

HiPerCem® – A New Refractory Binder Concept



Refractory producers as well as other types of manufacturers are facing a growing demand for durable, high performance products that require increasingly sophisticated raw materials. For refractory castables, the hydraulic binder plays an important role, which impacts:

- Rheology • Setting characteristics • Sintering and chemical resistance



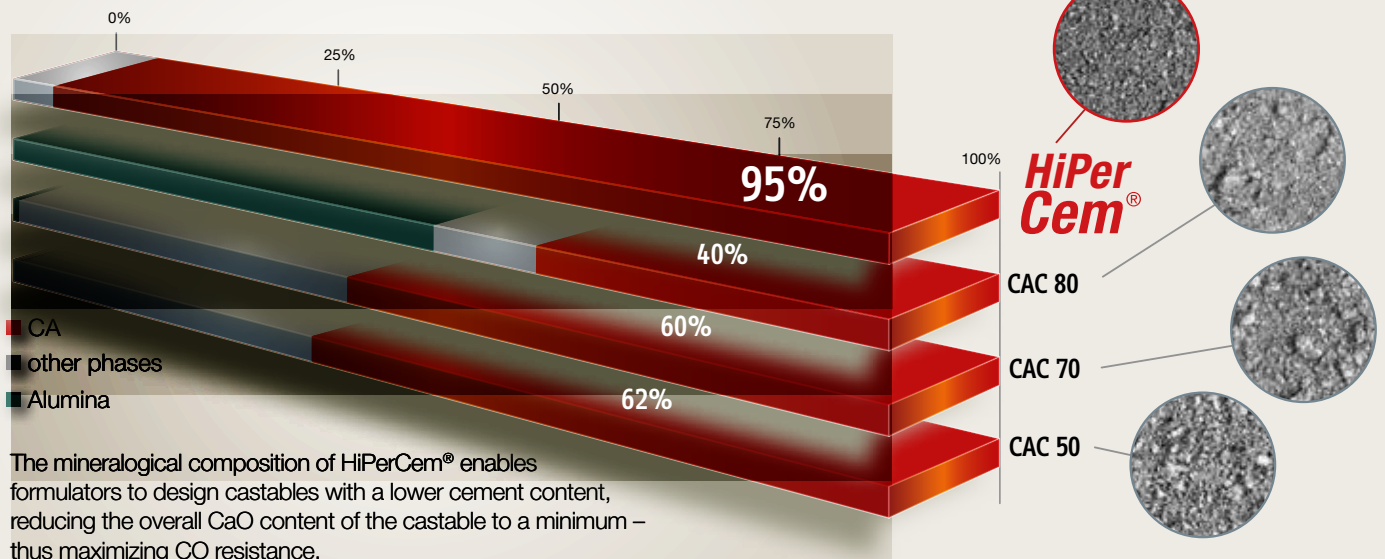
HiPerCem® – FOR HIGH PERFORMANCE REFRACTORIES

The new CALUCEM HiPerCem® calcium aluminate cement (CAC) provides a solution for the formulation of highly sophisticated refractory castables. The innovative HiPerCem® product concept focuses on combining the reactive CAC components with an optimized particle size distribution and the specific surface. HiPerCem® provides refractory formulators and manufacturers extended possibilities in developing castables; either to improve existing regular castables or optimizing the formulation of deflocculated castables. The HiPerCem® advanced product technology provides customers with additional formulation flexibility either by:

- **improving the technical properties of the castable or**
- **reducing the overall cost of the complete formulation**

Calcium aluminate cements are mixtures of different mineral phases. The most important hydraulic phase is mono-calcium-aluminate-CA. It directly influences the setting and hardening properties of a cement or castable. Traditional refractory grade CAC contain phases like CA_2 , C_2AS , Alumina, $C_{12}A_7$ that provide little to no hydraulic benefit or may even disturb the desired setting characteristics of the castable. HiPerCem® maximizes the reactive phase, CA, while reducing less desirable phases to a minimum. This result is achieved by carefully selecting raw materials and processing them in a proprietary production process.

MINERALOGICAL COMPOSITION OF CA-CEMENTS



The mineralogical composition of HiPerCem® enables formulators to design castables with a lower cement content, reducing the overall CaO content of the castable to a minimum – thus maximizing CO resistance.

