

H A S L E

WE PROTECT YOUR CEMENT PROCESS



We protect your process

HASLE Refractories A/S 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 develop, manufacture and supply high quality refractories in order to protect high temperature processes worldwide. We continuously improve our materials and solutions in order to be at the leading edge - this work is done in close co-operation with our customers.

Refractory products for cement kilns

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 porosity and high strength based on first quality 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



Testing the resistance to abrasion. ASTM 704C

wear on refractory linings in cement plants. To simulate the abrasive environment in wear zones, the resistance to abrasion is measured as material loss after sand bla-

sting at high temperature according to international standard.

All HASLE LCC's have an excellent resistance to abrasion: less than 5 cm³ material loss.

Build-up

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

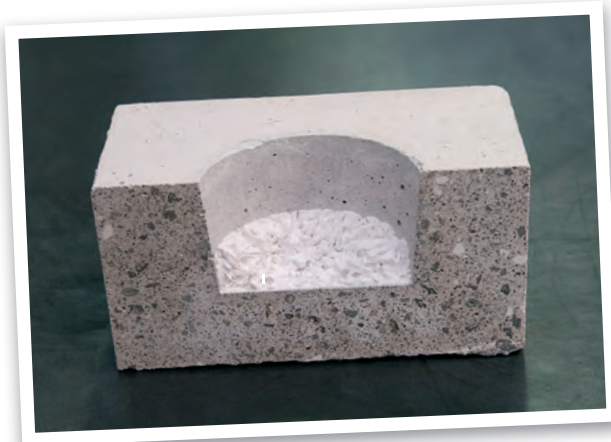
Alkali attack

Vapours of chlorine, sulphur and alkalis (especially potassium and sodium) are the main corrosive 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 relatively high SiO₂ content, which is achieved by combining several selected raw materials in both matrix and aggregates. This ensures a unique alkali-resistance.

Thermal shock

The ability to withstand thermal shock is important



Alkali-test with K₂CO₃ at 1100°C. EN/TS15418

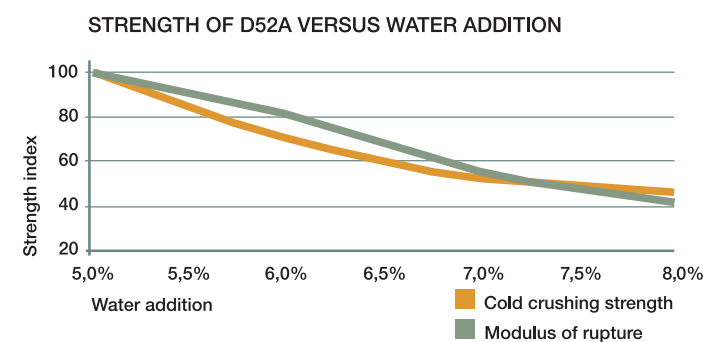
because this causes the formation of cracks in the lining. These cracks open the surface for chemical attack and build-up and reduce the mechanical strength. The size and thermal conductivity of the aggregate grains define the thermal shock resistance of a refractory lining. Coarse grains and shock resistant raw materials are combined in several of our LCC's.

How to achieve the best performance of your refractory lining

The properties of HASLE LCC's are achieved not only by choice of raw materials, but also by an optimal particle size distribution. Despite the very low porosity, sufficient permeability is retained to limit the risk of explosion without the use of drying additives such as polymeric fibers.

To ensure the best performance of the monolithic on site it is important not to compromise on the installation. Mixing, water addition, casting and vibration should be carried out thoroughly. The figure below illustrates the effect of surplus water addition on strength development in low cement castables.

