



## Manitoba Ready Mix Concrete Association

Technical Update

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### *What you should know about Curing of Concrete*

**By Wally Rooke, P. Eng.**  
MRMCA Executive Director

All concrete requires curing in order that the internal chemical reactions can proceed, developing within the concrete all the durability, impermeability and strength characteristics specified.

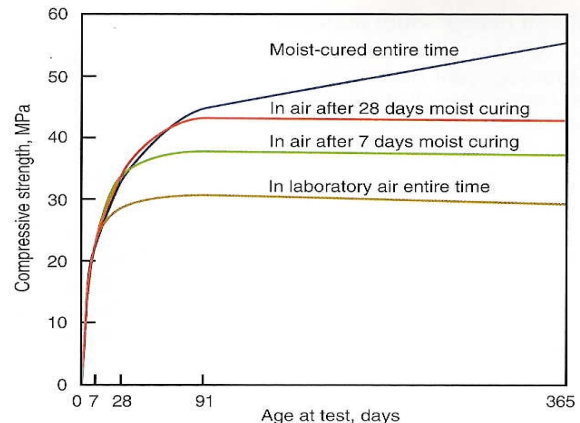
Without proper moist curing, concrete will develop only a fraction of its design strength as the illustration at right demonstrates. Why order 25 MPa for a floor, say, and then not cure it? Without moist curing, the graph shows that the mix will develop in the field only a little better than 50% of the strength the mix is capable of.

**Methods of curing:** Curing is the simple process of retaining moisture within the concrete at a temperature that permits the chemical reaction between water and the cementitious materials to proceed. The reaction is termed hydration, "hydro" being the Greek word for water.

Since almost all concrete has an excess of water beyond that needed to react with the cement, simply sealing in this moisture while keeping temperatures above 10°C will assure that the chemistry proceeds. The warmer the curing environment, the faster the reaction proceeds. Precast concrete plants take advantage of this with steam curing near 65°C to develop 28-day strength in less than 24 hours.

Sealing in the internal moisture can be accomplished either by spraying on a curing compound or by covering with waterproof paper or polyethylene. Liquid membrane-forming curing compounds meeting ASTM C309 may consist of waxes, resins, chlorinated rubber and solvents that retard evaporation from a concrete surface. A dye is added to assist in determining coverage. A white dye has the advantage of reflecting the heat from the sun.

For large surfaces or those outdoors subject to windy conditions, the sprays are the more appropriate choice. Yet they are all too commonly used improperly, with insufficient coverage to do a proper job. The picture below is from a recent Winnipeg project; curing was done with a lick and a pray and it looks more like graffiti



scrawled on the concrete instead of the even coverage shown below. The surface should literally drool with curing compound to achieve the coverage recommended by the manufacturer, usually 3 to 4 m<sup>2</sup> per litre.

On a pavement project, it is recommended that a rolling curing bridge equipped with spray nozzles be specified. The inspector and the contractor together must read the required coverage instructions and then place the drums of curing compound at appropriate spacing along the grade such that the second drum is not opened until the first one has been coated the required area in between.

All curing compounds should be applied as soon as possible after final texturing or trowelling of the surface. Application to a damp surface is preferred. Quick application is especially needed in spring and autumn work when evaporation rates are highest, with warm concrete being exposed to cool air temperatures. The immediate application assures that abrasion resistance of the surface is maximized and minimizes mortar flaking. Delay of a half day can mean significant loss of surface abrasion resistance and durability of a pavement slab or an industrial floor.





The other option for achieving good curing is to apply moisture continuously to the surface throughout the curing period of 3 to 7 days or longer.

This can be done by ponding water on a level floor surface, spraying with a sprinkler on a sloped surface, or by soaking a burlap or curing fabric with water and then sealing in the moisture by covering it with polyethylene.

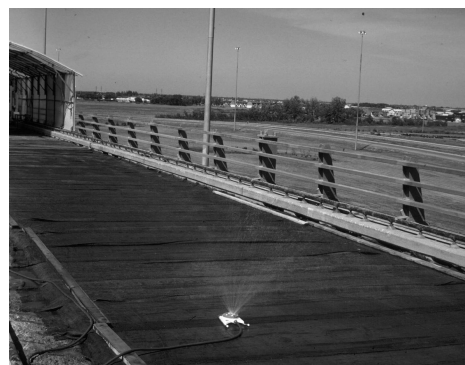
Using poly alone is sufficient provided the reflected wrinkled pattern that results is acceptable esthetically on the project. The downside to using poly is that it readily blows off the surface, permitting the surface to dry and the moist curing to be interrupted. Its use is appropriate only for interior floors and wall surfaces.



Ponding of water is the optimum curing method but is seldom used because of the inconvenience to other trades while the ponded water stays in place. If ponding is used, lukewarm, not cold water should be applied to minimize any thermal shock to the concrete.



**Ponding**



**Sprinkler  
on burlap**

Some mixes with a high proportion of flyash (labelled HVSCM1 or HVSCM2 in mix design statements) may require extended curing time since the rate of strength gain from the secondary reaction of the SCM may be delayed by as much as a day or two in comparison with a comparable mix with a lower flyash content. The Contractor and ready mix Supplier should discuss whether or not the use of such a high volume flyash mix - while economical and environmentally friendly - would prompt significant delays in a project's schedule.

When freezing weather is expected - usually overnight by late September - all freshly placed concrete must be protected with several layers of polyethylene or insulated tarpaulins to trap the heat of hydration and contribute to a good curing environment. As the thermometer drops further, supplementary heat is required to keep the concrete above the 10°C minimum required. CSA A23.1 requires that water curing be ended 12 hours before heat is removed so that the concrete can dry before being subjected to frost.

Curing must not be considered a special requirement. All concrete must be cured, whether it's in a simple driveway, a wall, a curb, a column, a floor or a pavement. The design strength and durability built into the mix cannot possibly be achieved in the field if curing is ignored or poorly performed.

### **CSA A23.1 7.4 & Table 20 Curing Requirements**

A Basic curing period of 3 days at 10°C is a minimum requirement for all concrete. The time may be shortened if 40% of design strength can be achieved sooner.

Extended curing is required where structural safety, mass concrete or durability is a factor.

Where the designated Exposure Class indicates that durability is critical - Classes F-1, C-XL, C-1, C-2, S-1 & S-2 - curing shall be for 7 days and the time necessary to attain 70% of the specified strength.

Reinforced mass concrete must be cured an additional 4 days beyond the Basic period; unreinforced mass concrete must be moist cured 7 additional consecutive days.

Reference: CSA A23.1-04: Canadian Standards Association, Mississauga, Ontario

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# **Concrete Rocks !**