Large quantities of bulk material are handled in the conveying and storing systems of cement plants. Unless they are suitably protected, these systems will experience frequent failure requiring repair or replacement. Kalenborn offer the complete array of wear protection materials. Depending on the type of installation and the operating conditions, different types of mineral, ceramic and metallic materials, compounds or engineering plastics are used.

In addition, Kalenborn has extensive experience in slide promotion. Interruptions of material flow inside of bunkers and silos must be avoided.

Advantages of Lining Materials:

Ceramic Wear Protection
- Very good abrasion resistance
- Tile, cylindrical or jointless lining
- Temperatures up to 1,000 °C/1,832 °F

Metallic Wear Protection
- Good resistance against sliding and impact wear
- Thin walls, self-supporting structures
- Good thermal shock resistance

Technical Plastic Lining
- Excellent slide promotion for many applications
- Good resistance against impact wear
- Low weight

Material Combinations
- Optimal wear protection for every application
- Optimized lining cost
- Optimized weight

Less Wear Protection in Cement Production

All sections of cement plants are at risk with regard to wear. This covers the raw material storage and raw material processing. It includes coal pulverizing and injection into the rotary kiln. Furthermore, clinker handling and clinker grinding as well as handling of additives and cement are characterized by the same problems.

Service lifetimes of many years are often achieved with the following materials:

- ABRESIST fused cast basalt
- KALCOR zirconium corundum
- KALCOR-S sintered zirconium corundum
- KALOCER high-alumina ceramics
- KALCERAM wear-resistant hard ceramic
- KALCRET hard compound
- KALSICA silicon carbide ceramics
- KALCAST hard casting
- KALMETALL hard overlay welding
- KALEN slide promotion plastics

In addition, material combinations have been very successful in practice. They enable both technically and economically optimal solutions.
Solutions for Wear Protection in the Cement Industry

RAW MATERIAL PREPARATION

CLINKER PRODUCTION

CEMENT PRODUCTION

<table>
<thead>
<tr>
<th>Plant</th>
<th>Components</th>
<th>Material for lining</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crushers</td>
<td>Housing, slides, transfer chutes</td>
<td>KALMETALL, KALCAST, ABRESIST, KALCOR, KALEN</td>
</tr>
<tr>
<td>Blending bed</td>
<td>Slides, transfer chutes, mechanical conveyors</td>
<td>KALMETALL, ABRESIST, KALCOR, KALEN</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plant</th>
<th>Components</th>
<th>Material for lining</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw material</td>
<td>Silos</td>
<td>ABRESIST, KALEN, KALCERAM</td>
</tr>
<tr>
<td>Raw mill</td>
<td>Chutes, transfer chutes, mechanical conveyors</td>
<td>ABRESIST, KALCOR, KALOCER</td>
</tr>
<tr>
<td>Raw meal separator</td>
<td>Separators, cyclones</td>
<td>ABRESIST, KALCRET, KALMETALL, KALOCER</td>
</tr>
<tr>
<td>Raw meal silos</td>
<td>Pneumatic raw meal transport</td>
<td>ABRESIST, KALCRET</td>
</tr>
<tr>
<td>Burners</td>
<td>Pneumatic fuel transport</td>
<td>ABRESIST, KALCOR, KALOCER, KALFLEX</td>
</tr>
<tr>
<td>Clinker cooler</td>
<td>Reciprocating grate plates, clinker crusher, chute</td>
<td>KALMETALL, KALCAST</td>
</tr>
<tr>
<td></td>
<td>Dust removal lines, dedusting collection cyclones</td>
<td>KALCRET, KALCOR, KALMETALL</td>
</tr>
<tr>
<td></td>
<td>Tertiary air duct</td>
<td>KALCRET, KALCOR</td>
</tr>
<tr>
<td>Clinker silos</td>
<td>Clinker chutes, silos</td>
<td>ABRESIST, KALCOR, KALMETALL, KALCRET</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plant</th>
<th>Components</th>
<th>Material for lining</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material feed</td>
<td>Bunkers, silos, slides</td>
<td>ABRESIST, KALCOR, KALEN</td>
</tr>
<tr>
<td>Cement mill</td>
<td>Vertical mill, ball mill</td>
<td>KALMETALL, KALCAST</td>
</tr>
<tr>
<td>Cement separator</td>
<td>Separators, cyclones</td>
<td>ABRESIST, KALCRET, KALCOR, KALMETALL</td>
</tr>
<tr>
<td>Cement silos</td>
<td>Pneumatic cement transport</td>
<td>ABRESIST, KALCRET</td>
</tr>
<tr>
<td></td>
<td>Silos</td>
<td>KALEN, KALCERAM</td>
</tr>
</tbody>
</table>
Clinker Production

