

9ª Semana de Tecnologia Metroviária

Novas tecnologias de injeção para o tratamento de trincas e infiltrações



MC-Bauchemie Brasil

Produtos Químicos para Construção

MC-Bauchemie

- **Multinacional Alemão**
- **Privado**
- **Mais de 40 anos de mercado**
- **15 fábricas e 30 centros de distribuição**
- **Atuação em mais de 40 países**

MC-Internacional



Alemanha



Hungria



Emirados Árabes



Taiwan



Brasil



Suiça



Áustria



Holanda

Linha de Produtos

Atualmente a linha de produtos engloba:

- Tecnologias de Injeção



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Atualmente a linha de produtos engloba:

- Tecnologias de Injeção
- Reparo e Proteção de Estruturas



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- Reparo e Proteção de Estruturas
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- Reparo e Proteção de Estruturas
- Pisos Industriais
- Sistemas de Impermeabilização **XYPEX**



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- **Tecnologias de Injeção**
- **Reparo e Proteção de Estruturas**
- **Pisos Industriais**
- **Sistemas de Impermeabilização**
- **Aditivos e Produtos de Obra**



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Atualmente a linha de produtos engloba:

- Tecnologias de Injeção
- Reparo e Proteção de Estruturas
- Pisos Industriais
- Sistemas de Impermeabilização
- Aditivos e Produtos de Obra
- Sistemas Especiais



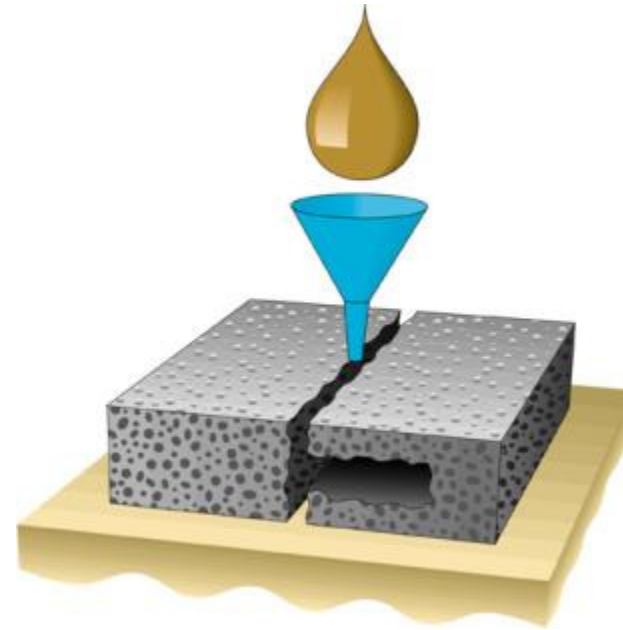
■ ■ MC-Bauchemie

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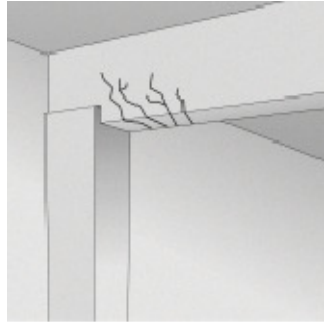
- **Tecnologias de Injeção**
- **Reparo e Proteção de Estruturas**
- **Pisos Industriais**
- **Sistemas de Impermeabilização**
- **Aditivos e Produtos de Obra**
- **Sistemas Especiais**

