




Concrete construction waterproofing system

System-based crystalline waterproofing

Liquid and powder concrete admixture for crystalline waterproofing with solutions for construction joints. As a new construction and renovation system.

Problems solved.

A photograph of an underground parking garage. The ceiling is made of concrete with several long, narrow, rectangular panels hanging from it. A network of pipes and conduits runs across the ceiling. Several concrete pillars support the structure. In the background, a pillar is wrapped in black and yellow safety tape. The floor is concrete with yellow parking lines.

Problems solved. For your reinforced concrete building projects

SCHOMBURG offers its customers a comprehensive range of sealing solutions. From cementitious mineral and bituminous waterproofing to integral crystalline waterproofing of concrete building components and membrane waterproofing, for example with fresh concrete composite systems.

In terms of cost-effectiveness and the improvement in building component properties, the integral concrete waterproofing with the crystalline concrete admixture BETOCRETE certainly stands out. When using BETOCRETE products, the cracks in a "watertight" concrete can grow closed due to the increased and accelerated crack healing ability on contact with water. In addition, the concrete becomes "more resistant" to attacks from the environment and the service life of the concrete building component is noticeably extended.

This brochure explains the background and effects. For more information, visit www.betocrete.com.



Concrete construction waterproofing system

Systematic crystalline waterproofing

Contents

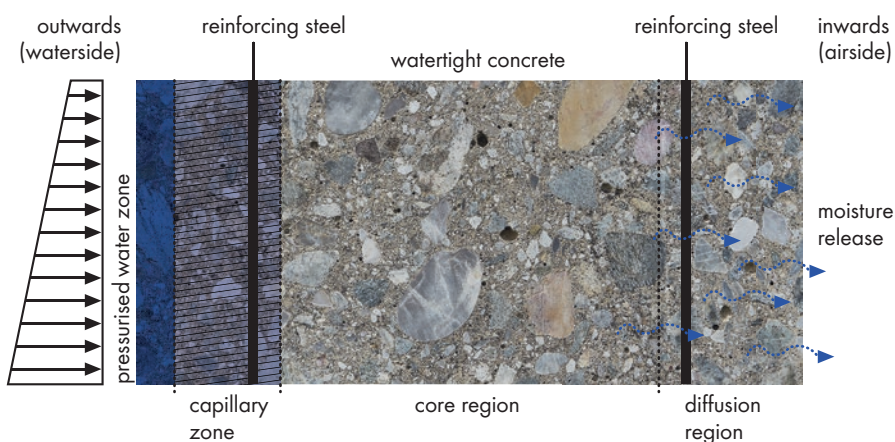
- 4 Capillary action of concrete**
 - Cracks in concrete
 - Generation of cracks
 - Crack types
- 6 Concrete degradation and concrete protection**
- 7 How BETOCRETE works**
- 8 Effects of BETOCRETE**
- 9 Areas of application**
- 10 Economical waterproofing of buildings with BETOCRETE concrete**
- 11 Guide for concrete formulations**
- 12 Extension of lifetime of concrete building components with BETOCRETE**
- 13 Range**
 - Liquid concrete admixture with crystalline effect
 - Concrete admixture in powder form with a crystalline effect
- 14 Dosing**
- 15 Supplementary products for concrete sealing in new buildings**
- 16 BETOCRETE renovation system**
- 18 Participants in the implementation of crystalline waterproofing products**
- 19 Reference projects**



Properties of concrete building components

Capillary action of concrete

Concrete is a building material with capillary action. If the concrete building component is exposed to water, the water is partially absorbed. The extent depends on the water pressure on the one hand and the concrete recipe on the other.



Graphic showing principle of capillary water absorption of a watertight concrete building component.



Cracks in concrete ¹

Cracks can affect the load-bearing capacity, serviceability and durability of concrete building components. **Cracks cannot generally be avoided**, but they are not fundamentally detrimental either. The width of the cracks only has to be limited to a harmless level or the crack has to be closed as planned.

Cracks and crack widths are planned during construction and dimensioning in accordance with DIN EN 1990 (EUROCODE 2).

