

## **Economic Wear Protection in Cement Plants Worldwide**



*Cooler waste gas pipe lined with  
KALCRET-BNY hard compound*



*Service by Kalenborn:  
rebuilding of a grinding roll  
with KALMETALL-W 100*

### **Reduce Costs and Avoid Downtime**

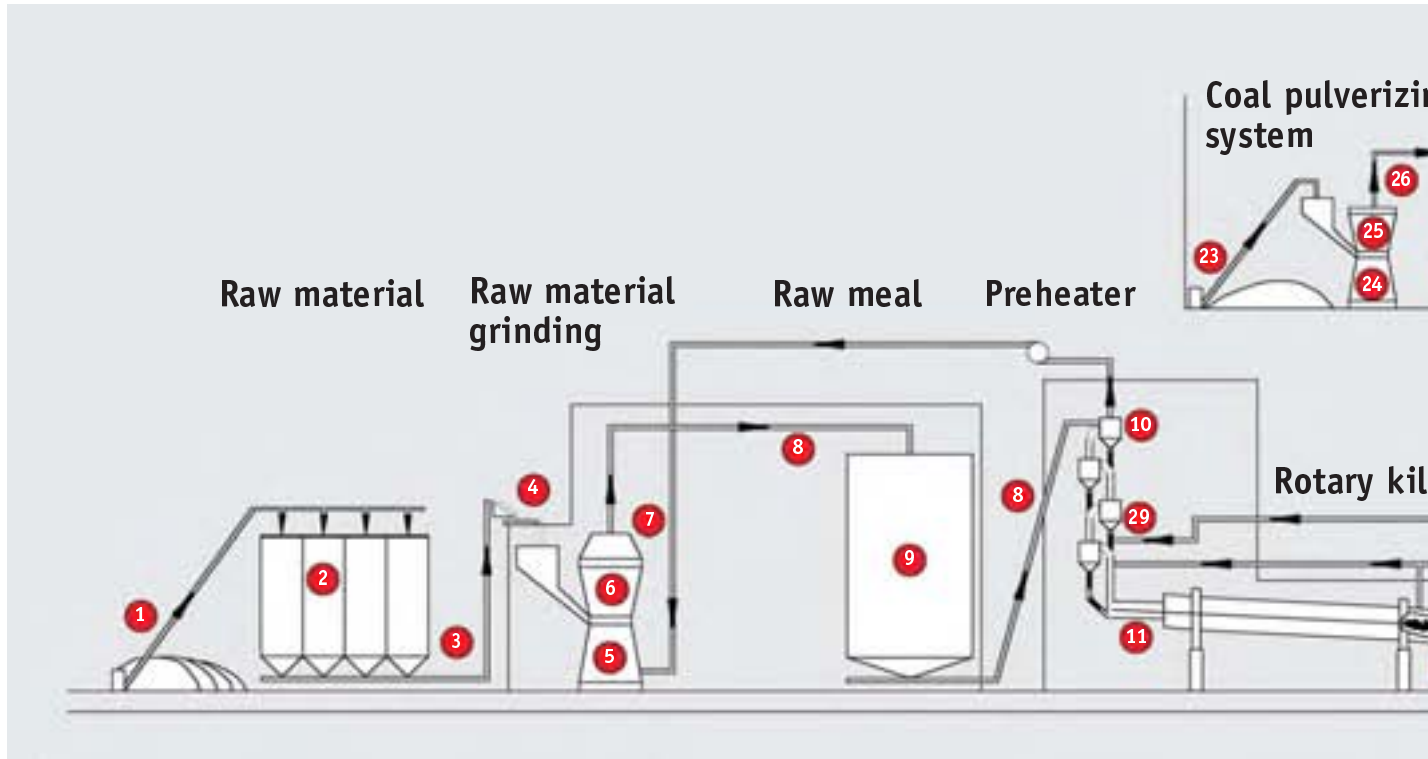
Large quantities of bulk material are handled in the conveying and storing systems of cement plants. Unless they are suitably protected these systems will experience frequent failure requiring repair or replacement. Kalenborn offer the complete array of wear protection materials including not only ceramic and metallic materials but also plastics and rubber.