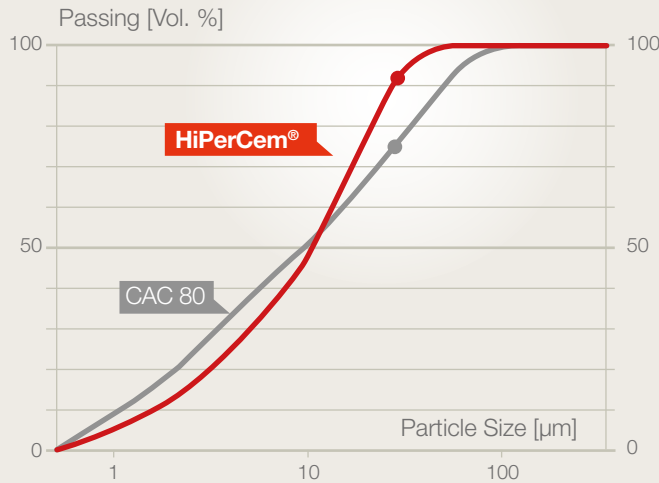
Moreover, the customer is completely free to adjust the binder system with their choice of alumina sources, which need not be fixed to the alumina content in CA Cement.



PARTICLE SIZE DISTRIBUTION

Due to its specific particle size distribution and specific surface, HiPerCem® shows excellent flow properties in a castable mix together with an optimized blend of aluminas.

At a constant flowability, the castable mixing water content can be significantly reduced, with the resulting improvement in high temperature castable performance.



Flow Behaviour Standard Castable



HiPerCem® applicable to	
Castable Type:	• RC • MCC • LCC
Installation Method:	• Vibrational • Self Flow • Gunning

of the resulting castable is capable of hydraulic bonding. The 25% CAC 80 can be replaced by approx. 10% HiPerCem® as it offers nearly the same amount of CA.

This leaves 15% more of the castable for other admixtures and aggregates. It enables the use of either lower cost materials or can improve the technical performance of a castable.

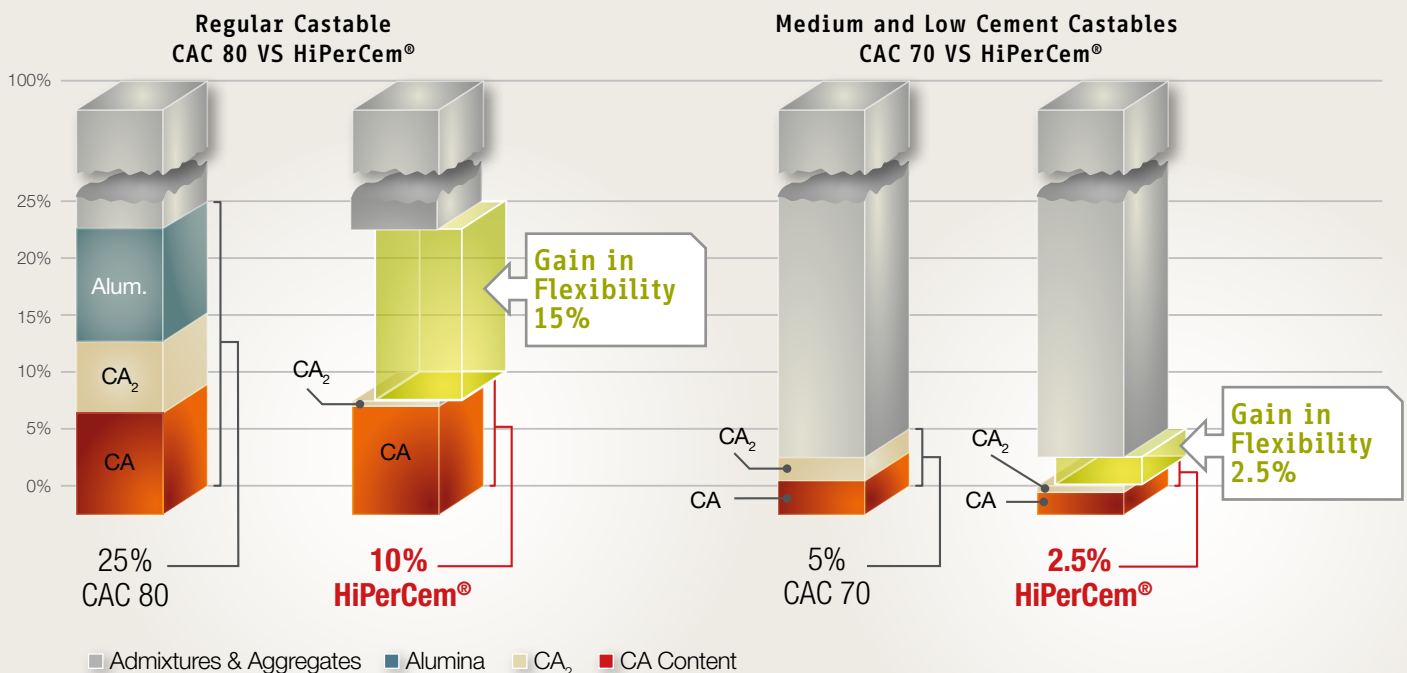
When using a standard CAC, the formulation designer must adjust the cement content in their formulation to account for the mineral phases in the cement that have little or no hydraulic benefit.