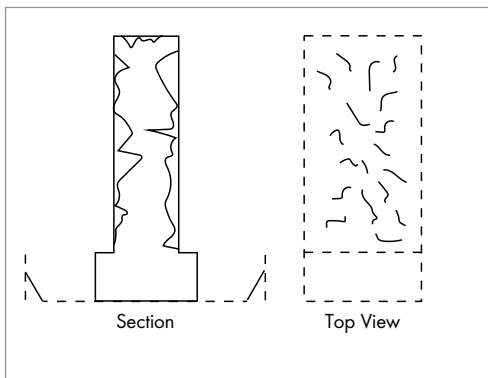
Generation of cracks ¹

Cracks in the fresh concrete are caused by the rapid reduction in volume of the concrete layer near the surface as a result of dehydration. This drying out is favoured by low humidity, wind, solar radiation and unfavourable temperatures.

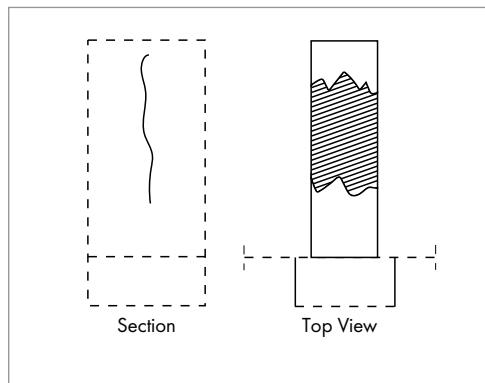
Cracks in 'green' and hardened concrete occur when the tensile stresses caused by internal stresses, constraint and external loads reach the tensile strength of the concrete up to that point in time or the strains caused by this exceed the current tensile strains at fracture.

Crack types

A distinction is made between near-surface cracks and separating cracks. Cracks close to the surface reduce the coverage of the reinforcing steel by the concrete. Separating cracks go through the building component.



Surface cracks



Tensile cracks

¹ CEMENT data sheet B18 2.2020

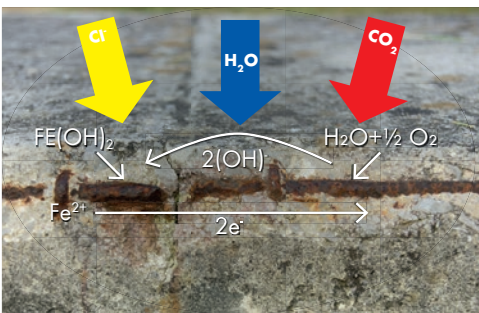


Concrete degradation

In reinforced concrete, the concrete absorbs the pressure and the reinforcing steel absorbs the tensile forces. The reinforcing steel is protected by the concrete cover and by the alkalinity of the concrete.

Oxygen in the presence of water oxidises the reinforcing steel. As long as the alkalinity of the concrete is $> \text{pH } 10$, the steel is protected from the rusting process. Chloride ions (XD, XS) accelerate the oxidation process. Oxidation of the reinforcing steel leads to an increase in volume, cracking and the concrete cover flaking off.

CO_2 in the presence of water leads to a decrease in the pH of the concrete through carbonation (XC). If the pH falls below 10, oxidation processes can progress. The presence of chloride ions accelerates this depassivation process.



Depassivation and oxidation lead to corrosion of the steel reinforcement

Concrete cover reduced by freeze-thaw weathering in conjunction with de-icing agents

Mechanical (XM) and chemical loading (XA) can attack the concrete cover. Likewise, freeze-thaw cycles (XF) have an effect in connection with de-icing agents.

Concrete protection

Reinforced concrete can be protected and its service life extended as follows:



Keep pH high = A high pH protects the reinforcement steel



Reduce water ingress = Lower water ingress means lower input of concrete-damaging substances (CO_2 , O_2 , chloride etc.)



Reduce chloride ion migration = processes of oxidation and depassivation take place more slowly



Protect concrete cover = The higher the concrete cover, the better the reinforcing steel is protected against oxidation

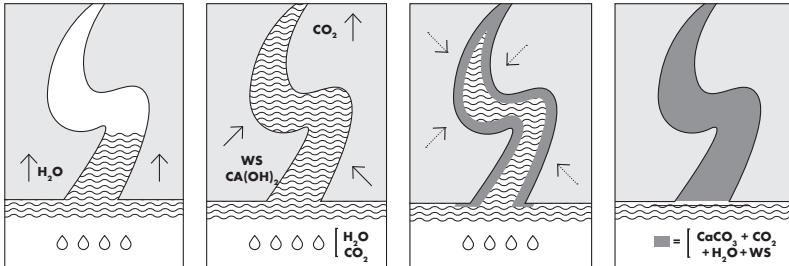
Exposure classes after EN 206-1

The right choice of exposure classes is decisive for many technical specifications. In the scope of the European standards the descriptions can be found under EN 206-1.



