HAHN READY MIX

Hot Weather Concreting

Technical Bulletin #7

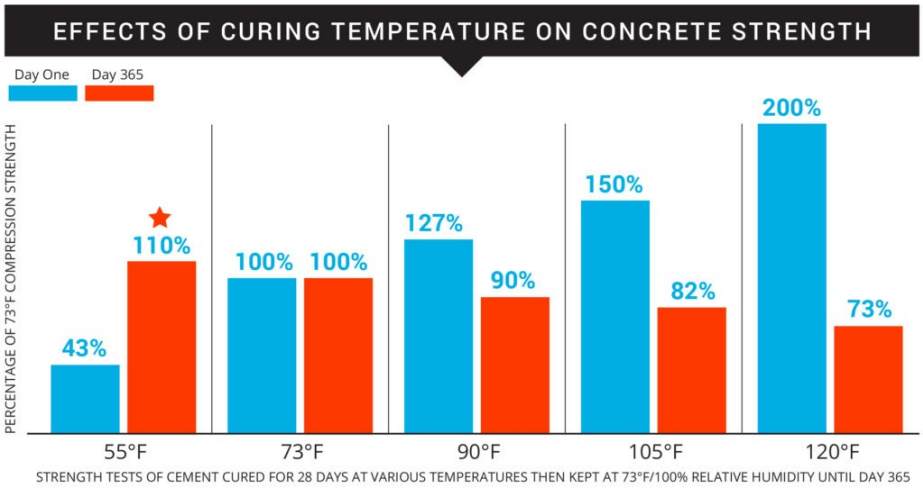
The Weather is Heating up…

And we still have lots of concrete to pour. Let's take a look at the impact of pouring concrete in hot weather, and what we can do to mitigate some of the negative effects of hot weather concreting.

It's probably best to think of this tech bulletin as a continuation of last month's bulletin on Evaporation Rates & Plastic Shrinkage Cracking. Many of the lessons from that bulletin are best followed in the hot summer months and could easily fall under the umbrella of hot weather concreting. For this month, we are going to focus more on the setting time limitations of concrete in the summer.

As mentioned in Technical Bulletin #2 Cold Weather Concreting, concrete setting times are heavily influenced by concrete temperatures. A good rule of thumb is that concrete setting times are cut in half or double with every 20° change in concrete temperature, depending on the direction of that change. For example, a mix that reaches initial set in 8 hours at 50°, will take 4 hours at 70°, and just 2 hours at 90°. In addition, pouring concrete at high temperatures means a quicker strength gain curve… likely you will be able to reach design strength much earlier in the summer. However, everything else being equal, a mix poured at high temperatures will eventually be outperformed by a mix poured at more

reasonable temperatures.



As you can see, hot concrete performs much better on day 1, but is significantly outperformed by cooler concrete at 1 year. Additionally, hot concrete mixes will have a tougher time entraining air, which is a concern for freeze-thaw durability. And finally, hotter concrete loses slump much quicker than cool concrete, and excessive additions of water can cause the concrete to flash set, leading to cold joints and unfinishable concrete. Thus, often the goal in the hot summer months is to pour concrete as cool as possible, and let it cure as cool as possible. How do we make that happen?

Mix Design Options

- - Use Supplementary Cementitious Materials (SCM's) like fly ash and slag. These materials hydrate and react less quickly than cement. By replacing some of our cement with these products, we can slow our setting time, lower the heat of hydration, and allow the concrete to cure more coolly.
- - Use a retarder/hydration stabilizer. These admixtures inhibit or slow the hydration reaction to cement. A hydration stabilizer, such as Recover, acts by metaphorically calling a “timeout” to cement hydration for a period of time, and then resuming it's earlier trajectory. A retarder affects some of the hydration actions in a cement grain, but not all, which can result in unpredictable elongated set delays or a “catch up” period where the concrete sets rapidly once the admixture has worn off. A hydration stabilizer is often preferred for it's increased accuracy in effecting set times, and will buy finishers more working time in warmer temperatures.

Chilling the Concrete

- - The quickest and easiest way to chill concrete is to use cooled water, where available. In general, you can cool a concrete mix by 1° for every 4° of water chilling. Typically, it is difficult to get more than a 10° effect of cooling through chilled water.
- - Another often used strategy is to replace mixing water with ice. In a dry batch plant, replacing nearly all of the water with ice can result in about 20° cooling of the concrete temperature. In a wet batch plant, the concrete needs to be able to flow out of the central mix drum and into the ready mix truck. This limits the amount of water that can be replaced with ice to about 2 bags/yard. In a wet batch plant, 10° degrees of cooling through ice is often the best that can be achieved. This method also limits production speed, as handling many bags of ice to toss into mixer drums is inevitably slower than the plant can operate.

- - Liquid Nitrogen is an extreme method for drastically cooling concrete. It is an effective, but often prohibitively expensive method for cooling concrete. Hahn Ready Mix no longer currently has this option available.
- - Aggregate stockpiles need to be sprinkled during hot, dry weather. There are two main benefits to this: one, evaporative cooling brings down the aggregate temperatures in the stockpiles, which in turn reduces the concrete temperature. Two, it's important that the aggregates in a stockpile not be in an absorptive state, or they will suck the free water right out of the mix and cause drastic slump loss in transit. If a mixer driver has ever shown up to your job with a 1" slump and claimed it was a 6" when he left the plant, absorptive aggregates is likely the cause.
- - Another trick is to spray down the mixer drum with water periodically throughout the day. The evaporation of that water from the surface of the drum will cool the drum and help prevent it from overheating and cooking the concrete.

Placement & Finishing Tips

- - As the window for finishing and placing concrete in the summer months is much narrower, it's a good idea to have extra help on hand to make sure quick-setting concrete doesn't get away from the finishers.
- - Make sure some thought is put into your planned pour rate. Having the trucks arrive too quickly can cause the concrete to get hot and old in the mixers and leave you with little time to get it placed and finished. Conversely, having the trucks spaced too far apart can leave you with a cold joint.
- - Avoid the hottest times of the day, if possible. On a typical day, the ambient temperatures are highest between 1pm and 4pm. Consider pouring early in the morning to avoid these times.
- - Be cognizant of the evaporation rate and take precautions against excessive evaporation.
- - Cure the concrete *as soon* as finishing operations are complete.

Specifications

It is good to be aware of concrete temperature specifications that might be present on your project. It is not uncommon to see 90° concrete temperature limits. These limits may or may not be appropriate, depending on the type of pour that is being done, but it's important not to be surprised by the limits the day of the pour. Illinois DOT has a 90° limit for all concrete placements, except bridge decks where the limit is 85°. Iowa DOT has no limit for concrete temperatures except on bridge decks, where the limit is 90°. Mass concrete may have more restrictive limits that require more extreme methods of cooling. Please let your concrete supplier know of these kind of specifications during the bidding process.

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