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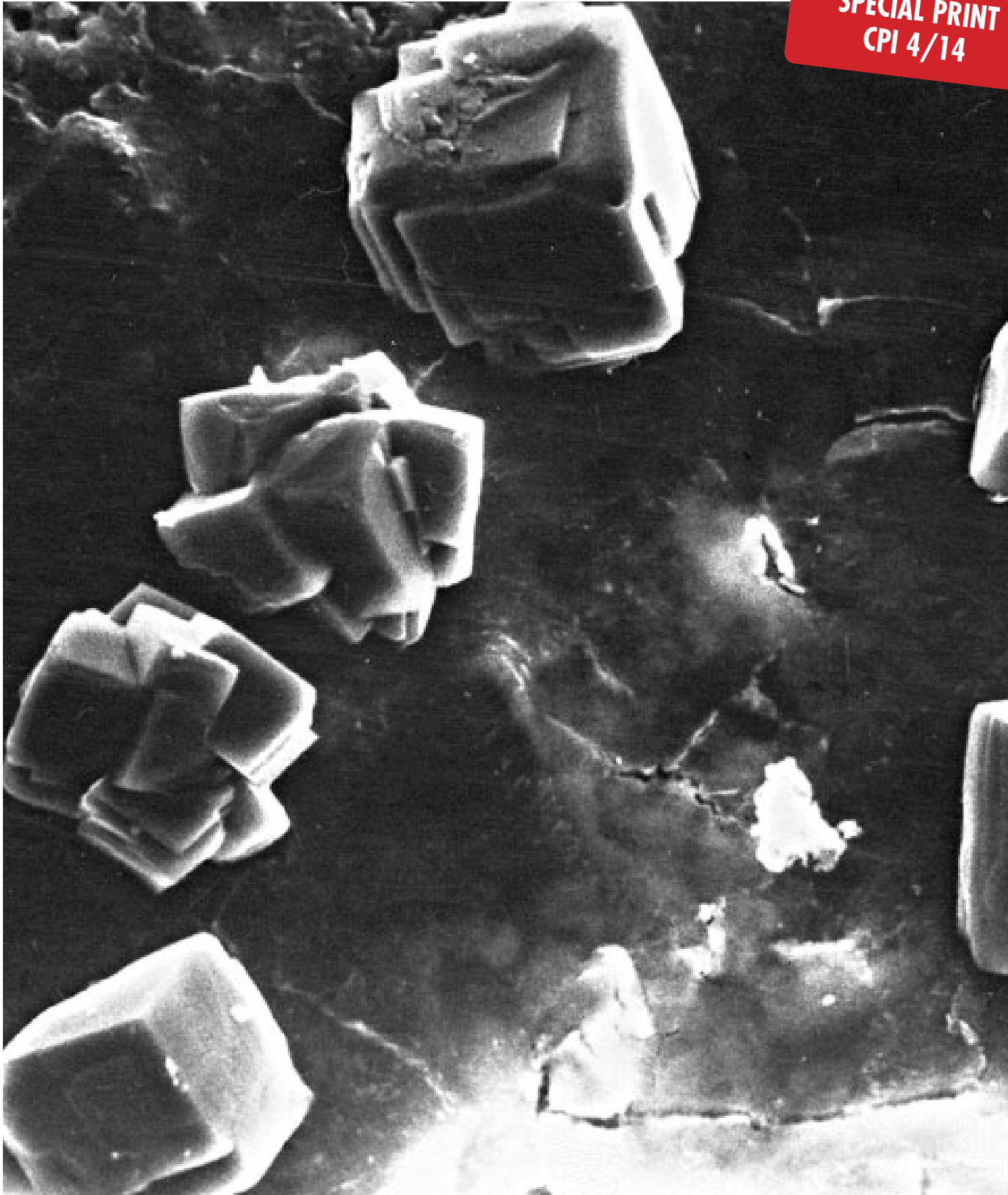
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SPECIAL PRINT | CONCRETE TECHNOLOGY

Crystalline Technology for Enhancing the Performance
of Precast Concrete in Marine and Sewer Structures



