

GEOPOLYMER MORTAR SOLUTIONS

How to avoid cold joint shear failure by using GeoSpray® geopolymer mortar

BACKGROUND

On real world construction sites, unexpected and unanticipated circumstances can result in delays or work stoppages. Additionally, many job sites can be subject to restricted work hours due to local traffic issues or community related ordinance.

When working with the placement of cement, these types of work stoppages or delays can result in the formation of a cold joint. A cold joint is an undesired discontinuity between two layers of concrete. A cold joint occurs due to the inability of a freshly poured wet cement to intermingle and bind with an already hardened cement. A typical cold joint in a poured structure is shown in **Figure 1**.

Cold joints can result in multiple problems ranging from minor to catastrophic. The spectrum of resulting issues include: minor cosmetic visually differences between layers, possible moisture intrusion into the joint resulting in degradation from environmental conditions, and areas of significantly compromised strength within a structure.

The Geopolymer Advantage

When water is mixed with portland cement (OPC) the cement reacts with the water to form a hydrate allowing the cement to harden around aggregates and form concrete. The chemistry of the reaction uses a hydration mechanism to create a hardened solid phase structure. However, once the hydration is complete and the structure is solid, it will not tie in or chemically intermingle with additional cement.

Geopolymers undergo a completely different set of reactions classified as condensation. This process creates large polymer molecules that react to form large chain molecules that create the solid structure. When a fresh geopolymer mixture contacts a hardened geopolymer, the polymer molecules from the hardened geopolymer are still active and will chemically bond with the new mixture preventing a cold joint from forming.



Figure 1. An example of a cold joint formed in a concrete wall.



www.geotreesolutions.com

+1.855.655.6750

GEOPOLYMER MORTAR SOLUTIONS

How to avoid cold joint shear failure by using GeoSpray geopolymer mortar

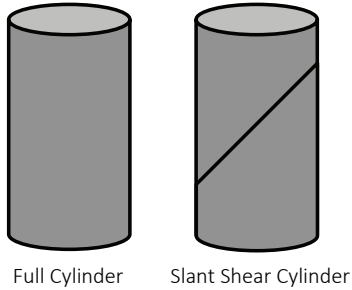


Figure 2. Diagram of slant shear cylinders used to test cold joints.



Figure 3. GeoSpray geopolymer slant shear cylinders tested in compression don't have cold joints.



Figure 4. Cylinders of the common pipe rehab OPC product shear on the cold joint in all cases tested.

Testing

To demonstrate the superior properties of GeoSpray geopolymer mortar as compared to OPC materials with respect to cold joints, a series of compression tests were conducted using 2 inch by 4 inch cylinders.

On the first day of the experiment, full cylinders were poured of GeoSpray geopolymer and an OPC based material. Both materials are used in structural pipe repair. In addition to the full cylinders, ½ pours of the same size were produced with both materials and vibrated on a slant to create an approximately 45° angle in the lower portion of the cylinder (as shown in Figure 2). At intervals of 1, 7, 14, & 28 days, a second pour atop the first pour (of the same material) was completed. All samples were then compression tested according to ASTM C39.

Results

- For all combinations, the full cylinders poured on day 0 have no joints and break in standard compression failure throughout the cylinder.
- For the GeoSpray geopolymer samples with the 45° joint, compression failure mode is the same as the full cylinder even when 28 days have elapsed between pours.
- The common OPC pipe repair material breaks along the cold joint in all of the test intervals. This shows that the cold joint formed in the OPC is the weakest part of the structure.

Conclusion

The chemical nature of GeoSpray geopolymer mortar resists the formation of cold joints and allows for more flexible scheduling on the job site. The testing shows that a monolithic material results with GeoSpray even with 28 days between application. This ensures behavior as a single structure when applied in multiple layers.



www.geotreesolutions.com

+1.855.655.6750