KRYSTALINE
WATERPROOF CONCRETE

Krystaline C-S-H Technology Overview

Krystaline Technology S.A., manufacturer of waterproofing admixtures for concrete and surface applied solutions, uses a unique proprietary C-S-H technology to provide the next generation of integral waterproofing systems.

The Krystaline "C-S-H technology" base provides a new and exceptional manufacturing component that allows Krystaline to enhance the hydration process of concrete/mortar. The improvement to the hydration process allows significantly improved development of calcium silicate hydrate within the micropore structure of the concrete/mortar while slowing down the development of calcium hydroxide, providing long term solutions and allowing the increased durability and sustainability of concrete.

What are the advantages of C-S-H Technology over traditional crystalline?

The optimized calcium silicate hydrate development when using Krystaline's C-S-H technology allows many advantages compared to traditional crystalline technologies such as:

- Dramatically better waterproofing capabilities in both short and long term
- Outstanding ability to perform in high hydrostatic environments and conditions
- Notable increases to concrete compressive, flexural, and tensile strengths
- Verifiable 28-day reductions in specific surface area, total pore volume, and average pore size diameter
- Remarkable and proven ability to self-heal cracks up to 0.5 mm
- Certification and approval as a replacement for waterproofing membranes
- Certification and approval as a replacement for waterproofing coatings
- Extraordinary increases in the durability and the sustainability of concrete

The reduced development of calcium hydroxide development in the concrete when using Krystaline C-S-H technology allows the following advantages compared to traditional crystalline technologies:

- Prevents leaching, thereby avoiding strength loss and increased porosity over time
- Reduces the risk of carbonation, a process which promotes corrosion
- Reduces risk of deterioration due to the formation of gypsum and ettringite
- Increases the durability and sustainability of concrete

The advantages are plentiful for each of the Krystaline products manufactured with C-S-H technology, but they all share the overall single greatest common advantage as follows:

Lower Cost
(compared to quality competitors)

Better Results
(compared to ALL competitors)

Best Cost To Quality Ratio in the Industry

How does C-S-H technology work?

Krystaline C-S-H technology functions through catalysis to improve hydration between cement particles and water. This helps to boost the development of calcium silicate hydrate while decreasing the rate of calcium hydroxide production in the concrete. The enhanced C-S-H gels and crystals are bigger, longer, thicker and there are many more of them to fill the pores and capillaries.

The increased development of the strong, non-soluble, C-S-H gels and crystals within the micropore structure continually develop in the presence of water or humidity, even many years later. Since concrete may hydrate for many years in the presence of moisture, C-S-H treated concrete will continue to develop for many years until the moisture has been stopped.

What does C-S-H technology require to function well?

Krystaline C-S-H technology requires 3 basic components to function properly, they are:

1. Cement

A reasonable cement content must be present within the concrete/mortars for Krystaline's C-S-H technology to properly function.

2. Water

The enhanced hydration process required for the development of calcium silicate hydrate within the concrete/mortar needs water.

