Concrete Trends

Not Your Father's Concrete

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Concrete sculpture: Stealth-Atlanta.

Concrete is the most widely used material in the world. With U.S. cement consumption at 3.4M metric tons through May and 9.4% growth over the same period in 2015, it is safe to say that concrete plays a significant role in nearly all types of construction projects (PCA July Monitor, 2016).

With such widespread use, it is easy to recognize that concrete is also a very versatile material. A wide-ranging rheology, the ability to develop strengths in excess of 10,000 psi and withstand harsh climates and corrosion make it clear why concrete is used in everything from our national monuments to art. A key point to remember is that concrete is a composite material; it is only as good as its weakest component. Additionally, concrete, as good as it seemingly is, still has some inherent flaws. The development of many admixture technologies was founded on the fact that the quality of materials and their respective properties vary widely and to improve upon some of the known gaps in concrete as a composite material. Concrete chemical admixtures help account for this variability by altering or improving various aspects of the mix and ultimately bring out the full potential of concrete as we know it today. However, many engineers know very little about concrete mix design and available products on the market that can unlock the full potential of concrete as a building material.

As engineers and specifiers, it is in the best interest of engineers and specifiers to know and understand the concrete admixture technologies available, how they can improve various concrete properties and the respective impacts they can yield on projects such as labor/material cost savings and improved construction schedules. ACI 212.3R-16 is the newly released Report on Chemical Admixtures for Concrete by the American Concrete Institute. This document provides a comprehensive review of all current admixture technologies, respective material properties, applications, the effect on plastic and hardened concrete, quality assurance and concrete production.

Among the leading trends is concrete durability enhancement. As the cost of structures increases so does the need to keep these structures in service for as long as possible. This effectively reduces the life-cycle costs and aids in the investment decision from a time-value of money perspective. The design community answered this trend with many prescriptive code based requirements all with durability in mind. Several admixture technologies at the forefront of this trend are:

- Shrinkage Reducing/Compensating Admixtures,
- Permeability Reducing Admixtures

Limiting and preventing cracks protects the high alkaline environment that the concrete inherently creates. This, in turn, protects the reinforcement from corrosion. This is one of the most important attributes of concrete durability and one of the hardest to achieve consistently, but that is all about to change. A new shrinkage reducing/compensating admixture will be coming to market soon that has the potential to generate a shrinkage neutral concrete, effectively, non-shrink concrete.

Permeability reducing admixtures (PRA) address another known characteristic of concrete, its porosity. PRA can be used to effectively reduce concrete's ability to absorb water either through capillary absorption or through application under hydrostatic pressure. Moisture is a leading contributor to corrosion within the concrete. Keeping moisture away from the reinforced zones within concrete can improve overall concrete durability.

Structure geometry is becoming more complex and more congested with reinforcement as design forces increase and the design envelope is pushed. Self-consolidating concrete (SCC) is an underutilized resource available to engineers to better ensure concrete placement quality and reduce structure cost. Other technologies, like hardening accelerators, help concrete achieve near design strength in 24 hours. Time-saving features allow forms to be pulled more quickly and improve construction sequencing, which can represent major cost savings to contractors and owners.

Most importantly, concrete should not be considered an unchanging material within standard specifications that work, without modification, for everything. Each project, each location represents a new set of variables to consider. So review your specifications while considering your project objectives. Utilize prescriptive specifications as required by design codes to establish certain minimums/maximums. Outside of what is prescribed by design codes, keep specifications more performance based. Performance-based specifications allow the ready mix producer flexibility to optimize mixes while still meeting design and durability requirements. In the end, there is a unique and optimized solution that exists, with the right combination of chemical admixtures.▪

Lincoln Memorial reflecting pool-Washington D.C.

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