MEMO

BUILDING TRUST

TO	whom it might concern
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FROM	OSc
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DATE	20th February 2017
E-MAIL	schwoon.oliver@ch.sika.com

TECHNICAL STATEMENT SIKA® WT-200 P

Inhaltsverzeichnis

SIKA SERVICES AG · Concrete & Waterproofing Division
Tüffenwies 16 · CH-8048 Zürich · Switzerland
Phone: +41 58 436 46025 · Fax: +41 58 436 41 50 · www.sika.com

1 PRODUCT SCOPE

Sika® WT-200 P is a combined water resisting and crystalline waterproofing admixture used to reduce permeability of and to enhance the self-healing ability of a concrete.

Sika® WT-200 P has been specifically formulated to produce high quality waterproof concrete. Concrete incorporating Sika® WT-200 P can be used as a part of the Sika® Watertight Concrete System. Please refer to Table 1 and 2 (see p.10) for an overview of performance and performance criteria.

Key Factors Assessed

- Resistance to water penetration: Concrete incorporating Sika® WT-200 P has reduced permeability when compared to the equivalent plain concrete.
- Resistance to water conductivity: Concrete incorporating Sika® WT-200 P has reduced water conductivity when compared to the equivalent plain concrete.
- Reinforcement protection: Concrete incorporating Sika® WT-200 P has enhanced resistance to reinforcement corrosion when compared to the equivalent plain concrete.
- Mechanical properties: The mechanical properties of the concrete incorporating Sika® WT-200 P are not adversely affected.
- Durability: Concrete incorporating Sika® WT-200 P is more durable than the equivalent plain concrete mix due to its reduced permeability.
- Self-healing: Concrete incorporating Sika® WT-200 P will enhance the self-healing of the concrete.

2 TECHNICAL SPECIFICATION

Description

Sika® WT-200 P consists of a mixture of cements, amino alcohols and fillers. These active materials will form non-soluble materials throughout the pore and capillary structure of the concrete and seal the concrete permanently against penetration of water and other liquids. In addition the special formula and ingredients of Sika® WT-200 P enhances the self-healing properties of concrete and will improve the ability to heal cracks in concrete.
Sika® WT-200 P conforms to the requirements of EN 934-2, Table 9 (water resisting admixture).

Packaging

- The product is supplied
    - in 1.75 kg water soluble bags, of which 6 or 10 are packed into 25 liter containers. There are 18 containers on each pallet.
    - in 18 kg bags. There are 40 bags on each pallet

All products must be stored in sealed original containers in a dry environment at temperatures between 5°C and 30°C. The product has a shelf-life of 12 months, when stored under these conditions. When handling, the normal health and safety procedures associated with cementitious materials should be observed.

3 ASSESSMENT AND TECHNICAL INVESTIGATION

Use

Sika® WT-200 P is used in concrete mixes at an addition rate of 1-2% of Sika® WT-200 P by weight of binder to provide waterproof concrete for basements, swimming pools, tunnels and culverts, without the requirement for additional applied internal or external protection.

The product is compatible with pure OPC and cement blends containing Secondary Cement Materials (SCM), pulverized-fuel ash, ground granulated blast furnace slag and silica fume blends as defined in EN 197-1. Maximal (SCM) content shouldn't exceed 40% of the total binder content. For higher content of SCM tests should be conducted to verify the performance.
The use of the Sika WT-200 P in combination with an air-entraining agent has to be verified by trials mixes. Sika® AerPro and SikaControl® AER-200 P have been successfully tested in combination with Sika® WT-200 P.

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Practicability of Installation

Waterproof concrete incorporating Sika® WT-200 P can be placed, compacted and cured by operatives with experience of conventional concreting methods and equipment.

Water Penetration, Water Conductivity and Absorption

Waterproof concrete incorporating Sika® WT-200 P has greater resistance to water penetration, water conductivity and water absorption than the equivalent plain concrete.

