Protective Treatments for Decorative Concrete Investments

All photos courtesy The Euclid Chemical Co.

by Jennifer Crisman

Offering both an aesthetic finish and structural capabilities, decorative concrete has become a popular material for the interiors and exteriors of not only residential projects, but also commercial structures. Designers specify decorative concrete flooring for a variety of reasons. The versatility, beauty, and sustainability of concrete mean it is often chosen for projects pursuing green goals, while owners appreciate its durability and ability to provide a healthy indoor environment. (Concrete does not support the growth of mold and bacteria, so it can be a 'cleaner' alternative to other flooring finishes.)

Since the installation of decorative concrete requires more complicated and specialized methods than traditional flooring materials, it is often more expensive. Planning for the long-term protection and maintenance of decorative concrete floors should be a critical part of the project design and specification process.

Visible wear patterns from foot and tire traffic is expected (and even tolerated) on conventional concrete pavement and floors, but are unacceptable on a decorative surface. A sealer or coating can be applied to architectural concrete to act as a sacrificial layer to withstand daily abuse while protecting the concrete below. These coating or sealing products are also often used to enhance the appearance of decorative concrete, highlighting colors and textures with finishes ranging from matte to high gloss. Since there are as many sealer and coating options as there are decorative concrete techniques, it can be difficult to specify the best product for a particular project.

Despite its inherent strength and durability, concrete is a porous material with an absorptive surface. This means it can be susceptible to the intrusion of water, chlorides, oils, and other liquids that cause damage ranging from surface stains and spalling to the internal corrosion of reinforcing steel. By treating decorative concrete with a sealer or coating, the penetration of these fluids can be inhibited, and the final appearance of the architectural finish enhanced.

Categories of concrete sealers

Generally, there are two broad categories of concrete sealers. Film-forming sealers block penetration of water and

contaminants by forming a barrier on the concrete; many also impart varying levels of gloss. Penetrating sealers, on the other hand, soak into the surface to a depth of 3 mm (0.125 in.) to increase water repellency and stain resistance on absorbent concrete. These products provide protection without changing the surface appearance.

Film-forming products

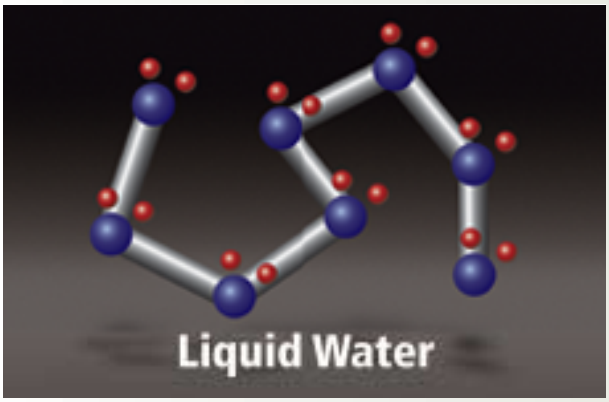
Concrete curing and sealing compounds (*i.e.* cure-and-seals) are a type of film-forming product often used to protect decorative concrete surfaces. Usually the most inexpensive option, cure-and-seals are generally formulated with a blend of styrene and acrylic polymers and can be either water- or solvent-based. They are applied on fresh concrete (as soon as the bleed water has disappeared) to form a membrane on the surface that prevents rapid evaporation of the water in the concrete. This ensures not only proper hydration, but also that the designed strength and durability are achieved.