How BETOCRETE works

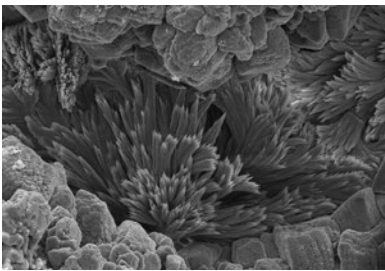
BETOCRETE crystalline waterproofing admixture is added to the fresh concrete and hardens with it. When it comes into contact with water, the active substance dissolves, reacts with the calcium hydroxide in the concrete and with CO₂. Crystals are formed.



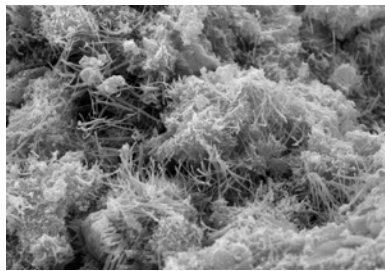
How BETOCRETE crack healing works

BETOCRETE in uncracked concrete

The capillary structure of the reinforced concrete fills with nanocrystals, the concrete becomes more compact.



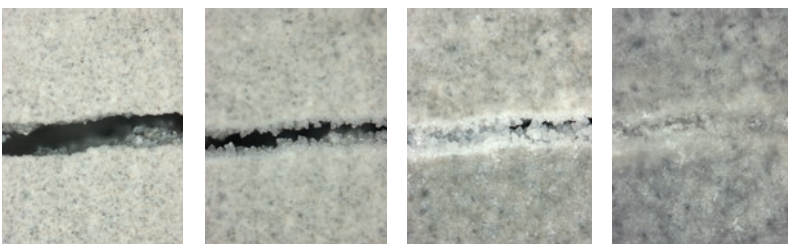
Macro view of nanocrystals



Nanocrystals in the capillary pore structure

BETOCRETE in cracked concrete

BETOCRETE has the ability to close separating and near-surface cracks watertight through crystallisation.



BETOCRETE crystal formation

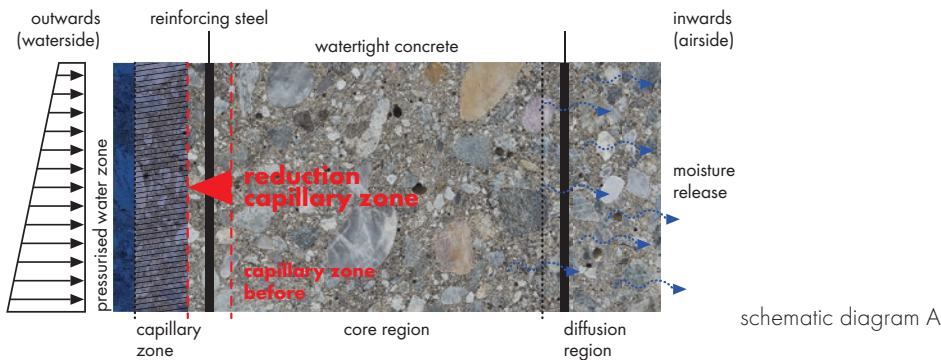
- leads to accelerated and increased crack healing, cracks up to 0.4 mm can be closed
- results in a denser/more compact concrete structure



Effects of BETOCRETE

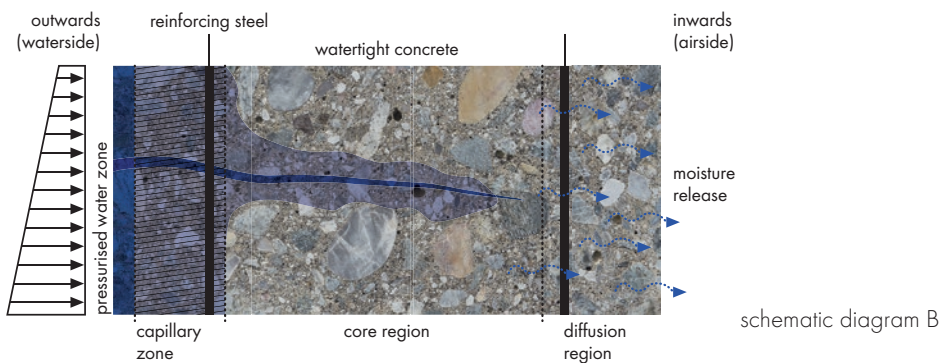
Effects of BETOCRETE on non-cracked concrete

The more compact / dense concrete structure resulting from crystal growth causes the capillary zone to shift outwards (schematic diagram A). Ground moisture and pressurised water are conducted to a lesser extent into the interior of the component and are therefore less close to the reinforcement. Substances that damage the concrete are kept away from the reinforcement with the water.



