



Chemical Admixtures & White Cement

Introduction

Lehigh White Cement Company is committed to your success, with technical personnel who understand the interactions between white cement and common chemical admixtures ready to assist you. This technical bulletin discusses considerations experienced users of gray portland cement may overlook when making the switch to white cement. It is not intended to supplant the role of admixture suppliers who are the authorities on their products. Admixture company personnel have a comprehensive understanding of their materials and we encourage you seek out these professionals early and often.

Admixtures

Modern portland cement concrete, including white cement-based mixes, rely on chemical admixtures to optimize their performance and reliability. Chemical admixtures are liquid solutions or dry compounds that when added to concrete during the mixing process can improve and/or control set times, workability, air content and hardened properties of the mix. They most often achieve these goals by altering the physical and chemical interactions of the cement and water to modify the paste portion of the mix.

Admixtures are powerful tools that aid placement and enhance a structure's service life; however, they are not a substitute for sound concrete mix designs and placement practices. In addition to contacting your admixture supplier and Lehigh White Cement sales representative, we recommend the following references for more information on admixtures:

- ACI E-4 (12) Education Bulletin E4-03, Chemical Admixtures for Concrete
- ACI 212.3R-16, Report on Chemical Admixtures for Concrete
- ASTM C494-19 Standard Specification for Chemical Admixtures for Concrete

Admixture Interactions - Low, Mid and High Range Water Reducers

Chemical admixture/cement interactions normally correlate to the admixture base chemistry. Section 4.1 of ACI Education Bulletin E4-03 explains that it is appropriate to categorize chemical admixtures by basic or primary ingredients.

Common types of admixtures include polyether-polycarboxylates or "polycarboxylate-based", lignosulfonic acids and their salts or "lignin-based", sulfonated melamine or naphthalene formaldehyde condensates e.g. "naphthalene-based" and hydroxylated Polymer admixtures. Many of these basic types can be combined with carbohydrate-based or sugar-based derivatives which have some water reduction properties but are most often used as retarders to delay set times.

Polycarboxylate-based admixtures have become the most widely used class of concrete admixtures in North America. These engineered materials feature mid to high water reduction and often yield good early strength development. They come in a wide range of formulas that tend to be cement specific in their interactions and mix performance. Contact your admixture supplier for advice and ask about their experience with the white cement source you are using. They may need to consult within their company to gain first-hand knowledge of what admixtures work best with our White Cement.

Lehigh White Cements can also be combined with lignin and naphthalene-based admixtures. At standard doses, cement interaction with these classes of admixtures tends to be predictable and consistent. High doses of lignin-based admixtures or admixtures containing sugar derivatives can cause severe delay of set times in some cases. Polycarboxylate and naphthalene-based admixtures should not be combined in Lehigh White Cement Concrete mixtures, as these products are often not compatible with one another.

Section one of ASTM C494-08, the Standard Specification for Chemical Admixtures for Concrete says, “Mixtures having a high range water reduction generally display a higher rate of slump loss. When high-range admixtures are used to impart increased workability..., the effect may be of limited duration, reverting to the original slump in 30 to 60 min depending on factors normally affecting rate of slump loss.” Rapid slump loss, especially during warm or hot periods, can be a significant issue in white cement/polycarboxylate admixture combinations. It is often necessary to add a “Workability Enhancing Admixture” or choose an alternative plasticizer to mitigate avoid this issue.

Polycarboxylate admixtures, with proven track records of successfully being combined with white cement, are usually formulated to provide extended slump life and are sometimes referred to as “long acting.” Slump retention is often improved by adding low to moderate doses of hydration stabilizers which delay hydration activity and are preferable to traditional retarders because they have minimum effect on initial strength gain.

Lehigh White Cement strongly encourages personnel designing mixes which utilize polycarboxylate-based admixtures to consult their admixture company and inquire what products work best with the white cement they are planning to use. Lehigh White Cement’s technical representatives typically have excellent insight into this issue and should be consulted as well. This is especially true if your admixture sales representative has limited experience with white cement.

Self-Consolidating Concrete, aka Self-Compacting Concrete

Self-Consolidating Concrete (SCC) is a highly fluid yet cohesive form of concrete. It will flow around congested areas of reinforcement and into tight sections and complicated forms, allowing air bubbles to escape without the need for using vibrators – all while resisting segregation.

Most SCC employs specialized high-range water reducers (superplasticizers) or several chemical admixtures combined with well-graded aggregates to achieve a balance between fluidity and cohesion. Typical admixture combinations include low or mid-range water reducers, along with superplasticizers for flowability and viscosity modifiers for cohesion. *Note:* Mixes combining multiple admixtures are sometimes hard to control and may become unstable. We advise customers planning to produce SCC consult with your admixture supplier and or Lehigh White Cement’s Technical representatives.

Supplemental Cementitious Materials

Supplemental Cementitious Materials (SCM’s) are used successfully in many white cement applications. When used appropriately, they can improve workability, strength and durability in white or gray cement concrete. It is important to note that SCMs like fly ash and GGBFS (slag cement) and silica fume are by-products from other industrial processes and are typically produced with no regard to color.

Fly ash is a combustion by-product of coal-fired power plants and has a high potential to discolor white or decorative concrete. Many slag cements are off-white in color but can impart a bluish-green hue that usually dissipates in time. Most silica fumes are very dark in color making them unsuitable in color sensitive mixes, however there are white and or off-white silica fumes now available in the market. SCM combinations should be checked in trial mixes for appearance.

Metakaolin is produced by pyroprocessing amorphous, alumino-silicate kaolin clays. It is often used in color sensitive concrete due to its light cream to pinkish color. Ground glass, pumice, and other “natural pozzolans” can be produced to a light, or off-white color. These products have also been successfully combined with white cement for architectural mixes. Each of these product’s color will depend on the consistency of the raw material source or feed stock, which can vary.

If you do not have a good working history with a given SCM, Lehigh White Cement recommends mock-ups be produced to see what effect a SCM may have on the finished concrete color. We also advise requiring the SCM supplier to produce historical samples for an extended period of time or otherwise demonstrate that the product will be a consistent color.

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