**SPECIAL PRINT
CPI 4/14**

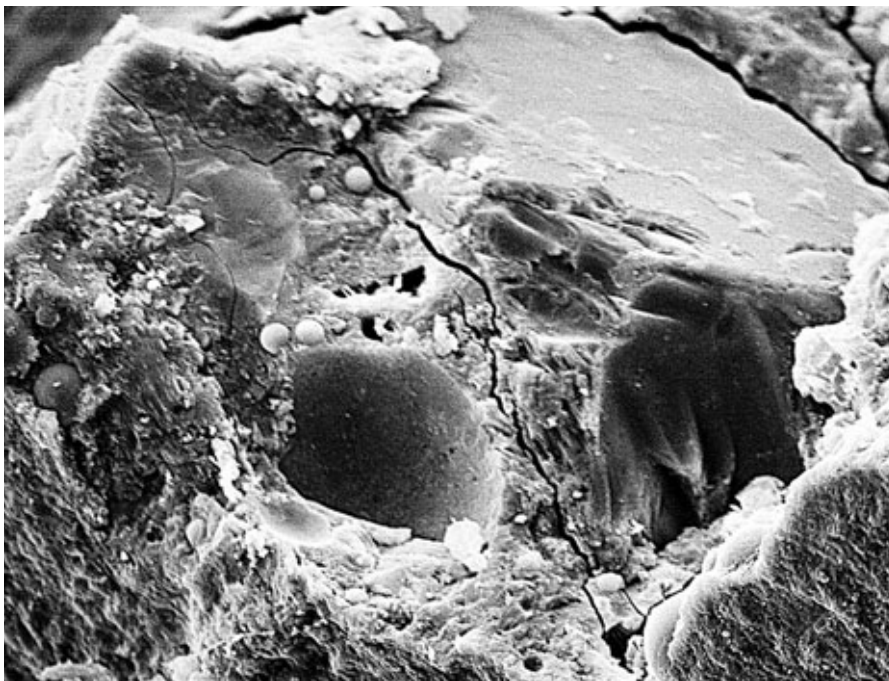


-  Abcic
-  ABTC
-  aci
American Concrete Institute
-  American Concrete Pipe Association
-  bibm
-  BRITISH PRECAST
-  CPMA
-  ICPI
-  OPMA
-  CPI
-  NATIONAL PRECAST
-  NPCA
-  NZCS
-  PCI
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Xypex Chemical Corporation, Richmond BC, Canada

Crystalline Technology for Enhancing the Performance of Precast Concrete in Marine and Sewer Structures

Concrete, the most widely used material in modern building construction, is by its very nature and structure susceptible to damage from water penetration and water-borne chemicals such as chlorides and sulfates. Whether used to construct water and wastewater treatment plants and tunnels or manholes and pipes all of these concrete structures are subject to deterioration caused by the penetration of water and exposure to aggressive environments. Even with water reducing and super-plasticizing additives to reduce the amount of water in the concrete mix, concrete will still have pores, voids, and capillary paths that can carry water and the aggressive chemicals that will corrode steel reinforcement and deteriorate the concrete thus jeopardizing the structure's integrity.

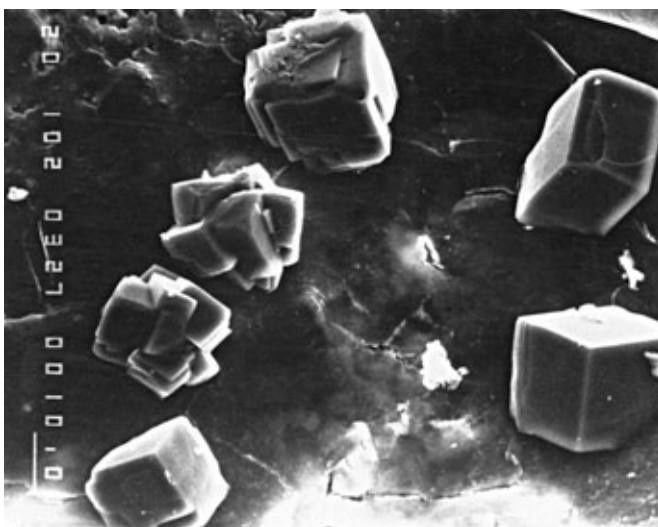


Magnified view of micro-crack

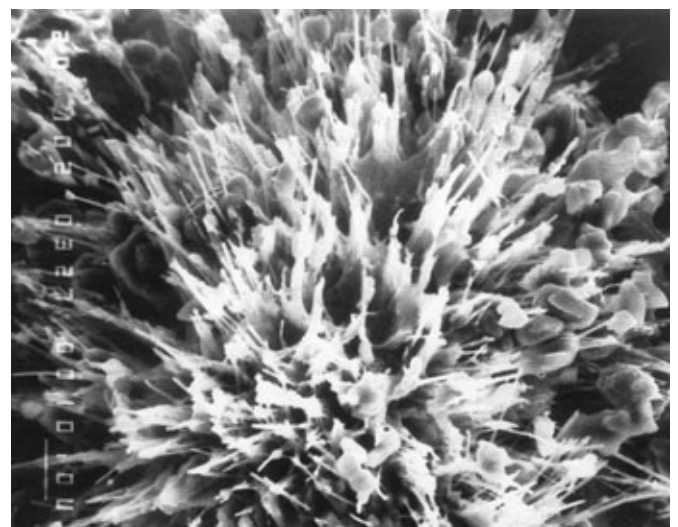
Conventional waterproofing solutions such as membranes and coatings may still leave concrete susceptible to water and chemical damage. Only with the addition of crystalline technology can the pores and micro-cracks which normally result from the process of setting and curing concrete be sealed. Dave Ross, Technical Services Director of Xypex Chemical Corporation has called crystalline technology "a cure for the inherent deficiencies inherent in concrete".

