Concrete Curing – The Good & Bad

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 alkalis 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 is 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").

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.