Tecnologias de Injeção

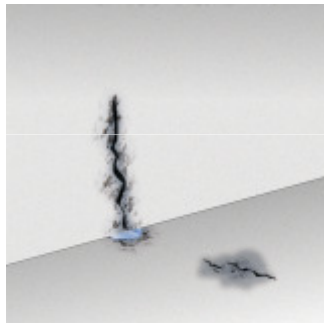
Produtos e Aplicações



Tipos de Injeção



■ Estrutural

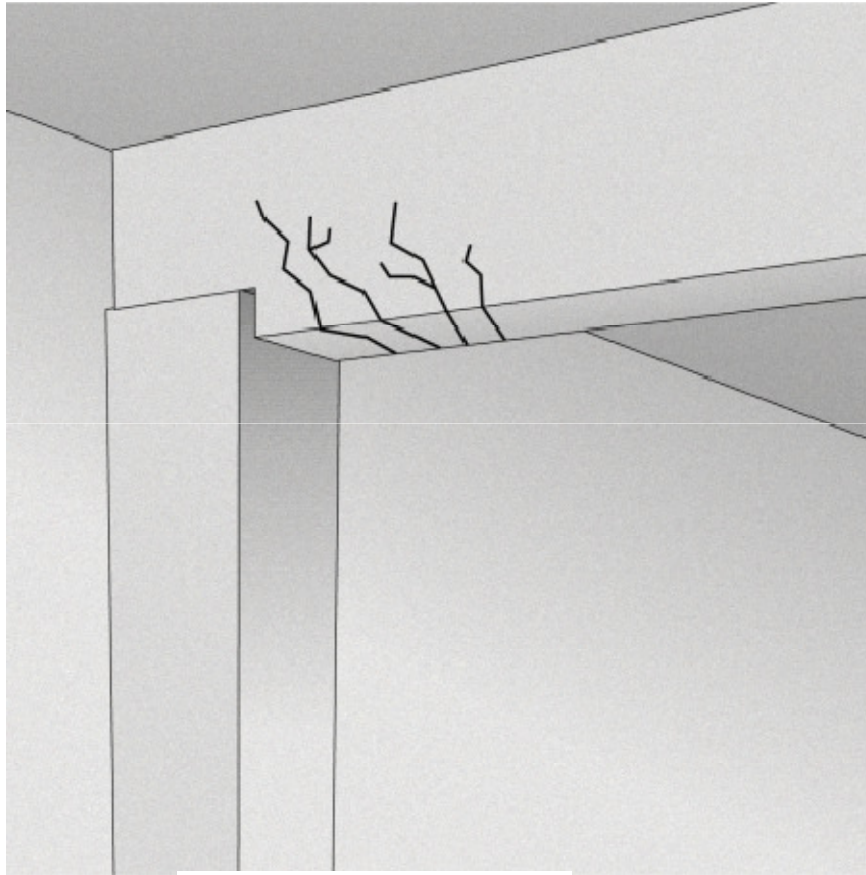


■ Selamento



■ Impermeabilização

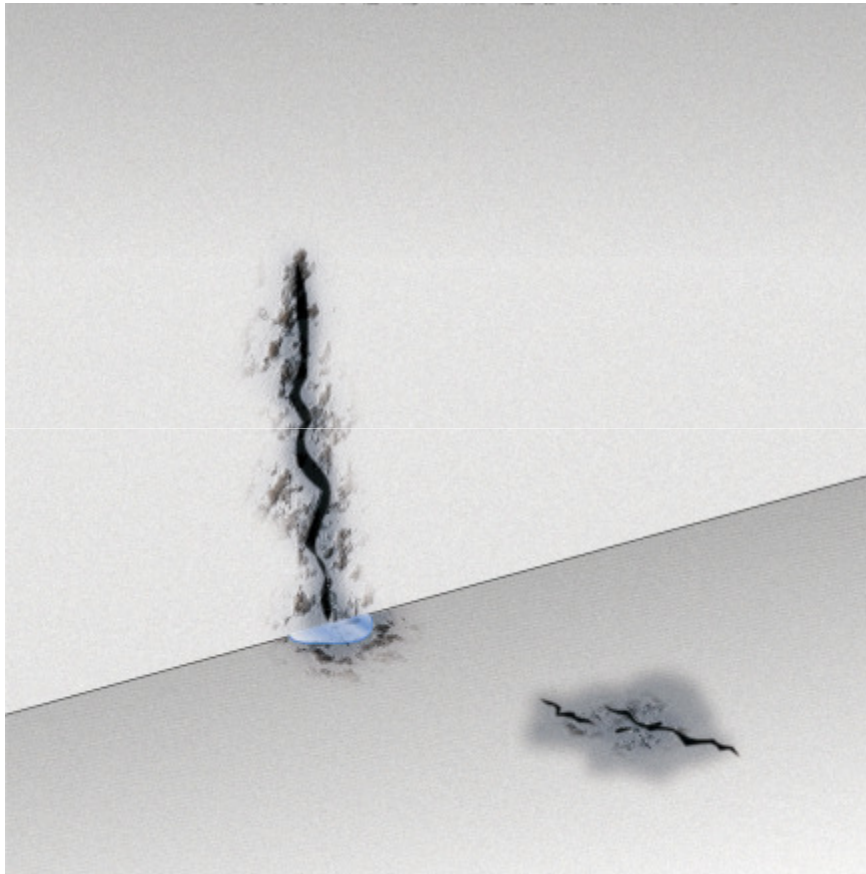
Tipos de Injeção



Estrutural

- Epóxi
- Cimentício
- Poliuretano Estrutural

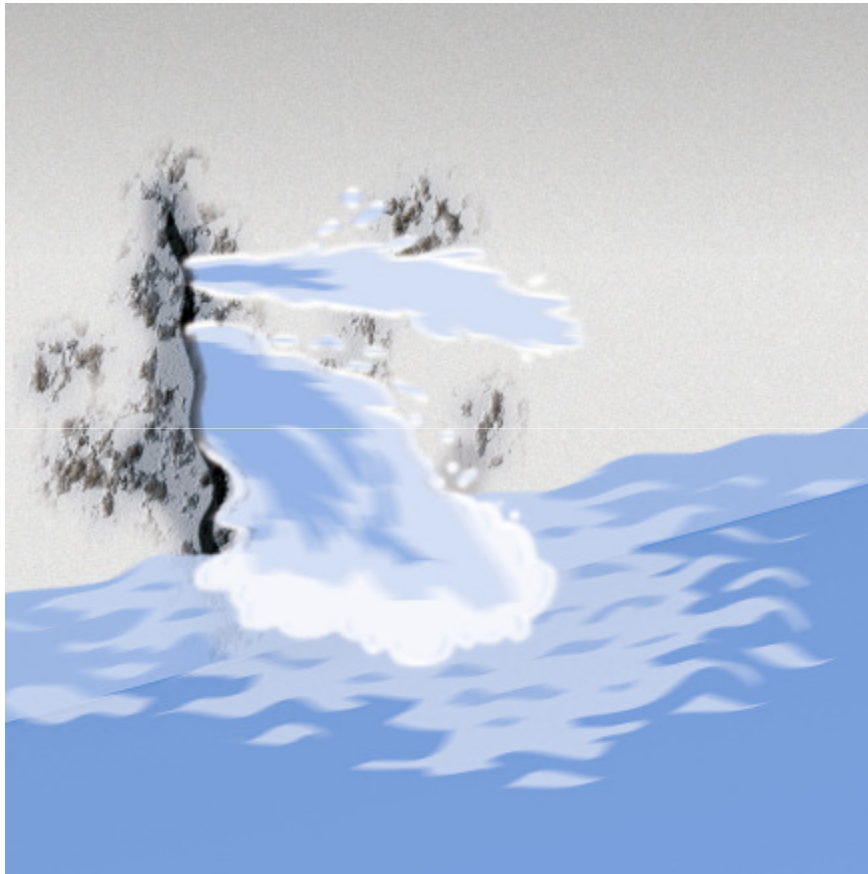
Tipos de Injeção



