



Concrete Curing Guide

What is concrete curing?

Curing is maintaining moisture in concrete following placement so that the concrete's designed properties can develop. Curing influences the concrete's ultimate durability, strength, water tightness, abrasion resistance, volume stability and resistance to freeze / thaw cycles and deicing salts. These properties are reduced significantly when curing is inadequate.

Why is curing necessary?

When portland cement is mixed with water, a chemical reaction called hydration takes place. As cement hydrates, the strength, durability and density of the concrete increases. The more complete the hydration, the higher these properties become. Complete hydration of cement takes a very long time. The hydration process is far from over when the surface of the concrete is hard. Theoretically, the hydration process continues

for years. With sufficient water, the hydration process will be approximately 30% complete in 3 days, 60% complete in 7 days and 98% complete in 28 days.

Most freshly mixed concrete contains more water than is required to hydrate the cement in the mix. Water loss in the first few days due to bleed water and evaporation reduces the water content of the mix and slows or stops the hydration process. It is critical to the long term durability of the concrete that water evaporation be minimized. Excess loss of water causes the concrete to shrink, creating tensile stresses within the concrete. If these stresses develop before the concrete achieves adequate tensile strength, surface cracking results.

How is concrete cured?

The water is held in concrete two primary ways:

1. Wet curing the concrete by keeping it constantly wet for a minimum of 7 days. This is done by ponding, immersion, spraying or fogging, or applying saturated wet coverings such as burlap.
2. Sealing the surface of the fresh concrete to prevent water from leaving. Typical methods include covering the concrete with impervious paper or plastic sheets or by applying a curing compound to form a membrane on the surface.

Each curing method has advantages and disadvantages. The method or combination of methods used may depend on availability, size and shape of the concrete, the location, environment or economics.

Wet curing by flooding the surface continuously with water is the best way to cure concrete. To be effective, wet curing must last at least 7 days. It is important that the concrete not be allowed to dry between soakings.

Alternate wetting and drying of the surface actually damages the concrete.

Membrane curing is the most common method of curing new concrete. Curing compounds can be waxes, resins, chlorinated rubbers, styrene acrylics or epoxies. Advantages of using a curing compound over moist curing include ease of application, cost effectiveness and the extended curing action provided beyond the 7 days required for wet curing.

What types of curing compounds are there?

Membrane forming curing compounds are of two general types; clear or white pigmented. Clear curing compounds may contain a fugitive dye (usually red) that make it easier to visually check for complete covering of the concrete surface when the compound is applied. The dye will fade after several days. White pigmented curing compounds have the added benefit of light reflectivity to aid in keeping the concrete cool improving the hydration process.

Are water-based curing compounds as good as solvent based?

As long as the curing compound passes ASTM C-309, it is effective in retaining moisture. The situation and application may dictate which type of cure to use. Although both are used for interior applications, water based materials have low odor and lower V.O.C's (Volatile Organic Compounds). Water-based products are preferred in interior occupied areas. Water based cures should not be used when temperatures are expected to go below 50°F prior to drying because they will not form an effective film at lower temperatures. It should be noted that all water-based products appear white in the pail and when first applied. Unless they include a white pigment such

as titanium dioxide, all water-based curing compounds will dry clear. Water based cures require soap and water clean-up while solvent based materials require mineral spirits. It is important to not mix solvent-based and water-based cures. Most applicators who apply both types will have different spray equipment for each type to avoid the extensive clean out required when switching from one type to the other.

When and how should curing compounds be applied?

Apply curing compounds immediately after final finishing, when the sheen has disappeared from the concrete and application of the cure will not mar the surface. ASTM C-309 and ASTM C-1315 normally require that curing compounds be applied at a rate of 200 - 300 square feet per gallon. Hand held or power driven spray equipment with a fan tip nozzle is the preferred applica-

tion method, but brushes or rollers may also be used. No matter how the cure is applied, a uniform, continuous film with no gaps or pinholes must be created for maximum moisture retention.

Will proper curing insure that concrete will be durable and will not spall or crack?

No. There are many factors that effect the durability and strength of the concrete.

