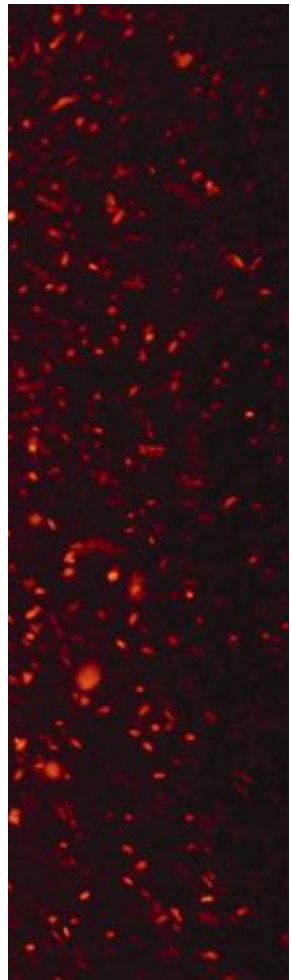


Refractory and acid-proof solutions for the Pulp & Paper industry





“Do you know what lies behind
the success of a refractory project?
It’s 10% engineering, 50% materials
and 40% installation technique.”

Refractories that keep you up and running



The pulp and paper industry is facing great challenges in the form of higher energy and raw material costs. Maintaining profitability is directly tied to operational efficiencies, including uptime and power use.

Höganäs BjuF's mission is to improve the lifetime of your refractory lining and minimize unplanned stops of your kiln. Our wide range of refractory solutions, including acid-proof bricks that can be used in bleaching towers, allows us to choose the best materials for your individual demands. In addition, we perform installation and maintenance services within all segments of the industry.

Content

Meet the refractory and acid-proof experts	4
Energy savings	6
Höganäs BjuF design solutions	
Lime kiln linings	8
Soda recovery boilers	16
Acid proof linings	18
Sulphur burners	20
Selection of refractory materials for boilers and furnaces	22
Notes	26

Meet the refractory and acid-proof experts

Höganäs Bjuv is a world-leading developer, producer and supplier of smart refractory solutions. We serve a wide range of industries that require refractories capable of withstanding high temperatures and highly corrosive or abrasive operating conditions. Our ambition is to offer the most cost-effective refractory products and turnkey solutions that will contribute to increased efficiency and profitability for our customers.



The right design

An efficient solution starts with selecting the right materials for your process. Our skilled engineers will help you analyse your needs and choose the best products and product combinations for your process conditions to optimize performance and installation costs.

The right qualities

Each application has different demands. That is why we offer a complete range of well-proven, acid-proof and refractory products, specially tailored to each production step.

The right installation

Our highly qualified engineers are available worldwide to supervise your installation, minimize its time and ensure the highest safety. Our refractory products are delivered directly from our production units and a ready inventory of our standard product range means that shipment can generally be made on short notice.

The right support

We provide first-class service from the detailed pre-delivery consultation and installation follow-up that is part of our basic contract to complete Refractory Management. Our experts and supervisors are always available to answer your questions.

One century of refractory expertise

At Höganäs Bjuv, we started producing refractory bricks in 1825, almost at the beginning of the Industrial Revolution. Our production unit is still based in Bjuv, Sweden, and approximately half of our raw material comes from our own mining pit. We are a modern company with strong roots in Swedish industrial traditions, committed to exceptional quality, ongoing innovation and the highest professional standards.

Global presence

Höganäs Bjuv has a worldwide network of wholly owned subsidiaries and a large number of agents to support our present and potential customers. We are present in all regions where our customers are active, so that we can respond as effectively as possible to your needs. Operating throughout the world enables us to better understand the challenges that you face and to provide even better solutions.



Höganäs' new range of monolithics.



Setting new standards



Energy savings – rewards for you and the environment

One of the key issues for the industry today when it comes to lime kilns is energy saving, as the prices of mazut and natural gas constantly rise. We know that many kilns around the world are still running without any insulation.

