

Curing Concrete

“holding water in the concrete”



Will:

- Increase concrete strength
- Increase concrete abrasion resistance
- Lessen the chance of concrete scaling
- Lessen the chance of surface dusting
- Lessen the chance of concrete cracking

Good curing is the final step in giving your customer the quality concrete job you intended

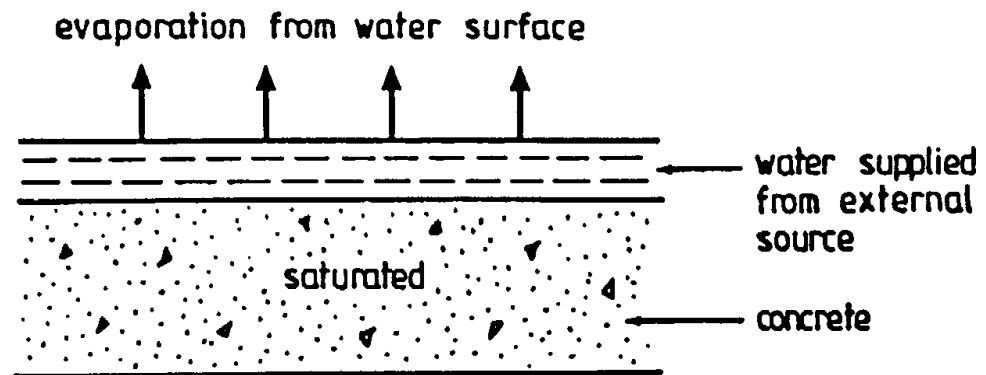
TK Products
11400 West 47th St.
Minnetonka, MN 55343
952-938-7223
TKProduct@aol.com
<http://TKProduct.com>

CURING OF CONCRETE

CURING DEFINED

Curing can be defined as a procedure for insuring the hydration of the portland cement in newly-placed concrete. It generally implies control of moisture loss and sometimes of temperature. The hydration of portland cement is the chemical reaction between grains of portland cement and water to form the hydration product, cement gel; and cement gel can be laid down only in water-filled space. Hydration can proceed until all the cement reaches its maximum degree of hydration, or until all the space available for the hydration product is filled by cement gel, whichever limit is reached first.

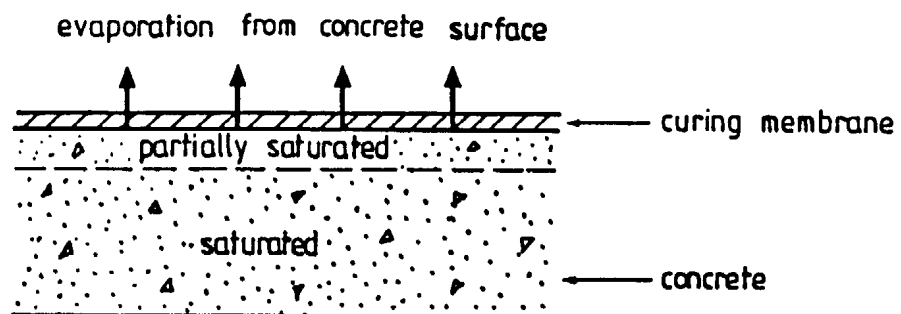
Water curing -is when the concrete is covered with a layer of water for a period of time and the evaporation of moisture is from the surface of the water.



Schematic diagram of ideal curing of concrete by supplying water.

This is the ideal way of curing concrete, although the concrete needs to stay continually wet for 7 days, preferably 14 days.

Membrane curing is the most practical with today's construction schedules.



Schematic diagram of membrane curing of concrete.

