



HOT WEATHER CONCRETE

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Hot weather conditions can impact mixing, placing, finishing and curing of ready-mix concrete. This guide offers some best practices to minimize those effects when faced with a combination of high temperatures, low humidity and high winds.

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HOT WEATHER CONCRETING

Rate of Evaporation

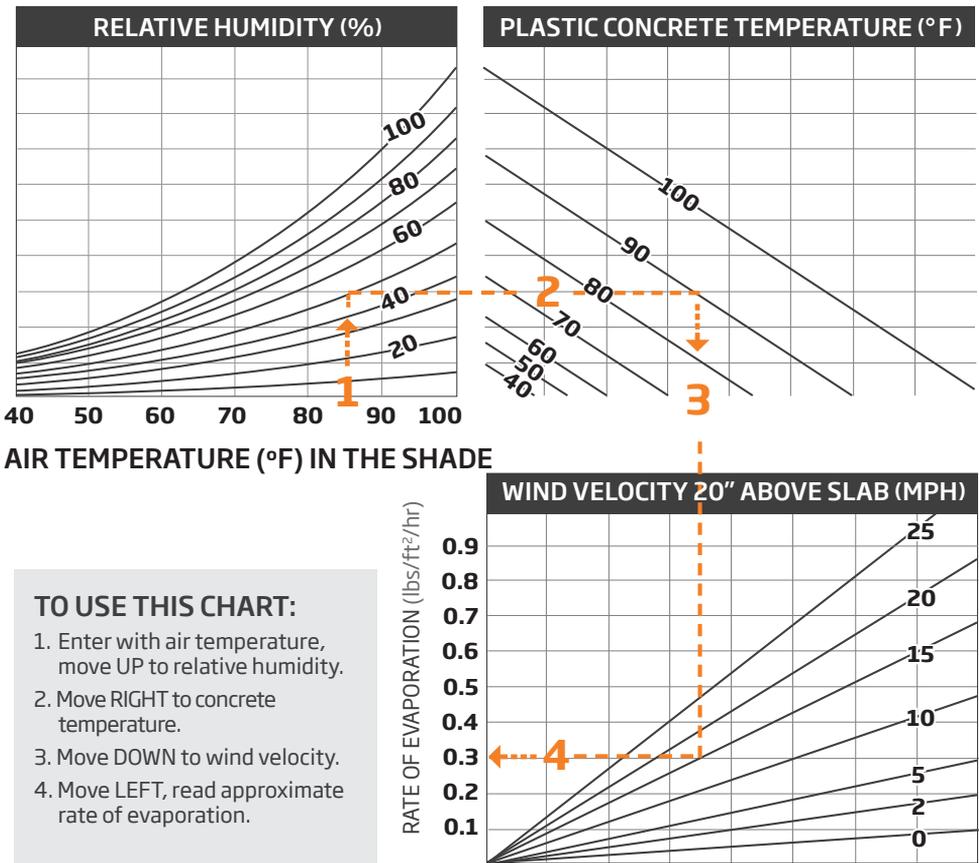
Surface drying and plastic-shrinkage cracking is frequently associated with hot weather concreting. It occurs in exposed concrete, primarily in flatwork, when the evaporation rate is greater than the rate at which water rises to the surface (bleed water) of recently placed concrete, i.e. bleeding. One or a combination of the following factors can lead to this condition:

- High air temperature
- High concrete temperature
- High wind speed
- Low humidity

The probability for surface drying and plastic-shrinkage cracking may be increased if the setting time of the concrete is delayed.

ACI 305 states, "If the rate of evaporation approaches 0.2 lbs/ft²/hr, precautions against plastic shrinkage cracking are necessary (Leach, 1957)." This rate is dependent upon the air temperature, relative humidity, plastic concrete temperature and wind velocity. Knowing these four factors, one can effectively estimate the rate of evaporation by using the following chart. It should be noted that the chart estimates the rate of evaporation provided the surface of the concrete is covered with bleed water.

RATE OF EVAPORATION CHART FOR HOT WEATHER



THEORETICAL RATE OF EVAPORATION CHART

If the evaporation rate approaches 0.2 lbs/ft²/hr, provide the following concrete evaporation protection:

1. Take special precautions to ensure that the forms and subgrade are sufficiently moist or protected to avoid lowering the water content at the pavement/form/subgrade interface. In hot weather conditions, moisten the subgrade prior to placing the concrete.
2. Minimize solar heat by shading or wetting concrete chutes or other equipment that comes in contact with the plastic concrete.
3. Use a fog spray to increase the relative humidity of the ambient air above the freshly placed concrete if there is a delay in immediately starting the curing process.
4. Ensure that the time between placing and curing is minimized.
5. Immediately apply an approved evaporation retarder to the concrete or increase the surface cure application to 1.5 times the standard specified rate. If an evaporation retarder is used, follow the manufacturer's instructions on usage and DO NOT FINISH THE EVAPORATION RETARDER INTO THE SURFACE OF THE CONCRETE.
6. Use micro-synthetic fibers to reduce the potential for plastic shrinkage.