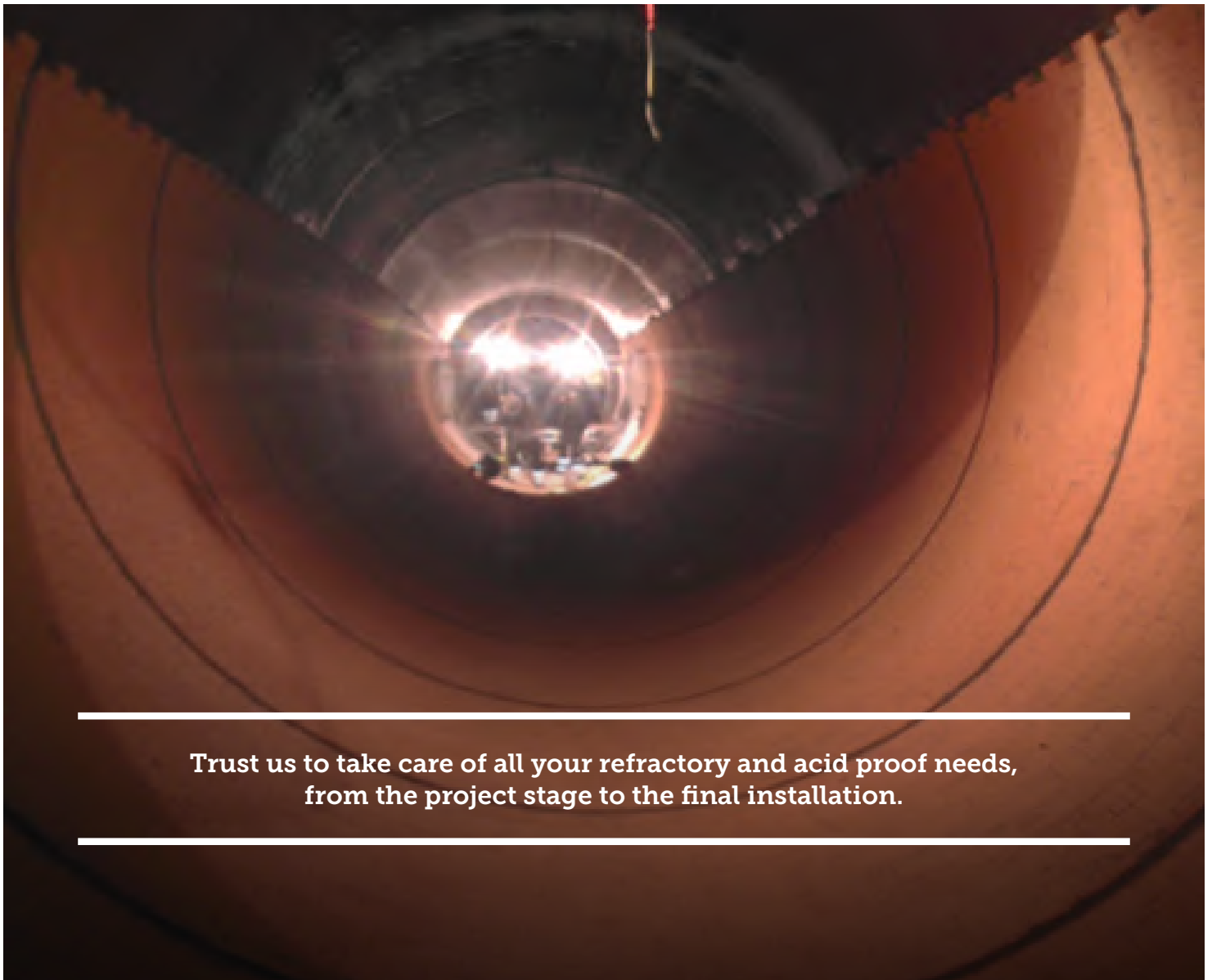
Savings for you

Being the world leaders in energy saving designs, we have developed these for thermal insulation in all zones of a lime kiln. With the right design and installation technique, you will save a lot of energy

and, at the same time, minimize damages to the steel shell. We are also able to eliminate the catastrophic twisting of the refractory lining, securing its safety and longer lifetime.

And the environment

Energy savings directly affects the CO₂ emissions. If you reduce the energy consumption with 30%, you will also reduce your CO₂ emissions with 30%, helping you to achieve your sustainability goals.

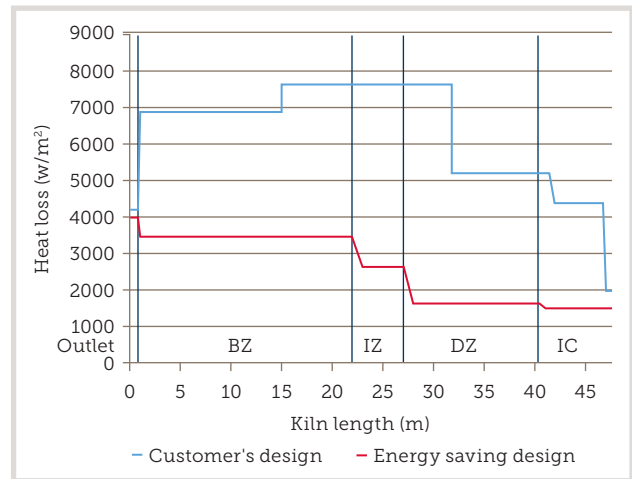


**Trust us to take care of all your refractory and acid proof needs,
from the project stage to the final installation.**

Thinking right can save you up to 50% of your energy consumption

Many of today's linings are designed to handle the challenges of the burning and the other hottest zones in the terms of lining thickness and isolation. When it comes to the cooler zones in the kiln less efforts to insulate is applied.

The problem of these types of designs is the thermal balance of the kiln, where huge amounts of costly energy are lost in unexpected areas. By applying a more optimized type of lining with insulation in the complete kiln energy consumption can be reduced with up to 50%. A properly designed and installed lining will last much longer, the savings is growing over the years.



How much can you benefit? The potential varies with the conditions of the production and today's lining design. In most cases we can achieve energy saving of 30–50%. The simple way is to let us make an energy saving calculation with a simulation of your kiln. We can give very accurate you're saving potentials. Below you will find two industrial examples.

Calculation for a typical lime kiln

Basic facts

Ambient temperature: 20°C
 Emissivity: 0.90
 Annual production: 340 working days

Result

				Energy saving design	Customer's design	Heat loss reduction	Savings
Zones	From (m)	To (m)	Length (m)	Heat loss (KW)	Heat loss (KW)	(MWh)	%
Outlet	0	0.8	0.8	23	24	8	4
Burning zone	0.8	22	21.2	518	1 072	4 516	52
Intermediate zone	22	27	5	94	272	1 455	66
Drying zone	27	40.4	13.4	159	580	3 435	73
Chain zone	40.4	47.632	7.232	78	216	1 129	64