Effects of BETOCRETE on cracked concrete

Cracks close to the surface bring water and substances damaging to the concrete closer to the reinforcement, and separating cracks bring water into the interior of the building (schematic diagram B).



Crack closure keeps the damaging substances away from the reinforcement and stops water entering the building (schematic diagram A). Sealing grouting need to take place less frequently.

BETOCRETE crystal structure/crystal formation

- reduces water ingress via the capillary zone and cracks
- protects the reinforcing steel by closing cracks near the surface
- reduces the need for sealing injections by closing separating cracks
- also induces crack healing if water is present later



Areas of application

Our BETOCRETE products are used today as economical waterproofing in commercial/manufacturing/ car park construction or in infrastructure construction as a measure to extend the service life of components.



Collection and retaining basins



Parking garages and parking decks



Swimming pools embedded in ground



Cooling towers of power stations



Foundations



Tunnels and concrete pipes



Tanks and containers



Drain and manhole access points

Further information

Our BETOCRETE video gives a brief introduction to the mode of action and the advantages of the BETOCRETE crystalline waterproofing admixture.



On our microsite www.betocrete.com you will find comprehensive information on properties, areas of application and also specific detailed solutions on the subject of BETOCRETE and system accessories.



Economical waterproofing of buildings with BETOCRETE concrete

Our products BETOCRETE-CP360-WP and BETOCRETE-CL210-WP have a sealant after DIN EN 934-2 integrated into the formulation. This results in an immediate decrease in capillary water absorption by > 50%. The concrete becomes more waterproof.

In addition, when exposed to water, crystals form in the capillary pores and cracks due to increased and accelerated crack healing. The negative effect of water ingress, even in unavoidable cracks, does not occur.

2 in 1 / BETOCRETE with integrated concrete admixtures after DIN EN 934-2 (CE)

- Concrete after DIN EN 206, which is ordered according to properties, may contain concrete admixtures according to DIN EN 934-2 and the concrete manufacturer assumes the guarantee for the concrete. In the case of admixtures without a CE marks after DIN EN 934-2, a concrete composition would result and the responsibility would pass to the customer.
- The sealants integrated in the BETOCRETE provide immediate hydrophobicity in the hardened concrete. With the water contact, crystals then form in pores and cracks (hydrophilic) as an additional effect.
- The plasticizer integrated in the BETOCRETE-CL170-P reduces the water/cement value and contributes to a smoother concrete consistency.

CE



Cost effectiveness of BETOCRETE waterproofing system

- The waterproofing with BETOCRETE becomes an integral part of the concrete construction component as early as during the production of the concrete in the concrete plant.
- Subsequent liquid waterproofing can be omitted and does not have to be organised, carried out and monitored on site.
- Crack injections for non-dynamic separating cracks up to 0.4 mm can often be omitted due to the crack-healing ability of BETOCRETE concrete.
- BETOCRETE waterproofing works for a component's lifetime. Renovation cycles can be eliminated.

Guide to BETOCRETE concrete formulations



Requirements for the concrete*

Cement content	Min. 270 kg/m ³ CEM I; 290 kg/m ³ CEM II; 380 kg/m ³ CEM III/A
Fly ash	Max. 80 kg/m ³
Granulated slag	Max. 100 kg/m ³
w/c ratio	< 0.55
Grain size	16 mm, in exceptional cases 32 mm
Construction component thickness	The construction component thickness should not be less than 15 cm

* Depending on the necessary exposure class and the proportion of fly ash and/or granulated slag. Further information can be found in the current technical data sheet.

BETOCRETE® CP

BETOCRETE® CL

Dosing*: w/c ratio

< 0.4	0.75 % relative to CEM	1.75 % relative to CEM
> 0.4-0.5	0.80 % relative to CEM	1.85 % relative to CEM
> 0.5-0.55	0.95 % relative to CEM	2.00 % relative to CEM

Application

In concrete factory	BETOCRETE-CP must be dosed onto the aggregates and mixed for at least 30 seconds before adding the water and cement. Then mix for a minimum of 45 seconds until usable.	Add BETOCRETE-CL with the mixing water or the finished concrete mixture.
On the building site	BETOCRETE-CP is added on site (mixer truck) using water-soluble sacks. The mixing time should be 1 minute/m ³ of drum content, but a minimum of 5 minutes.	Pour BETOCRETE-CL directly into the mixing drum and then add 1 minute/m ³ of drum content, but for a minimum of 5 minutes. BETOCRETE Deduct the amount from the mixing water.

