

Comparison of Penetrating Sealers and CN2000®

The Difference between "Penetrating Sealers" and **CN2000®B**

In general, Penetrating Sealers are a transparent liquid, which use silicate, polyester or polysiloxane as their base materials.

CN2000®B is a powder material that uses cement as the base material. Therefore, during application, the characteristics of the "Penetrating Sealers" - penetrating action mechanism as well as the chemical and physical properties are completely different from **CN2000®B Cementitious Capillary Crystalline Waterproofing (CCCW)**.

The Performance of "Penetrating Sealers"

As for the performance of "Penetrating Sealers", **Zhonghe Company** has performed thorough scientific research and investigation of their capabilities and gained a deep insight into their action and performance. The general descriptions are given below.

These types of "Penetrating Sealers" fall into two categories. The first is with inorganic material (silicate) as the basic material and the second is with organics as the basic material. There are various companies who claim to have **CCCW** characteristics such as the waterproofing, anti-corrosion performance, and freeze/ thaw durability. In fact, this is not the case.

Since 1996, Doctor S. Y. Qian, the Senior-Research officer of Concrete Structures for the Institute for Research in Construction for the Canadian National Research Council had been studying 9 kinds of Corrosion-Inhibiting Systems on a Concrete Bridge Deck in Laval, Quebec for the past 10 years. Among them, Organic concrete admixture, rebar water-based epoxy resin and concrete sealer (water-repellent penetrating silane) are used on the testing span G...

The testing results indicated that within one year after they have been applied, they behaved fairly well, but after the first year, chloride penetrating was apparent. This means, they didn't provide a protective action to the concrete and rebar (*See Evaluation of Corrosion-Inhibiting Systems on a Concrete Bridge Deck by Dr. Daniel Cusson and Dr. Shiyuan Qian*).

William F. Perenchio has investigated 37 bridges including Ohio and Oklahoma bridges in America as well as the Rhineland Bridge in West Germany.

All these bridges were treated whole or partly with "Penetrating Sealers". Among them only two bridges in West Germany showed enhancements to their freeze and thaw durability to some extent, the other 35 bridges show the treatment of penetrating sealer, silane, has had no effect to the concrete freeze and thaw durability, and "exfoliation" was the end result on these concrete surfaces. (*See Perenchio, William F.: Durability of concrete treated with silane. Concrete International, American Concrete Institute, Nov, 1988 30~40*);

Camina's report indicates, under high water pressure the protective action of silane will decrease dramatically (*See Camina. M: Site assessment of the integrity of coatings applied to reinforced concrete structures. Research contract report C6C2. Paint Research Association, 1988*);

The testing results made by Maltech and others show that while being soaked in water for a long term, silane loses its protective ability (*See Maltech P. A. M., Montgomery F. R., Long A. E. and Batayneh M: Durability of surface treated concrete. In Protection of Concrete, eds. R. K. Dhir and J. W. Green, Eand FN Spon, 1990. 212~221*).

Basheer's valuation to these kinds of "Penetrating Sealers" is that they do not noticeably decrease the carbonization depth (*Basheer, P. A. M., Montgomery F. R. and Cleland D. J: Assessment of the effectiveness of protective surface treatments. In International Conference on Bridges and Flyovers, Hyderabad, India, Tata-McGraw Hill Publishing, New Delhi, 1991 22~27*).

All the above investigations indicated that this kind of "Penetrating Sealer" is not only a less efficient waterproofing/ anticorrosive material with a lesser performance to resisting the freeze/thaw cycle, but also due to the freeze/ thaw cycle, it causes exfoliation damage to the concrete structures.

According to the information available today, there has not been any mention of any important or international projects coated with "Penetrating Sealers" up to this point in time.

