A Discussion on Curing and Sealing
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There is much discussion in our industry about curing and sealing concrete placements. Unfortunately, it is common to hear curing and sealing described as being synonymous. Nothing can be further from the truth. Curing and sealing are two distinct processes. Curing is a temperature and moisture control process that ensures proper development of the engineering properties of a concrete placement. Sealing, on the other hand, is a process in which compounds are applied to the surface of hardened concrete to reduce the penetration of contaminants into the concrete placement.

Sealers are typically not applied until the concrete placement has had a chance to “cure out” for 28 days. At 28 days of age the concrete has reached its design strength and characteristically the relative humidity within the concrete matrix is less than 80%. This is important with respect to alkali silica reaction and sulfate attack, which generally require greater than 80% relative humidity in order to have enough moisture for the negative reactions to occur. Applied too soon, it is possible for a sealer to “lock in” enough moisture for these destructive reactions.

Why is Curing So Important?

The need for adequate curing cannot be overemphasized. Improper curing can easily cut the strength of even the best concrete by 50%. Curing simply means keeping the water in the concrete where it can do its job of chemically reacting with the cement to form the hydration products that will create strong, durable concrete. Good curing means keeping the concrete damp and above 50 degrees F until the concrete is strong enough to do its job. Recommended practice calls for a minimum of seven days curing or the time necessary to attain 70% of the specified compressive or flexural strength, whichever period is less. (Refer to ACI – 308, “Standard Practice for Curing Concrete”.)

All concrete must be cured to attain maximum strength. Correctly cured concrete is best from every standpoint: It shrinks less, cracks less, and dusts less. It is stronger, more durable, and is more wear resistant.
Freshly placed concrete normally contains more water than is necessary for the hydration of the cement particles; however, excessive loss of water by evaporation can prevent adequate hydration. If the water loss due to evaporation exceeds the amount of water available for hydration, the hydration process can actually stop. In such a case, the engineering properties of the concrete do not fully develop. The surface of a concrete placement is particularly susceptible to insufficient hydration because it dries first.

Loss of water will also cause the concrete to shrink, thus creating tensile stresses within the concrete matrix. If these stresses develop before the concrete has attained enough strength, surface cracking can result.

Start curing the concrete as soon as possible. Early drying – especially in hot, windy weather – must be prevented or the concrete will not attain its full potential quality. (Refer to ACI 305, “Hot Weather Concreting”.)

**Results of Proper Curing**

- **More Durable Concrete:**
  Good concrete, properly cured, has a more complete crystalline structure due to an efficient hydration reaction. This concrete will have fewer pores and crevices where water can enter, freeze, expand and crack the concrete. Air entrainment is necessary to make a more durable exterior concrete, but its use must also be accompanied by proper curing.

- **More Wear-Resistant Concrete:**
  Well-cured concrete (28 day curing period) will develop a surface twice as wear resistant as a surface that is cured for only three days. Proper curing prevents dusting and means less cracking, crazing, and spalling of the concrete.

**Cure Concrete Longer In Low Temperatures**

Concrete strengths develop more slowly at lower temperatures. Below 50 degree F, special precautions should be taken. Heaters, if used, must be vented so combustion gasses are exhausted outside the enclosure in order to avoid carbonation of the fresh concrete placement. (Refer to ACI 306, “Report on Cold Weather Concreting”.)
Methods of Curing

For practical purposes, concrete can be kept moist by two curing methods:

1. **“Wet Curing” - maintaining adequate external water on the concrete**
   This method includes the techniques of ponding, spraying, fogging, and placing saturated wet coverings.
   - **Fogging / Water Spray**
     This is a good curing method only if the concrete is kept continually damp. Allowing the concrete surface to dry between sprinklings can create excessive wicking that results in crazing of the surface and cracking of slabs. The nozzle should produce a fine mist. This will avoid over-saturating any one area to the point of raising the water to cement ratio at the concrete surface.
   - **Saturated Wet Coverings**
     Fabric coverings saturated in water, such as burlap, cotton mats, or other moisture-retaining fabrics, can be effective for curing. However, the fabric must be kept continually damp. Allowing the fabric to dry out will create excessive wicking that results in crazing and cracking of the concrete placement. Caution should be exercised when using saturated fabrics because staining of the concrete surface may result. (Refer to ASTM C 171.)