We recommend a curing time of 24 hours irrespective of the thickness of the lining. During this curing the

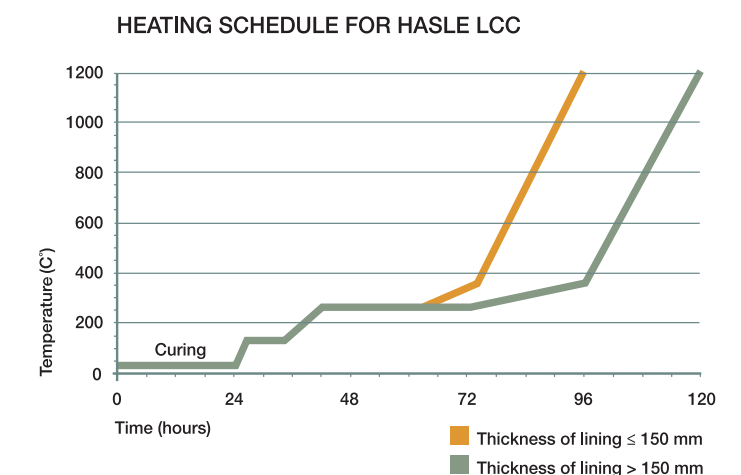


cement is hydrated and the bond between matrix and aggregates is strengthened. During the cur-

ing it is important that the surface is protected from

drying out.

It is crucial that the first drying out of the lining is carried out carefully to ensure 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 operation temperature.



Determination of cold modulus of rupture. EN1402-6



Determination of cold crushing strength. EN1402-6

Castables:

The 5 critical areas of a cement plant

It is no secret that the conditions in different cement kilns, and in different parts of cement kilns, vary considerably. No two kilns have the same raw materials, the same fuels and the same process. Therefore the responsible engineer has to focus on the specific areas of his kiln which need special attention.

Those areas require a better than average refractory lining.

Preheater – 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. As a rule of thumb the following materials are recommended:

Nosering and burner pipe

- Smoke chamber **D39A D59A PU55A D1550SC**
- Riser duct **D39A D59A PU55A D1550SC**
- Pre-calciner **D39A D52A D59A**
- Lower cyclones **D39A**

These two areas are subject to extremely harsh conditions. The demands on the refractory require:

- Very high strength
- Very high resistance to alkali attack and thermal shock
- Very high resistance to abrasion and mechanical impact

Here the best solution is a low porosity, medium alumina LCC with very high strength and above all very high resistance to alkali attack: **D52A D59A D65TA**



Casting the cyclone roof, Czech Republic

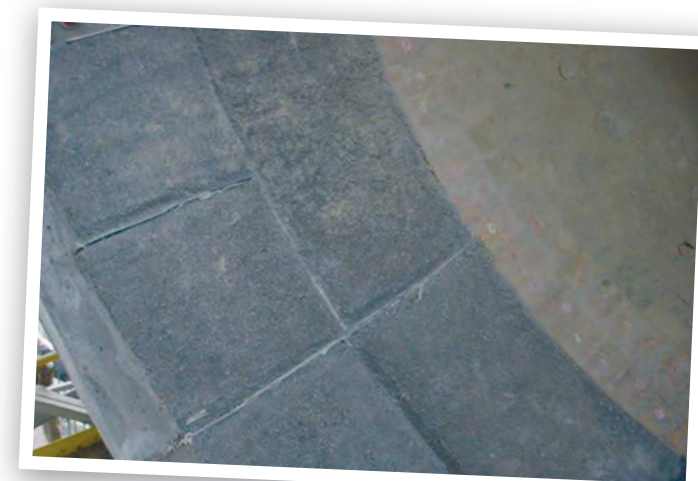
Kiln hood and Grate Cooler (including bull nose)

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, choice of insulation and the thickness, choice of anchors. The installation of these is also critical. For the hot-face:

- Kiln hood **D39A D52A D59A**
- Grate cooler (hot zone) **D59A**
- Grate cooler (cool zone) **D52A**

Tertiary Air Duct and Damper

The lining quality needs to be exceptionally resistant to abrasion due to high velocity clinker dust in T.A. Duct areas. **D66 D59A**