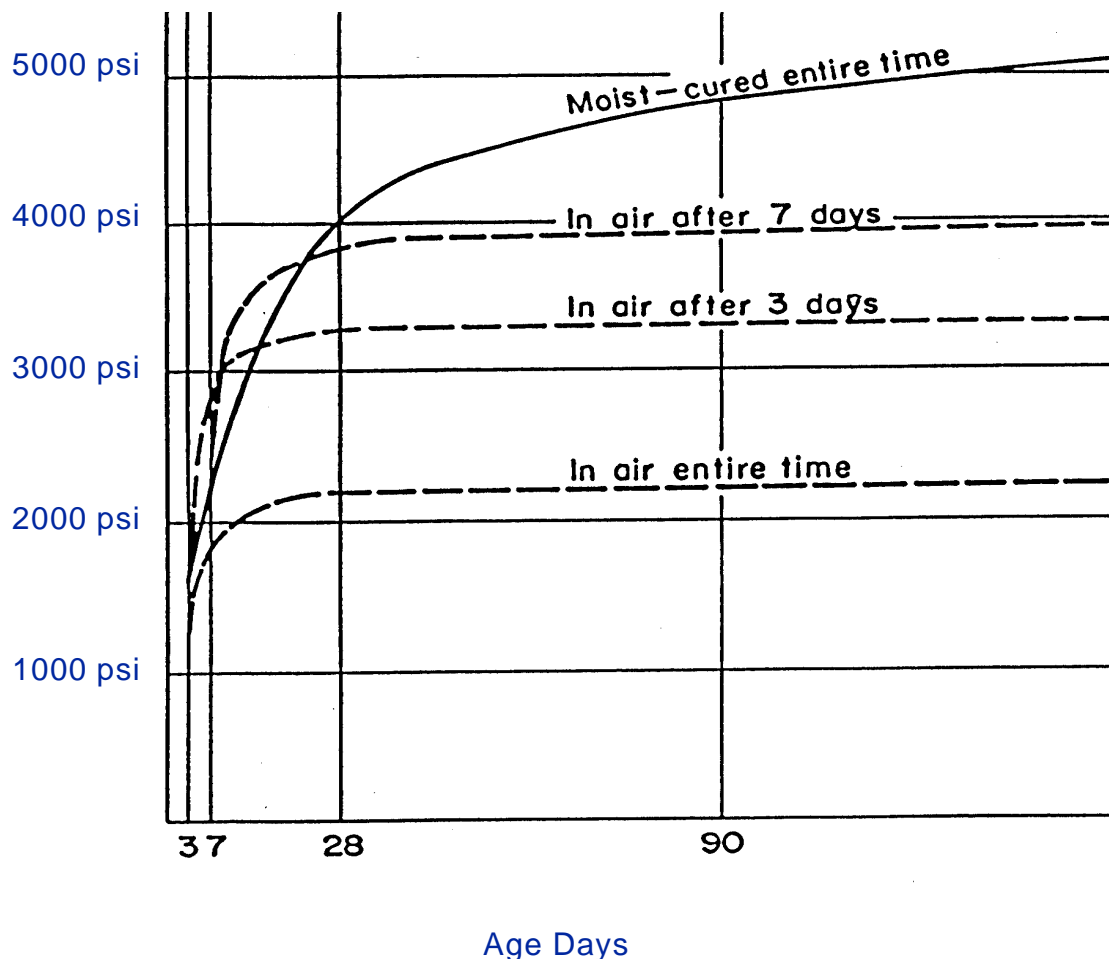
The curing of the concrete is dependent on the quality of the film, the thickness, and the uniformity of the film applied to the concrete. The curing membrane used is the least expensive component in the completion of quality concrete construction, and the most overlooked.

CONCRETE STRENGTH

Concrete strength increases with age as long as moisture and a favorable temperature are present for hydration of cement. In the figure shown below **concrete that is In air entire time is only 55% of the strength of Moist-cured entire time concrete at 28 days.** In air after 3 days is 80%, and In air after 7 days is 90%. A Quality curing and sealing compound will allow the concrete to continue in strength gain beyond 28 days as shown in the chart for moist-cured.

Concrete strength with moisture present for curing

according to the Portland Cement Association



Strength gain in colder temperatures slows down. 40° F. concrete will be 35% of its design strength in seven days as compared to 75% for 73° F. concrete.

Concrete poured in lower temperatures needs to be covered to maintain higher concrete temperatures to get sufficient strengths to withstand freeze-thaw cycles.

