted to the specific requirements
- Capable of reversibly absorbing (swelling) and releasing (shrinking) moisture

**Sika Solution**
Compartment injection through injection pipes with
- polyacrylate gel **Sika® Injection-305**

**Injection Equipment**
- **Sika® Injection Pump PN-2C** and **Sika® Injection Packer MPR** with button head fittings

## Structural Crack Repair of a Bridge

**Problem**
Cracks with the potential to become a problem for the structural integrity occurred in the support piers of a motorway bridge due to the dynamic loads.

**Injection Material Requirements**
- Different low viscosities for different crack widths
- High mechanical and adhesive strengths
- Suitable for both dry and damp substrate conditions

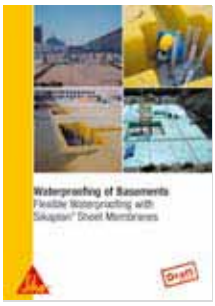
**Sika Solution**
Crack injection with
- Low viscous epoxy resin **Sikadur®-52 Injection** for cracks > 0.3 mm
- Ultra low viscous epoxy resin **Sika® Injection-451** for cracks 0.1–0.3 mm
- Epoxy patching material **Sika® Injection-490**

**Injection equipment**
- **Sika® Injection Pump EL-2** and **Sika® Injection Packer SP**

# Sika® Injection Systems for Concrete Structures

**Sika is a globally active company in the speciality and construction chemicals business. It has subsidiary manufacturing, sales and technical support facilities in over 70 countries around the world. Sika is THE global market and technology leader in waterproofing, sealing, bonding, dampening, strengthening and the protection of buildings and civil engineering structures. Sika has approx. 12 000 employees worldwide and is therefore ideally positioned to support the success of its customers.**

**Also available from Sika**



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