Casted nose ring, Chile



Casted burner pipe, Thailand

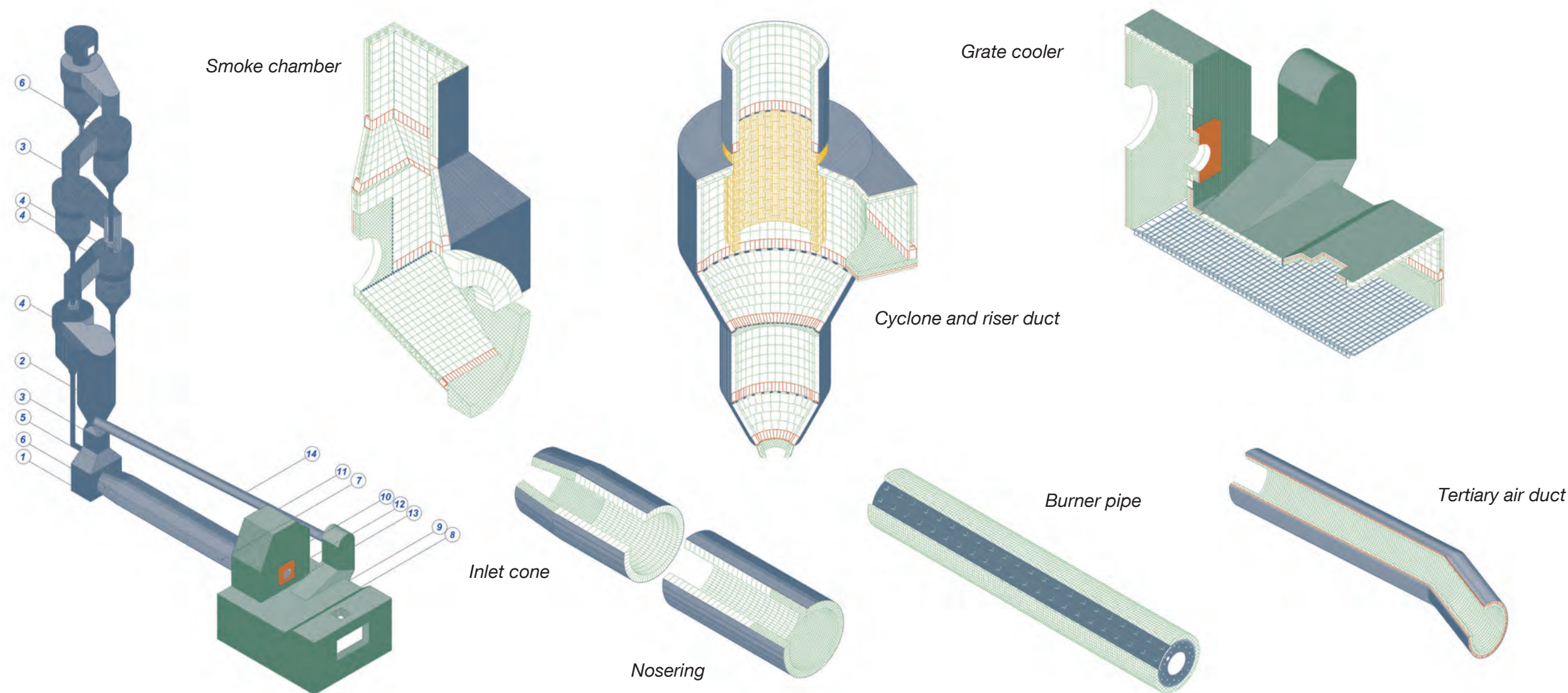


Casted bulls nose, Brasil



Casted grate cooler, Greece

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



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● = Low
●● = Medium
●●● = High
●●●● = Extra high