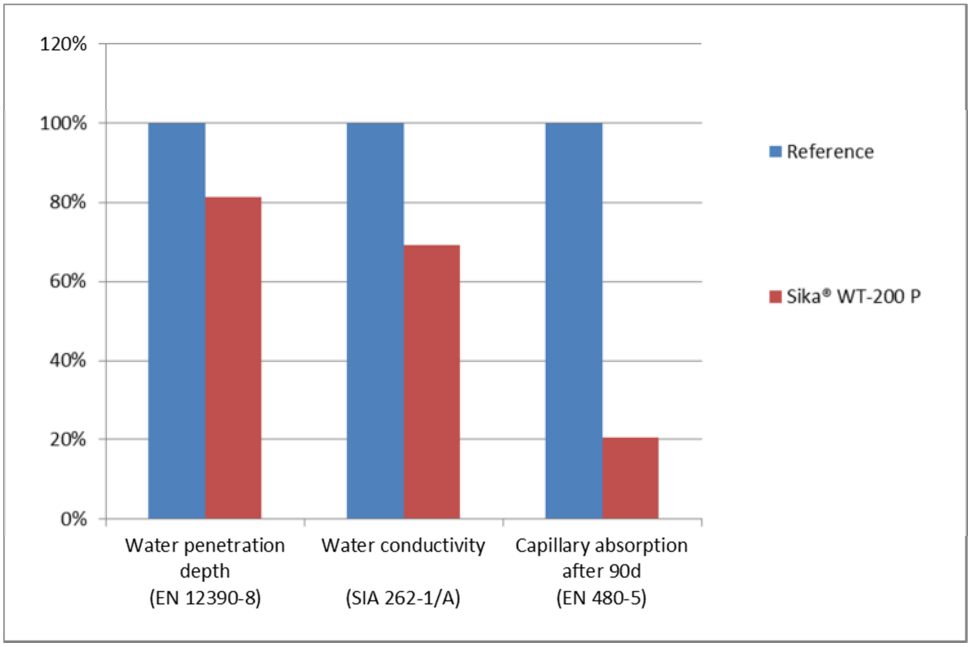

Figure 1: Comparison of test results for waterproof concrete

Reinforcement Protection

The high alkalinity required to prevent corrosion of the reinforcement (pH>13) will not be adversely affected by the incorporation of the Sika WT-200 P into concrete.

Corrosion of reinforcement is normally caused by the ingress of chloride to the steel or by the reduction in alkalinity of the concrete by the diffusion of carbon dioxide. The reduced permeability of waterproof concrete incorporating Sika® WT-200 P will slow down diffusion of aggressive agents into the concrete and so give improved protection against reinforcement corrosion.

The product complies with the corrosion behaviour requirements given in EN 934-1, Clause 5.1 and is labelled accordingly.

Mechanical Properties

The compressive strength of waterproof concrete incorporating Sika® WT-200 P is higher than the equivalent plain concrete with the same water content.
The static modulus of elasticity of waterproof concrete incorporating Sika® WT-200 P is not negatively affected compared to the equivalent plain concrete.

