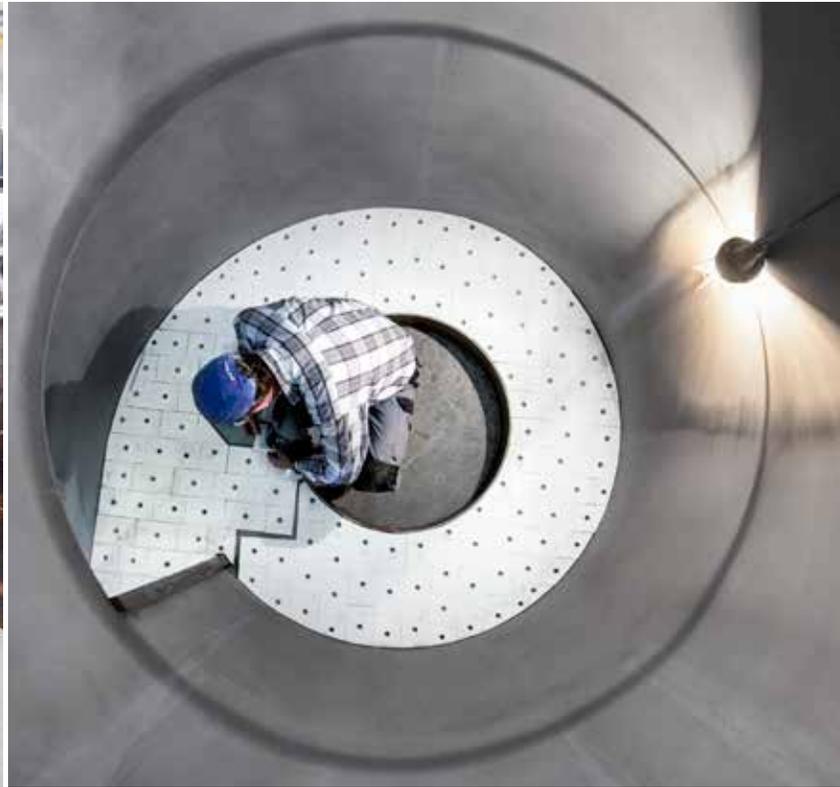


WEAR PROTECTION FOR PLANT COMPONENTS AND PIPE SYSTEMS



REDUCE COSTS AND AVOID DOWNTIME



The selection of the appropriate material is of vital importance as well as its correct application.

Kalenborn have been dedicated to plant protection since originally developing fused cast basalt for wear reduction and cost savings.

Starting with fused cast basalt more than eighty years ago, a wide range of wear resistant materials has been developed with each material offering special characteristics. The materials are valuable, but the knowledge from experience gathered all over the world in many branches of industry is just as important.

The transport of bulk products in the base material industry and other industrial sectors causes extensive wear in plant components. When that wear interrupts operations, the losses incurred even exceed the cost of procuring replacements and repairs.

This is unacceptable in today's competitive world markets. The solution to the problem is reliable wear protection.

The highest cost in many situations is the lost production time due to unplanned outages.

The money saved by using low cost steel components can result in a much higher cost later.

Abrasion resistant pipes and plant components save money as repair frequency is greatly reduced and production time is increased.

From that point forward, every repair that can be avoided as a result represents money saved.

Effective corrosion protection with ceramic, mineral and metal materials



Impact plates for bulk goods with KALOCER and pipes with ABRESIST



Pulverized coal distributors made of KALMETALL

WE MANUFACTURE WEAR PROTECTION LININGS MADE TO MEASURE

Consulting and design

Every wear problem requires an individual solution. We analyse the type of wear occurring and its associated parameters – in cyclone applications, for example, where we consider the size and shape of grains, the speed of conveyance and the angles of impact – so we can apply appropriately designed linings to extend the service life of plant components. We support your project right from the onset and ensure its rapid and economical completion.