Air entrainment of exterior concrete is a critical element affecting the durability of concrete subjected to freeze/thaw cycles. Too little air entrainment and the expansion and contraction of the concrete during freeze/thaw cycles will cause cracking and surface spalling. Too much air entrainment will cause the concrete to be lower strength and porous.

Finishing techniques also affect durability. Overworking or over watering the surface of fresh concrete will weaken it and make it more prone to cracking and spalling.

The **mix design** of the concrete and the **quality of the ingredients** are important. Porous stone is more prone to exploding from the surface in freeze/thaw conditions. Concrete that contains too little cement, too much fly ash, too little or too much water or an improper combination of concrete admixtures will not perform to the cus-

owner's expectations in the long run.

Aggressive **chemical attack** by deicing salts or chemicals, particularly in the first year of the concrete's life, may severely damage the surface.

Good concrete curing will reduce dusting of the surface, craze cracking, shrinkage and carbonation but will not eliminate the need for good concrete or good concreting practices.

Do some curing compounds work better than others?

Yes. While ASTM C-309 is the accepted standard for curing efficiency, some materials can retain much more water in the concrete than others. Generally, the level of solids in the cure affects the thickness of the film and its effectiveness as a vapor barrier. The higher the solids, the thicker the film, the more moisture the film will hold in the concrete.

A minimum 15% solids is usually required to pass ASTM C-309. Other common solids levels for curing compounds or cure & seal products are 20%, 25% and 30%.

What is the difference between a “Curing Compound” and a “Cure & Seal”?

A **Curing Compound** is designed to go over fresh concrete only. These products generally dissipate quickly (30 days). Most hydration of the cement is completed by the time the curing compound wears off. **Curing & Sealing** materials may also be applied to cure fresh concrete. These same products can also be applied to older concrete. When applied to older concrete, their purpose is to keep water, salts and other materials out of the concrete - not keep the water in. Cure and seal products are generally higher solids materials and contain other raw materials to enhance their durability. When applied to fresh concrete, a cure & seal product may last for more than a year. Often a second coat of a cure & seal will be applied several months after the concrete is cured to thicken the membrane on the concrete and give added sealing protection for the concrete. Generally cure & seal products cost more than products designed to cure only.

How long will a curing compound last on the surface?

Most curing compounds are designed to last on the surface for a minimum of 28 days. As stated above curing & sealing compounds may remain on the surface much longer. When the concrete is to be eventually treated with another product such as a penetrating sealer or an epoxy coating, the curing compound must be removed before these products are applied. Some curing compounds are described as dissipating resins. These products are designed to readily break down in 28 days. The degree to which they disintegrate is dependent on their exposure to ultraviolet light and abrasion.

Which curing compound should I choose?

Be sure that any curing compound used is manufactured by a reputable company and passes ASTM C-309 or ASTM C-1315. These

specifications set a maximum on the amount of moisture that can be transmitted through a curing compound. If in doubt, ask the manufacture to provide written certification that the curing compound passes ASTM C-309 or the cure & seal passes ASTM C-1315.

Consider the application environment to determine if a water based material is more suitable than a solvent type.

If final appearance is important, choose a clear, non-yellowing material such as a pure acrylic. Materials such as linseed oil, chlorinated rubber and styrene are excellent curing materials and are cost effective but they will discolor with continued exposure to ultraviolet light. This is particularly important when choosing a longer lasting cure & seal product.

When placing pavement, parking decks, curbing, sidewalks, mass concrete or mat foundations, a white pigmented curing compound is usually specified. Select a compound that stays in suspension with little agitation and one that will not clog sprayers. Use only pre-approved, D.O.T. tested materials on state projects.

ChemMasters has been a leading manufacturer of curing compounds and cure & seal products for over 50 years. ChemMasters offers a complete line of products to meet every specification requirement or application need. For more information contact us at 800.486.7866 or visit us on the web at chemmasters.net

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contact ChemMasters**

300 Edwards Street • Madison, Ohio 44057
440.428.2105 • 800.486.7866
fax 440.428.7091 • www.chemmasters.net