This not the case with HiPerCem®, as there is no filler, only CA. Two examples illustrate this advantage when comparing commercially available CAC 70 and 80 products applied in a castable. The formulation designer is able to convert a standard Regular Castable (RC) into a Medium Cement Castable (MCC).

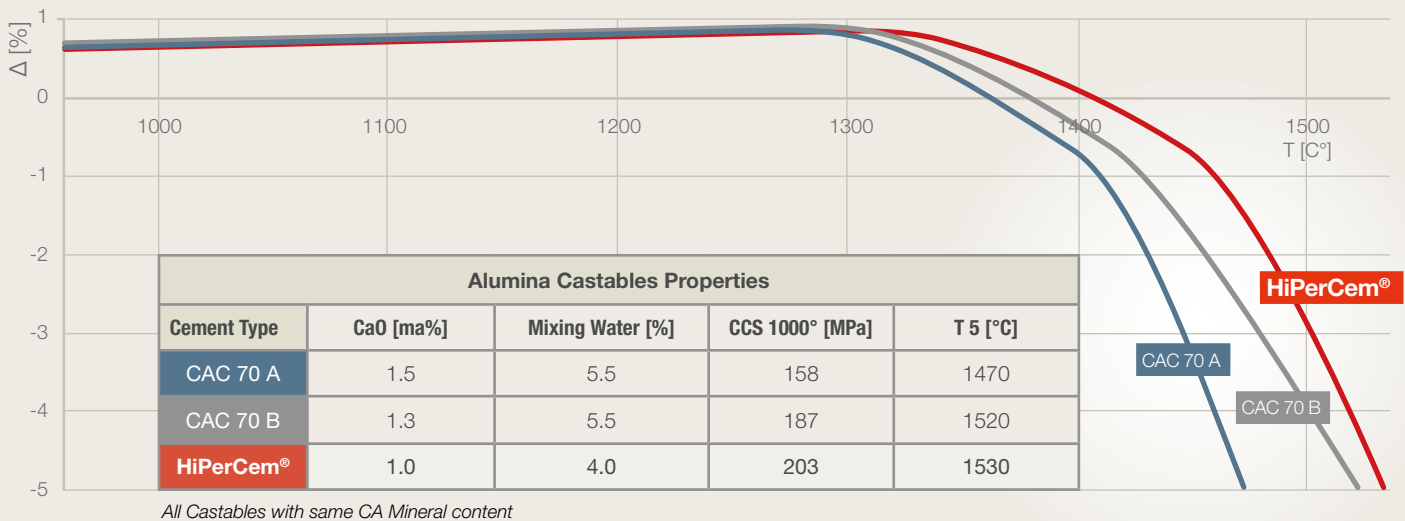
This becomes more obvious when a commercially available CAC 70 in a MCC & low cement castable (LCC) is replaced by HiPerCem®. The 5% CAC 70 content of the castable represents approximately 3% CA in the overall refractory formulation. It can be replaced by approximately 2.5% HiPerCem®, thanks to HiPerCem®'s high CA content and special particle size distribution.

The other 2.5% in the HiPerCem® based formulation is the gain in flexibility. The formulator can choose performance and /or cost optimization by selecting his preferred admixtures and aggregates.

In this example, a commercially available CAC 80% is used at a level of 25% in a regular castable formulation. However, because of the presence of inert materials in the CAC 80, only approximately 10%



HiPerCem® – REFRACTORINESS UNDER LOAD (RUL)



The specific product design of HiPerCem® optimizes the combination of the fines in the binder system. Thus the same rheological behavior is achieved at a lower water content. As a consequence the strength under load – here investigated in a LC castable based on sintered alumina – is higher than with a commercially available CAC 70. HiPerCem® allows for more

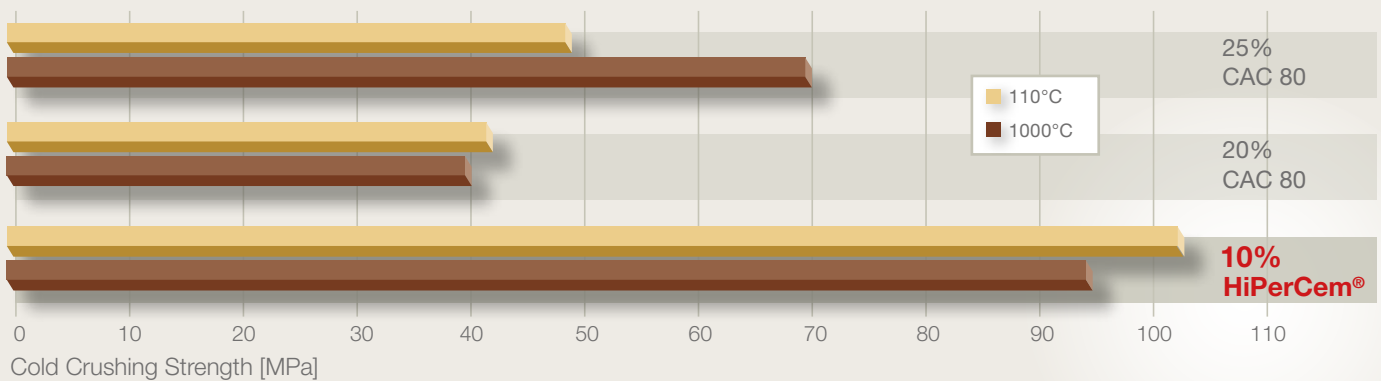
sintered reactive components to be integrated in a castable formulation, suppressing the overall CaO content. This positively influences the refractoriness of the castable and is one of the main criteria for the ultimate performance of the castable.