✓ = Recommended for this area – General recommendations

	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	●●	●●●●	●●●	●●●●	●●●●	●	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D65TA	●●●	●●●	●●●●	●●●	●●●●	●●												✓	✓	✓
D59A	●●●	●●●	●●●	●●●●	●●●●	●●	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PU55A	●●	●●●●	●●●	●●●●	●●	●	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
D66	●	●●	●●●	●●●●	●●●●	●														✓
D1550SC	●●●	●●●	●●●	●●●●	●●●	●●●	✓	✓	✓	✓	✓		✓	✓		✓		✓	✓	✓
D1600SC	●●●●	●●●	●●●●	●●●●	●●●	●●●●	✓	✓	✓	✓	✓		✓	✓		✓		✓	✓	✓
GUN39A	●	●●●●	●●	●	●	●	✓	✓	✓	✓		✓					✓			✓
GUN59A	●●	●●●	●●●	●●	●	●	✓	✓	✓	✓		✓			✓	✓	✓		✓	✓
MODULAR LINING	●●●	●●●	●●●●	●●●●	●●●●	●●	✓		✓	✓	✓				✓	✓	✓		✓	✓

HASLE Precast Modular Lining

All HASLE precast elements are manufactured under controlled conditions in our production facility. Great care is taken with the addition of water, vibration, curing, heat treatment and quality control to ensure the highest possible quality.

The modular lining system is based on standard shapes to enable a smooth and easy installation. The system is developed in co-operation with installation companies, HASLE engineers and with close teamwork with our customers.

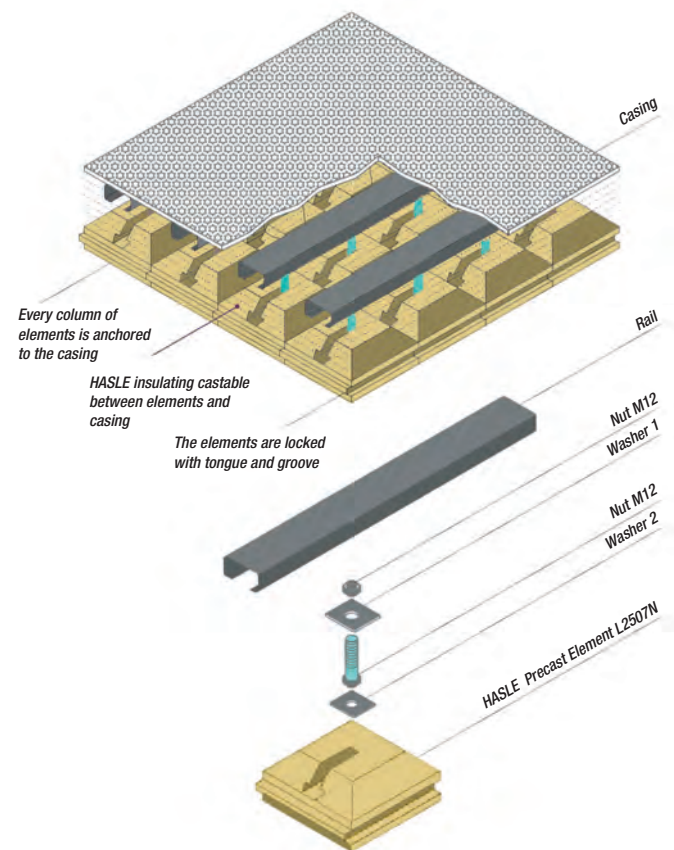
The result is a lining system which ensures maximum life. The very low porosity of the surface, in combination with highly alkali resistant material, reduces build-up and protects from corrosion. In many cement plants this lining has reduced, or even eliminated, the build-up in the smoke chamber and riser duct. This ensures smooth running of the process and maximum output with a minimum of downtime.

Advantages:

- **HASLE precast linings are 25% stronger than in-situ casted LCC linings**
- **Fresh mix, vibrated, cured and heated under controlled conditions**
- **Guaranteed quality**
- **Weather independent**
- **Thinner lining – or greater insulation**
- **Limited number of moulds**
- **Reduced build-up**
- **Installation time reduced by up to 50%**
- **No drying required before start-up**
- **Long life**
- **Easy to repair and remove**

The time of installation can be reduced significantly compared to in-situ casting or laying of bricks.

HASLE Precast Modular Roof Lining – new design



The modular lining system is based on precast refractory elements of size 248mm x 248mm. 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 fitting system.