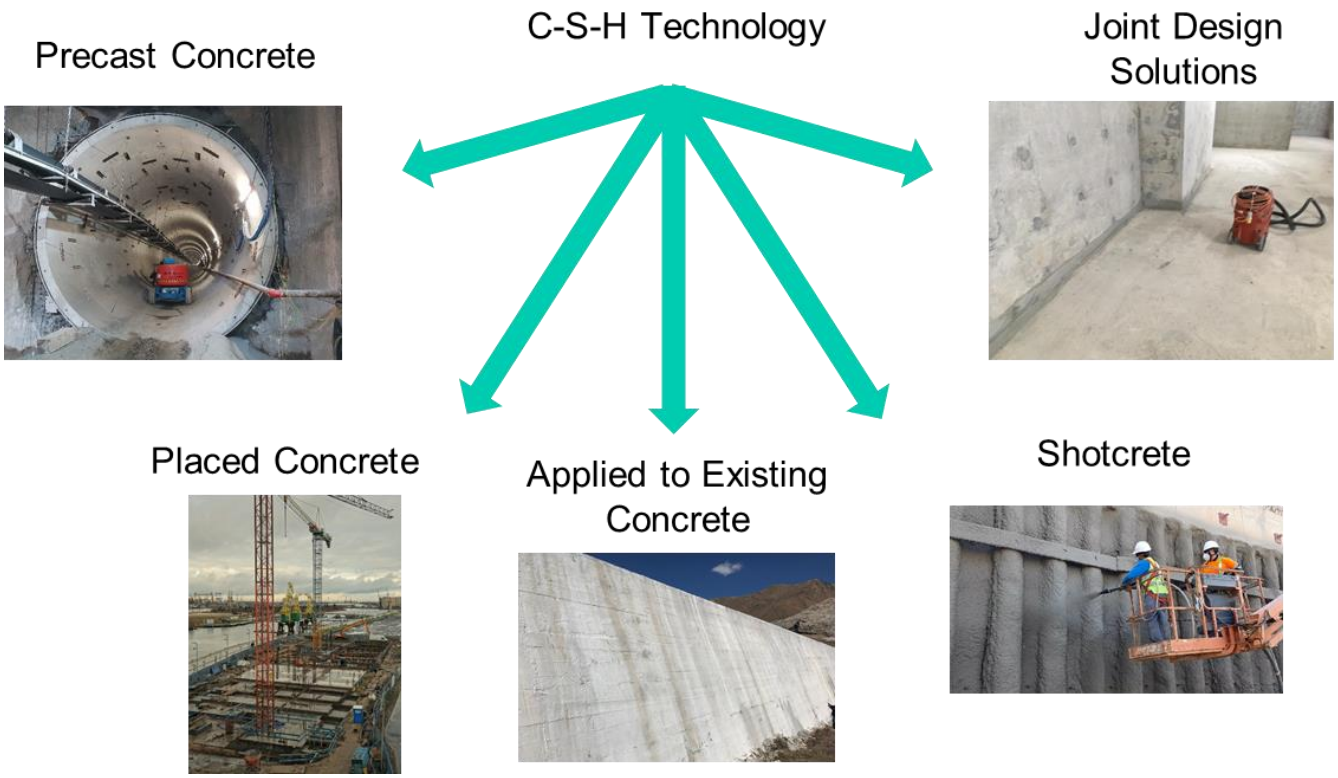
3. Time

The hydration of the concrete/mortar requires time. As the hydration process continues the calcium silicate hydrate enhancement will continue. The concrete/mortar will continually become stronger and less permeable.

How does the C-S-H technology transfer through the concrete?

Krystaline's C-S-H products rely on adsorption to move the C-S-H technology through the concrete. As Krystaline's C-S-H technology develops enhanced gels and crystals within the micropore structure, these enlarged gels and crystals encounter additional un-hydrated cement particles and in the presence of water continue the enhanced hydration process. This process follows the path of water eventually leading back to the source of the ingress. Since C-S-H technology promotes the enhanced reaction between the cement and the water using catalysis the process is never used up.

Where can C-S-H technology be used?



WATERPROOFING THE WORLD

Important Facts

Portland Cement facts

- Calcium silicates compose approximately 75% of the weight of Portland cement.
- When reacted with water (hydration) Portland cement results in 2 new components calcium silicate hydrate and calcium hydroxide.
- The calcium silicate hydrate is the most important concrete binder and is considered the glue that hold concrete together.

Calcium Silicate Hydrate facts

- Calcium silicate hydrate = calcium oxide (CaO) **+** Silicon Dioxide (SiO_2) **+** Water (H_2O) and is formed during the concrete hydration process
- The creation of calcium silicate hydrate occurs during both the short term and long term hydration process.
- Calcium silicate hydrate determines the physical and mechanical properties of the concrete including setting conditions, tensile and compressive strength, and the dimensional stability of the concrete.
- Calcium silicate hydrate occurs at the nano level.
- Calcium silicate hydrate is non soluble binder
- Calcium silicate hydrate is considered a hybrid as its structure shares both crystalline and gel-like characteristics.
- Increased calcium silicate hydrate will result in a reduced micropore structure.

Calcium Hydroxide facts:

- $Ca(OH)_2$ (calcium hydroxide) also known as Portlandite and referred to as CH in cement chemistry notation, grows within the capillary pore space
- Calcium hydroxide will only grow in free space, when it encounters another calcium hydroxide crystal it will grow in another direction.
- Calcium hydroxide is the weakest and most soluble of the hydration products.
- Calcium hydroxide will leach out of the concrete increasing the permeability of the concrete.
- Calcium hydroxide combined with carbon dioxide and moisture will lead to carbonation of the concrete.
- Calcium hydroxide can have deterioration effects in sulphate rich environments, where sulphate ions react with $Ca(OH)_2$ to form gypsum which then reacts with the hydration products of C3A to form ettringite

Important Definitions

Catalysis - a modification and especially increase in the rate of a chemical reaction induced by material unchanged chemically at the end of the reaction.
https://www.merriam-webster.com/dictionary/catalysis

Adsorption - the adhesion in an extremely thin layer of molecules (as of gases, solutes, or liquids) to the surfaces of solid bodies or liquids with which they are in contact.
https://www.merriam-webster.com/dictionary/adsorption