Curing of Concrete

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ABSTRACT - Efficient uninterrupted curing is the key to quality concrete. Proper curing of concrete is crucial to obtain design strength and maximum durability. The curing period depends on the required properties of concrete, the purpose for which it is to be used, and the surrounding atmosphere namely temperature and relative humidity. Curing is designed mainly to keep the concrete moist, by preventing the loss of moisture from the concrete during the period in which it is gaining strength. Curing may be applied in a number of ways and the most appropriate means of curing may be dictated by the site or the construction method. The present paper is directed to elaborate effectiveness of different curing methods and study the influence of climate on the strength properties of concrete.

***KeyWords*: Curing, Concrete, Efficient, Temperature**

1. INTRODUCTION

Curing is the maintenance of a satisfactory moisture content and temperature in concrete for a period of time immediately following placing and finishing so that the desired properties may develop. The need for adequate curing of concrete cannot be overemphasized. Curing has a strong influence on the properties of hardened concrete; proper curing will increase durability, strength, water tightness, abrasion resistance, volume stability, and resistance to freezing and thawing and deicers. Exposed slab surfaces are especially sensitive to curing as strength development and freeze-thaw resistance of the top surface of a slab can be reduced significantly when curing is defective. When Portland cement is mixed with water, a chemical reaction called hydration takes place. The extent to which this reaction is completed influences the strength and durability of the concrete. Freshly mixed concrete normally contains more water than is required for hydration of the cement; however, excessive loss of water by evaporation can delay or prevent adequate hydration. The surface is particularly susceptible to insufficient hydration because it dries first. If temperatures are favorable, hydration is relatively fast the first few days after concrete is placed; however, it is important for water to be retained in the concrete during this period, that is, for evaporation to be prevented or substantially reduced.

1.1 CURING PERIOD AND TEMPRUTURE

The curing period depends upon the type of cement used, mixture proportions, required strength, size and shape of member, ambient weather, future exposure conditions, and method of curing. Since all desirable properties are improved with curing, the period should be as long as practical. For most concrete structures, the curing period at temperatures above 5º C (40º F) should be a minimum of 7 days or until 70% of the specified compressive or flexural strength is attained. The period can be reduced to 3 days if high early strength concrete is used and the temperature is above 10º C (50º F).

1.2 SEVERAL FACTORS AFFECT TO COUNTERACT SELF- DESICCATION

1. Aggregate pore size: If it is very fine, water may not migrate readily into the surrounding paste.
2. The spacing between the aggregate particles: if it is too large, the paste surrounding the aggregates may not be accessible to the water in the aggregate within a reasonable time. These influences may be expressed in a simplified engineering approach in terms of an efficiency term, η, which is a factor in the range of 0 to, describing the portion of water in the aggregates that can become available for internal curing. Accordingly, whether any improvement in water retention was matched by an increase in degree of the cement hydration. Initial surface absorption tests and compressive strength measurements were made to assess whether any improvement in water retention was matched by an increase in degree of cement

hydration. Tests were also made to determine surface permeability and strength development. A scanning electron microscope was used to decide the influence of the admixture on cement paste microstructure.

1.3 DURABILITY

Whir et al reported results of several durability tests conducted on self-cure concrete specimens. It was found that initial surface absorption, chloride ingress, carbonation, corrosion potential and freeze/thaw resistance characteristics were all better in air cured self-cure concrete than in the air cured control concrete. This improvement appears to be dependent on the admixture dosage, although the durability properties obtained in the study were not as good as the film cured concrete. It may be possible to get such properties with higher quantities of self-cure chemical.

Concrete that is capable of retaining greater quantities of water then ordinary concrete when cured in air has been developed by means of an addition of a self-cure chemical (SCC) which was a water-soluble polymeric glycol identified as the chemical. The water retention leads to a greater degree of cement hydration and hence improved properties of concrete in comparison to control test specimens. One particular feature of self-cure concrete is its good sustained properties.

1.4 INITIAL SURFACE ABSORPTION TEST (ISAT)

The surface of the air cured control specimens absorbs water at a highest rate; the least permeable surfaces are those of the time cured specimens. The higher dosage of the self-cure chemical provided a greater improvement in surface characteristics, but at both concentrations the chemical decreases the rate of absorption at the surface.

With respect to surface quality, chloride diffusion, carbonation, corrosion potential and freeze thaw, resistance self-cure concrete provides improved performance when compared to air cured specimens. The improvements in concrete durability properties are dependent on chemical dosage. At the highest dosage used in these study properties, approaching, and in some cases as good as, those characteristics of the film cured control were achieved.

It is understandable that higher dosages could produce air-cured concrete with properties rivaling those achieved in the film-cured situation.

1.4 TYPES OF CURING

PONDING AND IMMERSION: On flat surfaces, such as pavements and floors, concrete can be cured by pending. Earth or sand dikes around the perimeter of the concrete surface can retain a pond of water. Pending is an ideal method for preventing loss of moisture from the concrete; it is also effective for maintaining a uniform temperature in the concrete. The curing water should not be more than about 11°C (20°F) cooler than the concrete to prevent thermal stresses that could result in cracking. Since pending requires considerable labor and supervision, the method is generally used only for small jobs.