“The better the material and the lining address the specific problem, the more durable and economical the solution.”

Wear-resistant materials

We produce wear-resistant materials with different properties and market them in the form of compounds, tiles, specially shaped components and cylinders.

- ABRESIST fused cast basalt
- KALCOR zirconium corundum
- KALOCER oxide ceramic
- KALSICA silicon carbide ceramic
- KALCERAM hard ceramic
- KALMETALL hard facing
- KALCAST hard cast iron
- KALCRET hard compound
- KALPOXY hard compound
- KALEA high performance plastic
- KALEN thermoplastic

Wear-resistant pipe systems

We line piping components, such as pipes or pipe bends, with wear-resistant materials to make them thereby resistant to wear. We also manufacture hard cast piping components. Flexible and wear-resistant KALFLEX pipes and pipe bends are used where conditions such as vibration and linear expansion exclude the use of rigid piping systems.

Wear protection for industrial plants

Our proven solutions ensure effective wear protection in plant components. The optimum wear protection design often involves combining different materials. Those materials are then matched to the different loadings. Here it is important to select a suitable installation method for the product. That method must address various general conditions, such as temperature, vibration or accessibility in the plant.

Customer-specific solutions

We manufacture customer-specific plant components that account for all essential aspects of the wear and provide long, cost-effective service life. Protective linings are installed at our factories or in situ on the customer's premises. Bunkers, cyclones, mixers, channels and other non-portable plant components are lined in place by our global installation team or under the direction of professional installers.



SERVICES RENDERED FOR MANY BRANCHES OF INDUSTRY, ACTIVE ON ALL CONTINENTS

Kalenborn offer a complete array of wear protection materials to achieve acceptable service lifetimes.

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.

Kalenborn can supply a tailor-made solution for almost any particular problem. Our experts are prepared to be of assistance.



Coal Fired Power Plants

Plant components are subject to substantial wear in coal storage and coal transport systems. This includes coal pulverizing and injection into the boiler, dust collection and ash removal including fly ash and bottom ash. The situation is similar for limestone and gypsum in desulphurization systems.



Iron and Steel Industry

Critical systems of the iron and steel industry are the raw material storage and processing at the sinter plant, coke plant and blast furnace operation. Comprehensive wear protection is also an absolute must for steel making and in the rolling mills.



Cement Industry

Endangered plant systems are raw material storage and processing. This includes pulverizing and feeding into the rotary kiln as well as handling of coal, clinker, additives and cement.



Further Industries

Kalenborn are active in a wide range of industries and these include:

- biomass
- chemical industry
- ore and mineral processing
- ore and coal mines
- foundries
- glass works
- smelting works
- waste incineration plants
- recycling operations
- raw and bulk material plants
- hydroelectric power plants

Worldwide Organization

The headquarters of the company are located in Germany at the original production site of fused cast basalt. From here the company organizes international sales and supplies the various products for most applications.

Affiliated companies are responsible for regional markets.

In addition, Kalenborn have set up a close network of regional representatives and cooperating companies that ensure contacts with our customers.



Around the world, we are readily available to attend to your needs. The Kalenborn Group offers its international customers a local, well-connected network of experts everywhere.

