WE PROTECT YOUR CEMENT PROCESS

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We protect your process



HASLE Refractories has been manufacturing refractory products for more than 100 years and since 1980 specialized in producing materials for the cement industry.

It is our mission to offer the best castable- and precast solutions to enable the cement industry improve the run factor, energy efficiency and lower their carbon footprint. In close collaboration with installers and customers, we continuously improve our materials and solutions in order to be at the leading edge.

Refractory products for cement plants

HASLE Low Cement Castables (LCC's) are characterized by having a very dense and strong matrix developed to withstand the challenges of modern cement production, where alternative fuels are customary. Alkali-resistant castables with low open porosity and high strength based on high-grade refractory materials of high chemical purity make up the backbone of our product range.

Resistance to abrasion

Clinker and air-born raw meal generate high abrasive wear on refractory linings in cement plants. To simulate the abrasive environment in wear zones. the abrasion resistance is measured as material loss after sandblasting at high temperatures according to international standards.



Testing the resistance to abrasion. ASTM C704

All HASLE LCCs have excellent resistance to abrasion: less than 5 cm3 material loss.



Heavy abrasion on a Burner Pipe lining

Build-up and coating formation

Build-up and coating can be a major problem in a cement plant, causing reduced process efficiency due to restricted airflow. This can end up jamming the process, leading to time-consuming removal of the build-up material, which often requires a shutdown. The more dense the lining, the lower the risk of chemicals penetrating the surface and of build-up forming.

Chemical attack

Vapors of chlorine, sulfur, and alkalies (especially potassium and sodium) are the main corrosive



Feed-pipe lined with other castable facing severe build-up



Chemical attack and abrasion at cooler bull nose

agents in alternative fuels. These compounds can penetrate into refractory materials and react with the alumina-silica structures, whereby new crystalline minerals are formed. This causes an increase in volume and hence cracking and spalling of the lining.

Along with low porosity, HASLE LCC's have a high SiO2 content, which is achieved by combining several selected raw materials in both matrix and aggregates. This ensures a unique alkali-resistance.

The 5 most critical areas of a cement plant

Thermal shock

The ability to withstand thermal shock is important because this causes the formation of cracks in the lining. These cracks open the surface for chemical attack and build-up, hence reducing the mechanical strength. The size and thermal conductivity of the aggregate grains define the thermal shock resistance of a refractory lining. Coarse grains and shock-resistant raw materials are combined in several of our LCCs.



Determination of cold modulus of rupture. EN1927-6



Determination of cold crushing strength. EN1927-6

Ensured quality

All HASLE castables are made exclusively from virgin materials to ensure no impurities. The properties of HASLE LCC's are achieved not only by choice of raw materials, but also by an optimal particle size distribution. We continuously carry out tests in our laboratory of the physical properties to ensure the highest possible quality.

Installation is key to achieving the best performance

To ensure the best performance of the refractory lining it is important not to compromise on the installation practice followed on-site. First, a proper anchor design is key along with sufficient expansion joints. For the casting method itself, mixing, water addition, application, and vibration should be carried out thoroughly. Subsequently, a curing time of 24 hours is recommended irrespective of the thickness of the lining.





Water addition is crucial for the strength of the lining.

It is crucial that the first drying out of the lining is carried out carefully to ensure the safe escape of both excess pore water (at approx. 100 to 150°C) and chemically bonded water (at approx. 175-350°C). After the water is removed safely, the temperature can be raised more quickly to the final operating temperature.





The conditions in different cement kilns, and in different parts of the kilns, vary considerably. No two kilns have the same raw materials, fuels or processes. Therefore the responsible for refractory maintenance has to focus on the specific areas of the kiln which need special attention.

Preheater - the lower part

Due to a large variety of alternative fuels and impurities in the raw materials, there is often build-up and chemical attack in this part of the preheater. If this is the case then a brick lining or a gunned lining will not be suitable. The porosity is too high and the chemicals will have easy access to the refractory matrix. Here the best solution is a low porosity, low alumina LCC with high strength - and above all very high resistance to alkali attack due to the increased usage of alternative fuels being charged into the preheating process.



HASLE D59A-ht after 36 months in conical part of the lowest-stage cyclone - Thailand



HASLE D59A installed in calciner Thailand – at installation and after 29 months

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HASLE D59A-ht in riser duct and inlet chamber – at installation and after 36 months - Thailand

Nosering and burner pipe

These two areas are subject to extremely harsh conditions facing very hot temperatures and high abrasion, further enhanced by the use of alternative fuels and the associated chemical attacks on the lining.





Burner pipe lined with HASLE D52A – at installation and after 6 months - Vietnam



To maximize the lifetime of the burner pipe refractory, the lining can be preheated. We have seen lifetimes exceeding 12 months by utilizing this method

Hence the demands for the refractory require high strength and thermal shock resistance along with high resistance to abrasion and mechanical impact. Here the best solution is a low open porosity, medium alumina LCC with high strength as well as a low open porosity to achieve high resistance to alkali attacks.