In addition, Kalenborn have extensive experience in the field of slide promotion. Interruptions of material flow inside of bunkers and silos must be avoided and Kalenborn cover the entire material range with plastics as well as metallic and ceramic materials.

In any case we can supply a tailor-made solution for your particular problem. Our experts are prepared to be of assistance.

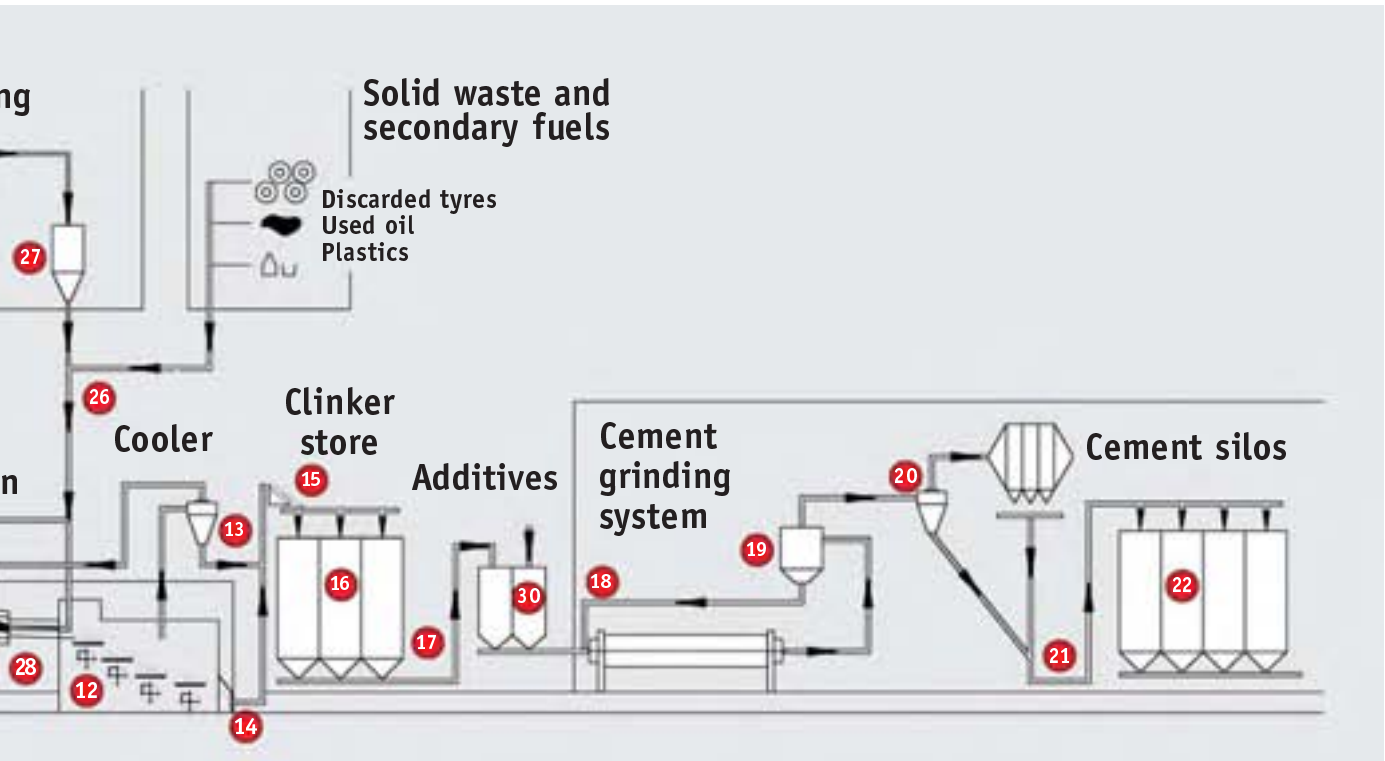
Material Handled / System	Plant Component	Lining Material as Wear Protection / Slide Promotion*
<b>RAW MATERIAL</b>		
<ul style="list-style-type: none"> <li>1 Bunkers</li> <li>2 Silos</li> <li>3 Transport</li> </ul>	<ul style="list-style-type: none"> <li>Chutes</li> <li>Transfer chutes</li> <li>Chain conveyors</li> </ul>	<ul style="list-style-type: none"> <li>ABRESIST, KALEN*, KALCERAM*, KALINOX*</li> <li>ABRESIST, KALEN*</li> <li>ABRESIST, KALCOR, KALOCER</li> <li>ABRESIST, KALCOR, KALOCER</li> <li>ABRESIST</li> </ul>
<ul style="list-style-type: none"> <li>4 Raw Mill (grinding/drying)</li> <li>5</li> <li>6</li> <li>7</li> <li>8 Pneumatic raw meal transport</li> <li>9 Raw meal silo</li> <li>10 Preheater cyclone</li> <li>11 Kiln feed</li> </ul>	<ul style="list-style-type: none"> <li>Ball mill - <i>feeding</i></li> <li>Roller mill - <i>side walls</i></li> <li>- <i>rolls, table</i></li> <li>- <i>separator</i></li> <li>- <i>pneumatic discharge</i></li> <li>Chute</li> </ul>	<ul style="list-style-type: none"> <li>KALMETALL-W, KALMETALL-C, KALCOR</li> <li>KALMETALL-W, KALMETALL-C</li> <li>KALMETALL-W, KALMETALL-C</li> <li>ABRESIST, KALCRET, KALMETALL-W, KALOCER</li> <li>KALCRET</li> <li>ABRESIST, KALCOR, KALCRET, KALMETALL-W</li> <li>ABRESIST, KALEN*</li> <li>KALCRET (in part with insulation)</li> <li>KALCRET</li> </ul>