Actual savings for a lime kiln

Basic facts

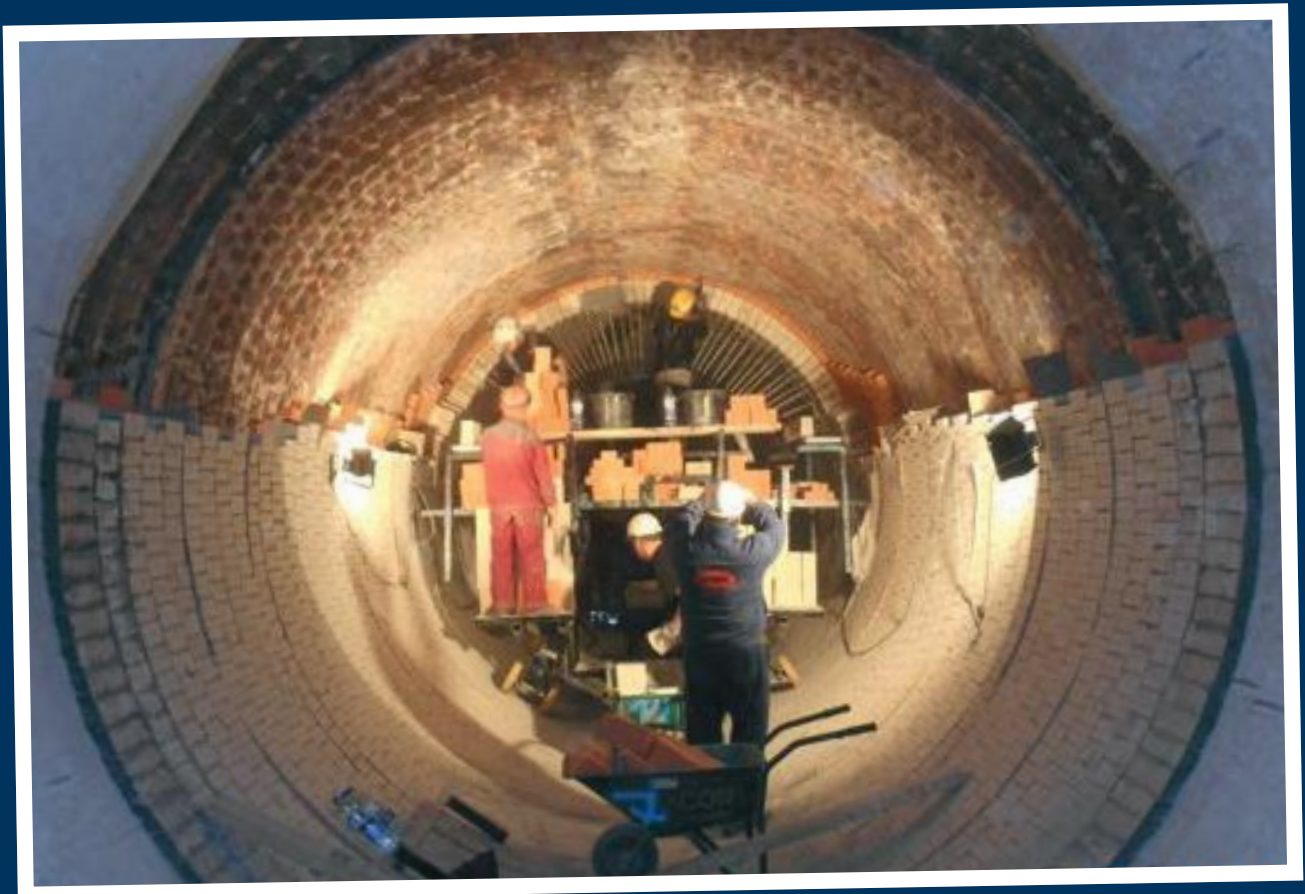
Ambient temperature: 0°C
 Ambient wind velocity: 2.7 m/s
 Annual production days: 340 days
 Heating value of mazut: 41,3 GJ/ton
 Mazut price: \$208/tn

Result

Annual heat loss: 7,757 MWh (-40%)
 Mazut savings: 449 tons per year
 Average shell temperature: 136°C (-26%)
 Weight of lining: 208 tons (+4%)
 Annual production hours: 8,160 hours (+0%)
 Annual carbon footprint reduction CO₂: 1,434 tons (-40%)

Lime kiln linings

A rotary lime kiln presents a very abrasive, thermally stressed environment. The refractories lining it must be able to withstand chemical attack from fuels and raw materials, changes in temperature as well as mechanical stress from rotating elements.



1. Reaction between bricks and lime/lime sludge

Lime and lime sludge react, primarily, with the part of the brick that holds the grains of mineral together. The reaction product has a considerably lower melting point than the original brick material, which means the brick is unable to withstand such high temperatures and can easily overheat.

Two ways to increase the application temperature of the brick in relation to lime are:

- A higher baking temperature when producing the brick will increase and improve sintering between the brick grains
- A denser brick (i.e. lower porosity), which obstructs the penetration of lime into the brick

2. Alkali attacks

Alkali easily permeates the pores of a brick and subsequently reacts with the brick material. This reaction often leads to a reaction product that brings about volume expansion and causes a slight flaking in the form of "round washbowls".

One way to avoid this flaking is to produce bricks with such a high porosity that the volume expansion during alkali attack has plenty of room in the brick. The reaction volume then forms a hard surface layer that, inter alia, obstructs abrasion of the brick.

3. Changes in temperature

In lime kilns, in which gases are ignited, enormous changes in temperature can occur. These often cause the brick to split into flakes. The thermal shock resistance of a brick depends, for example, on the particular temperature in which the brick is baked in relation to production and composition. A data sheet for a burning zone brick should provide specifications of its thermal shock resistance.

4. Ovality

The ovality of a lime kiln may expose a brick to alternating pressure and tensile stress during rotation. The insulating brick (i.e. back insulation) has a lower pressure resistance than the hot face lining. It is therefore, primarily, the back insulation that crumbles apart and causes a collapse of the hot face lining.

The temporary measures that can be taken are; to put in a higher grade insulating brick (i.e. a cold pressure resistance of over 20 N/mm²) or to put in a single-layer lining. In the long run, the ovality of the kiln must be reduced by, for example, shell replacement.

N.B. The above also applies to various refractory castables.