If the evaporation rate is 0.2 lbs/ft²/hr or greater, take **EXTREME CAUTION**.

HYDRATION STABILIZER ADMIXTURE USE AT HIGH TEMPERATURES

Hydration stabilizing admixtures retard the setting time of concrete by controlling the hydration of portland cement and other cementitious materials while facilitating placing and finishing operations.

RECOMMENDED HYDRATION STABILIZING ADMIXTURE DOSAGE CHART

Concrete Temperatures	Hours of Additional Working Time							
	0.5 - 1 Hours	1 - 1.5 Hours	1.5 - 2 Hours	2 - 2.5 Hours	2.5 - 3 Hours	3 - 3.5 Hours	4 - 4.5 Hours	5 - 5.5 Hours
100°F - 109°F	5 oz./cwt	6 oz./cwt	7 oz./cwt	8 oz./cwt	9 oz./cwt	10 oz./cwt	11 oz./cwt	12 oz./cwt
90°F - 99°F	4 oz./cwt	5 oz./cwt	6 oz./cwt	7 oz./cwt	8 oz./cwt	9 oz./cwt	10 oz./cwt	11 oz./cwt
80°F - 89°F	3 oz./cwt	4 oz./cwt	5 oz./cwt	6 oz./cwt	7 oz./cwt	8 oz./cwt	9 oz./cwt	10 oz./cwt
70°F - 79°F	2 oz./cwt	3 oz./cwt	4 oz./cwt	5 oz./cwt	6 oz./cwt	7 oz./cwt	8 oz./cwt	9 oz./cwt
60°F - 69°F	1 oz./cw	2 oz./cwt	3 oz./cwt	4 oz./cwt	5 oz./cwt	6 oz./cwt	7 oz./cwt	8 oz./cwt

cwt - 100 lb of cementitious material



CEMENT BURN WARNING

Working with cement based products without proper use of the appropriate Personal Protective Equipment (PPE), especially in hot weather conditions, can damage the skin. "Cement burns" range from minor redness or irritation to serious chemical burns. For more information on working with cement based products, visit cemstone.com and search for Cement Burns.



This document should not be used as a substitute for competent engineering advice, experience or project specifications. Cemstone cannot be responsible for the misuse of this guidelines. Please contact your Cemstone Representative at **800-CEMSTONE** or go to cemstone.com for more information.

HOT WEATHER CURING & SEALING

Curing is a critical process to increasing the surface durability and service life of concrete. In hot weather conditions, it is even more critical as the concrete is vulnerable to drying due to high evaporation which can lead to shrinkage cracking, scaling, mortar flaking as well as other surface defects. This guideline will discuss the importance of curing in hot weather conditions, how to properly cure and the steps for sealing concrete.

CURING CONCRETE

Immediately following completion of finishing operations, efforts should be made to protect the concrete from low humidity, drying winds and extreme ambient temperature differentials. Properly cured concrete retains the water added at the time of batching to maximize the hydration process of the cementitious materials within the concrete. This curing process increases strength, abrasion resistance, freeze/thaw resistance and resistance to surface scaling. Curing also decreases permeability thereby extending the service life of your concrete. There are numerous methods of curing concrete, the key is selecting the best method and the appropriate duration of curing for the application and intended use of the concrete. Methods of curing include:

MOIST CURING

Moist curing is usually the best method for maximizing the surface strength and durability while minimizing early-age drying shrinkage of concrete flatwork. Examples of moist curing methods include:

- Ponding
- Covering the concrete with impervious sheeting or fabric mats kept continuously wet
- Continuous sprinkling

Alternating cycles of wetting and drying should be avoided, as it could result in craze cracking or insufficient curing. To avoid thermal shock, the temperature of water used for initial curing should be as close as possible that of the concrete.