Extended Lifetime for Grinding Plants

ABRESIST used for the center discharge duct of a ball mill
Reliable protection of raw mill and duct system with KALCRET BNX hard compound

Grinding table segments of a roller mill of 5,000 mm diameter made of KALCAST; smaller parts are cast in one piece

KALCAST C153 hard cast tiles for the protection of grinding roll yokes
Kalenborn supplies grinding rolls, grinding tables and mill linings for grinding plant used for raw material, coal and clinker. Top: regeneration of a grinding roll with KALMETALL W100, bottom: newly cast component made of KALCAST C155 hard casting, each 1,500 mm Ø.

Safe with the Handling of Raw Meal

Raw meal transport to the preheater – reliably protected with KALCRET
Limestone bunker with slide promoting lining made of KALEN 1006
Pipe diverter in pneumatic pipe lined with KALCOR
Housing made of KALMETAL for a raw meal fan – 2,000 mm Ø – as segment lining
Proven Solutions for Clinker Systems

Lining of Preheater Cyclones
Solution offered by Kalenborn: prefabricated KALCRET shapes with insulation and mechanical fixing to the steel structure.

This equally ensures:
- high wear protection
- high thermal insulation
- short installation times

Cement Production

Longlife Pipes and Cyclones

Protection of raw meal pipes against abrasive wear with hard compound KALCRET, lining thickness 25 - 40 mm, operating temperature 200 °C / 392 °F

Precise fitting of KALOCER high alumina ceramics, 13 and 25 mm thick

Separator cones for cement made of KALMETALL W100 6+4, 3,000 mm Ø

Separator cones for cement made of KALMETALL W100 6+4, 3,000 mm Ø

ABRESIST fused cast basalt is a time-tested protective material for cement separators

Lining pipe parts used for cement grinding with KALCRET BNX, up to 3,200 mm Ø
Transport Pipes, Pipe Bends and Chutes

Cement Production

Pipe for clinker transport made of KALMETALL W100, 300 mm Ø

Jointless lining with KALCRES, even for asymmetric cross sections

Kalenborn deviation pots installed in case of narrow space

KALCOR S allows long duty cycles and high temperature stress

Pipes used in the cement industry are reliably protected with ABRESIST, KALCRET or – in case of extreme wear – with KALCOR and KALOCER

Materials at a Glance

ABRESIST Fused Cast Basalt
ABRESIST is a basalt based wear protection for plant components in which the material to be conveyed predominantly causes friction induced abrasion in bunkers, troughs, chutes, chain conveyors, mixers, separators, pipes, pipe bends, cyclones, etc.

Installation: the shaped cast tiles are laid in cement mortar. To meet special requirements other setting materials may be used, such as KALFRES synthetic mortar or potassium silicate based mortar for higher temperatures.

Application temperature: up to approximately 350 °C / 662 °F

Advantages: high abrasion resistance, lasting smooth surface, no corrosion.

KALCOR Zirconium Corundum
KALCOR is a material composed of alumina and zirconia. It is recommended for particularly high abrasion and/or thermal stress, e.g. in cyclones and separators, in chutes for hot sinter or clinker, for mixers, pipelines, etc.

Installation: the shaped cast tiles are laid either in cement mortar or special setting materials. Mechanical fixing is possible as well.

Application temperature: up to approximately 1,000 °C / 1,832 °F

Advantages: high abrasion resistance, high temperature stability, resistant to impact and corrosion. Available in thicknesses from 1.5 mm.

KALOCER High Alumina Ceramics
Special high alumina ceramics for system components exposed to extreme wear and/or thermal stress for which thin linings or smooth surfaces are required, such as in circulating air separators, cyclones, screw cementers, vibrating chutes, fans, fan blades, etc.

Installation: shaped elements or thin tiles laid in epoxy mortar. KALOCER tiles are also vulcanized into rubber mats to be fastened by adhesive. Mechanical fixing is possible as well.