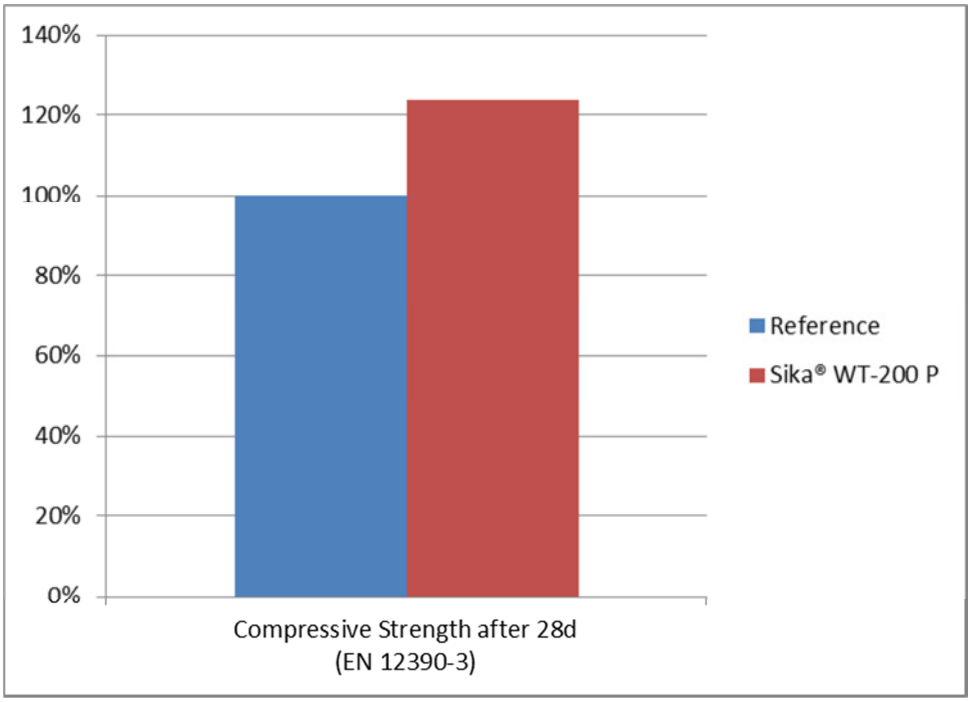

Figure 2: Comparison of compressive strength after 28d

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Setting Characteristics

The setting time of concrete mixes incorporating the Sika WT-200 P will be similar to an equivalent plain concrete, in higher dosage a retarding effect might occur. The chemical and physical composition of the components, concrete, Sika® WT-200 P and ambient temperature can affect the setting time of the concrete.
The effect of the product for a specific mix and site conditions should be evaluated through site trials prior to use.

Carbonation Resistance

Waterproof concrete incorporating Sika® WT-200 P has no negative effect on the carbon dioxide diffusion compared to an equivalent plain concrete. The reduced permeability of waterproof concrete incorporating Sika® WT-200 P will slow down diffusion of CO_2 into the concrete and so give improved protection against Carbonation.

Frost Resistance

Waterproof concrete incorporating Sika® WT-200 P has an equal or better resistance to freeze/thaw resistance to that of an equivalent plain concrete.

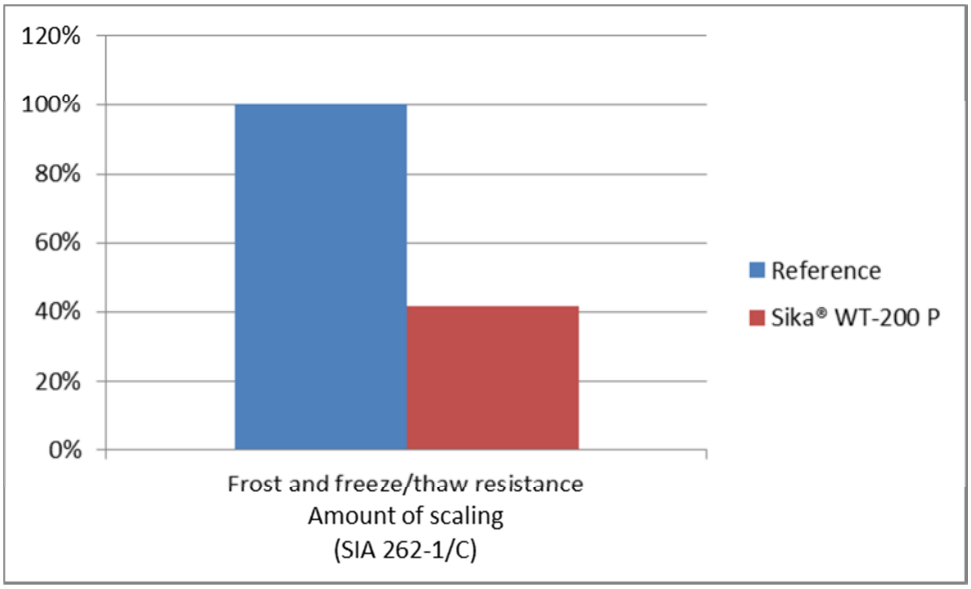

Figure 3: Comparison of test results for FT resistance

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Sulfate Resistance

The lower permeability (uncracked concrete or healed cracks in concrete) of the Waterproof concrete incorporating Sika® WT-200 P reduces the ingress of sulfates.

