Florida Department of Transportation Research

Evaluation of Shelf Life in Post-Tensioning Grouts

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Current Situation

Prestressed concrete is used in many prefabricated concrete structures, such as segmental and girder bridges. Prestressing is often accomplished by passing steel cables through ducts in the concrete, which is known as post-tensioning (PT) tendons. These PT tendons are tensioned to prevent the concrete from cracking under traffic load. The ducts are filled with a cementitious grout that hardens and bonds the cables to the concrete, as well as protecting them from the corrosive effects of humidity and salt. However, in recent years, grout that has retained moisture and not hardened has been found in bridges in Florida and elsewhere. This "soft grout" can cause severe corrosion, weakening PT tendons.

Research Objectives

University of Florida researchers studied the effect of heat, humidity, and time of exposure on the setting behavior of prepackaged grout products. Testing was also conducted on some of the constituents of post-tensioning grouts.

Precast, prestressed concrete is used in many bridges and overpasses.

Project Activities

Grout, like concrete, is formulated with Portland cement, but it contains no aggregate. Instead, other very fine materials may be added to increase its fluidity, curing time, hardness, and durability. The fresh mixture of grout must be smooth, flow well through prestressing PT ducts, and make good contact with the PT tendons. Dry grout mix is sold in heavy paper bags that are usually stored at a job site until needed. In Florida, this means that the bags can be exposed to high temperatures and high humidity for an extended period of time.

Five grout products were tested under four combinations of temperature and relative humidity (RH): 95°F and 95% RH; 85°F and 85% RH; 65°F and 50%-70% RH; and 65°F and 45%-65% RH. Samples of the following constituent materials were also tested: Portland cement; supplementary cementitious materials (SCMs), including fly ash, slag cement, and silica fume; and admixtures, including high-range water reducers, corrosion inhibitors, anti-bleed admixtures, pumping aids, and air-entraining agents.

An extensive program of testing focused on identifying material changes that might explain the formation of soft grout. After exposure, grout samples were tested by preparing a mixture and injecting the fresh grout into 15-ft by 3-in tubes that contained prestressing cables. This test determined if soft grout would form. For comparison, the material properties of small-scale grout samples were determined, including mass gain and particle size distribution. These same small-scale tests were run on SCMs and admixtures that were used to produce the grout. This thorough examination produced much new information. The researchers found that all grout products exposed to more extreme conditions for long enough would produce soft grout. They recommended a screening procedure to prevent the use of grout likely to form soft grout.

Project Benefits

A better understanding of construction processes can prevent the need for costly repairs operations and can support safer, more reliable, and more cost-effective post-tensioning construction.

For more information, please see www.fdot.gov/research/.