* The dosage depends on the cement content used and the w/c ratio of the corresponding concrete recipe. The tabular overview serves as a guide. Pre-testing is always necessary!



Extension of lifetime of concrete building components with BETOCRETE

BETOCRETE extends the service life of the concrete component through

reduced water ingress and thus reduced entry of substances that damage the concrete

- By crack healing
- Due to reduced water ingress in capillary and pressurised water situations



Reduction of concrete-damaging processes

- Reduction of chloride ion migration
- Reduction of carbonation rate



Protection of the concrete cover

- Improvement of frost-thaw weathering values
- Reduction of the attack surface for mechanical abrasion through crack healing



Less water, less aggressive substances, longer component life



Less carbonation, reduced rate of concrete ageing

Test proofs: Reduced water ingress through pressurised water and capillary water absorption

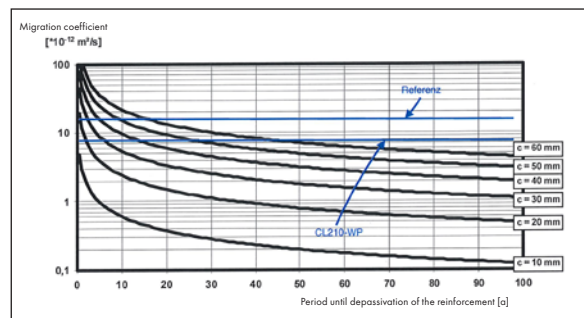
Test proofs: Reduced carbonation and chloride ion migration

The German Federal Institute for Hydraulic Engineering ("BAW") has developed a method to determine the service life of concrete structures based on chloride ion migration. Chlorides lead to increased carbonation and increased oxidation of reinforcing steel. The higher the chloride ion migration for a given concrete cover, the faster the concrete component ages.

Using a test report, SCHOMBURG can show an example of a concrete recipe that the BETOCRETE concrete leads to a 2.5-fold increase in the service life compared to the reference concrete.

Sample calculation

Specific lifetime extension for a concrete component according to the BAW method:





Liquid concrete admixture with crystalline effect



BETOCRETE-CL210-WP

Concrete admixture with crystalline effect and sealant

- possible crack healing for continuous cracks up to 0.4 mm and for tapering cracks up to 0.5 mm
- minimisation of servicing and maintenance costs
- integrated sealant (DM) after DIN EN 934-2
- economical dosing in the concrete plant via dosing pump



BETOCRETE-CL170-P

Concrete admixture with crystalline effect and concrete plasticiser

- possible crack healing for continuous cracks up to 0.4 mm and for tapering cracks up to 0.5 mm
- minimisation of servicing and maintenance costs
- integrated concrete plasticizer (BV) after DIN EN 934-2
- economical dosing in the concrete plant via dosing pump



Concrete admixture in powder form with a crystalline effect



BETOCRETE-CP360-WP

Concrete admixture with crystalline effect and sealant

- possible crack healing for continuous cracks up to 0.4 mm and for tapering cracks up to 0.5 mm
- minimisation of servicing and maintenance costs
- integrated sealant (DM) after DIN EN 934-2
- 3 kg water soluble bags available



BETOCRETE-CP350-CI

Concrete admixture with crystalline effect and corrosion inhibitor

- possible crack healing for continuous cracks up to 0.4 mm and for tapering cracks up to 0.5 mm
- minimisation of servicing and maintenance costs
- 3 kg water soluble bags available



Short terminology

BETOCRETE-C	Crystalline concrete admixture (C=Crystalline)
BETOCRETE-CP	Pulverulent concrete admixture (P=Powder)
BETOCRETE-CL	Liquid concrete admixture (L=Liquid)
BETOCRETE-CL210WP	2 in 1 effect / in addition to crystalline additives including sealant DIN EN 934-2 (WP=Water Proofer)
BETOCRETE-CL170P	2 in 1 effect / in addition to crystalline additives including plasticizers after DIN EN 934-2 (P=Plasticizer)



Dosing

Dosing of liquid concrete admixtures

Liquid BETOCRETE can be dosed directly into the concrete mix via the dosing system of the concrete plant. This is done without additional work steps and precisely with automated pump technology.



