Concrete in general is a popular material for underground construction and repairs. It is relatively inexpensive, stable, strong, and – for the skilled craftsman – easy to use. Portland cement concrete, from the 19th century, has been the standard for generations but it has its limitations. It requires quite a lot of water to hydrate, which sometimes causes bleeding. Most importantly, it does not set very quickly and it also has a tendency to shrink. This shrinkage leads to cracking, which in turn affects the durability of the final concrete structure.

Portland cement concrete can be accelerated with organic additives that can be expensive, have a short shelf life and require additional handling equipment to keep the material in suspension on a jobsite.

Calcium sulfoaluminate (CSA) cement has recently emerged as an innovative alternative to Portland cement for tunneling and underground construction projects. Chemically speaking, calcium sulfoaluminate cement is very different from Portland cement. The active compound in the cement is calcium sulfoaluminate and is also called Klein’s compound, from Alexander Klein who invented it in the 1950s. The hydration process for CSA cement involves the very rapid development of ettringite needles within the structure of the cement paste causing rapid strength gain. This cement was modified in the 1970s primarily as a concrete repair material. To date, the California Department of Transportation
CSA cement grouts formulated to flow easily and effectively in post tensioning grouts. They are suitable for cable bolting, rock bolts and various applications whenever non-shrink grouts are required.

GROUTING. CSA cement grout can be used for rapid placement applications where high strength and fast set times are required. They have been used to repair spalls in roads and to patch tunnel walls and crowns. A unique feature of CSA cement is the ability to use up most of its hydration water. CSA concrete mix can also, as an alternative to premixing, be placed into standing water and mixed in place. The result is a hard, permanent wearing surface for trucks and equipment within an hour. This method works well both on surface and in underground applications. Such applications are not within the scope of Portland cement concrete as the set time is often too long. With CSA cement it is also possible to match the elastic modulus of the repair material to that of the existing concrete ensuring a permanent and stable bond. The fast setting time and strength gain (3,000 psi compressive strength in one hour) allow reopening to traffic within hours.

REPAIR. CSA cements have been used for decades in repair applications where high strength and fast set times are required. They have been used to repair spalls in roads and to patch tunnel walls and crowns. A unique feature of CSA cement is the ability to use up most of its hydration water. CSA concrete mix can also, as an alternative to premixing, be placed into standing water and mixed in place. The result is a hard, permanent wearing surface for trucks and equipment within an hour. This method works well both on surface and in underground applications.

CONCLUSION

CSA cements as both standalone hydraulic cements and as a cementitious additive to enhance Portland cement. Standalone cements are generally preferred for their consistency.

CSA cement is a proven growing technology for the underground construction industry. The fast set time, high strength, low porosity, high chemical stability and sulfate resistance make it a material uniquely suited for underground repairs, shotcrete and other applications as needed. It can be used to replace portland cement concrete when durability and quick turn-around time is required.

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CTS Cement Manufacturing Corp. is the leading manufacturer of advanced calcium sulfoaluminate (CSA) cement technology in the United States. Our Komponent® and Rapid Set® product lines are renowned for proven performance, high quality, and exceptional service life. Contact CTS Cement for support on your next project. Call 1-800-929-3030