<b>CLINKER</b>		
<ul style="list-style-type: none"> <li>12 Cooler</li> <li>13</li> <li>14 Cooler discharge</li> <li>15 Clinker chutes</li> <li>16 Clinker store</li> <li>17 Clinker withdrawal</li> <li>18 Cement mills</li> <li>19 Cement separators</li> <li>20 Dust collection</li> </ul>	<ul style="list-style-type: none"> <li>Reciprocating grate plates</li> <li>Clinker crusher</li> <li>Dust collecting pipes</li> <li>Dust collecting cyclones</li> <li>Chute</li> <li>Chain conveyors</li> <li>Ball mill - <i>feeding</i></li> <li>Roller mill - <i>side walls</i></li> <li>- <i>rolls, table</i></li> <li>Cyclones</li> <li>Pneumatic pipes</li> </ul>	<ul style="list-style-type: none"> <li>KALMETALL-W</li> <li>KALMETALL-C, KALMETALL-W</li> <li>KALCRET, KALCOR, KALMETALL-W</li> <li>KALCRET, KALCOR, KALMETALL-W</li> <li>KALCRET</li> <li>ABRESIST, KALMETALL-W</li> <li>ABRESIST, KALMETALL-W</li> <li>ABRESIST</li> <li>KALMETALL-C, KALMETALL-W, KALCOR</li> <li>KALMETALL-W, KALMETALL-C</li> <li>KALMETALL-W, KALMETALL-C</li> <li>ABRESIST, KALCRET, KALOCER, KALMETALL-W</li> <li>ABRESIST, KALCRET, KALOCER, KALMETALL-W</li> <li>ABRESIST, KALCRET, KALMETALL-W</li> </ul>
<b>CEMENT</b>		
<ul style="list-style-type: none"> <li>21 Pneumatic transport</li> <li>22 Silos</li> </ul>	<ul style="list-style-type: none"> <li>Pipes</li> </ul>	<ul style="list-style-type: none"> <li>ABRESIST, KALCRET</li> <li>KALEN*, KALCERAM*</li> </ul>