Storage and dosing of liquid concrete admixtures in the concrete plant (photo credit: Würschum GmbH)



In addition to IBCs, the BETOCRETE-CL products are also available in barrels and canisters.

Dosing of pulverulent products

Pulverulent BETOCRETE is supplied in watertight foil bags for metering into the mixer or in water-soluble bags for dosing into the mixer truck.



BETOCRETE products in water-soluble bags and watertight foil bags

Info – System accessory for fresh concrete composite system AQUAFIN-WM12

In areas that are inaccessible (for injection agents) or in forms of use where temporary damp spots in the concrete building component are not permitted, even more safety can be brought into the concrete building component using the AQUAFIN-WM12 fresh concrete composite system.

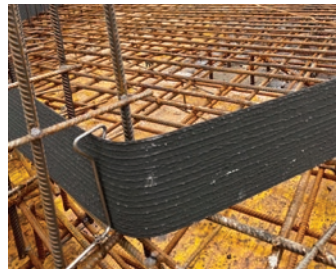
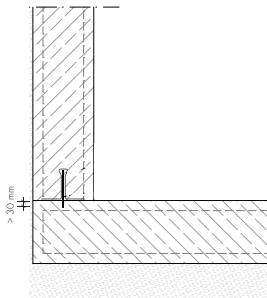


Supplementary products for concrete sealing in new buildings



The construction joint is the classic weak point in waterproofing. The SCHOMBURG system accessories for the construction joint can provide a reliable solution here.

In addition to grouting and expanding waterstops, the solution with the crystalline construction metal waterstop offers a high level of safety.

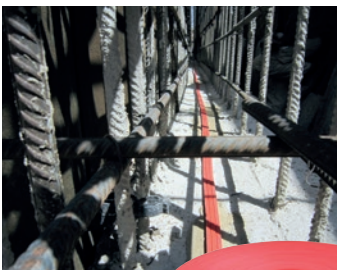


Waterproofing of a construction joint with AQUAFIN-CJ5

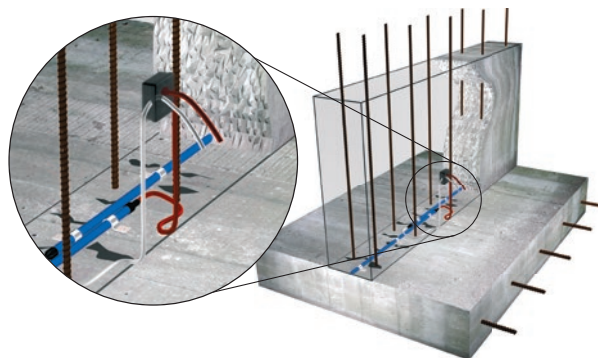
AQUAFIN-CJ5

Secure sealing with the crystalline joint sheet AQUAFIN-CJ5

- 1) Extension of the circulation of the water on the possible path through the cracked joint.
- 2) Cementitious coating on the AQUAFIN-CJ5 forms a high adhesion bond with the concrete, resulting in a reduced probability of cracking.
- 3) The metal water stop is "ready to use" and therefore not prone to processing errors. No film has to be peeled off.
- 4) If there is a crack in the construction joint, crystal formation is induced by the metal water stop and cracks can be sealed.



Working joint solution swelling joint tape AQUAFIN-CJ6



Construction joint solution injection hose AQUAFIN-CJ1

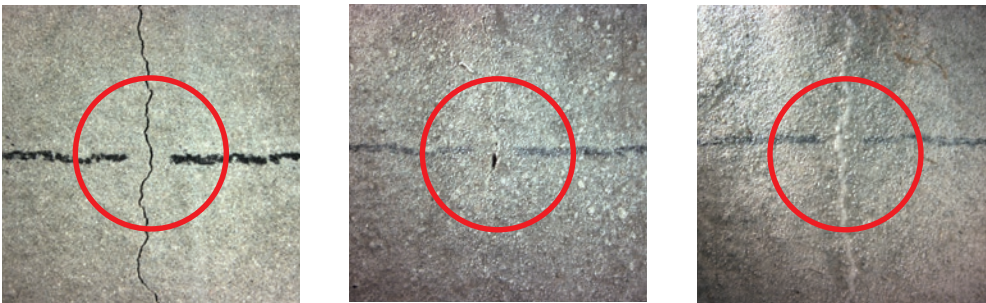


BETOCRETE renovation system

AQUAFIN-IC – Crystalline sealing slurry

The crystalline slurry is applied to the concrete body to be sealed using the spray, slurry or trowel techniques. The BETOCRETE crystals migrate into the concrete body and develop the crystalline sealing and concrete protection effect.