> USA

Kalenborn Abresist

> CANADA

Kalenborn Canada

> BRASIL

Kalenborn do Brasil

> FRANCE

Kalenborn France

> GERMANY

Kalenborn Kalprotect

> POLAND

Kalenborn Delma

Kalenborn OSW

Kalenborn Bazalt

> HUNGARY

Kalenborn Refmon

> SINGAPORE

Kalenborn Asia

> PHILIPPINES

Kalenborn Weartech Philippines

> VIETNAM

Kalenborn Asia

PROPER PROTECTION FOR HYDRAULIC AND PNEUMATIC CONVEYING LINES

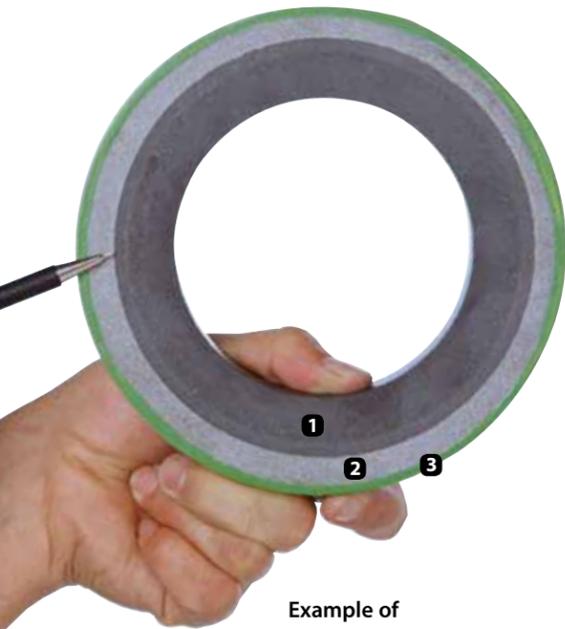
Pipe linings made of mineral, ceramic and metallic materials or of compounds and engineering plastics have proven themselves in practice. Depending on the requirements, there are material types with different properties.

Lining advantages:

- longer service life of components
- lower maintenance requirements
- no unscheduled downtime
- no unscheduled production outages
- lower pressure losses and lower energy costs
- no contamination of the conveyed materials due to abrasion, mixture or oxidation
- physiologically harmless, suitable for food products
- smooth surface to achieve good flowability and to avoid plugs

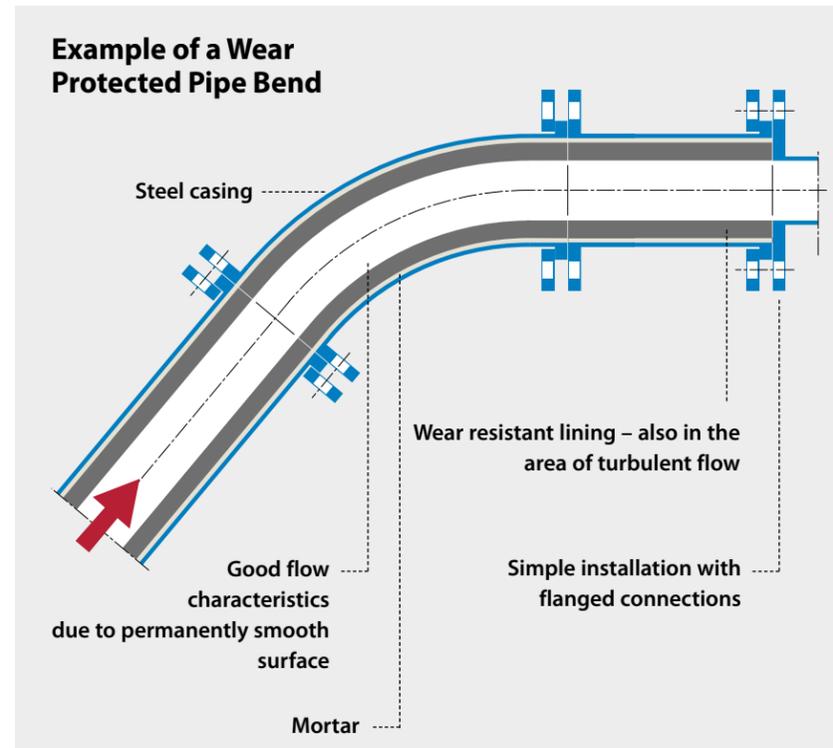
To achieve both technical and economical wear protection, many factors have to be taken into account. The choice needs to be based on the application.

Practical know-how and the availability of the different materials make it possible to achieve the desired long-term savings.