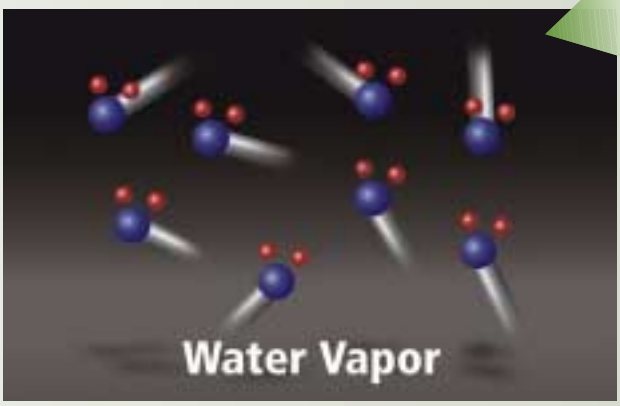
Additionally, a cure-and-seal gives moderate protection to the concrete surface from the damaging effects of weather, traffic, spills, and stains. Since they are applied in very thin films—usually just 0.05 to 0.08 mm (2 to 3 mils) thick—its protection lasts a maximum of two years in normal use conditions before wearing to the point where reapplication is necessary.

The use of a cure-and-seal to protect decorative concrete that has already cured can pose some performance issues, especially in wet conditions or on concrete slabs where a below-grade vapor retarder is not installed. To explain why, it is necessary to describe the basic styrene-acrylic co-polymer commonly found in these products, and examine how it works to retain moisture in fresh concrete.

The styrene resin in the co-polymer is employed because of its hydrophobic ('water-hating') nature; it performs as the moisture retention agent in a cure-and-seal. The acrylic resin provides gloss, weathering, and light stability. When a styrene-acrylic-formulated cure-and-seal is used on concrete that has already hydrated and hardened, the curing function is no longer needed. In this case, the retention of moisture in the concrete can be a disadvantage. When the moisture level in hardened concrete is high, or if a slab on grade is poured without a vapor retarder, there is likely to be a strong, driving force for internal moisture to move through the slab and evaporate out through its surface.

Does Sealer Breathability Go Both Ways?





Decorative concrete exposed to moisture is best protected by a sealer that is breathable—it should be able to allow water in the concrete to evaporate through the surface as much as possible. However, some may be concerned a breathable sealer is so porous it also allows liquids to soak into the surface. Examining the molecular structure of water's vapor and liquid phases can clear up some of the confusion.

Water vapor molecules are fast-moving singular particles in constant motion. Unless compressed under pressure, water vapor molecules exist relatively far apart from one another. Molecules of liquid water, on the other hand, are attached to one another and form structures much larger than water vapor molecules. Due to this difference in size and structure, water vapor is able to easily move through tiny pores in a breathable sealer film, unlike the liquid water. As a result, a breathable sealer protects concrete from the outside, while allowing the inside vapor to escape.

The presence of a cure-and-seal prevents this evaporation, leading to a 'battle' between the force of moisture evaporation and the membrane's retention function. Under this evaporative pressure, the cure-and-seal's adhesion to the concrete surface fails, causing a range of problems from sealer whitening (often called 'blushing') to membrane flaking/peeling. On decorative concrete, these appearance issues are intolerable.

This is not to say concrete cure-and-seal products should be forbidden from sealing previously cured and hardened concrete. Interior concrete where the moisture level of the floor is normally low and consistent, and slabs-on-grade where the moisture vapor transmission (MVT) rate is low, are often protected by these products with excellent results. However, either when testing shows a high MVT rate or exterior concrete is in damp conditions, a 'pure' acrylic sealer is a better choice.

Without styrene, an acrylic sealer has reduced moisture retention ability. This means it is not a good curing membrane, but still performs quite well as a breathable sealer for decorative concrete. (For more on sealer permeance, see "Does Breathability Go Both Ways?") As with cure-and-seals, acrylic sealers are relatively thin membranes and last about two years in normal use conditions before requiring reapplication.

To prolong the useful life of a cure-and-seal or acrylic sealer, many decorative concrete installers apply a floor polish or wax over the membrane after it has fully dried. This creates another sacrificial layer that protects the sealer. When scratches or wear patterns appear, the wax or polish can be easily reapplied to refresh the look—this is easier and less expensive than using new coats of the sealer. Most waxes and polishes are available in non-slip formulations and various gloss finishes.

Penetrating sealers

During application, penetrating sealers enter the voids and capillary pores at the surface of concrete. These sealers are usually formulated with silane or siloxane polymers that react with alkaline materials in concrete to form dense and hydrophobic compounds within the surface pore structure. The products' primary function is to repel water, salts, and chlorides, while remaining breathable so water vapor within the slab can evaporate.