The images below illustrate the crack sealing ability of AQUAFIN-IC in static (non-moving) cracks.



Crack sealing ability of AQUAFIN-IC in static (non-moving) cracks.

The following images show the basic behaviour of AQUAFIN-IC on a concrete substrate:



Fig. 1

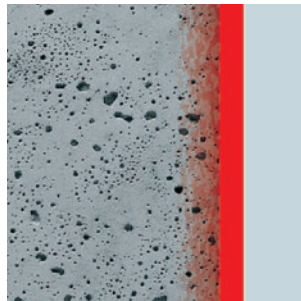


Fig. 2

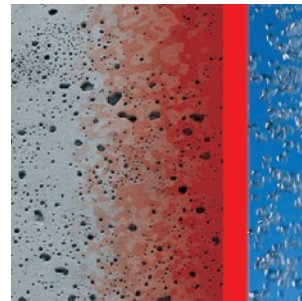


Fig. 3

Untreated concrete is porous and therefore very susceptible to water penetration (Fig. 1).

AQUAFIN-IC (red) is applied to the concrete surface (Fig. 2).

The active ingredients of AQUAFIN-IC begin to penetrate the capillaries. In the capillaries, the chemical substances react with the free lime and moisture and form insoluble crystals.

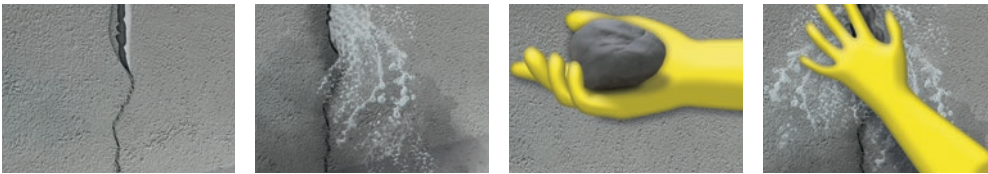
This process runs down to the bottom layer of concrete, closing the pores (Fig. 3).

The result: AQUAFIN-IC is not just a coating, it becomes an integral part of the concrete!



FIX 20-T - Crystalline plugging mortar / ASOCRET-IM

Water ingress can be stopped directly with crystalline plugging mortar.
The ready-set mortar unfolds its crystalline sealing and protective effect surrounding the area of application.



Crystalline effective repairs can then be carried out with ASOCRET-IM

System composition of retrospective crystalline waterproofing

- Step 1: Block water ingress with FIX 20-T
- Step 2: Repair large cracks and open joints with ASOCRET-IM
- Step 3: Apply AQUAFIN-IC crystalline slurry
- Step 4: Curing: Keep sealed concrete structure damp for 3 days

Participants in the implementation of crystalline waterproofing products

The watertight concrete structure is created through the interaction of structural engineering, concrete mix and the professional application of concrete on the building site. Accordingly, the interaction of those involved / those responsible in the "network" is of considerable importance.

The role of the structural engineer: Construction and dimensioning of the concrete structure in such a way that cracking due to stress and restraint is minimised.