Example of a mineral lining:

- 1 Lining
- 2 Mortar
- 3 Steel



APPLICATION EXAMPLES



Hydraulic pipelines generally need to be protected from wear along their entire length. Depending on flow characteristics and general operating conditions, fused cast basalt pipes such as hydraulic lines used to flush boiler slag can have a service life of more than 20 years.



In pneumatic conveyor pipelines, most wear occurs in pipe bend walls. For this reason, piping with wear-proof internal lining is used at such locations. Because of turbulence in the straight sections immediately after bends, similarly lined pipes should be installed there as well. Recommended length: 10 times the inside diameter or 1 – 2 meters.

Examples in Hydraulic Conveying

Industry	Material
blast furnace plants	slag
chemical industry	caustic solutions with solids
coal fired power stations	bottom ash
hard coal mining	raw coal
hard coal washeries	heavy media with solids
phosphate plants	phosphate ore
potassium & salt industry	potassium salts, kieserite, salts
quartz & gravel plants	gravel, sand
refuse incineration	non-combustible residue, slag
rolling mills, continuous casting plants	sintered material, mill scale
sewage treatment plants	sewage sludge

Examples in Pneumatic Conveying

Industry	Material
aluminum plants	calcined alumina, bauxite, electrode carbon
abrasive plants	abrasives
blast furnace plants	sintered material, lime, lime-oxygen mixture, packing compound, pulverized coal
cement plants	clinker dust, cement, blast furnace slag, fly ash
chemical plants	caustic lime, lime dust, fertilizer
coal fired power stations	pulverized coal, quick coke, fly ash, ash, slag, pyrite
coal mines	coal dust, tailings for backfilling
foundries	quartz sand, molding sand
glass works	feldspar, quartz, kaolin, nepheline, cullet
grinding mills and animal feed	cocoa beans, corn, sunflower seeds, cereals
ore mines	concentrate, tailings
breweries, malting plants	hops, malt, rice
mineral wool & insulation products	production waste, saw waste, perlite, stone dust
refuse incineration, vacuum refuse collection	industrial and domestic refuse
steel plants	carbon and limestone injection
technical carbon plants	technical carbon, graphite for electrodes

RELIABLE PROTECTION FOR LONG SERVICE LIFE AND TROUBLEFREE OPERATION

In order to protect plant components used in the production of energy and raw materials as well as in primary industries, Kalenborn provides tried-and-tested solutions for effective protection against wear. But when it comes to wear, no two conditions are exactly alike.

There is frictional wear on plant components in continuous operation (such as cyclones, separators and sifters) and impact wear on components used intermittently in batch operations (such as mixers, silos and transfer chutes). These components must also withstand the loading and discharge process.

The optimum wear-protection system often involves a combination of multiple materials. Those materials are then matched to the different loadings.

The selection of a suitable means of installation is also important. Different boundary conditions such as temperature, vibration or availability in the plant require different methods for mounting the wear protection elements.

Lining advantages:

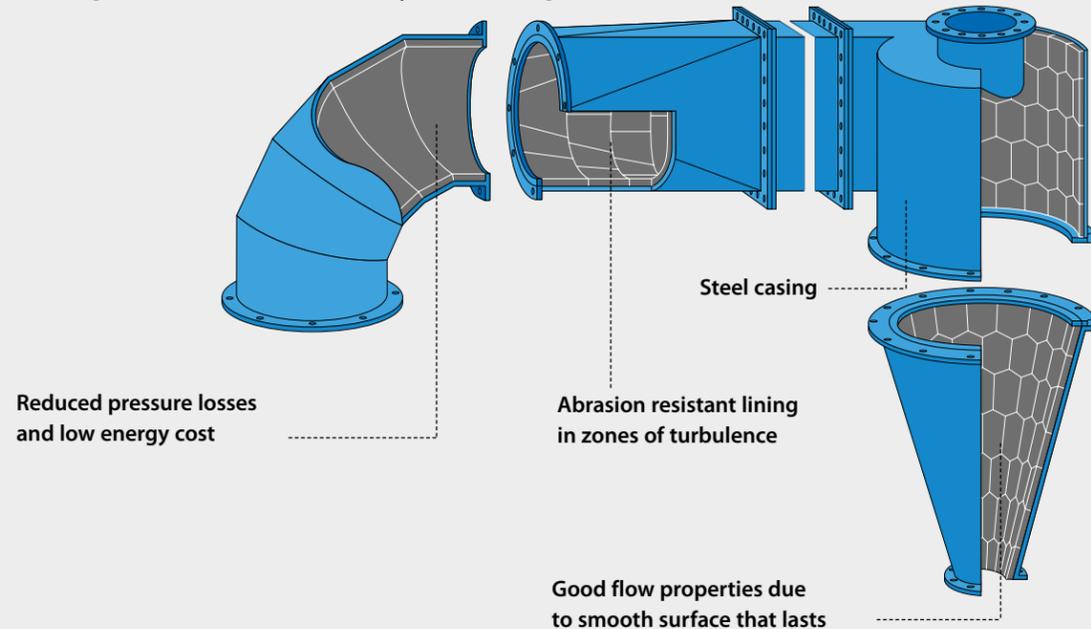
- longer service life of components
- lower maintenance requirements
- no unscheduled downtime
- no unscheduled production outages
- lower pressure losses and lower energy costs
- no contamination of the conveyed materials due to abrasion, mixture or oxidation



Convex dryer in a petrochemical plant with KALCOR

- physiologically harmless, suitable for food products
- smooth surface to achieve good flowability and to avoid plugs

Principle of Wear Protected System Components



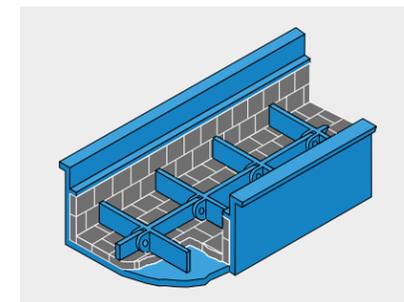
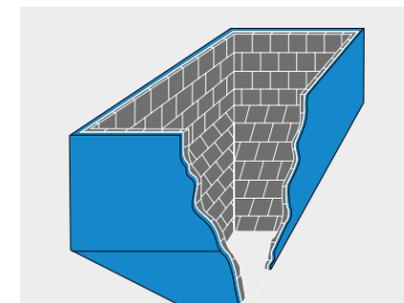
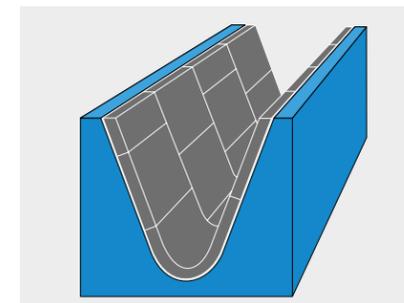
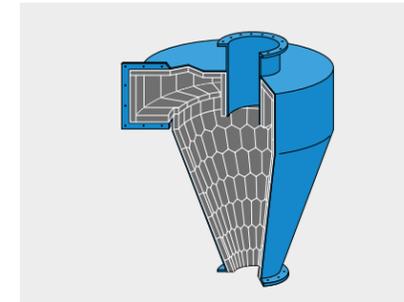
APPLICATION EXAMPLES

The large rocks handled in quarries and mines are not the only problems for conveying and processing systems.

In modern process plants, characterized by high throughput rates and conveying velocities, even apparently harmless materials cause significant wear.