How Crystalline Waterproofing Technology Works

Crystalline waterproofing reacts with the calcium hydroxide and other by-products of cement hydration to produce a non-soluble water and chemical resistant crystalline formation that fills and plugs pores, capillaries and micro-cracks in the concrete. The process is based on two simple properties, one chemical and one physical. Let's start with the fact that concrete is chemical in



Scanning electron microscope (SEM) view of a concrete pore



Scanning electron microscope (SEM) image of a concrete pore filled with crystalline formation

INTEGRAL

Concrete Waterproofing by Crystallization™

Xypex Admix is blended into the concrete at the time of batching to produce a non-soluble crystalline structure that blocks pores and seals micro-cracks throughout the entire concrete matrix. The result? Your precast pipes, manholes, vaults, foundations, slabs, and more will be waterproof from the moment they're poured. Xypex also resists chemical and sulfate attack.

nature. The hydration of cement particles allows the cement to form a hard, solid mass. However, the reaction also produces chemical by-products that lie dormant in the concrete. Crystalline waterproofing introduces a second set of chemicals. When these two groups are brought together (i.e. the by products of cement hydration and the crystalline chemicals) in the presence of moisture, a chemical reaction takes place that results in the formation of a non soluble crystalline formation that plugs the pores, capillary tracts and shrinkage cracks in concrete. Wherever water can penetrate the concrete, the crystalline formation will block its path.

Because the crystalline formation occurs within the concrete, it cannot be punctured or otherwise damaged like membranes or surface coatings. Crystalline technology also improves the durability of concrete structures, lowering maintenance costs and extending their life-span by protecting them against aggressive environments.

Crystalline waterproofing offers protection against the aggressive environments encountered in sewer infrastructure and marine construction. It is highly resistant to chemicals where the pH range is between 3 and 11 under constant contact and 2 to 12 under periodic contact as well as tolerating temperatures as high as 265°F (+130°C) in a constant state.

Crystalline technology products are manufactured in the form of a dry powder, which can be mixed with water and applied to concrete as a coating or, as is more common in precast applications, introduced as a dry powder into the concrete as an integral waterproofing and protective admixture.

Use of Crystalline Waterproofing as an Admixture for Concrete

Crystalline waterproofing admixture is added to the concrete at the time of batching. The sequence of procedures for the addition of crystalline waterproofing will vary according to the type of batch plant operation and equipment. For most mixtures, the dosage rate is 2% - 3% based on the Portland cement content.

When used as an admixture the cost to waterproof and chemically protect concrete is significantly reduced because the process eliminates the labor associated with the application of commonly used surface coatings such as epoxies, polyureas and similar technologies. Adding the integral admixture to the concrete mix at the batch plant ensures that the crystalline formation will develop uniformly throughout the structure optimizing waterproofing and chemical protection. The uniform development ensures that harmful chemicals such as chlorides and sulfates are not able to penetrate the concrete where they would initiate destructive reactions.

A common application for crystalline technology is for sewer infrastructure such as precast manholes, pipes and lift stations. The admixture is used to provide protection from water ingress, egress and enhanced resistance to destructive sulfate attack and MIC. A specialized product containing a red oxide pigment helps the precast producer identify those products that contain the crystalline technology enhancement.

A good example of crystalline technology's effectiveness at protecting precast structures in a marine environment is the Cronulla floating marine dock in Australia. The dock has been subjected to 19 years of salt exposure and was recently tested for chloride ion penetration. The results indicated that the initiation to time-of-corrosion of the steel would be 129 years.

Conclusion

Although concrete may appear to be a simple product to put together, it in fact requires a highly engineered approach. In today's design and construction environment – where more stringent requirements such as longer life cycles, more durable concrete and value engineering



READYMIX PRECAST SHOTCRETE

For more information: xypex.com



Manhole sections protected with Crystalline Technology



Cronulla Floating Dock

concepts are expected – careful consideration must be paid to not only the basic requirements such as the water cement ratio and cementing materials, but also to more sophisticated chemical admixtures.

With its ability to reduce the porosity and permeability of conventional concrete, crystalline waterproofing technology is a valuable addition to our armament of protection and enhancement for the industry's most fundamental and basic building material – concrete.

Pull Quotes

- Concrete, is by its very nature, susceptible to damage from water penetration.
- is both porous and permeable.
- Crystalline technology is a cure for the natural deficiencies of concrete.
- Crystalline technology fills voids with a non-soluble, highly resistant crystalline formation.
- Concrete shares the characteristics of both a kitchen based broth and a highly engineered product. ■

FURTHER INFORMATION



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