Selamento

- Gel de Poliuretano
- Gel Acrílico

Tipos de Injeção



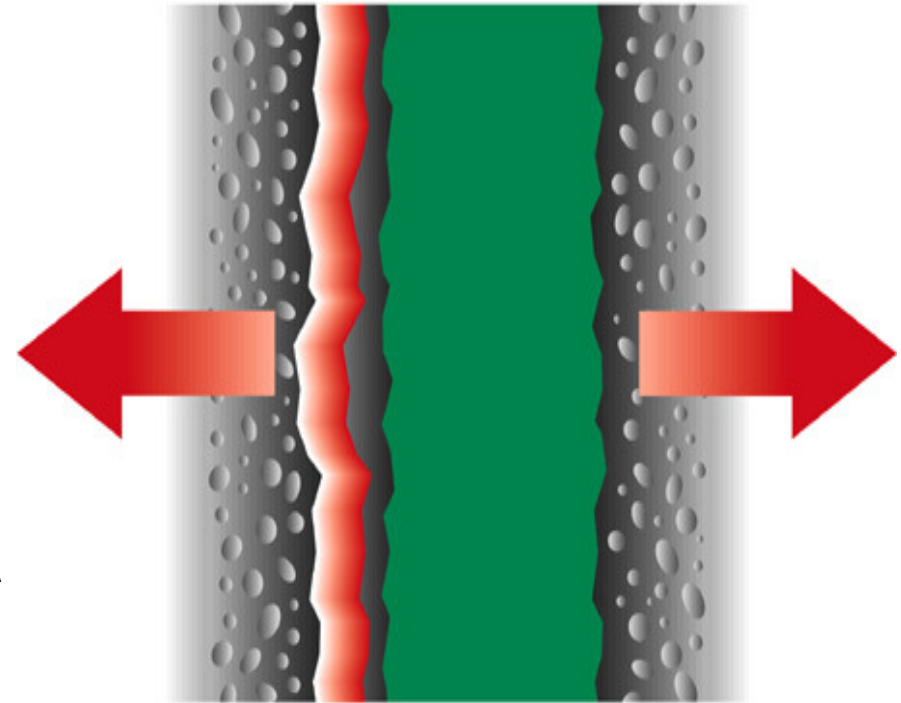
Impermeabilização

- Gel de Poliuretano
- Poliuretano Estrutural
- Gel Acrílico

Principais Características

Epóxi - Estrutural

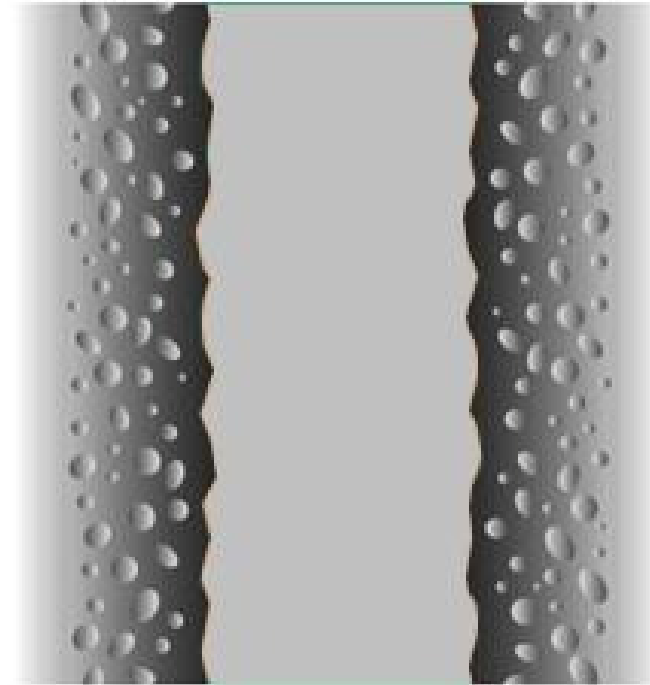
- Rígido
- Altas resistências
- Excelente aderência
- Grande durabilidade
- Não funciona com água



