

Comparative Analysis on Reducing Concrete Shrinkage and Cracking

A Closer Look at Four Commercially Available Shrinkage Reducing Admixtures as well as Two Low-Shrinkage Repair Mortars for Water Infrastructure Concrete Projects

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For critical structures where very low shrinkage is needed, such as spillway slabs or areas of large repair or great joint spacing is required, a shrinkage reducing and compensating product should be specified. Products such as Prevent C, Masterlife CRA007, or equal, should be acceptable.

Mission Issue

By allowing more modern shrinkage reducing admixtures Reclamation can reduce concrete costs during procurement and labor cost by increasing the distance between joints.

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Problem

Concrete cracking due to shrinkage is a common issue in construction. Internal strain can be generated by restraint, temperature, chemical shrinkage, and/or drying shrinkage. Joint spacing is generally selected using rules of thumb which were primarily based on older cement chemistries but during construction, requests are often made to extend the distances between joints and/or eliminating joints to increase the speed of construction and save in scheduling costs. Although many products and techniques claim to have an effect on concrete cracking, there is very little consistency in the testing and very little data available to compare the crack resistance of a concrete material to help Reclamation designers and specifiers make more appropriate materials selections.

Solution

Shrinkage reducing additives have been on the market for several years, but recent technologies have been developed to further decrease the risk of cracking due to shrinkage. New technologies allow crack widths to be minimized, which decreases the fluid ingress and subsequent deterioration if cracking does occur. This research compared four commercially available shrinkage reducing admixtures as well as two low-shrinkage repair mortars and tested them all using the same procedures and conditions.



Restrained shrinkage tests on modern admixtures show decrease in crack width and a greater time to cracking.

“Shrinkage reducing admixtures are an effective way to reduce the cracking potential of concrete.”

Catherine Lucero
Civil Engineer
Reclamation

Collaborators

U.S. Army Corps of Engineers
Engineer Research and
Development Center

More Information

<https://www.usbr.gov/research/projects/detail.cfm?id=7644>

<https://www.usbr.gov/research/projects/researcher.cfm?id=2176>

Application and Results

Reclamation's Concrete, Geotechnical, and Structural Laboratory performed testing in Denver, Colorado. The results show that modern shrinkage reducing admixtures, including those with expansive components, perform well in reducing the drying shrinkage of concrete in both the free drying test and the restrained shrinkage test. Reclamation specifications should continue to specify a traditional Shrinkage Reducing Admixture when moderate shrinkage reduction is required. For critical structures where very low shrinkage is needed, such as spillway slabs or areas of large repair or greater joint spacing is require, a shrinkage reducing and compensating product should specified. Products such as Prevent C, MasterlifeCRA007, or equal, should be specified.

Future Plans

Reclamation's Concrete, Geotechnical, and Structural Laboratory continues to research ways to improve concrete technology in a beneficial and cost effective way for Reclamation's water infrastructure projects. Future interested include additional testing on more expansive products and how they impact water conveyance concrete placements, new shrinkage reducing and compensating (expansive) products as they enter the market, testing over the full range of a products' dosage, the effectiveness of shrinkage reducing and shrinkage compensating admixtures in combination with fly ash, slag, or air entrainment, additional repair mortars, and colloidal nano-silica and carbon nano-tube technology for additional applications.