Here is a list of typical abrasion problem components:

- ash pipelines
- belt discharge chutes
- bunker spirals
- bunkers
- channels
- chutes
- circulating air separators
- continuous flow conveyors
- cyclones
- dissolving tanks
- drying sections
- dust collecting equipment
- dust collecting pipes
- fans
- flue gas ducts
- flumes
- gravel release tunnels
- hoppers of rotary dryers
- hydrocyclones
- launders
- mixer troughs
- pipe bends
- pipes
- pneumatic backfill lines
- prilling tower bottoms
- pulpers
- receivers
- screw conveyor troughs
- separators
- settling basins
- shaft spirals
- sifters
- silos
- sinter troughs
- tailings lines
- tanks
- thickeners
- tubular chain conveyors
- turbo separators
- vibrating troughs
- washing drums



Typical system components with wear protection lining

FUSED CAST BASALT FOR ABRASION RESISTANCE

ABRESIST fused cast basalt has been used successfully for years as a universal material for abrasion protection. Depending on the application and geometry, it can be used with temperatures up to 350 °C / 662 °F. Installed as original equipment, ABRESIST is an excellent solution to wear problems before they start.

During the manufacture of ABRESIST, selected natural basalt is melted and cast into molds, then moved into an annealing furnace. Due to the casting process, precise cylinders from 40 to 610 mm internal diameter can be produced for pipes and bends. Special tile shapes are engineered for larger pipe diameters and other equipment.

ABRESIST has an extremely hard and smooth surface. The material is corrosion resistant to most acids and alkalis. This makes ABRESIST very effective for pipelines where abrasion and corrosion occur together.

The idea to melt stone is age-old. However, melting of basalt only started with lab tests at the end of the 19th century. The development beyond this stage due to crystallization problems and inadequate application tests.

However, by the early 1920's our company successfully produced a basalt based abrasion resistant material. Today, under the trade name ABRESIST, fused cast basalt has become a proven product worldwide.

ABRESIST

Fused cast basalt is a mineral based wear protection material for plant components when the conveying material produces friction induced abrasion.

Installation: cylinders or shaped components. In special cases epoxies or synthetic mortars may be used due to strong mechanical stresses and/or vibration. Where higher temperatures are concerned, potassium silicate mortar may be used for installation. Mechanical fixing is feasible as well.

Application temperature: up to approximately 350 °C / 662 °F depending on application and geometry.

Advantages: highly abrasion resistant, smooth surface that lasts, no corrosion.



Fly ash pipelines in a coal fired power station



Hydraulic ash conveying pipe being manufactured at the Abresist Kalenborn Corporation plant in Indiana, USA



Flumes and hoppers of any shape can be lined with abrasion resistant ABRESIST



Worldwide ash removal pipes lined with ABRESIST reach lifetimes of more than 30 years. This US power plant operates more than 10,000 meters of 294 mm ID pipes.



Coke bunker in the iron and steel industry

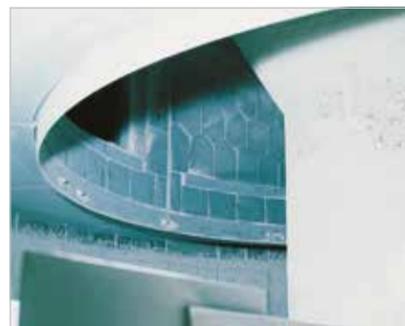


Irrigation weir protected by ABRESIST



Raw material hopper in a German blast furnace plant

FUSED CAST BASALT APPLICATIONS



ABRESIST lining of an air separator



Waste paper bales are mixed for paper recycling in pulpers. Since the bales contain considerable impurities the pulper bottom is durably protected with ABRESIST.



Hoppers of any shape for material discharge are fitted with ABRESIST as wear protection



Chain conveyor for wet ash removal in a power plant. Drains cast into the lining reduce the undesired carrying of water to the discharge zone thereby lowering the water consumption rate.



Quite often screw-type elevators are used for transport in waste water treatment plants. Continued proper functioning of the annular gap requires its being protected against wear. ABRESIST is successfully used for that purpose even at diameters of 3,000 mm and 15,000 mm length.



Separator components provided with ABRESIST wear protection



ABRESIST has performed well on automobile test tracks all over the world. Here, skid tiles are laid in Switzerland.