Resistance to Leaching

Use of the product reduces the leaching of lime from the hydrated cement in the concrete (uncracked concrete or healed cracks in concrete).

Maintenance

For a specific installation, the maintenance regime should be considered to ensure that the required design life of the concrete is achieved.

Durability

Under normal conditions of service, waterproof concrete incorporating Sika® WT-200 P, is more durable than the equivalent plain concrete due to its reduced permeability.

Where exposure to aggressive soil conditions or chemicals is anticipated, a full assessment of the site should be made.

Where concrete incorporating Sika® WT-200 P is exposed to an aggressive environment such as chlorides, freeze thaw, sulfates, sea water or other chemicals, the suitability of the concrete mix design should be approved by the client or an engineer who will be familiar with the local standard.

4 INSTALLATION

General

The use of the Sika WT-200 P will, produce a concrete with the following properties: comparative to that of an equivalent plain concrete.

- reduced porosity
- reduced permeability
- increased water resistance
- increased corrosion resistance

The product has no known detrimental effect on the properties of the concrete.

Mix Design

Waterproof concrete incorporating Sika® WT-200 P is should be obtained from a concrete supplier with a recognized third party accreditation.
The concrete must have a minimum cement content of 350 kg/m³, be batched with a maximum w/c-ratio of 0.45 and have a minimum consistence of S3 (100 – 150 mm). Further details of suitable mixes can be obtained from the Sika Technical Department. Once mixed, further materials must not be added to the fresh concrete. For further information on waterproof concrete please refer to the Sika® Concrete Handbook (p.150).
The consistence of the concrete has to be be adjusted using a suitable water reducing or superplasticizing admixture complying with EN 934-2 to ensure the maximum w/c-ratio of 0.45 is not exceeded.
Other admixtures should be evaluated before use and trial mixes carried out to establish the appropriate dosage and compatibility.

Concrete Mixing on Site (in Truck Mixer)

The Sika WT-200 P is added to the concrete mixer at the correct dose prior to batching the concrete constituents. When an additional superplasticizer is required, it should be added after the addition of the product. The resulting concrete should be mixed for a minimum of five minutes to ensure even distribution of the product throughout the concrete.

Placing

Waterproof concrete incorporating Sika® WT-200 P should be placed in the same way as normal concrete, in accordance with local standards as well as with health and safety guidance and the normal routine precautions for handling concrete.

Waterproof concrete incorporating Sika® WT-200 P should not be placed at temperatures of 5°C or below and should be fully compacted.

Curing

Waterproof concrete incorporating Sika® WT-200 P should be cured strictly in accordance with local standard and rules as well as recommendations where site specific information exists. Curing should start at the earliest opportunity.

Finishes

When water-based products are used to coat the hardened concrete, a bonding agent may be needed. For specific cases, advice should be sought from the Sika Technical Department.

Joints

If the concrete incorporating Sika® WT-200 P is to be used as part of the Sika® Watertight Concrete System guidance for the concrete mix design, construction and concreting must be followed and advice should be sought from the Sika Technical Department.
Construction and movement joints (movement/non-movement) should be sealed with waterstops to maintain watertightness of the whole structure. The advice of the Sika Technical Department should be sought on particular applications.
Service entries and penetrations of the concrete, such as pipe entries or formwork ties, must also be securely sealed to maintain watertightness. The advice of the Sika Technical Department should be sought on suitable systems.

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5 TECHNICAL INVESTIGATIONS

Water Penetration Depth (according to EN 12390-8: 72 hours with 5 bar)
Water penetration under hydrostatic pressure the water permeability limit for waterproofness is defined as a maximum water penetration into the concrete under a specific pressure over a defined period.