2. **“Membrane Curing” - reducing the loss of the initial mix water utilizing membrane-forming materials**
   Membrane-forming materials provide a controlled moisture loss from the surface of the concrete. Methods would include membrane curing compounds, plastic sheets, or waterproof paper.
• Membrane Curing Compounds:
These compounds consist of waxes, resins, chlorinated rubber and other materials that retard the evaporation of the water from the concrete surface. Membrane curing compounds are of two general types: clear, and white pigmented. White pigmented compounds have the advantage of reducing solar heat gain, thus reducing the concrete temperature. If a membrane compound is used, make sure it meets the moisture retention requirements of ASTM C-309 at the specified coverage rate.

• Plastic sheets / Waterproof Curing Paper
This method holds moisture in the concrete by preventing evaporation. Water is sprayed on the concrete surface and covered with plastic, or a non-staining, waterproof paper. Surface mottling can occur if plastic sheets are not evenly placed.

Concrete Sealers
Sealing compounds are liquids applied to the surface of hardened concrete to keep harmful substances from penetrating the concrete placement. Sealers are generally classified as either film-forming or penetrating.

Film-Forming Sealers

With film forming sealers, penetration of durable concrete will be slight at best, with most of the product remaining on the surface to form a barrier. The ability of these products to effectively penetrate concrete is restricted by the relatively large molecular structure of the materials. The use of solvents, therefore, will not enhance penetration capabilities. In addition to sealing out water, these products also offer some protection
against mild chemicals and prevent the absorption of grease, some oils, and other liquid spills.

Urethanes and epoxies are two of the most commonly used film-forming sealers. In general, urethanes typically demonstrate greater abrasion resistance while epoxies sealers have shown superior chemical resistance. Retreatment intervals will vary depending on traffic and exposure.

**Penetrating Sealers**

The effectiveness of penetrating sealers is a result of their very small molecular size in comparison with urethanes and epoxies. These materials are able to infiltrate and coat the pores and capillary structure of concrete. Penetrating sealers may achieve penetration depths of as much as 1/8 inch, depending on the density and finish of the concrete. Unlike film-forming sealers, the effectiveness of penetrants is not dependant upon the continuity of an exposed surface film.

Penetrants produce a durable sealing film embedded within the concrete itself that is relatively unaffected by abrasion or ultraviolet induced deterioration.

The two most common penetrating sealers, the silanes and the siloxanes, are both derived from the silicone family. When catalyzed by moisture, these silicon materials react with the silica available in concrete to form an interstitial, hydrophobic siloxane resin film that repels water without loss of vapor transmission properties.

Despite being very closely related, the two silicon-based materials have significant performance differences. Silane monomers are small molecules that have not yet reacted with similar molecules to form polymer chains and require a substrate with a high pH. Siloxanes are produced when silane molecules are partially reacted to form a larger chain structure that is not as dependent on the substrate pH. Because of this, siloxanes are ideal for treating brick, block, stucco, and stone.

Due to their very small molecular size, silanes will typically obtain deeper penetration and as a result are less subject to loss of effectiveness caused by abrasion and weathering.
A consequence, however, of this very small molecular size is that the molecule is relatively volatile. The solids content in a finished silane product should be high enough to compensate for the loss of reactive material due to evaporation during the application process.

For normal concrete placements that have a wear surface, such as pavements, decks, and flatwork, treatment with a silane will provide longer lasting protection. In regard to surface texture and color, treatment with silane sealers typically cannot be detected. Siloxane products may slightly darken the treated surfaces.

Concrete sealers are designed to supplement, not replace, the weathering characteristics of a durable, properly cured concrete surface. Best results will be obtained when applied to concrete surfaces proportioned, placed, and finished in accordance with standards defined in ACI Committee Report 201, “Guide to Durable Concrete”.


ACI Committee 306 “Cold Weather Concreting, ACI 305R-99, American Concrete Institute, Farmington Hills MI

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ACI Committee 308 “Standard Practice for Curing Concrete”, ACI 308-92 American Concrete Institute, Farmington Hills MI