World leader in energy saving design for rotary kilns

DAM/DISCHARGE ZONE

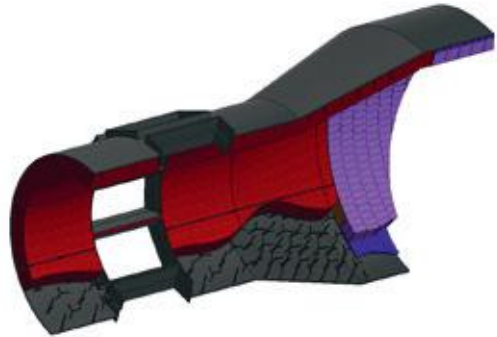
Type 1

Dam/Discharge zone

High abrasion on refractory and steel segments.
Hot face lining, t=200/300 mm
Process temp ~ 1100°C

Quality used

In this zone we use low cement alkaline resistance castable.
Low cement castable Höganäs Cast LC 50AR
Cone part; cone bricks or castable
Steel fibre MME 446: Steel anchors,
Welding electrodes Avesta AC/DC 309L



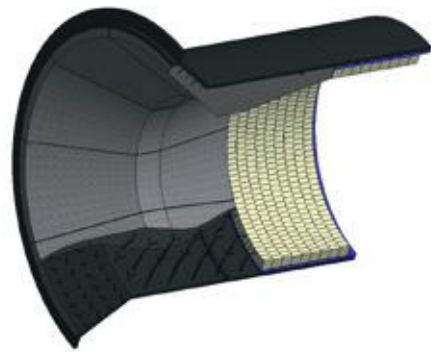
Type 2

Dam/Discharge zone

High abrasion on refractory and steel segments.
Hot face lining, t=240/300 mm
Insulating, t=50-100mm
Process temp ~ 1100°C

Quality used

In this zone we use low cement alkaline resistance castable.
Low cement castable Höganäs Cast LC 50AR
Insulating gun-mix: Höganäs Insul 1,5L
Steel fibre MME 446: Steel anchors, Welding electrodes Avesta
AC/DC 309L, Welding electrodes Avesta AC/DC 309L



Type 3

Dam/Discharge zone

High abrasion on refractory and steel segments.
Hot face lining, t=240/300 mm
Process temp ~ 1100°C

Quality used

In this zone we use low cement alkaline resistance castable.
Low cement castable Höganäs Cast LC 50AR
Steel fibre MME 446: Steel anchors,
Welding electrodes Avesta AC/DC 309L



BURNING ZONE

Burning zone

Hot face lining, t=220-200 mm
Insulating lining, t=64-38 mm
Process temp ~ 1150-1200°C

Quality used

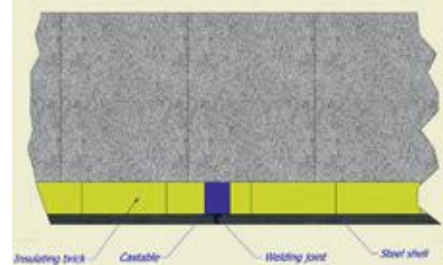
Important to have alkaline resistance brick, which can withstand variations in temperature.

Andalusite brick: Silox 60

Insulating Moler brick: Höganäs Insul ME

Mortar

Insulating gun-mix: Höganäs Insul 1,5L



INTERMEDIATE ZONE

Intermediate zone

The primary criterion here is alkali-resistance
Hot face lining, t=200-180 mm
Insulating lining, t=64 mm
Process temp ~ 800°C

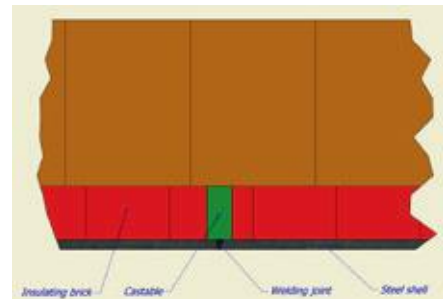
Quality used

Chamotte brick Viking 450 / Alex

Insulating Moler brick Höganäs Insul ME

Mortar

Insulating gun-mix: Höganäs Insul 1,5L



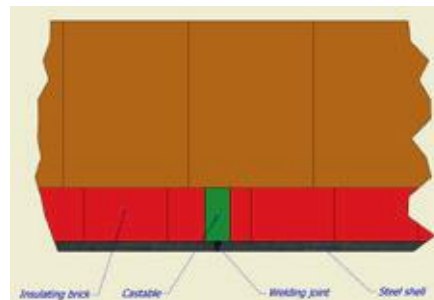
DRYING ZONE

Drying zone

The primary criterion is alkali resistance
Hot face lining, t=200-180 mm
Insulating lining, t=64 mm
Process temp ~800-600°C

Quality used

Chamotte brick Viking 330
Insulating Moler brick Höganäs Insul ME
Mortar
Insulating gun mix: Höganäs Insul 1,5L



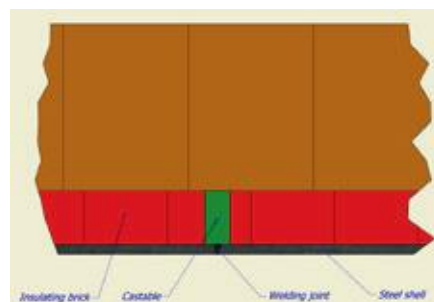
LIFTERS ZONE

Lifters zone

The primary criteria are alkali resistance and wear
Hot face lining, t=200 mm
Insulating lining, t=64 mm
Process temp ~800-600°C

Quality used

Chamotte brick Alex/Viking 330
Insulating Moler brick Höganäs Insul ME
Mortar
Insulating gun mix: Höganäs Insul 1,5L

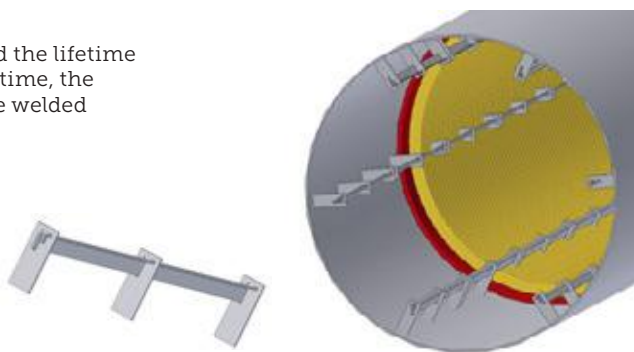


Lifters for rotary kilns

Designed to reduce the loads on the bricks and extend the lifetime of the refractory installation. To increase the lifter lifetime, the horizontal bar is not fixed to the holders. Holders to be welded against the kiln shell.

