Hydrophobic concrete sheds waterproofing membrane

Information provided by Hycrete Technologies' John de Mars

The hydrophilic property of conventional concrete has generated an array of waterproofing techniques. Exterior wraps, coatings, and membrane systems forming an impenetrable barrier under, around and above concrete slab, wall and deck placements have been used to counteract the capillary action by which water is sucked through the micro-crack network within concrete's hardened matrix to create a continuous "source to sink" cycle. Cracks, joints and penetrations also facilitate ingress of water, which is actively transported from areas of high concentration to those of low concentration within a structure's interior space.

Preventing contact between water and hydrophilic concrete by means of conventional membrane systems typically incurs a cost of $3 to $7 per square foot, though green-roof applications can exceed $12 per square foot. Yet, expense may be only one of several drawbacks in the use of membrane systems: installation is time intensive and weather sensitive, so delays are common; leaks are difficult to locate; and, repairs are problematic if access to the leak is restricted.

By contrast, an innovative waterproofing solution lies in the alteration of concrete's performance properties, transforming it from a hydrophilic sponge into a hydrophobic, waterproof, construction material. Hydrophobic concrete is produced by introducing admixtures that shut down the active capillary transport mechanism and reduce absorption levels to less than 1 percent, as tested under the BSI 1881-122 procedure. The test involves drying and weighing a concrete sample, immersing it in water, and reweighing it to determine the quantity of water drawn into the specimen through the capillary network. This quantity is expressed as a percentage of the original sample weight. While ordinary low water/cement ratio concrete absorbs 3–5 percent, hydrophobic concrete absorbs less than 1 percent.

Providing the cornerstone of a waterproof system, hydrophobic concrete is first cast in the slab, walls and decks that require water protection. Joints and penetrations are then treated with waterstop, and any cracks in the concrete are sealed. As joints, penetrations and cracks are permanently waterproofed, the need for external water protection is eliminated. The result is waterproofing that is both integral and permanent. Consequent design simplification leads to savings in materials, time and labor, plus schedule acceleration and risk reduction. If a leak occurs in waterproof concrete, furthermore, it is readily accessible for repair.

Millions of cubic yards in service over 45 years constitute hydrophobic concrete's successful track record in Australia, Asia and Europe. In the U.S., since production began in 1999, effective use of hydrophobic concrete on hundreds of waterproof structures has contributed to its growing acceptance. Primary applications include subgrade walls and slabs, elevated decks for parking structures, plazas and green-roof systems, tunnels, transportation infrastructure, and marine facilities.

Newark, N.J.-based Hycrete Technologies, LLC manufactures Hycrete Admixture, a hydrophobic concrete admixture developed in response to industry demand for a low-concentration, environmentally friendly additive. The admixture blocks penetration of water by forming a nonsoluble precipitate that fills concrete pores and attaches itself to polar particles, thus sealing internal voids. Further, the molecule has a long hydrocarbon chain that repels water.

Hycrete Admixture has achieved the highest level of "cradle-to-cradle" environmental certification—the first among construction materials. According to William McDonough, founding partner of McDonough & Partners and a leader in the sustainable development and green office movements, "The need for external membrane and coating systems is eliminated [with Hycrete]. Any time a process in construction can be avoided, more is accomplished with less, and savings through time and material are realized."

Hycrete Admixture was specified for the foundation walls of the 10,000 sq. ft. educational building at the Living Future project in northern Vermont.

Crews from concrete contractor S.D. Ireland observed good workability and placement characteristics of the Hycrete Admixture-dosed mixes.

The Living Future project in Huntington, Vt., offers a vivid demonstration of the use and benefits of Hycrete waterproof concrete. Hydrophobic concrete provides the primary waterproofing system for foundation walls within the 10,000-sq.-ft. educational building. As designers for the project sought to reduce the use of hydrocarbon-based products throughout the construction process, waterproof concrete was employed to eliminate the entire external membrane system.

Owner Melissa Hoffman affirms, "Living Future is committed to sustainable construction from the ground-up. Besides allowing us to reduce the hydrocarbon content for the project, Hycrete is certified as a 'cradle-to-cradle' construction material, confirming its status as a sustainable technology, which we believe will assist in the LEED point process."

Using hydrophobic concrete on the project also proved advantageous for the construction team as it limited the impact of rain, snow and freezing temperatures during northern Vermont's winter construction season. Elimination of the entire membrane-application step allowed the team to move forward despite weeks of rain and snow encountered during the foundation build-out.

Favorable feedback was forthcoming as well from S.D. Ireland, the supplier of concrete and forming/placement services for the job. Notes Project Manager Mike Sienkiewicz, "Waterproof concrete is new for us—this is the first placement in Vermont. That there were no surprises was important. The workability, set and strength properties were all there, and the mix pumped well."

In addition to waterproofing concrete, Hycrete Admixture protects steel reinforcement from corrosion. The combination of waterproofing and corrosion control offers significant benefits, especially to the infrastructure and DOT construction community. Hycrete Admixture also has been shown to decrease shrinkage cracking, the manufacturer asserts.

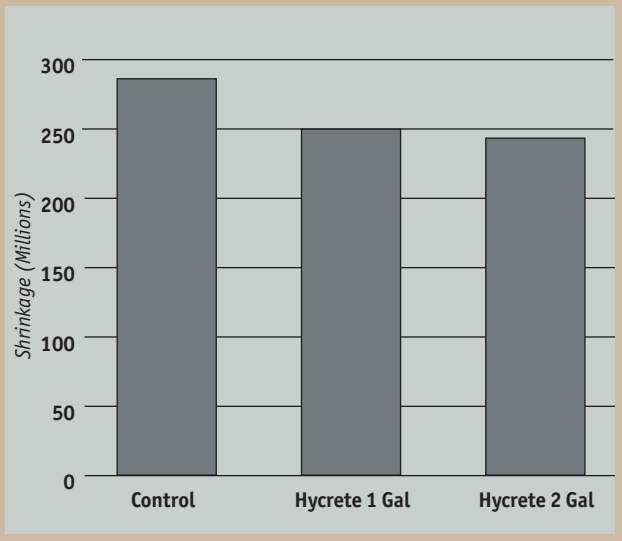
"Providing the lowest life-cycle cost protection to concrete exposed to aggressive environments is important," observes Paul Tourney, a corrosion specialist and vice president of Materials Service Life. "In choosing among protection systems—implemented at the concrete surface, at the reinforcing level, integral to the concrete, or in combination—owners and designers should objectively weigh various options on the basis of performance, apply some form of redundancy, and allow innovation to blossom."

CONCRETE PERFORMANCE

TEST MIX CHARACTERISTICS

Hycrete Admixture dosage	1 gallon/yd.
W/C ratio	0.43
Slump	7-inches
Set time	4–6 hours
Compressive strength	4,500 psi
Absorption	< 1 percent

DRYING SHRINKAGE ASTM C157



Nelson Testing Labs, Chicago
Results—Excellent: shrinkage reduction versus control of 10–15 percent (Cement + Fly ash, 0.40 w/c)

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