CURING COMPOUNDS and CURING AND SEALING COMPOUNDS

Difference of **CURING** compounds and **CURING AND SEALING** compounds is the resin used. Curing compounds use a resin that breaks down in months, and curing and sealing compounds use a resin that will resist sun light, abrasion, most chemicals and will be on the surface of the concrete for a while.

CURING compounds are meant for curing the concrete only. No other sealer or adhesive for a floor covering can be put down unless the curing compound is stripped off. CURING AND SEALING compounds can accept paints and adhesives for vinyl tile and carpets (it is recommended to put a sample down to check for compatibility), and they can be recoated for long term sealing of the concrete.

EXTERIOR CONCRETE

For concrete poured outside long term sealing of the concrete will require a recoat after the concrete is 28 days old or older, so the resin can penetrate into the pours and capillaries of the concrete after the moisture has left. Shown in the diagram below.

The difference of Curing and Sealing Fresh Concrete and Sealing Concrete after it is 28 days old

- A- Curing and sealing fresh concrete
- B- Sealing 28 day old concrete



For outside concrete the curing and sealing compound used should be a solvent-based, because when reapplied the solvent in the second coat will re-emulsify the resin left from the first coat and allow it to penetrate the concrete. **Water-based curing and sealing compounds when reapplied do not re-emulsify the first coat**, so you can only apply another coat over the top of the first.

CONCRETE CONTAINING FLY ASH

"Use of additional cementitious material such as fly ash has become more prevalent in concrete construction. Several investigations have reported that the strength development and durability of concrete containing fly ash is related to the extent and degree of curing. It has also been substantiated that drying ambient conditions greatly reduce the strength potential of fly ash concrete because the secondary (pozzolanic) reaction fails to contribute to the development of the strength." , Given adequate curing the strength development of cement-fly ash paste was superior to plain cement paste.

Curing and sealing compounds that meet ASTM C-1315 should be used, because this specification requires more moisture retention for curing than ASTM C-309, more in line for concrete containing fly ash. Products to use are: AS-1 1315, AK-2 1315, TK-26UV.

CARBONATION OF CONCRETE

Carbonation results in a soft dusty surface to normal concrete. It is most prevalent in cold weather concreting.

Carbonation defined - is the chemical combining of carbon dioxide with the hydration products of portland cement. Carbon dioxide combines principally with calcium hydroxide, but will also attack and decompose the calcium silicate and aluminates and combine with the calcium portion of these compounds to form calcium carbonate (an acid which kills cement).

Concrete is susceptible while it is in its plastic state. As temperatures dip below 40° F. proper hydration of concrete is severely slowed. The concrete stays in the plastic state for a longer period of time, and the likelihood of carbonation increases. Carbonation can affect concrete to various degrees from a light dust on the surface to a depth of 1/4 inch or more.

To lessen or prevent carbonation damage to floors placed during cold weather.

- a. Use an accelerating set admixture in the concrete.
- b. Use temporary heaters which do not allow combustion gases to contaminate the atmosphere surrounding the floor.
- c. Open the building to fresh air at the time of the pour to ventilate exhaust fumes from trucks, troweling machines, etc.
- d. The concrete is most susceptible in the first 24 hours. Use a membrane curing and sealing compound as soon as possible, to block the carbon dioxide gas from the concrete. A uniform and heavy film will be necessary. It was proven that burlap and poly for curing do not offer adequate protection.

References

1. Haque, M.N., "Some Concretes Need 7 Days Initial Curing", Concrete International, February 1990, pp.42-45.

CRACKS IN CONCRETE SURFACES

Two basic causes of cracks in concrete are (1) stress due to applied loads and (2) stress due to drying shrinkage or temperature changes.

Stress Cracks can be eliminated by having a proper subbase and proper concrete design for the load.