Principais Características

Microcimento - Estrutural

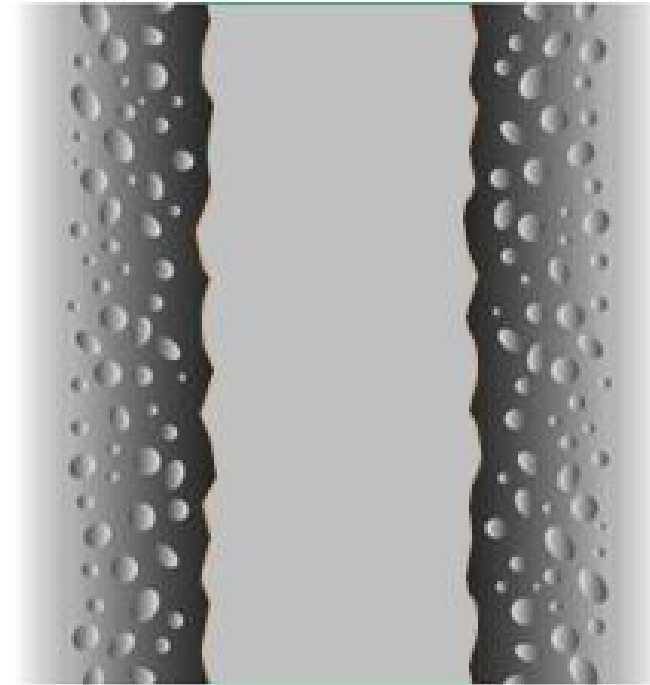
- Rígido
- Boas resistências
- Excelente aderência
- Grande durabilidade
- Proteção alcalina
- Funciona com água



Principais Características

Poliuretano Estrutural – Estrutural / Impermeabilização

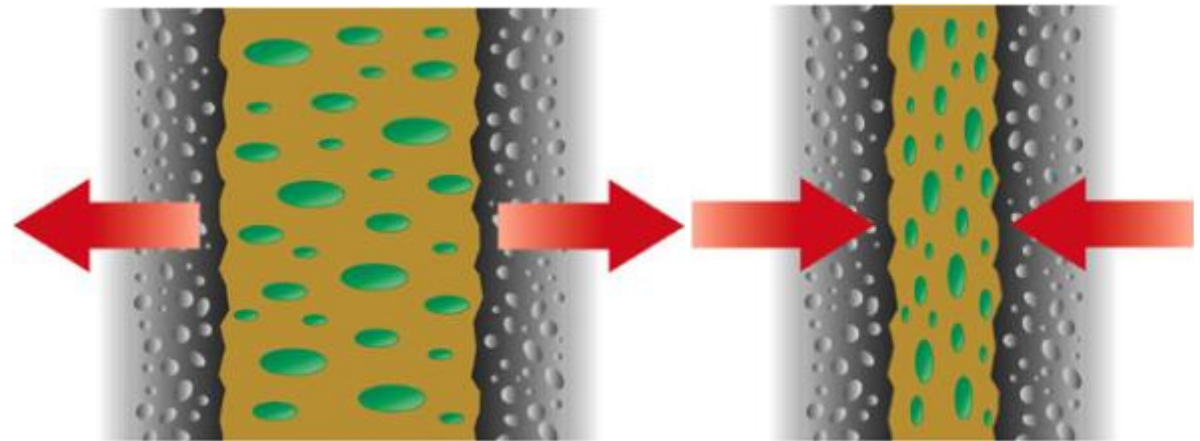
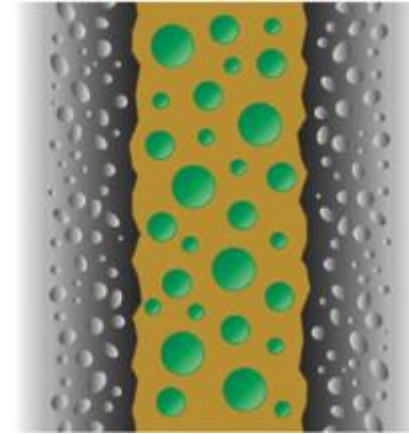
- Rígido
- Boas resistências
- Excelente aderência
- Grande durabilidade
- Funciona com água



Principais Características

Poliuretano - Selamento / Impermeabilização

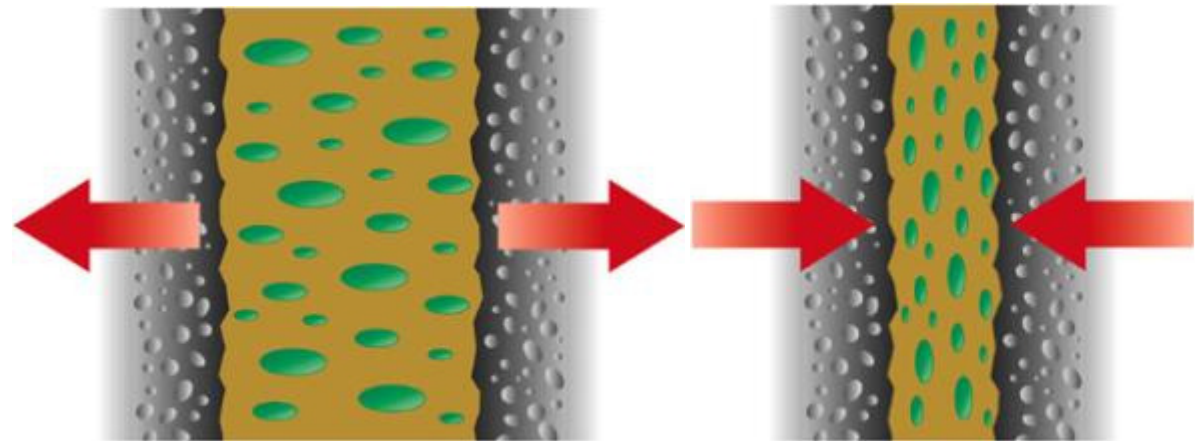
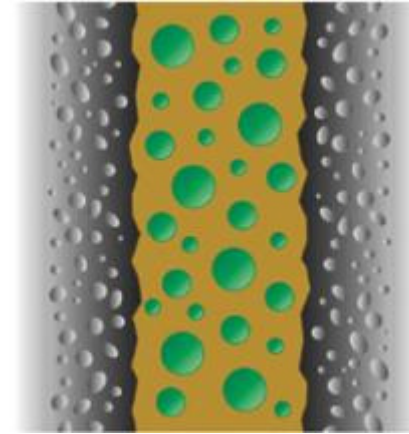
- Flexível
- Impermeável
- Excelente aderência
- Grande durabilidade
- **Funciona** com água