CURING COMPOUND

When job conditions are not favorable for moist curing, the most practical method of curing is liquid membrane-forming compounds. When applied to concrete, these compounds form a membrane that prevents the internal moisture from evaporating, thus continuing the hydration process. **Note: The moisture-retention rate varies considerably between products.** Cemstone recommends the following when curing with membrane-forming compounds, i.e. curing compounds:

- Always follow the manufacturers installation instructions.
- Concrete surfaces exposed to direct sunlight should use heat-reflecting, white pigmented compounds where applicable (typically curb and gutter or municipal projects).
- In hot weather conditions, it is critical that a curing compound meeting ASTM C309 or C3515 be used in accordance with the manufacturers instructions to prevent surface moisture loss and continue the hydration process.
- Application of the curing compound should immediately follow the final finishing pass.
- The spray nozzle(s) should be positioned sufficiently close to the surface to ensure a consistent film application and proper application rate in accordance with the manufacturer's instructions.
- Curing compounds should not be used on any surface against which additional concrete or other materials are to be bonded.
- For information regarding cold weather curing, please consult Cemstone's Guide to Cold Weather concrete.

AKALI SILICA REACTION (ASR) SAND POP-OUTS

ASR occurs when alkalis (potassium and sodium) from Portland cement react with certain siliceous aggregates. When this reaction occurs, a gel is formed and in the presence of moisture, this gel expands causing internal pressure which often leads to surficial sand pop-outs. These sand pop-outs predominately occur in high evaporation rate conditions. To mitigate this, Cemstone has developed a curing compound, Cure & Seal Plus - ASR Sand Pop-Out Minimizer, that has been proven to minimize the effects of this reaction.

CURING IN HOT WEATHER WITH THE POTENTIAL FOR ASR SAND POP-OUTS

When ACI 305 hot weather conditions exist and there is the possibility of ASR sand pop-outs, apply Cemstone Cure & Seal Plus - Sand Pop-Out Minimizer immediately after final finishing is completed.

Please see Cemstone Cure & Seal Plus - Sand Pop-Out Minimizer data sheet for coverage rates, technical data, application instructions and other pertinent information.

CEMSTONE CURE & SEAL PLUS ASR SAND POP-OUT MINIMIZER



SEALING CONCRETE

Properly sealing concrete helps maintain the appearance and durability of the concrete after it has had adequate time to cure, which is approximately 28 days after placement. Sealing is designed to keep moisture and contaminants, like deicing chemicals, from penetrating into the concrete. Since sealers eventually will degrade from wear and environmental exposure and thus no longer function as intended, concrete should be sealed on a regular basis in accordance with the sealer manufacturer's instructions or as needed. Cemstone recommends the following when sealing your concrete:

- Always follow the manufacturers installation instructions
- Prior to sealing/resealing, an aggressive power washing or power brooming may be required to remove any dirt or stains from the concrete surface. For deeper stains that are not easily removed, contact your Cemstone Sales Representative for a list of products and methods designed to remove tough stains
- After power washing, the concrete surface must be allowed to dry for a period of 72 hours before applying any sealer material.

SEALING CONCRETE BEFORE OCTOBER 1ST

Based on the method of curing, sealing your concrete **before October 1** should be implemented using one of the following methods:

METHOD 1

Curing Method - Acrylic Based Curing Compound (Cemstone Cure & Seal, Cemstone Cure & Seal WB, Cemstone Cure & Plus - ASR Sand Pop-Out Minimizer, Cemstone Super Clear Coat or Cemstone Diamond Glaze)

Recommended Sealer - Acrylic Based Sealer (Cemstone Cure & Seal, Cemstone Cure & Seal WB, Cemstone Cure & Plus - ASR Sand Pop-Out Minimizer, Cemstone Super Clear Coat, Cemstone Diamond Glaze), or Cemstone Siloxane Final Seal which needs to be sprayed and aggressively back-rolled.

METHOD 2

Curing Method - Wet Curing or Dissipating Curing Compound

Recommended Sealer - Siloxane Based Sealer (Cemstone Siloxane Sealer) or **Acrylic Based Sealer** (Cemstone Cure & Seal, Cemstone Cure & Seal WB, Cemstone Cure & Plus - ASR Sand Pop-Out Minimizer, Cemstone Super Clear Coat, or Cemstone Diamond Glaze)

SEALING CONCRETE AFTER OCTOBER 1ST



Special precautions must be taken when sealing exterior concrete after October 1st. Contact your Cemstone Sales Representative for more information.

ACI (American Concrete Institute) 305

HOT WEATHER CONCRETING

Hot weather is any combination of the following conditions that tend to impair the quality of freshly mixed concrete by accelerating the rate of moisture loss and rate of cement hydration or otherwise causing detrimental results:

- High ambient temperature
- High concrete temperature
- Low relative humidity
- High wind speed
- Solar radiation

IT SHOULD BE NOTED THAT, HOT WEATHER CONDITIONS CAN OCCUR DURING THE SPRING, FALL AND WINTER MONTHS.