Each elements is secured by a bolt and washer which slide into a steel rail. The system can be installed on all kinds of roof and vertical and sloping walls. On vertical walls a foundation block is used to support the system.

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 back-up castable the thickness of the lining can be reduced from 250 mm

to 160 mm without losing heat. This principle can be used where a bigger area is needed in the riser duct or smoke chamber to achieve increased production.

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

The inlet arch of the smoke chamber is an area where installation time can be reduced and the quality can be ensured. These elements are self-supporting and do not need to be fixed by anchoring systems.

In the smoke chamber and riser duct, where coating formation (build-up) often occurs we have successfully

reduced or even eliminated the coating problem by installing the precast lining. The precast elements are produced and pre-fired in our Danish workshop and thereby have very low porosity. This factor, and with the choice of raw materials which do not allow penetration from alkalies and sulphur, we are able to ensure a long trouble-free life of the lining in the smoke chamber and riser duct. This lining is also used in feed pipes, calciners and lower stage cyclones.



Kiln hood in precast shapes, Germany



Precast Bull nose, Germany



Precast slope in the smoke chamber, Czech Republic



Precast pyro chamber, Norway



Precast smoke chamber, Germany



Precast grate cooler, Turkey



Partly precast burner pipe, USA



Precast walls and cones, Mexico



Precast inlet arch, India

HASLE Ceramic Vortex Finder

The HASLE Ceramic Vortex Finders are manufactured in our factory, and assembled from individual precast refractory elements which fit together to form a stable cylinder hanging from brackets in the cyclone roof.

The HASLE Ceramic Vortex finder (CVF) was first installed in cement kiln cyclones in the late 1980 ´s. Since that early start the development has continued and lifetimes have improved. During that time the steadily increased use of alternative fuels has caused more and more aggressive conditions in preheater cyclones.

In these environments the steel-alloy tubes are suffering more due to corrosion or buckling. The lifetimes have become shorter and fallen steel-alloy pieces can easily block the cyclone and/or damage the kiln or cooler or crusher. Where this is the case, the HASLE CVF is the correct alternative.

Benefits of the HASLE CVF

- Does not corrode
- Does not buckle
- Reduces build-up
- (Build-up sticks less easily to the CVF)
- Quick and easy to install
- (6 – 16 hours)
- Fallen pieces rarely block the cyclone

Example of calculation of fuel saving. Make this calculation together with your plant engineers:

STAGE 4 CYCLONE	
Kiln (Clinker) Capacity:	3000 tons/day (= 3,000,000 Kg/day)
Thermal saving:	10 Kcal/Kg clinker
Fuel cost:	EUR 100/ton (=0.1EUR/Kg Fuel)
Thermal capacity (Fuel):	6000 Kcal/Kg
Fuel saving per day =	3,000,000 x 10 = 30,000,000 Kcal/day
30,000,000 / 6000 =	5000 Kg Fuel/day
Total saving/month:	5000 x 0.1 x 30days = EUR 15,000/month



Maintenance of CVF , Czech Republic. A mountaineer is doing the inspection in an unusual way. Normally the inspection is carried out visually from the manhole or by erecting a scaffolding.

Maintenance

The lifetime of the HASLE Ceramic Vortex Finder can be extended with regular inspections and necessary repairs. Depending on the working conditions an inspection should take place every 8 to 12 months.

The length of the HASLE Ceramic Vortex Finder can easily be adjusted during a kiln stop to suit changes in the process conditions.

Guarantee

Each HASLE Ceramic Vortex Finder is supplied with a product guarantee, based on the operating conditions of your kiln. Please ask us for an unconditional offer and the related product guarantee.

The installation



A steel ring is welded into the roof of the cyclone.



Ceramic fibre blanket is installed - to allow for thermal expansion.



Ready to close the top ring of elements on the suspension brackets.



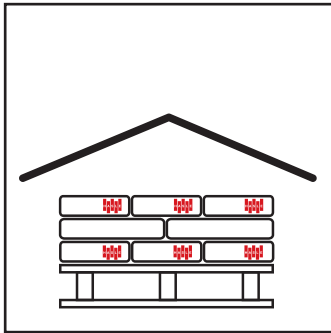
The top ring of precast elements are installed.