# Reliable Control of Wear Problems



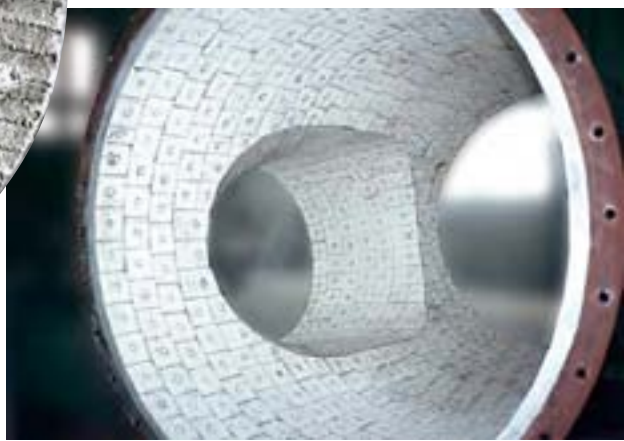
COAL		
23 Bunkers		ABRESIST, KALEN*, KALCERAM*
24 Coal pulverizer	Roller mill - side walls - rolls, table	KALMETALL-W, KALMETALL-C KALMETALL-W, KALMETALL-C
25 Separator		ABRESIST, KALCRET, KALOCER, KALMETALL-W
26 Pneumatic transport	Pipes	ABRESIST, KALCOR, KALOCER
27 Silo – fine coal		KALEN*
28 Burner		KALMETALL-W, KALSICA
PRECALCINING		
29 Feed Burner		ABRESIST, KALCOR KALMETALL-W, KALSICA
ADDITIVES		
30 Gypsum	Bunker	ABRESIST, KALEN*
Marl	Bunker	ABRESIST, KALEN*
BFS	Silo	ABRESIST, KALEN*
Fly ash	Silo	ABRESIST, KALEN*
Pneumatic transport	Pipes	ABRESIST, KALCOR, KALCRET

# Work with Kalenborn for Your Optimal Solution



*Screw conveyor protected with KALMETALL-W 100, up to 2,000 mm diameter, up to 10,000 mm length*

*Slide promotion lining of a silo discharge for additives with KALEN-1000*



*KALOCER high alumina ceramics lining of a separator with mechanically fixed tiles, 100 x 100 mm*

## Pipes, Components and Service



*Protection for hydraulic and pneumatic pipes*



*Extended service life of plant components*



*Kalenborn Service solves wear problems on site*

### Optimal Solution for Every Plant Component

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
- KALCRET hard compound
- KALSICA silicon carbide ceramics
- KALMETALL-C hard casting
- KALMETALL-W hard overlay welding
- KALINOX slide promotion steel
- KALEN slide promotion plastics

In addition, material combinations have been very successful in practice. They enable both technically and economically optimal solutions.

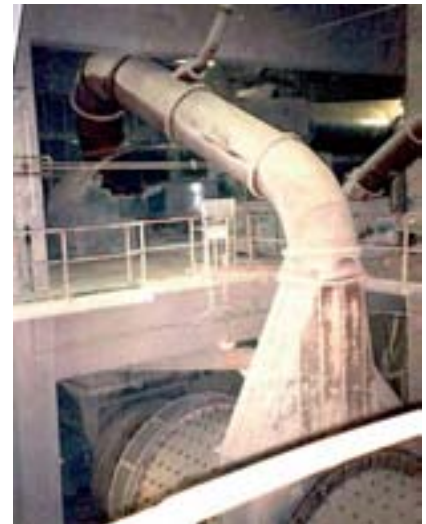
### Wear Protected Components

Components	Lining Materials
<b>Cyclones</b>	ABRESIST, KALCOR, KALOCER, KALSICA, KALMETALL-W
<b>Fan housings</b>	KALOCER, KALCRET, KALMETALL-W, KALMETALL-C
<b>Fan rotors</b>	KALOCER, KALMETALL-W
<b>Gates</b>	KALOCER, KALCOR, KALSICA, KALMETALL-W, KALCRET
<b>Hydraulic conveyors</b>	ABRESIST, KALCOR, KALOCER, KALCRET
<b>Mechanical conveyors</b>	ABRESIST, KALOCER, KALCRET, KALMETALL-W, KALMETALL-C
<b>Nozzles</b>	KALOCER, KALSICA
<b>Pneumatic conveyors</b>	ABRESIST, KALCOR, KALOCER, KALCRET, KALMETALL-C, KALMETALL-W
<b>Pumps</b>	KALSICA
<b>Separators</b>	ABRESIST, KALCOR, KALOCER, KALSICA, KALMETALL-W
<b>Sieves</b>	KALMETALL-W, KALMETALL-C
<b>Transfer stations</b>	ABRESIST, KALOCER, KALMETALL-W
<b>Valves and fittings</b>	KALOCER