Technical data

Material: Heat resistant steel AVESTA 253MA
Length/lifter: 3000 mm
Height: 400-500 mm
Lifters/turn: 6-12
Holders/lifter: 3
Weight/lifter: 55-60 kg



TRANSITION ZONE

Transition zone – Chain/inlet zone & cone

The primary criterion is alkali resistance
Hot face lining, t=200-150 mm
Insulating lining, 38-no insulating
Process temp ~600°C

Quality used

Chamotte brick Viking 330/Viking 450/Alex
Insulating Moler brick Höganäs Insul ME
Mortar
Höganäs Cast LC 50AR



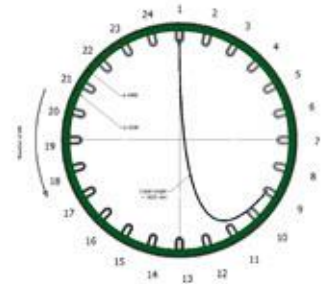
CHAIN ZONE

Chain zone

The primary criteria are alkali resistance and wear
Hot face lining, t=150-100 mm
Insulating lining, no insulating
Process temp ~600-200°C

Quality used

Castable Höganäs Cast LC 50AR/Höganäs Cast LC 40AR
Steel fibre MME 446: Steel anchors,
Welding electrodes Avesta AC/DC 309L



INLET ZONE

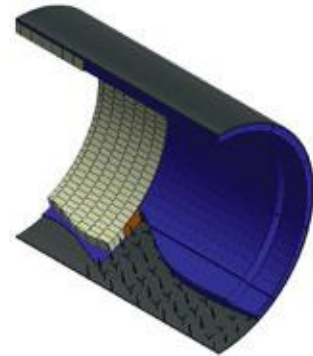
Type 1

Inlet zone

High abrasion on refractory and steel segments
Hot face lining, t=200/100 mm
Process temp ~600-500°C

Quality used

In this zone we use low cement alkaline resistance castable
Castable Höganäs Cast LC 50AR/Höganäs Cast LC 40AR
Steel fibre MME 446: Steel anchors,
Welding electrodes Avesta AC/DC 309L



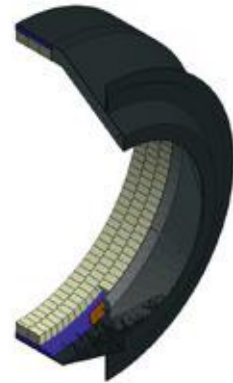
Type 2

Inlet cone

High abrasion on refractory and steel segments
Hot face lining, t=220-180 mm
Process temp ~ 600°C

Quality used

This zone we use low cement alkaline resistance castable
Castable Höganäs Cast LC 50AR/Höganäs Cast LC 40AR
Steel fibre MME 446: Steel anchors,
Welding electrodes Avesta AC/DC 309L



KILN HOOD

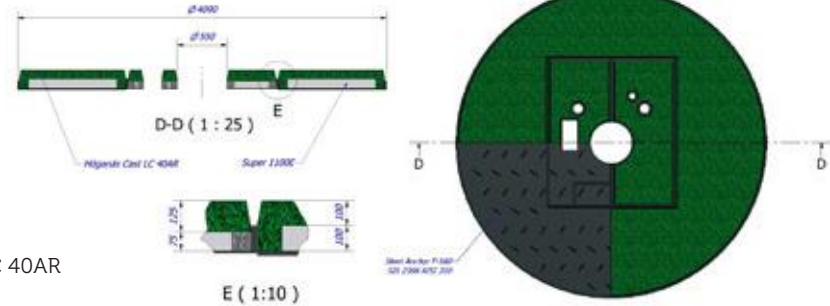
Type 1

Kiln hood

Hot face, $t=100-125$ mm
Insulating, $t=75-100$ mm
Process temp $\sim 1100^{\circ}\text{C}$
External shell temp $\sim 98^{\circ}\text{C}$

Quality used

Low cement castable Höganäs Cast LC 40AR
Insulating calcium silicate Super 1100E
Conventional gun mix Höganäs Gun CC 651



Type 2

Kiln hood

Hot face, $t=200-300$ mm
Insulating, $t=100-150$ mm
Process temp $\sim 1100^{\circ}\text{C}$