The following is a list of practices and measures designed to reduce or avoid the potential problems of hot weather concreting:

- Schedule a pre-placement meeting to discuss the requirements of hot weather concreting
- Select concrete materials and proportions with satisfactory records in hot weather conditions
- Reducing and controlling the temperature of the fresh concrete
- Use a concrete consistency (slump) that permits rapid placement and effective consolidation
- Minimize the time to transport, place, consolidate and finish the concrete
- Plan the job to avoid adverse exposure of the concrete to the environment; schedule placing operations during times of the day or night when weather conditions are favorable
- Protect the concrete from moisture loss during placing and curing periods

Potential hot weather problems for concrete in the freshly mixed state include:

- Increased water demand
- Increased rate of slump loss and corresponding tendency to add water at the job site
- Increased rate of setting, resulting in a greater difficulty with handling, compacting and finishing and a greater risk of cold joints
- Increased tendency for plastic shrinkage and thermal cracking
- Increased difficulty in controlling air entrained content

Potential hot weather problems for concrete in the hardened state include:

- Decreased strengths resulting from higher water demand
- Increased tendency for drying shrinkage and differential thermal cracking from either cooling of the overall structure or from temperature differentials within the cross section of the member
- Decreased durability resulting from cracking
- Greater variability of surface appearance, such as cold joints or color difference due to different rates of hydration or different water-cementitious material ratios (w/cm)

RESOURCES

Aggregate and Ready Mix Association of Minnesota

- Website: armofmn.com

American Concrete Institute

- ACI-305 Hot Weather Concreting
- Website: concrete.org

Concrete Network

- Website: concretenetwork.com

Iowa Ready Mixed Concrete Association

- Website: concretestate.org

National Ready Mixed Concrete Association CIP12 - Hot Weather Concreting

- Readable PDF copy at cemstone.com
- Available to purchase at nrmca.org

Portland Cement Association

- Website: cement.org

Wisconsin Ready Mixed Concrete Association

- Website: wrmca.com

CEMENT BURN INFORMATION

- Website: cemstone.com



CEMENT BURN WARNING!



EXPOSURE TO WET CONCRETE CAN LEAD TO SERIOUS INJURIES!

Working with concrete without proper use of the appropriate Personal Protective Equipment (PPE) can damage the skin. "Cement burns" range from minor redness or irritation to serious chemical burns.



ALKALI BURNS FROM WET CEMENT

When water is added Portland cement, calcium hydroxide is formed. This wet cement is caustic, i.e. a pH as high as 12.9 and can produce third-degree alkali burns after 2 hours of contact. Unlike professional cement workers, inexperienced finishers are usually not aware of the danger and may stand or kneel in the wet cement for long periods. As illustrated in a case report, general physicians may not recognize the seriousness of the injury in its early stages or the significance of a history of prolonged contact with wet cement.

All people working with wet cement should be warned about its dangers and advised to immediately wash and dry their skin if contact does occur.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

The best way to prevent cement-related skin problems, is to minimize contact with wet Portland cement. Compliance with OSHA's requirements for provision of PPE, washing facilities, hazard communication and safety training, along with the good skin hygiene and work practices listed below, will aid in protecting against hazardous contact with wet cement.

- Anyone who may come into contact with wet Portland cement should wear proper gloves. Consult with the glove supplier or the cement manufacturer's SDS for help in choosing the proper gloves. Butyl or nitrile gloves, rather than cotton or leather gloves, are frequently recommended for caustic materials such as Portland cement.
- Use only well-fitting gloves. Loose-fitting gloves can let wet cement in. Often the use of improper gloves and clothing makes the exposure worse when wet cement gets inside or soaks through the garment. Use glove liners for added comfort.
- Wash and thoroughly dry hands before putting on gloves. Wash and dry your hands every time that you remove your gloves.
- Follow proper procedures for removing gloves, whether reusing or disposing.
- To prevent wet cement from coming in contact with your skin, protect your arms and hands by wearing rubber gloves duct taped to a long sleeved shirt and your legs by wearing rubber boots duct taped to long pants.
- Wear protective goggles or face shield, hardhat and protective over-boots.



PPE Products are available at
Cemstone Supply
651.905.1500

SKIN CARE

- Wash areas of the skin that come in contact with wet cement in clean, cool water. Use a pH-neutral or slightly acidic soap. Check with the soap supplier or manufacturer for information on the acidity and alkalinity of the soap.
- Consider using a mildly acidic solution such as diluted vinegar or a buffering solution to neutralize caustic residues of cement on the skin.
- Do not wash with abrasives or waterless hand cleaners, such as alcohol-based gels or citrus cleaners.
- Avoid wearing watches and rings at work since wet cement can collect under such items.
- Do not use lanolin, petroleum jelly, or other skin softening products. These substances can seal cement residue to the skin, increase the skin's ability to absorb contaminants, and irritate the skin. Skin softening products also should not be used to treat cement burns.