Since penetrating sealers soak in and do not leave a membrane on the surface, they do not provide any appearance benefits (*i.e.* no color highlights or gloss) and are not as effective as film-forming products in preventing chemical attack or staining. However, the absence of surface film means better durability—a penetrating sealer can last

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10 years before requiring re-application. Penetrating sealers are a good choice when no change in appearance is desired, or when the concrete will be frequently exposed to water or deicing salts. Concrete countertops are protected especially well by penetrating sealers, since these products can withstand higher temperatures and tougher impacts than film-forming sealers or cure-and-seal products.

With decorative concrete, stunning visual effects can be created as exemplified by the striking palette of color produced in this highly trafficked community quad area on the campus of a major Ohio university.

Epoxy and urethane coatings

Epoxy and urethane coatings are used to protect decorative concrete projects that need exceptional abrasion and chemical resistance. Simply stated, a coating differs from a sealer primarily in the application thickness; coatings are often applied at 0.76 mm (30 mils) thick or more. As previously explained, sealers are much thinner—a typical sealer membrane is only as thick as a page in this magazine.

Since epoxy and urethane coatings are essentially impermeable to water vapor, new concrete should be at least one month old and have a low MVT rate before application. Otherwise, moisture in the concrete causes blistering and bond failure of the coating due to evaporative pressure. One should check with the manufacturer for its maximum MVT recommendation—the common flooring industry standard is a maximum of 1.4 kg/90 m^2 (3 lb/1000 sf) over 24 hours.

Epoxy and urethane coatings are arguably the most durable options for protecting decorative concrete. The useful life of a coating can be many years, depending on in-use conditions. However, its specification should take into account:

- high material costs;
- complexity of surface preparation requirements for the initial application and future recoating; and
- compatibility with the type of architectural concrete finish installed (*e.g.* most urethane coatings do not bond well to concrete and must be used in conjunction with an epoxy primer).

Additionally, some water-based epoxy and urethane formulations are incompatible with certain acid stain colors. It is good practice to always consult with both the decorative concrete material manufacturer and coating manufacturer to ensure the components of the specified system perform together. Further, because surface

preparation, application method, and coating coverage rate are critical when using epoxies and urethanes, the manufacturer's recommendations should be followed precisely for best results.

Sustainability and maintenance considerations

The importance of using environmentally responsible building materials, coupled with tightening volatile organic compound (VOC) regulations, has made water-based sealers and coatings an increasingly popular option for protecting decorative concrete. Nearly every type of sealer/coating is available in water-based formulations, but one must consider the application and performance issues that are associated with these products.

Unlike their solvent-based counterparts, water-based sealers and coatings are sensitive to the environment during application and while in service. At cool temperatures and/or high humidity conditions, water evaporates very slowly from a freshly applied water-based product, resulting in poor film formation. (This manifests in the form of a milky white appearance or a weakly bonded, powdery film.) Water-based products are also susceptible to performance problems in wet conditions; for this reason, some decorative concrete contractors do not use these products on outdoor projects.

Maintaining a sealed or coated decorative concrete floor is straightforward and normally does not require any special methods other than those normally used for conventional floors. Mild detergents are typically sufficient for regular cleaning, but removing scuffs and tire marks can often require a stronger product that could affect the final appearance of the sealer or coating. Eventual reapplication of these sealers and coatings should be expected—and planned for—as part of a routine maintenance program, since the products are constantly taking the abuse of traffic or weather.

Treating decorative concrete with a sealer or coating can inhibit the penetration of water, chlorides, oils, and most other liquids, while enhancing the finish.

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Until recently, decorative concrete was specified primarily on high-end projects, where a generous construction budget permitted the added expense. This has changed—despite the increased expense, decorative concrete specifications are now made on projects of all sizes and budgets. As this will inevitably increase, designers can truly optimize the return on the investment in decorative concrete by specifying an appropriate protective treatment.

Additional Information

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Abstract

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