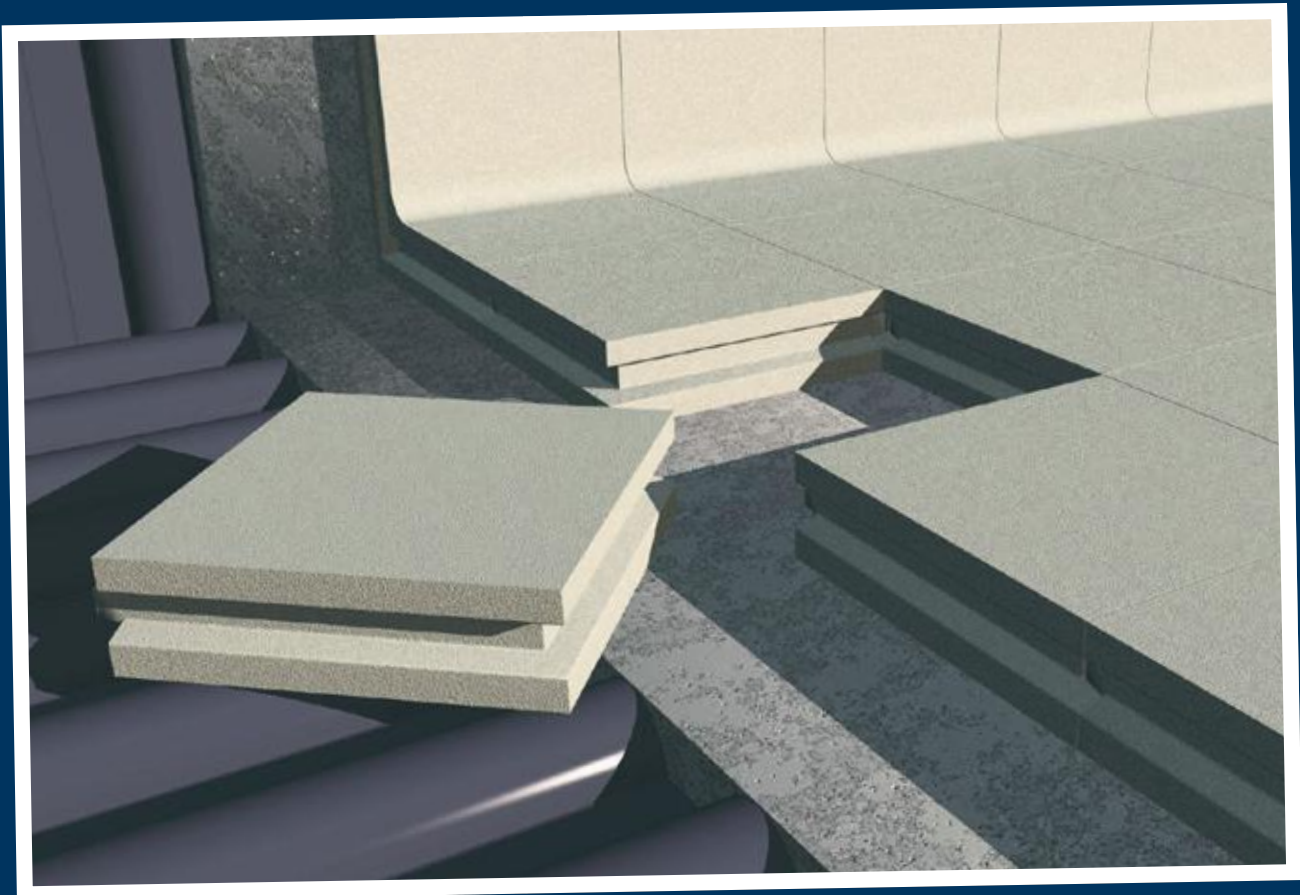
Quality used

Low cement castable Höganäs Cast LC 40AR
Insulating calcium silicate Super 1100E
Conventional gun mix Höganäs Gun CC 651



Soda recovery boilers

Refractory materials are used in soda recovery boilers to protect the tubes, i.e. to prevent the tubes from coming into contact with soda melt.



Mac-tec is a complete system of changeable parts making it possible to limit the repairs of the damaged area. The parts are made of special refractory material where above all the material's characteristics to resist alkali attacks and large changes in temperature is important. The parts have been temperature treated before delivery. The Mac-tec-parts are guaranteed a good contact with tubes by using alkaline resistance castable.

The refractory materials that are used are some form of castables. The castables must be able to withstand contact with soda melt at the temperatures existing in the boiler without reacting or being destroyed by the soda. That is to say that the castables must have good resistance to alkali.

At present, the best castables available with regard to good alkali resistance are certain types of low cement castables. A substance is added, a so-called alkali inhibitor, in order to prevent a reaction with alkali (i.e. soda). Previously, the problem with such castables has been the difficulty in removing them for processes such as tube inspection. Nowadays, castables can, however, be removed by employing water jets without destroying the tubes.

Phosphate castables are another favourable type that can be used in soda recovery boilers. These do not, however, have the same resistance to alkali as castables with alkali inhibitors. The phosphate does not provide these castables with complete sintering in the temperatures occurring in a soda recovery boiler. However, the lack of sintering does normally allow phosphate castables to be removed by flushing with water.

In the past, castables that have contained large amounts of chromium oxide were often used in soda recovery boilers. Due to the risks that can be brought about by the health-impairing 6-grade chromium, chromium oxide castables have been removed from our range. Instead, materials with the same properties but without chromium oxide have been produced.

Summary

The main thing is that you need to protect the tubes that are in contact with melt soda. Thereby the most important thing is to choose an alkaline resistant castable, not to look at wear resistance. The right material to choose is a alkaline resistant low cement castable, which is designed for installations in Soda Recovery Boilers.

In our concept for soda recovery boilers, we include the best-suited materials for the different parts of the boiler. For more information regarding the materials in different zones of the soda recovery boiler see the following pages.

Höganäs Bjuf carries out inspections and installations and provides documents and follows up on the work carried out in order to get the boilers into the best possible running order.

Acid proof linings pulp & paper

The handling of acids and other corrosive liquids is to be found, to a lesser or greater degree, in almost all industries. The tanks or equipment in which corrosive liquids are found must be executed so that they are able to withstand the effects of such chemicals. Equipment made of steel or concrete is often protected by linings of acid-proof bricks and mortar. Factory floors are also exposed to the effects of corrosive liquids as a result of spilling. This is a continual occurrence in places in which pickling, galvanising and nickel-plating take place, as well as in tanneries, bleach plants and other chemical industries.



In general, an acid-proof brick should exhibit a high degree of acid resistance, have a high density, high resistance to abrasion and high compressive strength. Brick work that is exposed to temperature changes must be built of bricks that are able to withstand such stresses and strains.

To choose the right mortar and tiles is the most important thing for an acid proof lining.

Bleaching towers

We use acid-proof ceramic bricks. This acid-proof brick could be used in lining of containers such as bleaching towers, digesters, cooling towers, pickle tanks, reaction/absorption towers, acid tanks, but even acid-proof floors where the mechanical stresses are large. We have special shapes for cone parts and top parts. We have two kind of mortar for bleaching towers, one for low temperature and one for high temperature. The primer we use is based on vinyl ester. For the top part we have a new design to be able to protect the steel against corrosion.

Chlorine storage tanks

Here we use the same type of materials as in the bleaching towers. Before most of these tanks were lined with bricks, today it is FRP plastic, but more and more mills go back to the old method. Bricks lining has very long lifetime and requires almost no maintenance, so comparing to FRP, which needs much more maintenance and causes much more problems, the lifetime and cost are much lower at long term. This bricklaying design is the best both in regards to quality and economy.

Other tanks and pools

In places where there is acid, hot water, salt, bacteria etc., i.e. media that cause problems for concrete or steel and are difficult to clean away, we always use acid proof lining. The type depends on the media inside the tank. If you have problems with bacteria, it is difficult to clean the concrete. Here we use glassed tiles, which are easy to clean.