DANGER - CONCRETE MAY CAUSE BURNS TO EYES AND SKIN!

ROUTES OF ENTRY AND HEALTH EFFECTS: WARNING: INJURIOUS TO THE EYE, CAUSES SKIN IRRITATION. READ THIS WARNING BEFORE USING.

SKIN/EYE CONTACT: Fresh ready-mixed concrete has an alkalinity level (pH) between 12 and 13; therefore, it may cause irritation and alkali burns, particularly when exposure is an area of skin previously subjected to abrasion or irritation. Prolonged or repeated contact may cause allergic dermatitis in sensitive individuals. Skin contact may cause local irritation of the affected areas. Preexisting skin conditions may be aggravated by exposure.

INGESTION: Unlikely, may cause irritation.

INHALATION: Fresh ready-mixed concrete does not pose an inhalation hazard. However, sawing, grinding, cutting, drilling or otherwise disturbing hardened concrete may contribute to elevated airborne respirable silica dust, which may cause silicosis. Always use appropriate respiratory protection in industry environments in accordance with OSHA Regulations.

EMERGENCY AND FIRST AID PROCEDURES: DANGER: MAY CAUSE BURNS TO EYES AND SKIN, READ BEFORE USING.

SKIN CONTACT: Wash skin with large amounts of soap and water. For minor irritation, apply a lanolin-containing cream to skin after washing. Contact a physician if persistent or severe irritation or discomfort occurs.

EYE CONTACT: Contact a physician immediately. Flush eyes with large amounts of water for at least 15 minutes.

INGESTION: Due to the nature of this material, it is unlikely that it will be ingested. If this does occur, remove individual from the area. If the individual is conscious, two or three glasses of milk or water should be provided to dilute stomach contents. Do not induce vomiting. Contact a physician or poison control center.

AVISO: CONCRETO MEZCLADO FRESCO PUEDE CAUSAR IRRITACIÓN DE LA PIEL, GRAVES QUEMADAS QUÍMICAS O DAÑO PERJUDICIAL A LOS OJOS!!!

(vea el lado contrario para precauciones)

- Evite contacto con la piel y lárese pronto las partes expuestas con agua.
- Si el polvo del cemento o la mezcla fresca de concreto le cae en los ojos, enjuáguese los ojos inmediatamente y repetidamente con agua y obtenga pronto atención médica.
- Evite contacto indirecto a través de la ropa. Enjuague la ropa que y estado en contacto, cemento con el concreto, cemento o mortero mojado.
- Las siguientes clases de ropa debieran ser usados para obtener contacto mínimo con la piel cuando se usen estos productos:
 - botas de caucho altas y ajustadas suficiente para impedir el contacto
 - guantes de caucho
 - pantalones largos metidos dentro de las botas
 - cojincillo impermeables para los rodillos
 - gafas ahumadas que la queden bien pegadas a los ojos

No Corra el Riesgo!

CEEB TOOM: COV XIS MAS UAS NYUAM QHUAV TOV TAU MUAJI PEEV XWM UA KOM YUS TEJ TAWV NQAIJ MOB KHAUS, MUJA TSHUAJ KUB, LOSSIS UA KOM QHOV MUAG PÚAS.

(xyuas sap nrauv kom paub txhuag)

- Ua knm cov tawv nqaij txhob muja Mob, muab dej ntxuav kom huv si.
- Yog cov hmoov lossis cov xis mas uas nyuam qhuav tov tau nkag rau hauv qhov muag yuav tsum tau maub ntxuav tamsim ntawd thiab if sij txuav ib lwm thiab yuav tau muab tschuaj rau.
- Tsis txhob pub kom cov hmoov xis mas paug rau cov khaub ncaws. Maub cov khaub ncaws uas paug lossis lo xis ntxhua.
- Yog yuav tov lossis pua xis mas yuav tsum hnab cov khaub ncaws raws li nram no:
 - rau cov khau roj hmab siab, rau cov khau kom mws siab es cov xis mas thiaj li nkag tsis tau
 - rau hnab looj tes roj hmab
 - hnab ris ntev, muab ntswas rau hauv nkawm khau
 - rau cov looj hauv caug thaiv dej
 - rau cov iav taiv qhov muag

Tsis Txhob Kav Liam!