Kiln hood and Grate Cooler

In modern grate coolers and kiln hoods the temperatures are now higher and the loading on the refractory lining is more severe. Great care is needed in the design of the lining – choice of hot-face castable, insulation and its thickness along with anchor design are all important elements for a successful lining achieving a long lifetime.

Tertiary Air Duct and Damper

The lining quality in tertiary air duct areas needs to be exceptionally resistant to abrasion due to high-velocity clinker dust.



Nose ring cast with D52A in the Middle East - at installation and after 8 months



Cooler bull nose cast with HASLE D59A in combination with HASLE precast Modular Lining for the roof section at a cement plant in Austria



Cooler roof at an Asian Cement plant, lined with HASLE D52A – at installation and after 36 months (48 months achieved)



Kiln hood at a cement plant in Thailand, lined with HASLE D52A. At installation and after 3 years



Tertiary Air Duct lined with HASLE D59A - at installation and after 36 months - Thailand

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HASLE Castable for hot face lining in cement kiln with grate cooler



		Thermal shock resistance	Alkali resistance	Slag/build-up resistance	Abrasion resistance	Strength	Thermal conductivity	1 Smoke chamber	2 Calcinator	3 Riser duct	4 Cyclones and cyclone roofs	5 Inlet arch	6 Inlet cone	7 Nose ring	8 Horse shoe	9 Side walls and roof	10 Inlet wall	11 Kiln hood	12 Burner pipe	13 Bull nose	14 Tertiary air duct
	D39A						•	~	 ✓ 	 ✓ 	 ✓ 					~					~
	D52A	••			•••	••		~	~	~	 ✓ 				~	<	<		<	~	~
= Low	D65A	•••			•••		••												~	~	~
Medium	D59A	•••			•••	••	••			~	 ✓ 				~	~	~			~	~
High	D66	•	••		••••		•														~
Extra high	D1550SC	•••			••••		•••	~	~	~	 ✓ 	~	~	~	~		~		~	~	~
	D1600SC				••••		••••	~	 ✓ 	~	 ✓ 	~	~	~	~		~		~	~	~
 Recommended for this area General recommendations 	GUN39A	•	••••	••	•	•	•	~	~	~	 ✓ 		~					~			~
	GUN59A	••			••	•	•	~	~	~	 ✓ 		~			~	~	~		~	~
	MODULAR Lining	•••	•••	••••	••••	••••	••	~		~	~	~				~	~	~		~	~

HASLE Precast Modular Lining

HASLE Precast Modular Roof- and Wall Lining

The HASLE precast Modular Lining has a low open porosity and smooth impact surface which makes it highly resistant to alkali attack as well as build-up – even in extremely hostile environments.

A traditional in-situ casted solution typically has an open porosity of 18 - 20% or more, whereas the HASLE Modular Lining is designed to have an extraordinarily low open porosity of only 8 - 10%.

This quality is achieved by a combination of a high-performance castable with an optimal corn distribution curve and minimal water addition during mixing, which is then carefully cast in specialized moulds and subsequently pre-fired to 500°C at our production facility in Denmark. The result is a strong refractory lining that has an exceptionally long lifetime, is highly abrasion and alkali-resistant, and even when installed in plants operating on 100% RDFs, build-up is practically eliminated. This ensures smooth running of the process and maximum output with a minimum of downtime.

A flexible system that can be tailored to individual applications

The Modular Lining system is based on standard shapes to enable a smooth, flexible and easy installation. Available for both straight and circular walls, roofs, slopes, bull noses as well as cylindrical applications such as feed pipes, making the system highly customizable.

Each element has a tongue and groove joint on all 4 sides which is filled with 2mm mortar. This reduces the penetration of gases to the insulation and the anchoring system behind the hot face precast lining.

The precast refractory elements are usually in the size 25cm x 25cm and weigh 15-16 kg, meaning no heavy lifting equipment is needed for installation.

- The precast elements are cast and prefired under controlled conditions at our factory in Denmark for maximum strength
- Increase the alternative fuel usage
- high resistance to chemical attacks
- Reduce build-up and coating
- smooth surface with low open porosity
- Thinner lining for maximum throughput

 or greater insulation
- Long lifetime reduced maintenance cost
- Fast installation and at 15-16 kg the precast elements are easy to handle

The thickness of the lining can be reduced or increased according to the specifications of the lining. The quality of the back-up insulation can be chosen according to the requirement for heat transfer. By using a low thermal conductivity material such as ceramic fiber blankets or insulating back-up castable, the thickness of the lining may be reduced down to 185 mm without affecting the shell temperature. Hence, a significantly higher cross-section area can be realized in, for example, the riser duct or smoke chamber, which enables an increased throughput.

HASLE precast solutions can also be tailor-made to reduce in-situ casting in difficult areas where the quality of the casting is hard to control.