The mechanism of "penetrating" of sealers and how it differs completely from the mechanism "capillary crystalline" action of **CN2000®B**

The "penetrating" of the silane kind of Penetrating Sealer is that, silane itself penetrates into the concrete substrate through a siphoning action. This does not form a coating layer on the concrete surface. Usually in a short period of time, it penetrates deeply (to depths of more than 10 mm or up to 4 inches) into the structure. The penetrated material reacts directly with the components of cement producing crystalline material or water-repellent matter.

It is the "penetrating" actions, which causes the substrate concrete damage in the environment of freeze and thaw cycles. Perenchio believes the reason is due to the absolute pressure. While freezing on the front edge of ice, because of the pressure being greater than that of the atmosphere, and due to volume expansion, this pressure breaks through tiny holes in the concrete with the silane in it, and causes the water to permeate into the concrete.

Due to the existence of silane, tiny holes show it as a "repellant", and the pressure inside the concrete is higher than that under normal conditions. When ice on the external surface, as well as the ice in the tiny holes thaws, the pressure releases rapidly. But the water-repellent silane prevents the water from separating out of the interior of the concrete.

When there is a sufficient number of freeze/thaw cycles, the concrete surface becomes water-saturated. It is at this point, after several more freeze- thaw cycles, that the concrete begins to show exfoliation, which produces damage to the concrete structure.

This is a similar situation that has been observed by JOHN F. STATON —“products of this nature have been suspected to corrupt the effectiveness of the concrete's internal entrained air-void system”.

CN2000®B is completely different from “penetrating sealers” in the penetrating mechanism. After **CN2000®B** is applied, it forms a coating layer on the concrete surface.

This waterproof layer itself will not penetrate into the concrete, only the “activating chemicals” will act in the role of “Capillary Crystalline”, and its content is very small. The “activating chemicals” diffuse through the solid phase and liquid phase obeying the “Second Fick Law”, into the concrete and catalyze to form a much more insoluble crystal substance i.e. C-S-H crystal which is usually produced during the hydrating process of concrete itself. Even if there is no catalyst in it, it increases along with age.

“Activating chemicals” only catalyze the reaction, and will not be consumed themselves. It is due to the continually produced C-S-H crystal which makes the concrete substrate become denser and denser and prevents water and other harmful matters to invade. Thus it acquires a waterproofing and anticorrosion ability.

In regards to the freeze-thaw cycles, **CN2000®B** has performed 200 freeze-thaw cycles (-20 to 20 °C) with total experiment time of 1600 hours without any damage to the concrete structure becoming apparent. This is equivalent to 40 years of useful life in Michigan.

So by treating with **CN2000®B**, the phenomenon of exfoliation that is associated with concrete treated with “Penetrating Sealers” has not, and will not occur.

Early in 2001 Chinese experts and the experts of Concrete Waterproof Companies of countries that include, the United States, Canada, Germany, France, Italy, Australia, Switzerland, and Singapore, worked together to establish the Chinese National Standard **GB18445—2001: Cementitious Capillary Crystalline Waterproofing Material**, which, to some extent, is now an International Standard.

Furthermore on August 28, 2006, the Beijing Municipal Construction Committee and Beijing Bureau of Quality and Technical Supervision released the Bridge Deck Waterproofing Project Technical Regulation (**BD11/T380-2006**), which officially came into force on November 1 2006.

In this standard the Cementitious Capillary Crystalline Waterproofing Material has been listed. This also shows that **CN2000®B (CCCW)** is confirmed as a having superior waterproofing, anticorrosion and freeze-thaw resistant performance.

Summary of the Different Characteristics of the CN2000® Waterproof Materials and Penetrating Sealers

Sealers and **CN2000®** waterproof materials are distinctively different materials from each other. There are vast differences between them in their compositions and various physical properties. The differences are summarized below.

Sealers are generally organic materials. **CN2000®B** is an inorganic material, which includes formulations consisting of cement, fine quartz and multiple activating chemicals that provide an effective, permanent concrete waterproofing system.