Principais Características

Gel Acrílico - Selamento / Impermeabilização

- Flexível
- Impermeável
- Excelente aderência
- Grande durabilidade
- **Funciona** com água



Como escolher o produto certo ?

Quais as condições de trabalho ?

Selamento ou **Estrutural**

Quais as condições da obra ?

Trincas secas ou **úmidas**

Como escolher o produto certo ?

A/1 (selamento, trincas úmidas)

- Poliuretano ***
- Gel Acrílico **
- Microcimento **

B/1 (estrutural, trincas úmidas)

- Microcimento ***
- PU Estrutural **

A/2 (selamento, trincas secas)

- Poliuretano ***
- Epóxi **
- Microcimento **

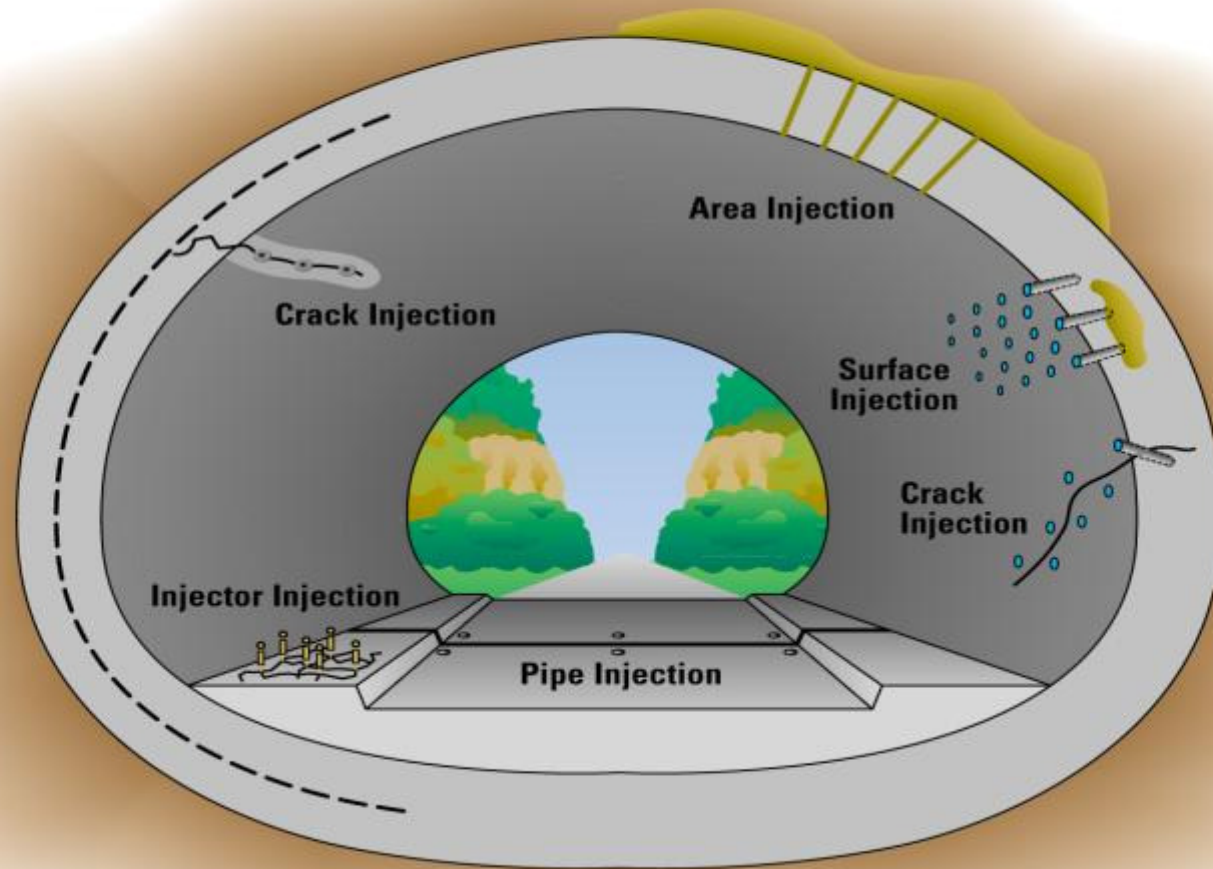
B/2 (estrutural, trincas secas)

- Epóxi ***
- PU Estrutural **
- Microcimento **

Como escolher o produto certo ?