Water Conductivity (according to SIA 262-1/A)
Water conductivity of wet concrete surfaces the water permeability limit for waterproofness is defined as g/m^2 x h, where water permeability is smaller than vapor volume of water without pressure over a defined period.

Explanation: Water Conductivity of Wet Concrete Surfaces
Vapor or moisture will transmission through the concrete. As long as the air can convey the vapor away from the element ($q_d > q_w$), the concrete element will stay dry. As soon as $q_d < q_w$ the vapor will condense on the surface of the concrete element. q_d is dependent on the relative air humidity and the air temperature.

Picture 1: Overview of water transmission

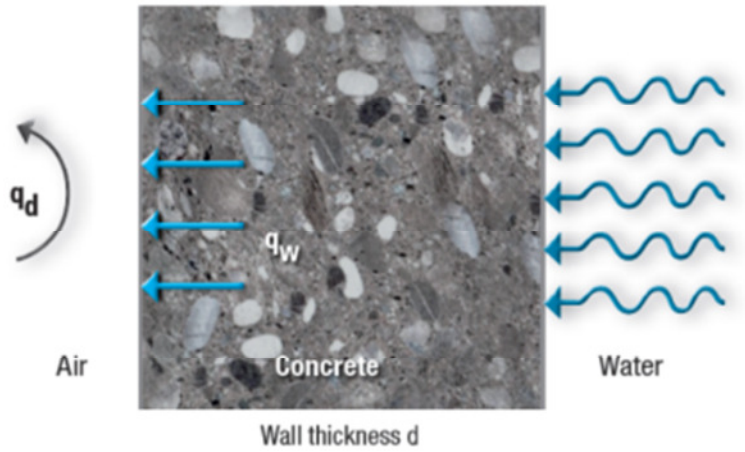

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Table 1: Overview over general improvement with Sika® WT-200 P

	Reference concrete	Sika® ViscoCrete®	Sika® ViscoCrete® / 1%Sika® WT-200 P	Sika® ViscoCrete® / 2% Sika® WT-200 P
w/c-ratio	0.58	0.45	0.45	0.45
Resistance to water penetration depth	0	++	+++	++++
Resistance to water conductivity	0	++	+++	++++
Resistance to capillary absorption	0	++	+++	++++
Compressive strength 28d	0	++	+++	+++
Flow table spread (FTS)	0	++	++	++
Retardation	0	0	-	--

Table 2: Overview of Sika Watertight Concrete System performance criteria

Performance Criteria – Concrete Watertightness		
Test	**Value**	**Source / Standards**
Water conductivity	<6 g/m²/h	Sika AG SIA 262-1 Annex A
Water penetration	<30mm	Sika AG EN 12390 Part 8
Maximum water penetration	5 bar / constant	Sika AG EN 12390 Part 8
Drying shrinkage	<0.5‰	SN 262-1 Annex F
BBA Certificate	Approval	BBA

6 ENHANCEMENT OF SELF-HEALING

Autogenous healing or self-healing known as natural healing was first noticed in 1836 in concrete pipes by the French Academy of Sciences. This phenomenon is mainly based on continued hydration and calcium carbonate precipitation. It happens in ordinary concrete and it is increased when using low water/binder rates and high binder contents.
Crystalline-based self-healing: This type of healing is based on the reaction of crystalline admixtures, which react with portlandite (calcium hydroxide) to create water-insoluble crystals.

Cracks occur always if tensile strength of concrete is lower as the stress generated by shrinkage or mechanical stresses. Very often that happens in a very early stage within the first couple of days when concrete has limited tensile strength behavior. Cracks in concrete imply always a problem if they influence the appearance of the concrete (fair faced concrete) and/or the durability of concrete (mainly the reinforcement) is negatively influenced. For that reason based on the concrete exposition class according to EN 206 maximum crack widths are fixed:

XC1, XC2	0.4 to 0.6 mm
XC3, XC4	0.3 to 0.4 mm
XD1, XD2a	0.3 to 0.4 mm
XD2b, XD3	0.2 to 0.3 mm

