

The advantages of C.S.A. cement

Calcium sulfoaluminate cement

What is CSA Cement?

Calcium Sulfoaluminate cement (CSA Cement for short), was developed in China. This special cement distinguishes itself from Portland cement by a high-speed bonding, fast strength development, and a shrinkage reduction. CSA Cement has been used for decades as a binder in concrete for bridges, airport start- and runways, concrete road-repair, and many other applications where a quick reuse is required. Nowadays, CSA cement is also used in dry mortars for self-levelling floors, levelling compounds, casting mortars, tile adhesives, grouts, etc.

Fast bond.

The initial set of the CSA cement begins after approximately twenty minutes and its final set is then arrived after ten more minutes. With the use of retarders, the processing time can be considerably extended. Even in low temperature environments CSA cement maintains its reactivity unlike other cement types.

Rapid Strength Development

When CSA cement is applied to concrete or mortars it vastly increases its strengths and its strength development. Compared to Portland cement, mortars and concrete with CSA will achieve the same strength within 24 hours where Portland takes 28 days.

Shrinkage compensation

There are several criteria that show the shrinkage compensative characteristics of CSA cement:

1. The tension that occurs during hydration is build up in a much shorter timespan compared to traditional cements.
2. CSA cements require more water compared to Portland cement – 0,35 versus 0,25 for Portland. However, the water is chemically completely bound causing **no** water surplus. It is the water surplus that occurs with other cement types and is the cause for shrinkage, cracking, and warping.
3. During the hardening phase a chemical and stable expansion occurs that prevents further shrinkage over time.

Short curing phase

All hydraulic binders need to be prevented from drying to rapidly. With very fast binders the temperature development is often so explosive that it leads to further moisture loss. The temperature development in CSA cement is significantly lower and shorter, which results in a “curing” stage of only several hours. This guarantees durable and stable strengths.

Low alkali

CSA cement forms predominantly the following phases:

C4A3S	Ettringite	Anhydrous calcium sulfoaluminate	$4\text{CaO}\cdot 3\text{Al}_2\text{O}_3\cdot \text{CaSO}_4$
C2S	Belite	Dicalcium silicate	$2\text{CaO}\cdot \text{SiO}_2$
Di-hydrate	Gypsum	Gypsum calcium sulfate	$\text{CaSO}_4\cdot 2\text{H}_2\text{O}$

The main phases of Portland cement are calcium trisilicate (C3S) responsible for the initial strength at approximately 60% and calcium disilicate (C2S) the main phase at approx. 20%, responsible for the strength over time.

CSA cement does not form any free lime like Portland cement, which results in a lower alkali content. The pH of CSA lies at 10.5-11 whereas Portland has a pH of 13. Thusly the alkali-silica reaction is reduced and makes it a suitable product to combine with glass fibre and sand substitutes like glass. CSA cement does not or hardly work with pozzolan such as silica fume, fly ash, metakaoline, etc. These additions would sooner have a negative effect than a positive one in combination with CSA because no free lime exists.

Reduced CO₂ emissions

CSA cement is considered to be a green binder because of the following factors:

1. CSA cement is calcined at 1250°C (2250°F) whereas Portland is calcined at a temperature of 1500°C (2700°C).
2. CSA clinker is much softer compared to Portland clinker, which reduces the energy requirement during grinding.

It is estimated that the production of Portland cement is responsible for approximately 8% of the total, worldwide emission of CO₂. Carbon dioxide is released in the air when CaO changes to CaCO₃ during calcination. For every 1000kg (2200 lbs) of Portland cement produced, 579kg (1275 lbs) of CO₂ is emitted. This is solely based on the chemical reaction, regardless of the fuel used during production. Understandably the use of fossil fuels would further increase this number.

In contrast the production of CSA cement emits 216kg (476 lbs) of CO₂ for every 1000kg produced, which shows a 62% reduction compared to the production of Portland. The production of CSA cement has the lowest emission of CO₂ compared to other alternative cements such as magnesium cement (Sorel), sodium metasilicate (water glass), and calcium aluminate cement.

CSA-OPC ratio

CSA cement can be divided into two main types:

1. Calumex: a ye'elinite-based system. Replaces Portland cement at a ratio of approx. 1:2.
2. Belicem: a belite-based system. Can be used as a 100% replacement of Portland cement.

Colour

Calumex and Belicem are both a creamy, light colour. In addition, there is now a Calumex WHITE CSA, which has a guaranteed whiteness of 85%. All types are easy to colour with the aid of iron oxides or other pigments.

Cost

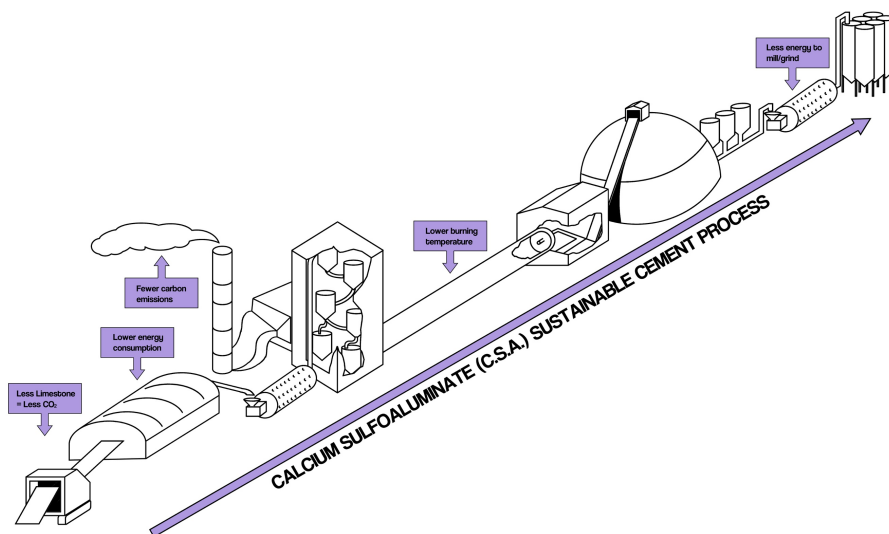
The price of CSA cement per ton is higher compared to traditional cements. However, the advantages mentioned such as rapid set, high early strength, and shrinkage reduction makes it a very versatile addition or replacement of Portland. These characteristics are very suitable in formulations for tile adhesives, repair mortars, water plug, self-levellers, and many more. Furthermore, CSA can be applied in the production of precast concrete where rapid demoulding increases productivity and thus profitability. Likewise, it is suitable for acid-treatment, polishing, or blasting even after six hours.

Special attention

When new to CSA cements there are a few factors to consider before formulation. The quick set and the water demand, require special attention to ensure a positive end result. Furthermore, a higher water, material, or ambient temperature may accelerate binding times as well as increasing the mixing speed. We ensure a stable product but keep in mind the different variables in Portland cement when used together.

Conclusion

With over thirty years of experience in CSA cements, Caltra prides itself on developing and manufacturing several CSA-based products such as the Calumex Quick, Belicem CSA, Calumex EA, Calumex Q-XP, and the Calumex WHITE. We aim at assisting formulators in the building chemistry sector on how to apply CSA to their system. With a high quality control and state-of-the-art production facility we are able to provide a high quality and stable product.



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