Kiln hood in precast shapes, Germany



Precast smoke chamber, Germany



The precast HASLE modular element is manufactured and heated up to 500°C at our plant in Denmark

Smoke chamber and riser duct

Heavy abrasion and alkali-attacks in the lower parts of the preheater at elevated temperatures pose challenges to many castable linings. In these harsh environments, the Precast HASLE Modular Lining can help extend the lining lifetime.

Inlet slope area of the Smoke Chamber, India.



At installation

After 14 months



Furthermore, the tendency of coating formation &

build-up has substantially increased as alternative

fuels have become customary. This can disturb the

regular operation of the plant, and frequent clean-

ing can become necessary. In the smoke chamber

and riser duct, the coating problem has been suc-

cessfully reduced or even eliminated by installing a

HASLE Modular Lining precast solution.

After 22 months

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The kiln inlet arch

The kiln inlet arch of the smoke chamber is an area where installation time can be reduced and a high lining quality can be ensured. These specialized precast elements are self-supporting and do not need to be fixed by anchoring systems nor is any time-consuming formwork required.





After 24 months

Vertical bull nose in cyclones

The vertical bull nose areas in preheater cyclones are exposed to extremely high abrasion from strong air flow and dust, especially in the lowest stage cyclone with high temperatures, further enhanced by alkali and other chemical attacks as a result of the







Germany - lowest stage cyclone, 80-90% alternative fuels

After 1 year

Riser duct, Canada

After 18 months (4 years lifetime achieved)

Feed pipes

The HASLE Precast Cylindrical Modules are typically used in Feed pipes. They help give a smooth surface inside the pipes, so the risk of blockage and jamming

due to buil-up is greatly reduced. The precast elements fully interlock via the tongue-and-grove joints, meaning no anchoring is needed.

At installation

From India. At installation

After 36 months

Inspection after 6 years

increased use of alternative fuels. Here, the refractory lining is prone to cracking due to the sharp angles and the high level of abrasion, often needing frequent repair or relining. A curved version of the HASLE Modular Lining is specially developed for this area.

Australia - 2nd lowest stage cyclone - after 62 months

Clinker cooler

HASLE Ceramic Vortex Finder - 3rd generation

The horizontal bull nose found at clinker coolers present special challenges for the refractory lining due to the high abrasion from the passing dust and clinker combined with high temperatures and a sloping section. Likewise, the lining in the roof sections of the cooler can be difficult to install with traditional castables or with heavy precast shapes. The HASLE precast Modular Roof Lining offers a long-lasting alternative for these areas, utilizing our standardized precast shapes hanging from the roof and along bull nose slopes, providing a smooth impact surface and maximal protection from alkali attacks.

Horizontal bull nose in cooler, Vietnam

After 3 years

After 4 years

At installation

Cooler roof, Germany

The HASLE Ceramic Vortex Finder (CVF) is designed to improve operations in industrial cyclones at elevated temperatures and provides an alternative to traditional steel dip tubes.

It is assembled on-site by individual ceramic elements, which interlock to form a stable tube hanging from a steel ring welded to the roof casing of the cyclone.

Originally developed in the 1980s, the latest generation 3 of the HASLE Ceramic Vortex Finder is completely re-engineered with an optimized element design system. It is furthermore manufactured from a new non-cement castable developed to withstand the aggressive environment found in cyclones operating at high temperatures, including the burning of alternative fuels.

Advantages

- Withstand temperatures up to 1200 °C / 2200 °F
- No corrosion Excellent resistance to chemical attacks
- Does not buckle dimensional stability
- High abrasion resistance
- Smooth surface Minimal build-up and coating
- Ceramic elements are Chromium-free
- Easy and quick to install (CVF element weight 6-19 kg)

At installation

After 5 years

The HASLE Ceramic Vortex Finder is based on a modular system of ceramic elements, which makes it possible to tailor the installation to individual operating conditions and cyclone dimensions. The system consists of standardized shapes in different angles which interlock via advanced tongue-andgroove joints, allowing

Variable diameter options: 1,5 m to 7,5 m
Lengths up to 5 m (can easily be adjusted to suit changes in the production process)

Scan me for installation video

Technical Design Service

As experts in installation, design, use of refractory materials and the manufacturing of precast elements, our engineers can help design and optimize your refractory lining.

We work with you from initial design to installation at the site. Through 3D-modelling tools and heat loss calculations, we can help ensure that the lining meets your requirements and is suitable for the specific operating conditions present at your plant.

We can

- Guide you in the choice of materials and components
- Make refractory lining design to fit individual operating conditions
- Manufacture specialized precast elements
- Provide detailed drawings, heat-loss calculations and documentation

HASLE on-site supervision

Whenever a precast Modular Lining installation or other complex installation tasks takes place, a team of HASLE supervisors is on-site coordinating with the local installation team to ensure all parts of the installation are carried out in accordance with best practice.

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