Sealers, especially adhesive sealers are toxic and damaging to the environment. **CN2000®** products are non-toxic and **Environmentally Friendly**.

Sealers do not have crystalline waterproofing performance. **CN2000®B** is a cementitious capillary crystalline waterproofing (**CCCW**) product. The activating chemicals catalyze hydration to produce insoluble crystalline hydrate, which can block the capillaries and holes in the substrate concrete and yet still allows it to breathe.

The sweep electron microscope scans of **CN2000®B**, conducted by the independent testing unit of the Zhongnan University (China), approved and verified the crystalline performance.

Sealers do not have self-healing ability once they have been penetrated and begin to leak.

After leaking under invading pressure higher than the first impervious pressure, then through 28-day curing, **CN2000®B** is able to set up a second impervious pressure, which is as high as .9MPa.

When exposed to ultraviolet radiation, the organic materials in sealers begin to lose adhesion of their molecular chains. **CN2000®B** is stable when exposed to ultraviolet radiation.

The impervious pressure of sealers is generally less than an order of magnitude of 0.1MPa (for example, polyurethane flexible sealant). The impervious pressure of **CN2000®** can reach and exceed 1.2MPa.

The banding strength of sealers are less for silicon construction sealants, the maximum tensile adhesion strength is 0.45 MPa, while for polyurethane construction sealants, it is less than 0.2MPa, and for polyvinyl chloride, it is only 0.02 - 0.15 MPa. **CN2000®** is a cementitious material, and it bonds with concrete with adhesion strength that is greater than 2.34 MPa.

Projects Using CN2000® Waterproof Materials

The Cementitious Capillary Crystalline Waterproofing material has achieved a special status in Concrete Waterproofing, and is recognized and utilized by many countries worldwide as an advanced high efficient waterproofing and anticorrosion coating material.

CN2000® waterproof materials have been used broadly in many projects from Hydro Electric, Bridges, Vehicle Overpasses and Tunnels, Potable Water Treatment and Sewage Facilities, Military uses and in Industrial and Civic construction.

Among them is the world famous "Water Cube" (the Beijing National Aquatics Swimming Center for the 2008 Olympic Games). This project was selected last year as one of the ten most ambitious constructions in the world.

As a matter of fact, 26 various types of waterproofing products were tested for this project.

Once the final test results were reviewed, the **CN2000®** line of waterproof materials was selected as the superior waterproofing/ anti-corrosion product for this amazing international project.

The No.3 Air Harbor Command Center of the Capital Airport, Three Gorges Dam and other important national projects have also been protected with **CN2000®B**. We have also applied **CN2000®B** on many bridge decks such as the Beijing SANHUAN road, SHIHUAN road, WUHUAN road and LIUHUAN road.

While the listing below is not all-inclusive, it does identify some bridge deck projects that have utilized **CN2000®C** and **CN2000®D** waterproof products:

Project: The waterproof project on the body of the Cuiwei Bridge on Sihuan Road, Beijing
Product used: **CN2000®C, CN2000®D**

Project: The waterproof project on the body The Shinan cable stayed bridge on Wuhuan Road, Beijing.
Product used: **CN2000®C, CN2000®D**

Project: The waterproof project of the spanning bridge on the Yongding River, of the beltway of main line of the national road in Beijing
Product used: **CN2000®C, CN2000®D**

Project: The waterproof project of the bridge body of the West Heping bridge of Sanhuang Road, Beijing
Product used: **CN2000®C, CN2000®D**

Project: The waterproof project of the bridge surface of No.12 bridge of South Liuhuan Road, Beijing

Product used: **CN2000®C, CN2000®D**

Project: The waterproof project of the bridge surfaces of No.3 and No.4 bridge of Lianhuachi West Road, Beijing

Product used: **CN2000®C, CN2000®D**

Project: The waterproof project of the Shibali Bridge, Beijing

Product used: **CN2000®C, CN2000®D**

CN2000® a Revolutionary Concrete Solution