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The Use of Silicate Solutions to Cure Concrete

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March 15, 2007

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Summary

Introduction
Sometimes the action of concrete hardening is referred to as the curing process. But for the purpose of this white paper, concrete curing will be defined as in the American Concrete Institute (ACI) Report 116: "The action taken to maintain moisture and temperature conditions in a freshly placed cementitious mixture to allow hydraulic cement hydration and (if applicable) pozzolanic reactions to occur so that the potential properties of the mixture may develop." When concrete is not properly cured, its strength, durability, appearance, and resistance to freeze-thaw damage will suffer. Here's why: Cement in concrete needs water in order to chemically react and form a hard, durable matrix, or "glue" that holds the concrete together. This reaction between cement and water is called hydration, and it can continue for a long period of time after concrete placement. It is beneficial to keep the concrete curing method in place for as long as possible, since a long, slow hydration process will result in concrete with the best strength and durability. If water evaporates too quickly from concrete (as it will if no legitimate curing method is used) there will be cement in the concrete that did not properly hydrate. This can lead to the durability and strength problems mentioned earlier.

More specifically, improper curing can cause plastic shrinkage cracking, which occurs when moisture rapidly evaporates from a fresh concrete surface faster than the bleed water can appear to replace it. Stress in the new concrete surface resulting from this rapid drying causes the short, irregular cracks known as plastic shrinkage cracking. Use of an evaporation retardant while

finishing, especially in dry or windy conditions, as well as application of a legitimate curing compound or cure and seal after finishing can prevent plastic shrinkage cracking.

Plastic shrinkage cracking, which always takes place before the concrete sets, should not be confused with drying shrinkage, a condition that can occur when hardened concrete loses moisture. Drying shrinkage is an inherent characteristic of hydraulic-cement concrete; simply put, when concrete is wet, it expands. When it dries, it contracts or shrinks. This contraction is always subject to some form of restraint from the foundation, another part of the structure, or the reinforcing steel in the concrete. The combination of shrinkage and restraint develops tensile stresses within the concrete – which due to the inherent low tensile strength of concrete, will likely lead to cracking.

Concrete Industry Statements on Using Silicate to Cure Concrete

The application of a curing compound to a freshly finished concrete surface will help ensure that the water required for proper hydration of the cement stays *in* the concrete, instead of evaporating out. A quality curing compound does this by forming a thin, continuous film on the concrete surface that greatly reduces the amount of internal water that can pass through as vapor. Think of it as stretching a large, thin piece of plastic wrap over the concrete to hold the moisture in.

The American Concrete Institute (ACI) in its Guide for Concrete Floor and Slab Construction (ACI 302.1R), as well as the American Society for Testing and Materials (ASTM) specification C 309 clearly define concrete curing compounds as **"membrane-forming"**. Solutions of sodium, potassium, or lithium silicate are not membrane forming, and therefore do not comply with the above industry standards for concrete curing compounds. When discussing the use of sodium silicate on concrete, ACI 302.1R states:

> *Products in this group are not specifically formulated for curing applications and do not meet the requirements of either ASTM C 309 or ASTM C 1315 for liquid membrane-forming compounds. While their use may offer some desirable benefits when applied after curing, they should not be applied on fresh concrete.*

Additionally, ASTM C 309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete, addresses silicate solutions this way:

> *Solutions of silicate salts are chemically reactive in concrete rather than membrane-forming; therefore, they do not meet the intent of this specification.*

The Intended Purpose of Silicate on Concrete

Silicate solutions are very useful materials that can improve the durability of concrete when used properly. First and foremost, silicate solutions are penetrating materials on concrete. In order to work properly, silicates need to be able to soak into the concrete surface to form a hard, glassy substance (calcium silicate) within the pores of the concrete. When applied to fresh concrete, when the surface pore structure is filled with water, silicates will not penetrate properly and will not chemically react as intended.

But when applied to well-cured concrete that is dry and absorptive, silicate solutions will provide reduced dusting and improved density of the concrete surface. Also, improperly placed or finished concrete floor slabs that have pervious and soft surfaces can be improved by application of a silicate or silicofluoride solution to "bind" and densify the dusty surface.

Appropriate Curing Options

There are three general methods for curing new concrete. The first method is called **water curing** and involves keeping a continuous flow, ponding, or fog of water on the concrete surface for at least 7 days. Often, this is not practical for concrete work as it makes it difficult to impossible for other trades to continue work on the project while the curing is taking place. The second method is the placement of moisture-retaining coverings such as plastic sheeting, wet burlap, or curing blankets over the freshly finished concrete (also recommended to stay in place for a minimum of 7 days). These coverings can be challenging to work and walk on, and can leave stains or marks on the concrete surface if place improperly. The third method of curing is the application of liquid membrane-forming curing compounds or curing and sealing compounds. Curing and sealing compounds, besides retaining moisture in fresh concrete, have the added benefit of providing a longer-lasting protective and decorative seal on the surface.

By their nature, curing compounds and cure and seals leave a film on the concrete surface that can interfere with the adhesion of other materials to the treated surface such as resilient floor coverings, protective coatings, sealers, or liquid densifying treatments. Because of this, it is tempting to use a silicate solution as the curing compound on a new project, as silicates do not form a film that can interfere with adhesion. However, the use of a **dissipating curing compound** is a much more appropriate option to cure new concrete that will later be coated or covered. Dissipating curing compounds meet all the industry standards and guides for concrete curing including ACI 302.1R and ASTM C 309, and over time they lose adhesion from the concrete and wear away under traffic and UV exposure. Concrete cured with a dissipating curing compound need only a simple wash to ready them for covering or sealing.

Summary

Sodium silicate solutions do not provide the two primary functions of a concrete curing compound: they do not form a continuous film on the concrete surface and they do not retain moisture or promote proper cement hydration in freshly placed concrete. Concrete industry standards clearly state that the use of a silicate solution as a curing compound puts the concrete at risk for low strength development and surface durability issues. Used for their intended purpose, silicates can densify a well-cured concrete surface but should not be mistaken as a suitable option for curing new concrete.