C (impermeabilização, fluxo de água)

- Poliuretano (espuma + gel)
- Poliuretano Estrutural
- Gel Acrílico



Produtos para selamento / impermeabilização

Produto	Viscosidade	Tamanho da trinca
MC-Injekt NP	300 mPas	≥ 0,3mm (0,15mm)
MC-Injekt 2300	285 mPas	≥ 0,2mm (0,10mm)
MC-Injekt 2300NV	100 mPas	≥ 0,1mm (0,05mm)
MC-Injekt 2033	250 mPas	≥ 0.2mm (0,20mm)
Produto	Viscosidade	Tamanho da trinca
MC-Injekt 2700	200 mPas	≥ 0,2mm (0,15mm)
Produto	Viscosidade	Tamanho da trinca
MC-Injekt GL 95	5 mPas	≥ 0,05mm

Produtos para injeções **estruturais**

Produto	Viscosidade	Tamanho da trinca
MC-DUR 1200VK	500 mpas	≥ 0,5mm (0,3mm)
MC-DUR 1264	180 mpas	≥ 0,2mm (0,1mm)
MC-DUR 1264KF	95 mpas	≥ 0,1mm (0,05mm)

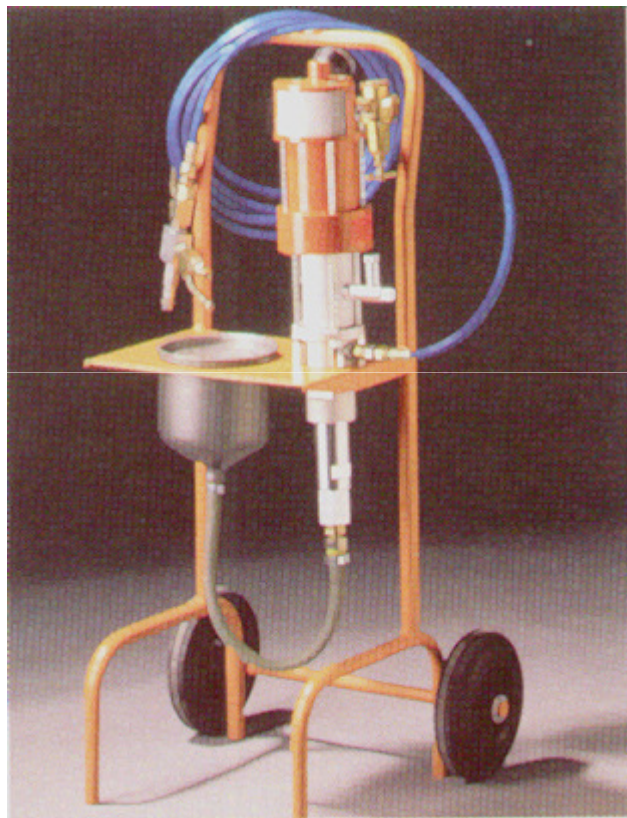
Produto	Granulometria	Tamanho da trinca
Centricrete MV	90μ	0,8-3mm (0,5mm)
Centricrete FB	60μ	≥ 0,6mm (0,2mm)
Centricrete UF	8μ	0,2-1mm (0,05mm)

Produto	Viscosidade	Tamanho da trinca
MC-Injekt 2700	200 mPas	≥ 0,2mm (0,15mm)