For floorings, waste channels etc.

Here we also use acid proof lining. For protection we use extruded tiles. These unglazed tiles can be used for both floors and walls. The properties of these tiles make them particularly suitable for floors that require durability, resistance to chemicals, ease of cleaning and a non-slip surface, e.g. in industrial facilities, chemical factories, dairies, breweries and warehouses, laundries, boiler rooms, fire stations, etc. The mortar we use displays excellent resistance to acids and alkalis in higher concentrations, as well as oxidizing media, greases and oils.

Installations of acid proof linings

We use the newest techniques and equipment for both installation and mixing. Mixing of the mortar is the most important thing for acid proof lining. If that is not done correctly then the entire lining will display bad quality.

We follow all environmental and labour requirements. All our employees have special licences for this kind of work.

Should you be uncertain as to which acid-proof brick and mortar to use in your particular case, please contact Höganäs Bjuf. We will analyse your problem thoroughly and inform you of the optimal solution.

Höganäs Bjuf has the knowledge of materials, technologies and workmanship required to ensure that these applications meet the highest industry demands. We carefully analyse every assignment in order to come up with the best possible solution. Our goal is always to supply an acid proof installation with the longest possible lifetime.

Höganäs Bjuf will take care of all your acid proof needs, from project stage to the final installation.

Sulphur burners

Höganäs BjuF has a great deal of competence and knowledge in the field of sulphur burners. We line many different types and sizes of sulphur burners for, amongst others, Chellchem Nobel Industries Sweden, which supplies sulphur burners worldwide.

We carry out the installation of both sulphur burners and cooling towers including cooling tower connection pieces, in which the cooling tower can be lined with both refractory material and acid-resistant material, dependent on the type of sulphur burner.

We use well-proven installation techniques and materials.



Priming

After the shell plate has been blast-cleaned, all plating is coated with a primer solution comprising a mixture of HVKD powder and potassium silicate. This protects the shell plate against corrosion.

Material

The fire bricks used are Bjuf SX and mortar. If either or both of these are not available then bricks and/or cement of similar quality are used. The same type of brick is used in the cooling tower section but the cement used is silicated mortar HVKD. Conventional castables are Höganäs Gun CC 652 or Höganäs Cast LC 40AR. There are also other alternatives of similar quality available.

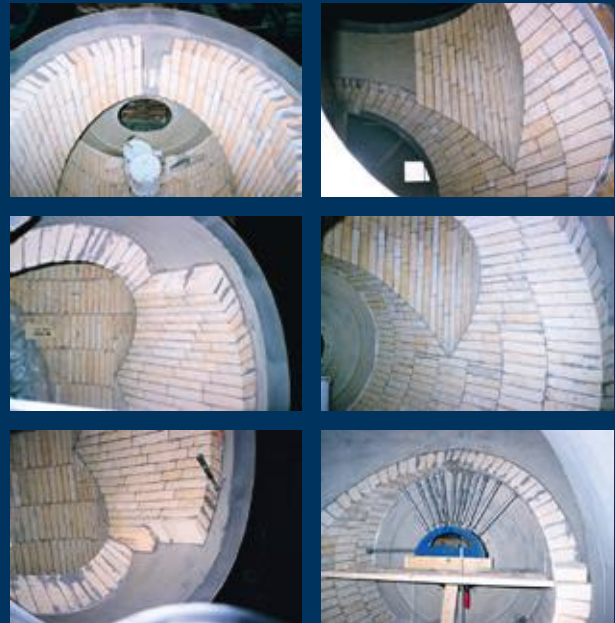
Prefabricated Modules

Nozzle bricks and other specialised bricks used in kilns are produced at our prefabrication department.

Installation

Castables are not used in yawing, but instead the yawing is sawn to form a good match. This technique is employed in order to obtain the best possible resistance. See Figure 1-6, which illustrates how bricklaying can look.

Höganäs Bjuf carries out inspections and installations as well as documents and follows up on the work carried out in order to ensure that the sulphur burners are in the best possible running order.



Selection of refractory materials for boilers and furnaces

Boilers and furnaces are exposed for thermal stress various atmospheres. The refractory lining protects boilers/furnaces for high temperatures, wear and alkali attack.



When selecting a refractory lining for a boiler or a furnace, several factors must be taken into consideration.

- Alkali is always found in ashes of chip/ bark/ wood/ peat. Alkali reacts relatively easily with most refractory materials and breaks them down. In boilers/ furnaces, in which an alkali-rich ash (e.g. potassium carbonate) is found, a dense material should be used with an additive that inhibits the reaction with alkali.
- The operating temperature requires the material chosen to have a certain minimum resistance to temperature.
- The atmosphere in a boiler/ furnace is significant. The atmosphere can contain substances that will react with refractory materials. The maximum operating temperature of the refractory material is thereby lowered, in certain cases by as much as several hundred degrees below that of the value given in the data sheet.
- The operation of the boiler/ furnaces. Is it run continuously or is it often ignited and extinguished? The material selected must have proper resistance to changes in temperature.
- If there is a problem of slag adhering to the walls and bottom, there are now materials available that prevent this from happening.
- Is the refractory material subject to severe wear, e.g. abrasion? If this is the case, then it must be taken into consideration when selecting the refractory material.

Recently, lining parts for boilers/ furnaces have become available as prefabricated components in special refractory materials of high density, with exceptional alkali and temperature resistant properties and with high mechanical wear resistance. The lining is tailor-made for each object. Even though this method may be expensive, it has proven to be superior in terms of durability and favorable in terms of cost per operating hour.

Due to those facts Höganäs BjuF has chosen the best quality material suitable for both Soda Recovery Boilers and Power Boilers, to make handling of our and the customers' stock as efficient as possible. This also reduces the risk that wrong material is used. Our design is the best on the market today, both in terms of cost efficiency and quality.