Application temperature: up to approximately 1,000 °C / 1,832 °F

Advantages: high abrasion resistance, high temperature stability, resistant to impact and corrosion.

KALMETALL and KALCAST Metallic Wear Protection
Metallic wear protection is offered in various qualities. It is particularly suitable as protection against sliding and impact wear. The range includes hard castings as well as overlay weldings.

Installation: blade-to-measure castings laid in setting compounds or mechanically fixed. Plates with overlay welding are fixed mechanically or designed as self-supporting structure.

Application temperature: up to approx. 350 °C / 662 °F (hard castings), up to 750 °C / 1,382 °F (hard overlay welding).

Advantages: highly wear resistant and resistant against impact wear, castings economic upon series production, overlay weldings characterized by good adaptability.

KALCRET Hard Compound
Cement bonded hard compound for continuous lining of plant components where high wear and temperature occur, e.g. troughs, chutes, bunkers, cyclones, etc.

Installation: by trowelling, casting or spraying.

Application temperature: up to approximately 1,000 °C / 1,832 °F

Advantages: high wear resistance and compressive strength, jointless lining and high temperature resistant.
## Wear Resistant Linings

<table>
<thead>
<tr>
<th>Lining</th>
<th>Material Hardness</th>
<th>Vickers HV 1</th>
<th>Max. conveying speed m/sec.</th>
<th>Max. temperature °C</th>
<th>Wear resistance</th>
<th>Thermal shock resistance</th>
<th>Impact resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABRESIST fused cast basalt</td>
<td>Mohs 8</td>
<td>770</td>
<td>20</td>
<td>350</td>
<td>662</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>KALOCER high alumina ceramics</td>
<td>Mohs 9</td>
<td>1,050</td>
<td>30</td>
<td>1,000</td>
<td>1,832</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>KALCOR zirconium corundum</td>
<td>Mohs 9</td>
<td>900</td>
<td>30</td>
<td>1,000</td>
<td>1,832</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>KALCOR S sintered zirconium corundum</td>
<td>Mohs 9</td>
<td>970</td>
<td>25</td>
<td>1,200</td>
<td>2,192</td>
<td>+++</td>
<td>+++</td>
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<tr>
<td>KALSICA N silicon carbide ceramics</td>
<td>Mohs 9</td>
<td>1,100</td>
<td>25</td>
<td>1,550</td>
<td>2,822</td>
<td>+++</td>
<td>++++</td>
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<tr>
<td>KALSICA S silicon carbide ceramics</td>
<td>Mohs 9</td>
<td>1,600</td>
<td>35</td>
<td>1,250</td>
<td>2,282</td>
<td>+++</td>
<td>++++</td>
</tr>
<tr>
<td>KALCERAM wear-resistant hard ceramic</td>
<td>Mohs 7</td>
<td>500</td>
<td>20</td>
<td>350</td>
<td>662</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>KALCRET hard compound</td>
<td>Mohs 8</td>
<td>1,250 *</td>
<td>20</td>
<td>1,200</td>
<td>2,192</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>KALMETALL W100 hard overlay welding</td>
<td>Mohs 7</td>
<td>700</td>
<td>20</td>
<td>350</td>
<td>662</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>KALCAST C155 hard casting</td>
<td>Mohs 7</td>
<td>700</td>
<td>20</td>
<td>350</td>
<td>662</td>
<td>+++</td>
<td>+++</td>
</tr>
</tbody>
</table>

* referred to the hard aggregate material

## Slide Promotion Linings

<table>
<thead>
<tr>
<th>Lining</th>
<th>Slide Promotion</th>
<th>Max. Temperature</th>
<th>Wear Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>KALEN slide promotion plastics</td>
<td>++++</td>
<td>80</td>
<td>176</td>
</tr>
<tr>
<td>KALCERAM wear-resistant hard ceramic</td>
<td>+++</td>
<td>350</td>
<td>662</td>
</tr>
<tr>
<td>ABRESIST fused cast basalt</td>
<td>+++</td>
<td>350</td>
<td>662</td>
</tr>
</tbody>
</table>

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*ABRESIST, KALCERAM, KALCOR, KALCRET, KALEN, KALENBORN, KALFIX, KALINOX, KALMETALL, KALOCER, KALPOXY, KALPROTECT, KALCAST, KALIMPACT, KALRESIST and KALSICA are trademarks of Kalenborn.*

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