Shrinkage Cracks

Drying shrinkage is an inherent, unavoidable property of concrete. [Shrinkage of plain concrete drying is .72 inches per 100 feet](#) from its plastic state to a dried state with 50% relative humidity, [this shrinkage will take place when the moisture leaves the concrete](#). To minimize these cracks we need proper placement of saw cuts, and proper curing to hold the moisture in the concrete long enough to get adequate tensile strength gain in the concrete before the moisture leaves and the concrete shrinks. With adequate strength the concrete should pull together and crack in the saw cuts and not in between them.

Plastic Shrinkage Cracks

Plastic Shrinkage Cracks is a type of cracking that appears on the surface of freshly placed concrete during finishing operations, or soon after. Most often, this form of cracking is caused by the rate of evaporation water being greater than the rate at which it is being replaced by bleed water. The surface shrinks while underlying concrete maintains a constant volume.

Contributing factors:

- a. increased wind velocity.
- b. ambient temperature increase
- c. a decrease in relative humidity.

To minimize plastic cracking:

- a. dampen the subgrade.
- b. don't work in the sun or wind, erect a roof over the slab and a wind barrier.
- c. schedule work for the early morning or late afternoon.
- d. have sufficient man power and equipment.
- e. cover the concrete with poly in between finishing operations.
- f. spray on an evaporation retarder, Tri-Film, to form a liquid monomolecular barrier on the surface of the concrete after each finishing operation.

Craze Cracking

Crazing is the occurrence of numerous fine hair cracks in the surface of a newly hardened slab due to surface shrinkage. These cracks form an overall hexagonal pattern.

Causes:

- a. Rapid surface drying usually caused by either high air temperatures, hot sun, or drying winds, or a combination of these.
- b. not using an evaporation retarder during placement in hot or windy conditions.
- c. excessively high slump, over troweling the surface, floating the surface when there is an excess amount of moisture at the surface.
- d. over use of a jitterbug, vibrating screed, darby or bull float may contribute by working an excess of mortar to the surface.

SPECIFICATIONS AND TEST METHODS RELATIVE TO CONCRETE AND FLOOR CONSTRUCTION

- ASTM C 172 Standard Method of Sampling Fresh Concrete
- NRMCA 47 Specifications and Test Methods for Ready-Mixed Concrete
- ASTM C 143 Standard Method of Test for Slump of Portland Cement Concrete
- ASTM C 231 Tentative Method of Test for Air Content of Fresh Mixed Concrete by Pressure Method
- ASTM C 173 Standard Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method
- ASTM C 31 Standard Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Field
- ASTM C 94 Standard Specifications for Ready-Mixed Concrete
- ASTM C 125 Standard Definitions of Terms Relating to Concrete and Concrete Aggregates
- ACI 302 Guide for Concrete and Slab Construction
- ASTM C 309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- ASTM C 1315 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- ASTM C 672 Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals
- ASTM C 779 Test Method for Abrasion Resistance of Horizontal Concrete Surfaces
- ASTM C 1151 Standard Test Methods for Evaluating the Effectiveness of Materials for Curing Concrete

REFERENCE LIST

Manual of Concrete Inspection, American Concrete Institute.

Concrete Manual, U. S. Bureau of Reclamation.

Standard for Recommended Practice for Selecting Proportions for Concrete (ACI 613), American Concrete Institute.

Standard for Recommended Practice for Measuring, Mixing and Placing Concrete (ACI 614), American Concrete Institute.

Standard for Recommended Practice for Winter Concreting (ACI 604), American Concrete Institute.

Standard for Recommended Practice for Hot Weather Concreting (ACI 605), American Concrete Institute.

Design and Control of Concrete Mixtures, Portland Cement Association.

Organizations concerned with concrete are usually referred to by their initials. Listed below are initial designations followed by full names and addresses of these organizations.

ACI - American Concrete Institute, P.O. Box 4754, Redford Station, Detroit, Mich. 48919

ASTM - American Society for Testing and Materials, 1916 Race St., Philadelphia, Pa. 19103

NRMCA - National Ready Mixed Concrete Association, 900 Spring St., Silver Spring, Md.

PCA - Portland Cement Association, Old Orchard Road, Skokie, Ill. 60076

USBR - U. S. Bureau of Reclamation, Denver Federal Center, Denver, Colo. 80202