



Technical Bulletin

MasterLife[®] 300 Series Crystalline Capillary Waterproofing Admixtures: Sealing Hairline Cracks in Concrete

Overview

MasterLife 300 Series are integral crystalline capillary waterproofing admixtures for concrete. They are designed for use in above and below-grade applications, as part of a system where necessary, to inhibit the penetration of water and other liquids. It functions by reducing concrete permeability and helping to seal hairline cracks, should they occur.

Watertight Concrete

The American Concrete Institute (ACI) defines watertight as “impermeable to water except when under hydrostatic pressure sufficient to produce structural discontinuity by rupture.” In practice, dense, watertight concrete starts with good mixture proportions. Good mixture proportions incorporate strategies and the use of materials that are proportioned and optimized to achieve low permeability. Very little water will pass through a low permeability concrete. Steps to achieve low permeability concrete can include the use of:

MasterGlenium[®] high-range water-reducing admixture

- Reduces the water-cementitious materials ratio (w/cm) → reduces permeability

Supplementary cementitious materials (SCMs such as fly ash, slag cement metakaolin or silica fume)

- Produce more C-S-H gel → densify the microstructure and consequently reduce permeability

MasterLife 300 Series crystalline capillary waterproofing admixtures

- Produces additional C-S-H gel and crystalline precipitates → Fill pores and capillaries → reduced permeability
- Seals hairline cracks

Concrete produced with low permeability provides a good baseline level of performance for resisting water or other fluid penetration.

Concrete Cracking

Even well-proportioned, low permeability concrete can crack. Cracks can be small hairline cracks or larger cracks. Hairline cracks are very thin cracks and do not generally affect the structural integrity of concrete. Hairline cracks may, over time, develop into larger cracks. While there is no specific information available on the width that defines hairline cracks, the industry consensus is that cracks with widths less than approximately 1/64 in. (0.016 in. [0.40 mm]) are typically considered hairline cracks.

CT-18: ACI Concrete Terminology defines hairline crack as “a concrete surface crack with a width so small as to be barely perceptible”

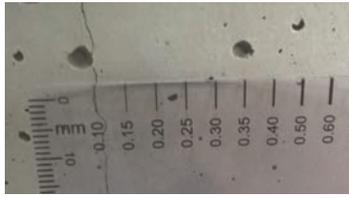
If concrete cracks, water or other liquids may eventually penetrate the structure as shown in the photo on the right. Water penetration and leakage can lead to durability problems, an undesirable damp/humid atmosphere, mold growth, and premature deterioration.

It is recognized that the presence of cracks will increase the rate of ingress of fluids and ions - ACI 201.2R



Sealing Hairline Cracks

MasterLife 300 Series admixtures are added during concrete batching to become part of the hardened microstructure and, ultimately, help reduce concrete permeability. If hairline cracks (as shown in the photo on the right) occur in the hardened concrete, MasterLife 300 Series admixtures will help initiate and facilitate insoluble crystal growth in the cracks in the presence of moisture, resulting in the sealing of the cracks.



The process is illustrated below using magnified pictures taken with a digital microscope.

Enlarged view:



Magnified hairline crack in concrete



- Concrete is exposed to moisture
- MasterLife 300 Series of admixtures are activated
- Insoluble crystals start to form



- Continued exposure to moisture
- Crystals begin to bridge the crack



- Hairline crack begins to seal



- Sealed hairline crack
- Inhibits fluid penetration

Time to Sealing:

The hairline crack-sealing phenomenon is not immediate and not necessarily complete at a defined time. The time to crack-sealing varies due to several factors such as mixture proportions, crack width and morphology of the crack, temperature, time of exposure to moisture, and any structural movement. Time to sealing can range from several days to weeks, depending on the severity of these conditions.

When MasterLife 300 Series admixtures are used at their recommended dosage, crack widths of approximately 1/64 in. (0.016 in. [0.40 mm]) are generally considered to be the maximum width that can be sealed by the admixture.

Cracks larger than hairline may require the use of a membrane, urethane caulk, epoxy injection or other method(s) to minimize/eliminate water penetration. Master Builders Solutions offers these technologies as crack-treatment solutions as part of a comprehensive portfolio of waterproofing and repair products to help keep concrete structures watertight. More information on these technologies can be found at the following link:

<https://www.master-builders-solutions.com/en-us>

References

- ACI 201.2R-16 Guide to Durable Concrete
- ACI 212.3R-16 Report on Chemical Admixtures for Concrete
- ACI CT-18: ACI Concrete Terminology

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