HAHN READY MIX

What's the deal with Water Reducers?

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We established last month that water-cement ratios are key to understanding the potential quality of a concrete mix. However, we also discussed the lack of correlation between w/cm ratio and slump in today's concretes. How is that possible? Water reducers.

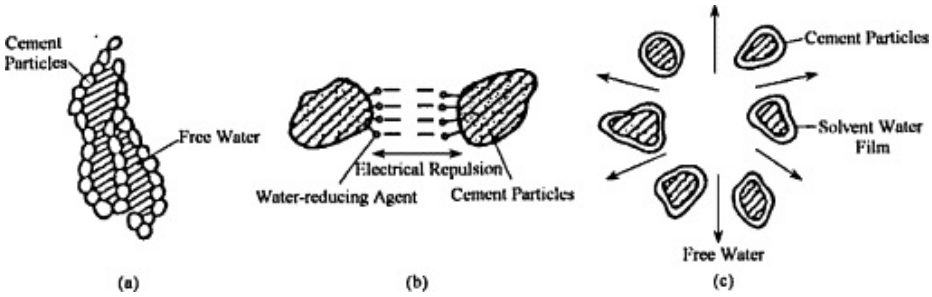
Water reducers are a chemical admixture that is added to a concrete mix, typically to achieve one or more of the following three goals:
1) Decrease w/cm ratio while maintaining slump and workability at an existing level.
2) Increase slump and workability while maintaining w/cm ratio at an existing level.
3) Decrease cement contents at a target workability level and w/cm ratio.

In other words; make the concrete better without sacrificing ease of finishing, make the concrete easier to finish without sacrificing quality, or make the concrete cheaper without sacrificing quality or finishability. Often the third of those options is built in to mix designing just about everywhere, and stronger water reducers are used to achieve the first two options if necessary. Using water reducers to achieve these goals often results in higher strengths,

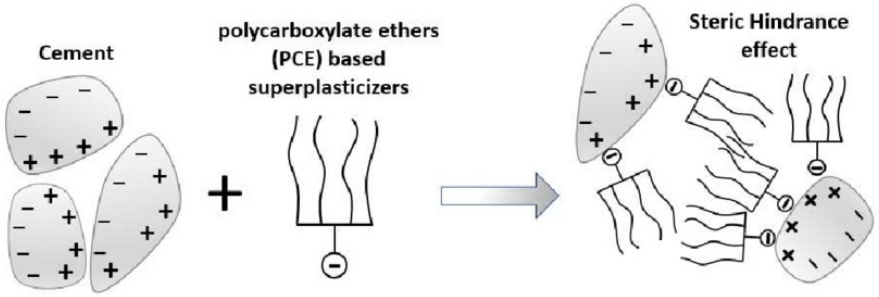
What kind of water reducers are out there?
Water reducers largely fall into three categories: Normal-range water

reducers, Mid-range water reducers, and High-range water reducers (Superplasticizers).

Normal-Range Water Reducers are classified as ASTM C494 Type A admixtures and are typically made from salts of lignosulfonates (from the wood processing industry) or hydroxylated polymers (such as corn syrup). These water reducers work by coating cement particles and imparting a negative charge, causing the cement grains to magnetically repel each other. This releases trapped free water and disperses the cement grains. Normal range water reducers have a 5-10% water reduction or can increase slump by up to 2". A normal range water reducer, such as GCP's WRDA 82, is often standard in any mix from most ready mix producers.



High-Range Water Reducers are classified as ASTM C494 Type F admixtures, but are often known as superplasticizers. There are kind of two generations of superplasticizers, with the traditional ones being made of naphthalene or melamine. These superplasticizers had a very short window of extreme water reduction, making it necessary for them to often be dosed on site. This is why it is common to see specifications reference a slump on site before *and* after addition of a HRWR. The newer generation of superplasticizers are made with polycarboxylate ether (PCE), and have a significantly expanded life span of water reduction. The newer generations generally perform better when added to the concrete mix at the batch plant like a typical water reducer. PCE's work by attaching physical “combs” to the cement particles magnetically which then physically keep the cement particles at an optimum distance from each other, again freeing up trapped water. Superplasticizers are best for making concrete with a slump greater than 6" and can range from 12-40% water reduction, depending on dosage rates. Some of the Superplasticizers in Hahn Ready Mix's arsenal are ADVA575 (PCE), Daracem 19 (Naphthalene), and Concera (PCE + VMA).



Mid-Range Water Reducers are classified as both Type A and Type F admixtures by ASTM C494. These are often low-power PCE's and are meant for 5-7" slumps (about 2" more than a normal-range water reducer would offer), and have a 5-18% water reduction. GCP's MIRA 62 is a common mid-range water reducer.

A common misconception is that mid-range or high-range water reducers can be added to a mix design and it automatically allows a variance from

specified slumps on a jobsite. Unfortunately, it is still the engineer of record's decision as to if the addition of a water reducer allows a change in the slump specifications. There is a movement in the concrete construction field to eliminate slump specifications in most instances, which would pave the way for concrete mixes to be designed in a manner that allows for the highest possible quality and ease of placement and finishing.

What other benefits to water reducers provide? In particular with HRWR's, the even dispersion of the cement grains allows them to hydrate uniformly and can significantly increase the potential strength of a mix design... even at the same w/cm ratio and cementitious contents. A HRWR is essentially a necessity to achieve ultra-high strength concrete.

Are there any downsides to water reducers? As with most anything in life, there can be too much of a good thing. A HRWR dosage that is too high can result in not enough water in the mix design. This can lead to issues where the mix is difficult to pump, is “sticky” and doesn't close up well. Issues could arise with proper air build as water is necessary for an air entraining agent to work properly. In an extreme case, there might not be enough water to fully hydrate the cement grains and the mix could prematurely self-desiccate, causing excessive shrinkage cracking. Therefore, caution should be used when dealing with high dosages of HRWR so that the mix design is not “starved” of water.

All in all, water reducers are one of the most important and versatile tools of modern concrete, allowing us to create concrete that vastly outperforms the concrete of generations past.

See Previous Tech Bulletins

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