Equipamentos

Bombas de injeção



MC-I 500

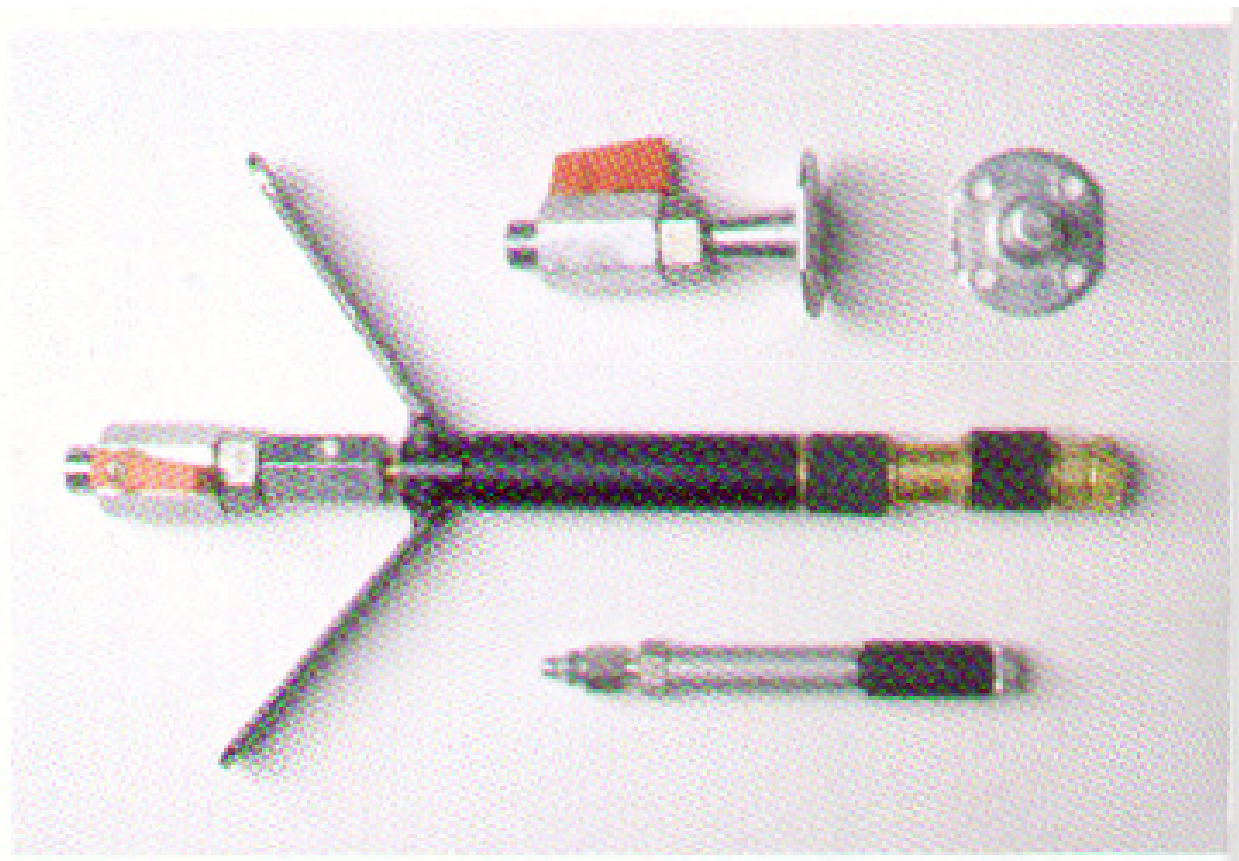


MC-I 200



■ ■ Acessórios

Bicos de injeção





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Ação para a Expansão do Sistema Metro
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2 a 5 de setembro de 2003



Tecnologias de Injeção

Referências





SAO PAULO, BRASIL

Metro Station

Objective: To stop the flow of pressurized water coming through cracks in the tunnel and the station roof.

Product: MC-Injekt 2033, MC-Injekt 2300 NV

Year: 2001

Project Information: Pressurized water was leaking through the concrete lining of the tunnel and the station approach area. The construction joints were particularly affected. A combination of injection materials was used to initially stop the flow and then permanently seal all cracks.





GERMANY

ICE – New Route

Cologne – Frankfurt

Objective: Sealing of cracks and joints in the tunnel.

Product: MC-Injekt 2300 NV, MC-Injekt 2033

Year: 2000 – 2002

Project Information: The new ICE route between Cologne and Frankfurt necessitated the construction of different types of structure to ensure a continuous and even track for the high-speed trains. Cracks in the concrete and resultant water leaks cannot always be avoided when building tunnels through different rock types and ground conditions. A programme of resin injection using MC-Injekt 2300 NV and MC-Injekt 2033 enabled a successful sealing.





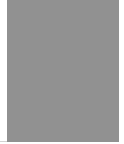
PRAGUE, CZECH REPUBLIC
Metro

Objective: To prevent the leakage of water through the reinforced concrete and steel tunnel lining.

Product: MC-Injekt 2300, MC-Injekt 2033

Year: 1997 / 1999

Project Information: Groundwater, under pressure, had penetrated between the reinforced concrete and the steel plates that formed the final lining towards the tunnel. Water was emerging from the joints between the steel plates and not only accelerating steel corrosion but affecting the operation of the metro. Using an injection technique with a combination of a foaming and a flexible polyurethane the joints were sealed and the water ingress was stopped.





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PRAGUE, CZECH REPUBLIC Zlichov Tunnel

- Objective:** To prevent the ingress of water through and under a previously installed synthetic membrane.
- Product:** MC-Injekt GL-95
- Year:** 2002
- Project Information:** The waterproof membranes installed on the extrados to prevent water penetration and protect the concrete had been damaged and were not performing their design function. Despite extreme weather conditions MC-Injekt GL-95 was successfully applied and restored an absolutely watertight structure.

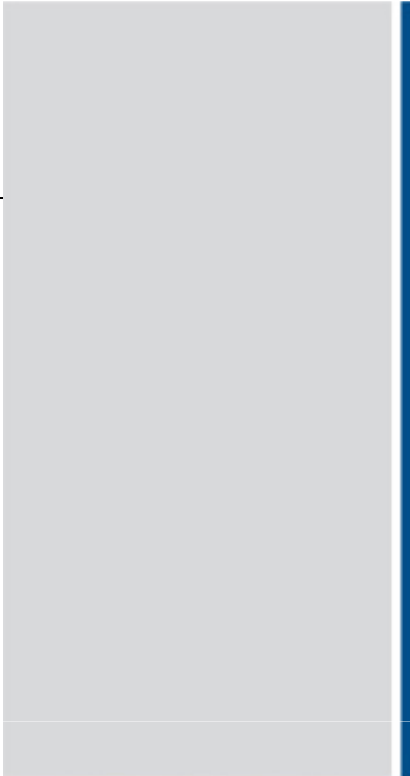




STUTTGART, GERMANY
Engelberg Basis Tunnel

- Objective:** To prevent possible water ingress through the joints between precast tunnel lining segments.
- Product:** MC-Injekt 2300 NV
- Year:** 1998 / 1999
- Project Information:** An injection hose was fixed between the individual precast segments. Upon completion of a section the hoses were injected with MC-Injekt 2300 NV. This resin egressed the hose throughout its length and penetrated into any fine cracks encountered. This product was selected because of its low viscosity, long wearing resistance and zero environmental impact.