Extremely high quality materials with specially-developed properties, such as enhanced resistance to thermal shock and excellent resistance to sulphur and alkalis and proven energy saving designs, are features of Höganäs BjuF grades, which, in combination with proven installation technique, guarantee the required availability of the plant together with the longest possible service life of the lining.

Service and maintenance are a natural part of our offer. By servicing your plant regularly we can make sure that the furnace works optimally in order to prevent unplanned stops and thereby reduce maintenance costs over the long term.

Höganäs BjuF will take care of all your refractory needs, from project stage to the final installation and documentation.

Multi fuels boilers

When selecting a refractory lining for a boiler or a furnace, several factors must be taken into consideration.

Alkali

Wear

The operating temperature

The atmosphere

The operation of the boiler/ furnaces

If there is a problem of slag adhering to the walls and bottom



INCINERATORS

Type 1

Incinerators

We use well-proven installation techniques and materials.

Design

Due to high temperature, we use two layers of insulating bricks. For protection of these insulating bricks we use Hôganäs Insul SX, Porosil 23 and Porosil 26. As for the hot face we use alkaline-resistance Silox 60/Viktor 60 bricks.



Type 2

Incinerators

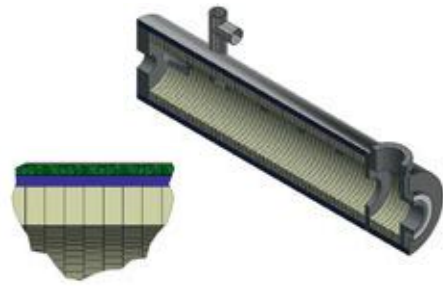
We use well-proven installation techniques and materials.

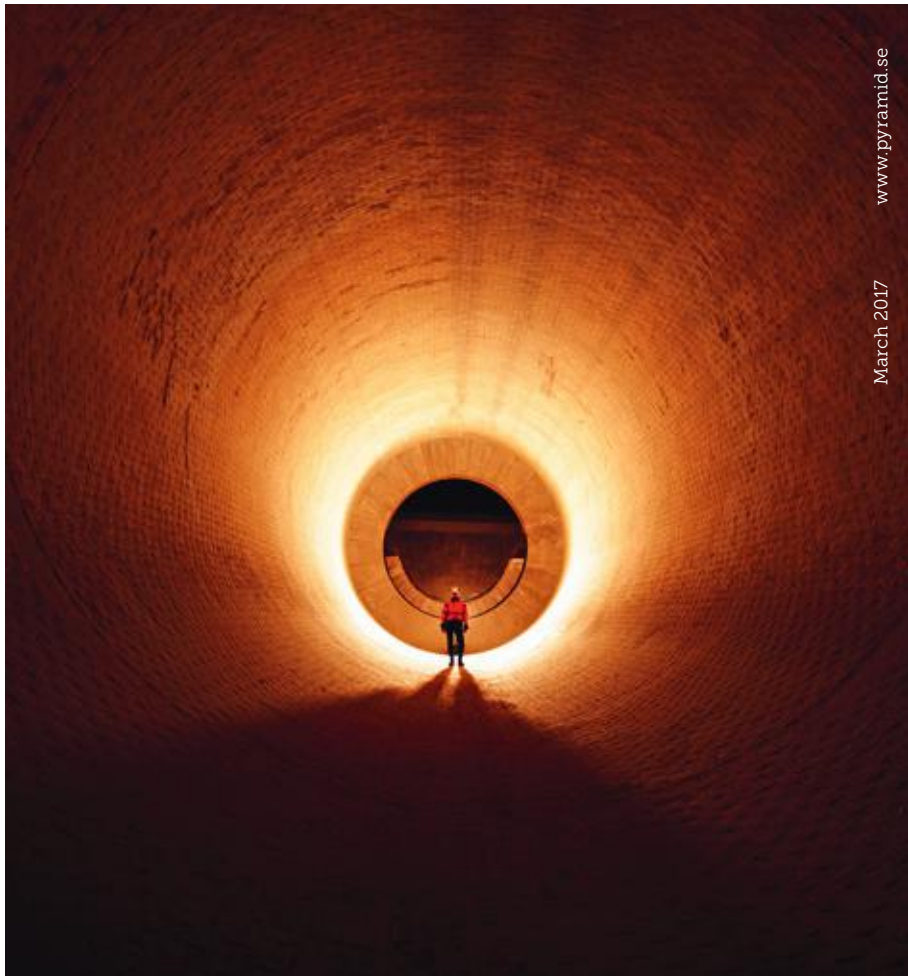
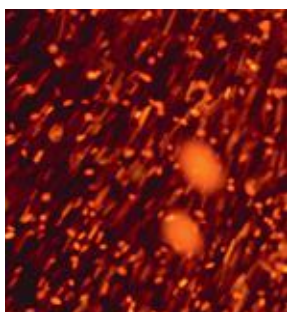
Installation

By using Rotary Kiln shapes for the hot face we get much safer lining. Installation time will also be shorter. We also use installation technique with poggosticks.

Design

Same as Type 1





Our offices

HEAD OFFICE:

Höganäs Bjuf AB
Phone: +46 42 855 00
cement@hoganasbjuf.se

REGIONAL OFFICES:

Höganäs Bjuf Asia Pacific Sdn. Bhd.
Phone: +60 3 9054 9978
ake.eriksson@hoganasbjuf.com

Höganäs Bjuf Middle East Ltd.
Phone: +357 22 662 406
camil.farhat@hoganasbjuf.com

GROUP COMPANIES:

AG-Port
Phone: +358 3 3122 8200
office@agport.fi

Borgestad Fabrikker
Phone: +47 35 54 23 00
roger.kvam@asborgestad.no

GL Contracting
Phone: +47 35 55 06 00
firmapost@glcontracting.no

J.H. Bjørklund
Phone: +47 67 16 66 70
salg@jhbjorklund.no

Macon
Phone: +46 26 12 01 00
info@macon.se

Mektec
Phone: +46 26 14 00 30
info@mektec.se

T Knutsson
Phone: +46 40 38 44 00
birger@tknutsson.se