MASTER® BUILDERS SOLUTIONS

Technical Note

Qualifying Permeability-Reducing Admixtures for an Intended Application

Overview

Chapter 15, "Permeability-Reducing Admixtures" in ACI 212.3R-16, "Report on Chemical Admixtures for Concrete" (Ref. 1) categorizes permeability-reducing admixtures (PRAs) based on whether the concrete will be exposed to nonhydrostatic or hydrostatic conditions. PRAs formulated for use in concrete exposed to nonhydrostatic conditions are termed PRANs and those for use in concrete exposed to hydrostatic conditions are referred to as PRAHs. It is, therefore, imperative that the intended application of a PRA is considered in the choice of test method that is used to evaluate its effectiveness. This technical note discusses the test methods used to evaluate PRAs and the relevance of these tests with respect to concrete exposed to either nonhydrostatic or hydrostatic conditions.

Test Methods to Evaluate PRAs

The following excerpts from Section 15.3 of ACI 212.3R-16 describe some of the test methods that are used to evaluate the effectiveness of PRAs.

"15.3 – Selection and evaluation:

The selection of a permeability-reducing admixture (PRA) depends largely on the service conditions. Nonhydrostatic service conditions can be defined as those exposed to little or no water under hydrostatic head pressure, primarily when the main mechanism of water movement is capillary absorption. In these situations, PRAs for concrete exposed to nonhydrostatic conditions (PRANs) are often sufficient.

On the contrary, under hydrostatic conditions, moisture is transported into concrete under pressure. Whereas PRANs are unable to effectively block the movement of water under hydrostatic head pressure (Ramachandran 1995) experienced in below-grade structures and water-retaining structures, PRAs for concrete exposed to hydrostatic conditions (PRAHs) are well suited to these applications. PRAHs are also suited to withstand ponded water (Palmer 2004).

When evaluating a PRA for use against direct water pressure (PRAH), a direct measurement using hydrostatic pressure should be used, as this most closely simulates the service conditions found in water tanks, basements, and similar applications. The U.S. Army Corps of Engineers (1992) test method is a direct measurement of concrete permeability resistance during exposure to water under 200 psi (1.28 MPa) of hydrostatic pressure.

European tests, such as DIN 1048-5 and BS EN 12390-8, measure the penetration of water under hydrostatic pressure into a concrete specimen.

Various absorption methods are used to evaluate PRAs as well, including ASTM C1585 and BS 1881-122. Absorption or sorptivity tests generally report the mass of water uptake after a certain time interval, or rate of water uptake over a given time period to determine the rate of water penetration. Absorption tests do not apply hydrostatic pressure and are, therefore, most suitable for testing PRANs. The length of testing should be considered. Longer-term adsorption tests, such as ASTM C642, indicate total porosity but not the rate of penetration. Some results may only report absorption for a short time periods (for example, up to 60 minutes), which would make such results most applicable to applications with intermittent and short-term water exposure. Absorption tests alone are not recommended for evaluating admixtures for PRAH applications because of the lack of hydrostatic water pressure."

The MasterLife® 300 Series of Admixtures

Master Builders Solutions markets crystalline capillary waterproofing admixtures under the brand "MasterLife 300 Series." The admixtures under this series include, MasterLife 300D crystalline capillary waterproofing admixture (both regular and red-pigmented versions), MasterLife 300C, a concentrated version of MasterLife 300D admixture that is used at a lower dosage to provide the same degree of performance and MasterLife 300L admixture, a liquid version of MasterLife 300D admixture.

The MasterLife 300 series of capillary waterproofing admixtures are portland cement-based crystalline cementitious materials that react in concrete to form non-soluble crystalline hydration products in the capillary pores of the concrete. These crystalline hydration products effectively reduce the permeability of concrete thus reducing capillary absorption and the penetration of water and other liquids.

Test Methods used to Evaluate the MasterLife 300 Series of Admixtures

The permeability-reducing performance of the MasterLife 300 series of admixtures has been evaluated using CRD-C 48 (Ref. 2) and DIN 1048 (Ref. 3) test methods. These test methods measure the penetration of water into the concrete samples under hydrostatic pressure. As detailed in ACI 212.3R-16, these are the test methods that are recommended to evaluate a permeability-reducing admixture used in concrete that is subject to hydrostatic pressure. Based on the evaluations, it is proven that the MasterLife 300 series of admixtures are PRAH and are ideally suited for concrete exposed to hydrostatic conditions, such as that in water/wastewater structures.

References

1. ACI 212.3R-16 Report on Chemical Admixtures for Concrete, American Concrete Institute, Farmington Hills, MI, 76 pp.
2. CRD-C 48-92 Standard Test Method for Water Permeability of Concrete, U.S. Army Corps of Engineers, 4 pp.
3. DIN 1048 Part 5 Testing Concrete – Testing of hardened concrete (specimens prepared in mould), DIN (Deutsches Institut Fur Normung, Germany), 7 pp.

Italicization is done for emphasis only.

Master Builders Solutions Admixtures US, LLC
23700 Chagrin Boulevard
Beachwood, OH 44122 USA
(800) 628-9990

Master Builders Solutions Canada, Inc
1800 Clark Boulevard
Brampton, Ontario L6T 4M7 CANADA
(289) 360-1300

master-builders-solutions.com/en-us
admixtures@masterbuilders.com