**Extended Lifetime for Grinding Plants ...**



*Reliable protection of raw mill and pipe system with KALCRET-BNX hard compound*



*ABRESIST used for the center discharge chute of a ball mill*

*Grinding table segments of a roller mill of 5,000 mm diameter made of KALMETALL-C; smaller diameters are cast in one piece*



*KALMETALL-C 153 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-W 100, bottom: newly cast component made of KALMETALL-C 151 hard casting, each 1,500 mm Ø.*

## ... and for Separator Systems



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



*Separator cones for cement made of KALMETALL-W 100 6+4, 3,000 mm Ø*



*Precise fitting of KALOCER high alumina ceramics, 12 and 25 mm thick*



*Lining the separator used for cement grinding with KALCRET-BNX, up to 3,200 mm Ø*



*Protecting an impact plate of a cement separator with KALCRET-CNY*

## Proven Solutions for Raw Meal Handling



*Raw meal bunker with slide promoting lining made of KALEN-1006*



*Raw meal transport to the preheater – reliably protected with KALCRET*



*Pipe diverter in pneumatic pipe lined with KALCOR*

*Protection of a raw meal mill: KALCRET for the piping, KALMETALL-W 100 for the mill lining*



*Housing made of KALMETAL-W for a raw meal fan – 2,000 mm Ø – as self-supporting structure*



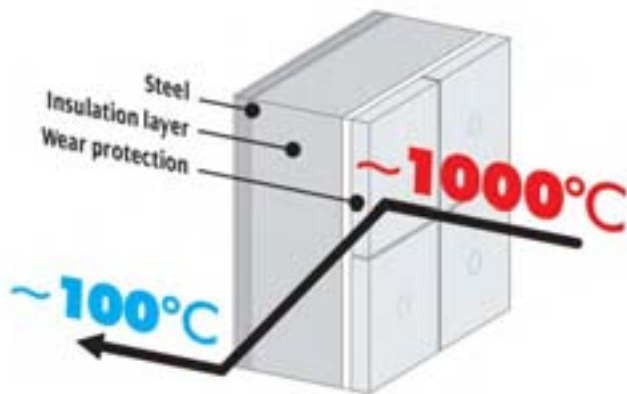
# From the Preheater to the Rotary Kiln

## 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



*Discharge chute lined with KALMETALL-C, 25 mm thick; fastened with countersunk screws*



*Pulverized coal pipe with ABRESIST and burner tubes made of KALMETALL-W 100; depending on the operating conditions pipes are protected with ABRESIST, KALCOR, KALCRET or KALOCER*

## Reliable Protection of Clinker Systems



*Plate of a reciprocating grate clinker cooler armored with KALMETALL-W 145*



*Conveyor for clinker transport lined with KALMETALL-W 100; 800 mm Ø*



*Pneumatic transport components with efficient ABRESIST wear protection*



*Dust collecting pipe for clinker fitted with 6 mm thick KALOCER mosaics set in KALFIX epoxy adhesive*



*Clinker dust pipe protected with KALCRET hard compound*



*Pipe for clinker transport made of KALMETALL-W 100, 300 mm Ø*



*Impact hammer of a clinker crusher made of KALMETALL-C*

# Pipes and Chutes



*Jointless lining with KALCRET, even for asymmetric cross sections*



*Kalenborn deviation pots installed in case of narrow space*



*KALCOR-S allows long duty cycles and high temperature stress*



*Clinker dust pipe: cyclone exit protected with KALMETALL-W*



*Transport pipe to the cement silos; the bends are protected by ABRESIST just like the straight extensions*