BSL BÖHLEN, GERMANY
Rail Bridge

Objective: To seal cracks in the concrete with a rigid material.

Product: MC-DUR 1264 KF

Year: 1995

Project Information: The cracks in the bridge were sealed to restore adequate stability, functionality and durability. The dry surface conditions permitted injection by means of adhesion peckers eliminating the need for drilling.





VÁC-VERŐCE, HUNGARY Railway Bridges

Objective: To prevent the penetration of water from the bridge deck through the structure.

Product: MC-Injekt GL-95

Year: 2001

Project Information: Following two successful trial applications 12 bridges were successfully repaired eliminating water penetration by means of MC-Bauchemie's MC-Injekt GL-95. The applications were carried out without disruption to the traffic using the bridge deck.





BUDAPEST, HUNGARY Metro Ventilation Tunnel

Objective: To prevent the penetration of ground water into the tunnel.

Product: MC-Injekt 2300 NV,
MC-Injekt GL-95

Year: 2000

Project Information: Due to cracks in the concrete water could penetrate and enter into the tunnel. Water leaks were sealed with MC-Injekt 2300 NV. In areas where the water was penetrating through permeable concrete, that did not have visible cracks, sealing was carried out by drilling through the concrete to the exterior and injecting MC-Injekt GL-95.

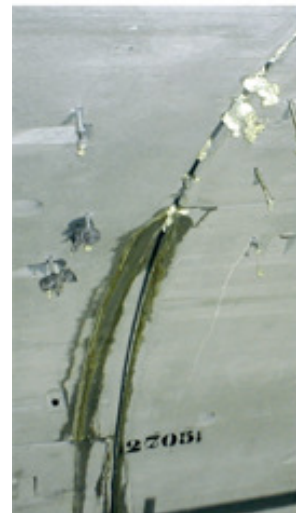




ALBLASSERDAM, NETHERLANDS

Sophia Tunnel

- Objective:** To seal the connection joints against water ingress.
- Product:** MC-Injekt 2300, MC-Injekt 2033
- Year:** 2001
- Project Information:** Leaking joints between the precast segments were sealed by injecting polyurethane foam and polyurethane resin through drill packers.





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SINGAPORE

Mass Rapid Transit System

Objective: To seal leaking joints and cracks in precast concrete tunnel segments.

Product: MC-Injekt 2033 and MC-Injekt 2300 NV

Year: 1999 – 2001

Project Information: Cracks and joint leakages occurred during the construction of the Underground subway in Singapore. They were repaired to restore the durability of the tunnel. Running water was stopped by first injecting MC-Injekt 2033 and then MC-Injekt 2300 NV in order to ensure a permanent seal. MC-Bauchemie was involved in seven different contracts on this project and established dual injection as the only method to ensure a long-term repair.





GELTERKINDEN, SWITZERLAND SBB Natural Stone Viaduct

Objective: To strengthen the foundations of a railway viaduct by injecting a cement suspension and to repair the edge beams.

Product: Centricrete MV, Zentrifix GM2

Year: 1996 / 1997

Project Information: The foundations were damaged due to permanent contact with water and were therefore injected with Centricrete MV. The edge beams were grit blasted and coated with an anti-corrosion system and subsequently sprayed with Zentrifix GM2.





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MANNENBERG, SWITZERLAND SBB Bridge Effretikon

Objective: To strengthen the masonry bridge and repair the pointing with compatible materials.

Product: Centricrete MV / Zentrifix GM-25

Year: 2001

Project Information: Rain water had penetrated through the vaulted arches and subsequent freezing temperatures caused horizontal and vertical cracks. Furthermore the masonry pointing became porous and in some cases had been washed out. Centricrete MV was used for the injection of the masonry to seal the structure and prevent water penetration. Zentrifix GM-25 was used to restore the pointing work.





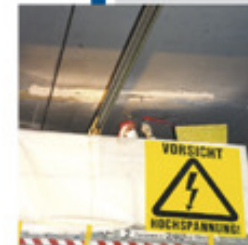
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ZURICH, SWITZERLAND Sihltal-Zurich-Vetliberg Railway





- Objective:** To stop the water leaking through the cracks into the concrete soffit.
- Product:** MC-Injekt 2300
- Year:** 2000
- Project Information:** The station is situated under the river Sihl. Groundwater was leaking through the concrete and created a dangerous situation due to the presence of power lines fixed to the concrete and in close proximity to the leaks. During necessarily short shut-down periods the cracks were effectively and permanently sealed thus eliminating a serious potential hazard.





Injection saves structures






Eliminating leaks - ensuring durability






MC Reference

References

Injection systems and technologies









MC-Injection Systems and Technology

With additional security

MC-Injekt 2300 plus



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Obrigado pela atenção !

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