From an aesthetical point of view the interpretation is more subjectively, as the perception is different form the viewpoint, surface humidity and distance to the concrete surface, but a crack width of 0.5 mm is always visible.
Reduce crack wide is the result of the concrete mix design, the curing procedure, the geometry of the structure and the reinforcement concept of the concrete structure. As concrete ways of looking at things as a cracked structure, there are always cracks, thinner or wider ones. The only one exception is pre stressed concrete.
Enhancement of the self-healing properties of watertight concrete admixtures offers the possibility to reduce and/or close the amount and/or width of theses cracks in a structure. Only if there is no more water penetration through these cracks the structure will be watertight.
Depend on the mix design and the hydration conditions cracks have so called self-healing properties up to 0.2 to 0.4 mm. This effect can be enhanced by the use of crack healing admixtures. In addition cracks with larger crack widths can be healed partly or even completely. Sika WT-200 P improves the self-healing ability of the concrete mix design itself.

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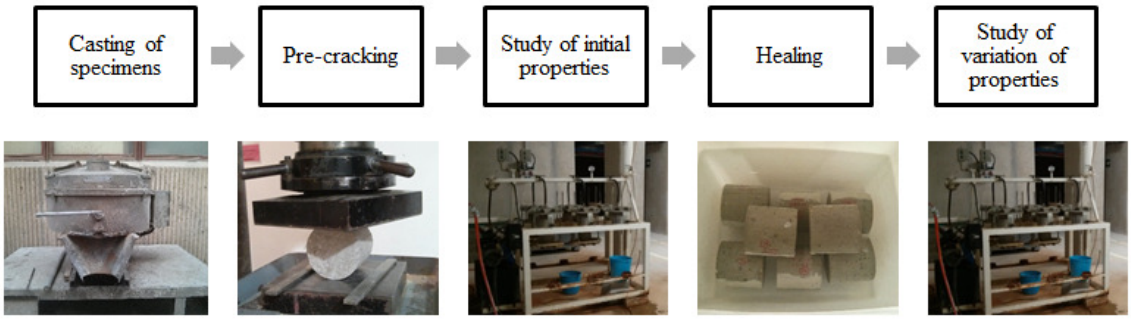
Testing of self-healing of concrete

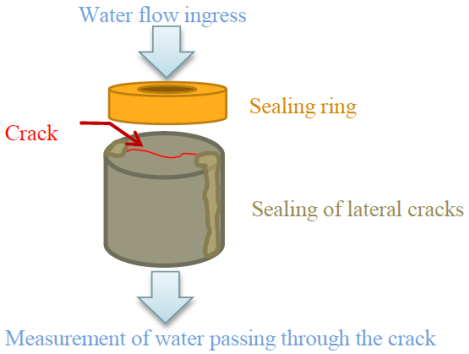
In cooperation with the University of Valencia several studies have been conducted and a testing method has been developed by the University of Valencia. Picture 2 shows a general overview of the testing procedure. ***It is uncertain until now if this test becomes commercial available.***

Picture 2: General overview of testing procedure



After a defined amount of time and healing conditions the samples will be assessed. The assessment will be done by different ways:

a) Water penetration
Before and after healing water penetration will be measured. The difference shows the healing rate of the sample.



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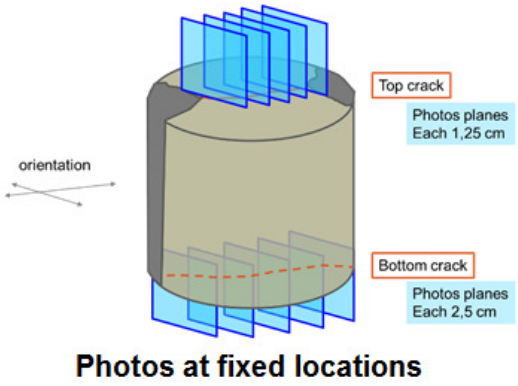
b) Optical assessment
Before and after healing pictures of various spots on the crack has been taken and will be compared with pictures after healing exposure (see Picture 3).



Picture 3: Example of optical assessment