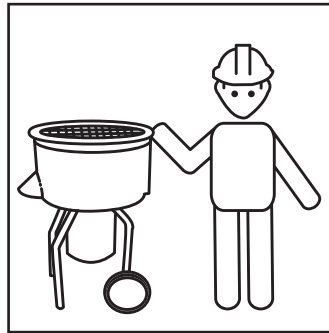
The ceramic fibre has been trimmed.



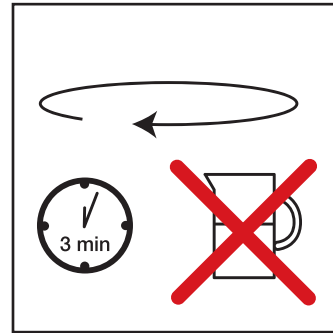
Locking the final elements.



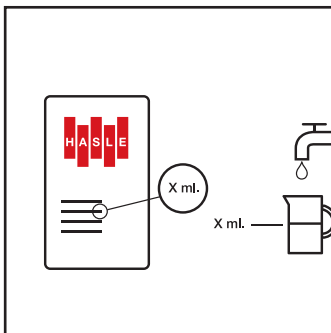
Store bags in dry conditions, sheltered against rain, wind and direct sunshine.



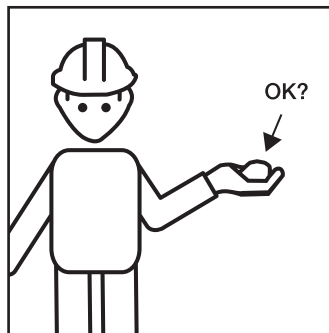
Use clean pan mixer.



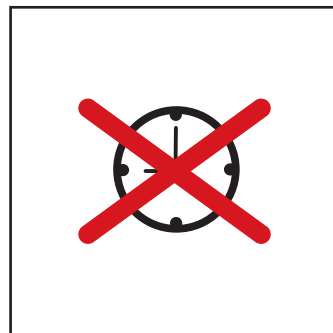
Mix dry material for 3 minutes.



Add water according to prescriptions on bag. Use clean tap water only.



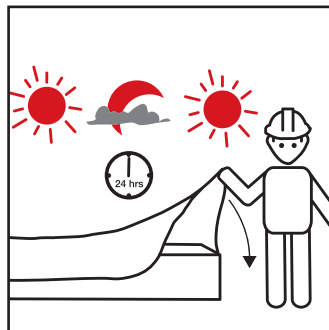
Mix for 4 minutes with water. Add more water if too dry and mix for 4 minutes.



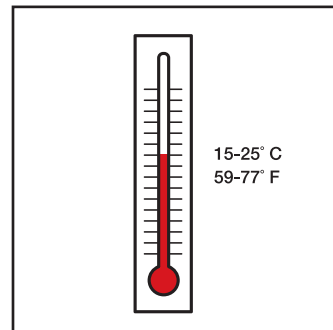
The material should be installed immediately after mixing. Please note: PU- versions are for pumpcasting.



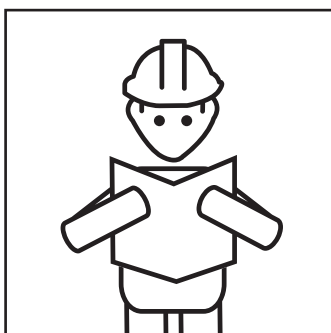
Vibrate thoroughly until castable flows together. Please note: PU- and EF-versions need less vibration.



Allow curing for a minimum of 24 hours. Protect surface from drying out.



Ideal casting temperature is 15-25°C / 59-77°Fahrenheit. Under very cold or warm weather, hardening of the castable can be significantly prolonged or accelerated respectively.



Follow HASLEs instructions for drying out and firing.

HASLE REFRACTORIES

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