*KALCERAM hard ceramics lining for a chute of a cement bag loading system*

### Wear Resistant Linings

Lining	Material Hardness		Process Parameters					Impact wear resistance	Remarks
	Mohs(1)	Vickers HV (2)	Max. conveying velocity m/sec	Material density g/cm <sup>2</sup>	Max. temperature (3)		Thermal shock resistance		
					°C	°F			
KALSICA-S silicon carbide ceramics	9.3	(2,300)	35	>3.0	1,000	1,832	++++	++	For extreme applications
KALOCER high alumina ceramics	9.1	(2,100)	>30	>3.0	350	662	0	+	Standard tiles, thin wall cylinders and tiles
KALCOR zirconium corundum	9	(2,000)	>30	>3.0	800	1,472	++	++	Large tiles, shaped elements, great wall thickness
KALSICA-N silicon carbide ceramics	8.8	(1,800)	>25	>3.0	1,000	1,832	+++	+	Good temperature resistance/thermal shock resistance
KALCOR-S sintered zirconium corundum	8.5	(1,600)	>25		800	1,472	+++	++	Economic KALCOR
KALCRET-B hard compound	8.1	(1,250)	22	≤3.0	800	1,472	+++	+	Supplied in bags, no joints, high temperatures
ABRESIST fused cast basalt	8	(1,140)	22	≤3.0	350	662	0	+	Flow volumes up to 3.0 g/cm <sup>3</sup> , up to 22 m/sec, limited temperatures
KALMETALL-W 100 hard overlay welding	(7.5)	700	20	-	350	662	++	++	Impact resistant, low weight
KALMETALL-C hard casting	(7.2)	580	20	-	350	662	++	+++	Impact resistant, economic in case of large quantities
KALCERAM hard ceramics	6	(500)	-	-	350	662	0	+	Bunker lining, slide promotion

(1) The Mohs scale is applicable only to ceramic materials - no more than comparison values for other materials (values given in brackets)

(2) The Vickers HV values are only valid for metallic materials - no more than comparison values for other materials (values given in brackets)

(3) The specified temperatures refer to standard applications; other temperatures must be agreed upon with the technical departments of Kalenborn

### Slide Promotion Linings

Lining	Slide Promotion	Max. Temp.		Wear Resistance	Remarks
		°C	°F		
KALEN slide promotion plastics	+++++	80	176	+	No corrosion, very smooth surface, low weight
KALINOX slide promotion steel	+++	550	1,022	++	Slide promotion in case both sliding wear and sticking problems exist
KALCERAM hard ceramics	+++	350	662	+++	Slide promotion and more efficient wear protection
ABRESIST fused cast basalt	+++	350	662	++++	Good material flow in case of hard, abrasive conveyed material

# Proven Kalenborn Offerings



## ABRESIST fused cast basalt

Mineral protection made of cast basalt to protect against abrasive wear.

Advantages: high wear resistance, permanent smooth surface, no corrosion.



## KALMETALL-W hard overlay welding

Tough basic body and hard overlay welding with primary chromium carbides.

Advantages: highly wear resistant, good resistance against impact wear, self-supporting structures.



## KALCOR zirconium corundum

Cast or sintered material made of alumina and zirconia oxide.

Advantages: high wear resistance, resistant against high temperatures, corrosion resistant.



## KALMETALL-C hard casting

Different materials characterized by corresponding resistance against abrasion and impact wear.

Advantages: alloy matched to the specific application, of advantage in case of larger quantities.



## KALOCER high alumina ceramics

Special oxide ceramics for plant components subject to extreme wear.

Advantages: high wear resistance, permanent smooth surface, no corrosion.



## KALCRET hard compound

Cement bonded compound for jointless protection to be trowelled, cast or sprayed-on.

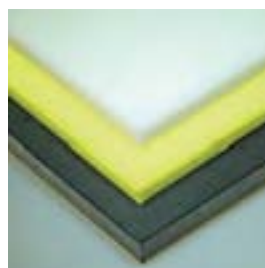
Advantages: high wear resistance and compressive strength, jointless, temperature resistant.



## KALSICA silicon carbide ceramics

Suitable for plant components that are exposed to extreme wear and/or high temperatures.

Advantages: highly wear resistant, resistant against thermal shocks and producible with narrow dimensional tolerances.



## KALEN slide promotion plastics

Range of different polyethylene (PE) and polyurethane (PU) materials.

Advantages: good durability, free of corrosion, smooth surface.

### 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

#### Plastic lining

- excellent slide promotion
- good resistance against impact wear
- low weight

#### Material combinations

- optimal wear protection for every application
- optimized lining cost
- optimized weight

## Optimal Solution for all Requirements



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



*Immersion pipe of a cyclone for separation of granulated slag. The pipe inside has been lined with KALCRET, the cover armored with KALMETALL-W.*

*Kalenborn supply wear protected plant components. In addition we provide for regeneration of worn components - here a grinding table of a coal pulverizer.*



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