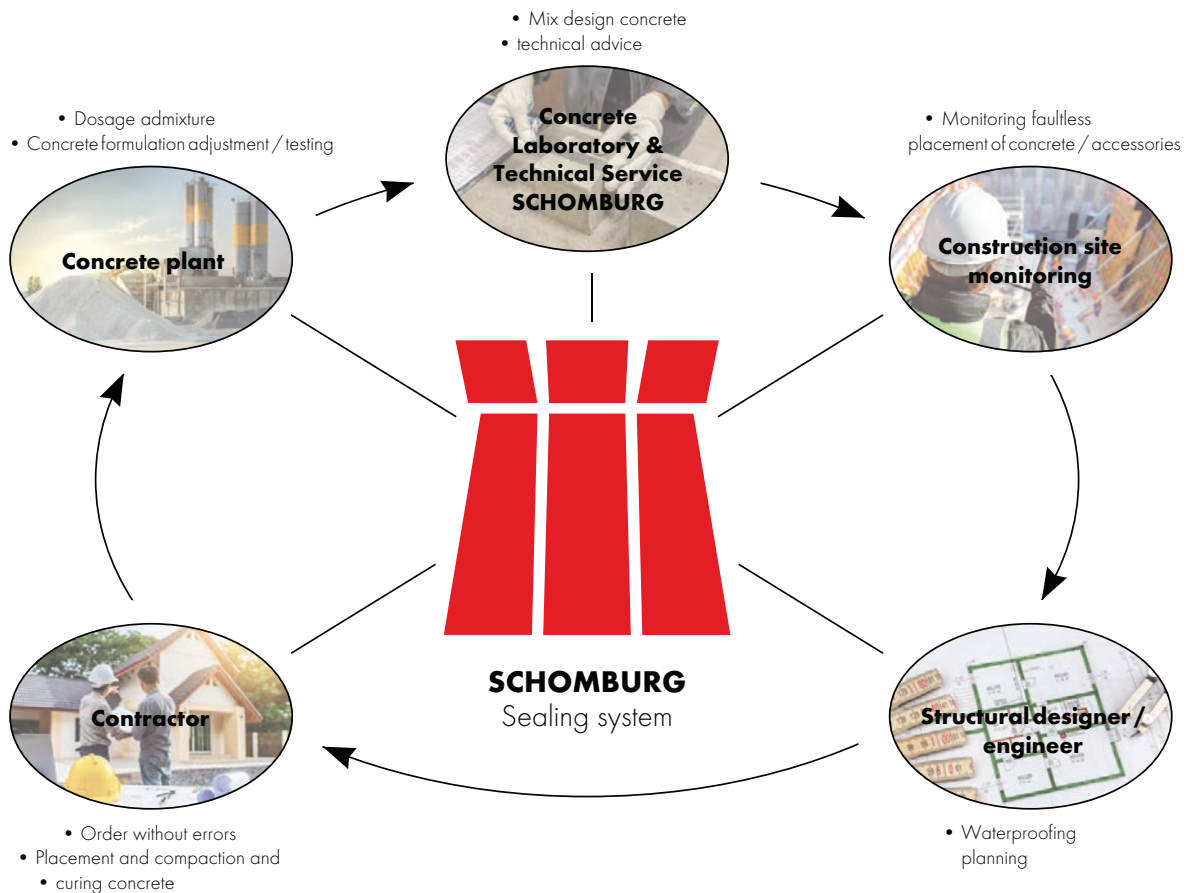
The role of the concrete factory: Provision of a suitable concrete recipe, which is equipped with crystalline properties via a concrete admixture. The formulation must be validated in advance in the form of an initial test.

The role of the construction contractor: The correct ordering, application and compacting as well as curing of concrete.

The role of construction site surveillance: In the case of watertight concrete qualities, construction site monitoring is often provided in order to ensure that the correct concrete recipe is introduced without errors

The role of SCHOMBURG: SCHOMBURG as a supplier of concrete admixtures with crystalline properties, supports and advises in every phase of the project. An important aspect is the recommendation for the mix design of the concrete recipe in the accredited concrete laboratory and the provision of proof of suitability.

The network in interaction:





Reference projects

With our proven and economically efficient systems, we have supported numerous construction projects at home and abroad.



Bulvar apartment building / service and residential building with garage section, Poland



Underground garage Vienybės Square Kaunas, Lithuania



Floating docks in the historic port of Hamburg



Ski jump Średnia Krokiew in Zakopane, Poland



Ibis Center Vilnius, Lithuania



Sea thermal spa with hot springs, Iceland

The SCHOMBURG Group develops, produces and distributes building product systems for the areas of:

- Waterproofing and repair of buildings
- Tiles/natural stone/screed application
- Ground protection/floor coating systems
- Concrete technology

For over 80 years SCHOMBURG's development competence has been a recognised feature in both the domestic and the worldwide marketplace. Building product systems that are produced in-house are highly prized around the world.

Experts value the quality and the efficiency of building product systems, the services and therefore the core competence of the group of companies.

To meet the demanding requirements of an ever-changing market, we continuously invest in the research and development of new and already existing products. This guarantees an ever increasing product quality to the satisfaction of our customers.

SCHOMBURG GmbH & Co. KG
Aquafinstraße 2-8
D-32760 Detmold (Germany)
Telephone +49-5231-953-00
Fax +49-5231-953-333
www.schomburg.com