Fig.1 ponding and immersion

FOGGING AND SPRINKLING: Fogging and sprinkling with water are excellent methods of curing when the ambient temperature is well above freezing and the humidity is low. A fine fog mist is frequently applied through a system of nozzles or sprayers to raise the relative humidity of the air over flatwork, thus slowing evaporation from the surface. Fogging is applied to minimize plastic shrinkage cracking until finishing operations are complete. Once the concrete has set sufficiently to prevent water erosion, ordinary lawn sprinklers are effective if good coverage is provided and water runoff is of no concern. Soaker hoses are useful on surfaces that are vertical or nearly soothe cost of sprinkling may be a disadvantage. The method requires an ample water supply and careful observation. If sprinkling is done at intervals, the concrete must be prevented from drying between applications of Fogging and sprinkling Burlap must be free of any substance that is harmful to concrete or causes discoloration.

Fig2 fogging and sprinkling

WET COVERINGS: Fabric coverings permeated with water, such as burlap, cotton mats, rugs, or other moisture-retaining fabrics, are commonly used for curing. Treated burlaps that reflect light and are resistant to rot and fire are available

IMPERVIOUS PAPER: Impervious paper for curing concrete consists of two sheets of Kraft paper cemented together by a bituminous adhesive with fiber reinforcement. Such paper, conforming to, is an efficient means of curing horizontal surfaces and structural concrete of relatively simple shapes. A crucial advantage of this method is that periodic additions of water are not required. Curing with impervious paper enhances the hydration of cement by preventing loss of moisture from the concrete. As soon as the concrete has hardened sufficiently to prevent surface damage, it should be thoroughly wetted and the widest paper available applied.

PLASTIC SHEETS: Recommended they reduce solar-heat gain, thus reducing the concrete temperature. Pigmented compounds should be kept agitated in the container to prevent pigment from settling out. Curing compounds should be applied by hand - operator power-driven spray equipment immediately after final finishing of the concrete. The concrete surface should be wet when the coating is applied. On dry windy days, or during periods when bad weather conditions could result in plastic shrinkage cracking, application of a curing compound immediately after final finishing and before all free water on the surface has evaporated will help prevent the formation of cracks.

MEMBRANE-FORMING CURING COMPOUNDS: Liquid membrane-forming compounds consisting of waxes, resins, chlorinated rubber, and other materials cane used to retard or reduce evaporation of moisture from concrete. They are the most practical and most widely used method for curing not only freshly placed concrete but also for extending curing of concrete after removal of forms or after initial moist curing. However, the most effective methods of curing concrete are wet coverings or water spraying that keeps the concrete continually damp. Curing compounds should be able to maintain the relative humidity of the concrete surface above 80% for seven days to sustain cement hydration.

INTERNAL MOIST CURIN: Internal moist curing refers to methods of providing moisture from within the concrete as opposed to outside the concrete. This water should not affect the initial water to cement ratio of the fresh concrete. Lightweight (low density) fine aggregate or absorbent polymer particles with an ability to retain a significant amount of water may provide additional moisture for concretes prone to self-desiccation. When more complete hydration is required for concretes with low water to cement ratios (around 0.30 or less),60 kg/m3 to 180 kg / m3 (100l b/yd3 to 300lb/yd3) of saturated lightweight fine aggregate can provide additional moisture to extend hydration, resulting in increased strength and durability.

FORMS LEFT IN PLACE:- Forms provide satisfactory protection against loss of moisture if the top exposed concrete surfaces are kept wet. A soaker hose is excellent for this. The forms should be left on the concrete as long as practical. Wood forms left in place should be kept moist by sprinkling, especially during hot, dry weather. If this cannot be done, they should be removed as soon as practical and another curing method started without delay. Color variations may occur from formwork and uneven water curing of walls.

STEAM CURING:- Steam curing is a process for hardening concrete, cement, mortar that involves exposure to warm steam. Materials subjected to this hardening technique tend to cure more uniformly and also much more quickly than those hardened via other processes. There are some disadvantages to this process that must be considered before deciding to use it for curing, and there may be certain applications where this method is not useful. In steam curing, objects to be cured are placed inside a chamber or room. Using a control panel, an operator can set the temperature and humidity level. Variations in pressure may also be possible, depending on the device. The heat and moisture penetrate the materials rapidly to fully hydrate and harden them. Steam curing needs fraction of the time involved with traditional curing and quickly strengthens the products so they can be used immediately.

CONCLUSION

It can be concluded that method of curing has fundamental effect on the mechanical properties including compressive, split tensile, flexural and shear strength of SCC. The strengths are found better for SCC than NVC. Immersion curing seems to be best method for curing in SCC and NVC as well. Hot water curing achieves satisfactory results for all the strengths. This method may be useful for precast/prefab industry where maintaining a controlled temperature is feasible. Ice curing does not give satisfactory results for all the strengths. Necessary precautions should be taken while casting in low temperature regions. However M30SCC has better strength than M30NVC. SCC shows good performance for curing with sea water than NVC. The early age strength is better than normal water immersion method

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