HiPerCem® – Excellent Rheology – High Strength – High Refractoriness

HiPerCem® – COLD CRUSHING STRENGTH (CCS)

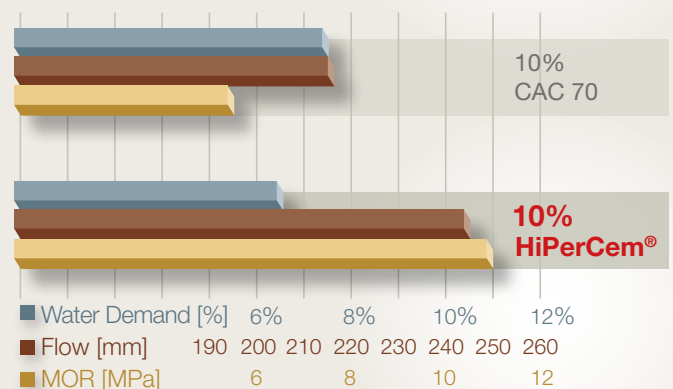
The outstanding characteristics of HiPerCem® are easily demonstrated when compared to other commercially available CAC's with a standard composition and particle size distributions. HiPerCem® can be used with all typical raw materials and also with all admixtures which are necessary for the optimization of the technical performance of a castable.

The difference becomes apparent when comparing a standard CAC 80 to HiPerCem® in a castable based on sintered alumina. Rheology and strength evolution can be optimized in a very versatile manner.



HiPerCem® – WORKABILITY

In spite of a lower water demand, HiPerCem® yields a significantly better flow, and a slightly higher bulk density. A much higher cold crushing strength after drying and after firing at the critical transition temperature of 1,000°C is also achieved with HiPerCem® in alumina based castables. HiPerCem® provides the same benefit in Fireclay based Medium Cement Type castables. Optimizing your formulation with HiPerCem® creates a new type of efficient refractory castables. Test the new concept by choosing other admixtures, aluminas and aggregates. Keep the cement content in your castables at a minimum and gain maximum castable performance.





Commercial

- ▶ Higher Flexibility in Raw Material Selections
- ▶ Lower Admixture Dosage in Castable Formulations
- ▶ Lower Cement Dosage in Castable Formulation

Technical

- ▶ HiPerCem®-Mineralogy for Maximum Hydraulic Binding
- ▶ HiPerCem®-Granulometry for superior Workability and Refractoriness
- ▶ RCC/MCC/LCC Formulation with one Binder type

HiPerCem® – IN SHORT

- ▶ Maximizes hydraulic mineral phases
- ▶ High formulation flexibility
- ▶ Special particle size distribution for optimum flowability
- ▶ Low water demand
- ▶ Robust installation properties
- ▶ Excellent strength and abrasion performance upon heating
- ▶ High temperature Resistance
- ▶ Strictly monitored production process for consistent and superior product quality

HiPerCem® – CHARACTERISTICS

Al ₂ O ₃ [ma%]	CaO [ma%]	Fe ₂ O ₃ [ma%]	SiO ₂ [ma%]	CA-Mineral Content [ma%]	Blaine [cm ² /g]	Sieve Residue 63 µm [%]	Pyrometric Cone Equivalent [°C]	Specific Gravity [g/cm ³]
> 62.5	< 37	< 0.3	< 0.9	> 90	> 4000	< 5	1560 – 1580	2.9 – 3.1

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Disclaimer:

All data in this brochure are based on laboratory tests which had been carried out according to the state of the art and the best of our knowledge. The data may vary according to the formulas, admixtures and grain size distributions used.

As the data do not refer to standard quality assurance procedures, the results shown in this brochure cannot be taken as base for any claims against CALUCEM, as well as for rejection of deliveries.

Please consult our Technical and Safety Data Sheets and ask our technical staff for detailed information.