ABRESIST skid tiles at the right showing their natural surface; skid tiles with polished surface at the left to ensure a minimum friction coefficient



Combi-sorter made of high-grade steel used by the paper industry - protected from wear by ABRESIST tiles



The bends and straight extension sections of the feed pipes to cement silos have been lined with ABRESIST



ABRESIST pipe for hydraulic ore transport

ZIRCONIUM CORUNDUM WEAR PROTECTION FOR HIGH TEMPERATURE AND ABRASION RESISTANCE

With the growing knowledge of preventive wear protection the demand for durable materials with extended service life has increased.

KALCOR, a zirconium corundum was developed for extreme abrasion resistance and high temperatures up to 1,200 °C / 2,192 °F.

Alumina and zirconia are formed into tiles, shaped components and cylinders. This shape capability allows KALCOR to be manufactured into many different components demanded by various industries.

KALCOR

Material of alumina and zirconia for plant components, where extreme wear and/or high temperatures occur.

Installation: cylinders or shaped components in cement mortar or special setting compounds. Mechanical fixing is also possible.

Application temperature: up to approximately 1,200 °C / 2,192 °F depending on application and geometry.

Advantages: highly abrasion resistant, temperature resistant, corrosion resistant.

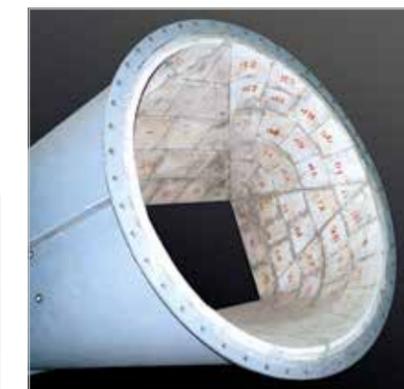


KALCOR lined pipes

High temperature wear protection in a dedusting cyclone of a blast furnace plant in Europe



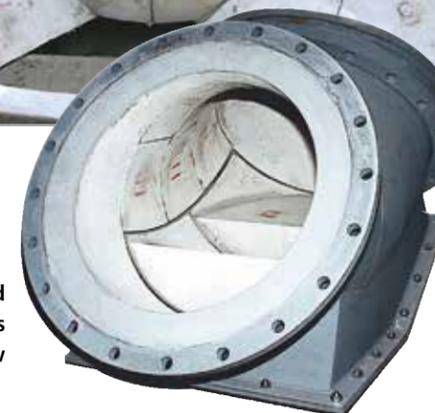
Wear protection for high temperatures involves problems due to thermal stress between the outer steel component and the rigid lining. These problems can be solved by using KALCOR as wear protection material and the right mechanical fixing method: bolted connections or welded steel inserts. Example: drying drum in a chemical plant at 800 °C / 1,472 °F.



With custom-cast special moulded elements or pre-cut shapes, KALCOR wear protection conforms well to the surfaces being lined.

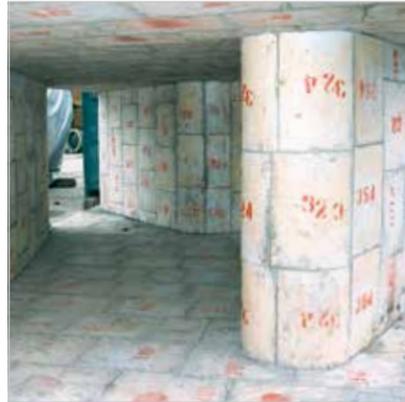


KALCOR pipe bend with deflectors to regulate flow



ZIRCONIUM CORUNDUM APPLICATIONS

Flue gas dust collector for dust removal from petroleum coke calciner in an oil refinery at temperatures up to 450 °C / 842 °F: 10 cyclones incl. immersion pipes, supply channels and raw-gas bends have been lined with abrasion resistant KALCOR



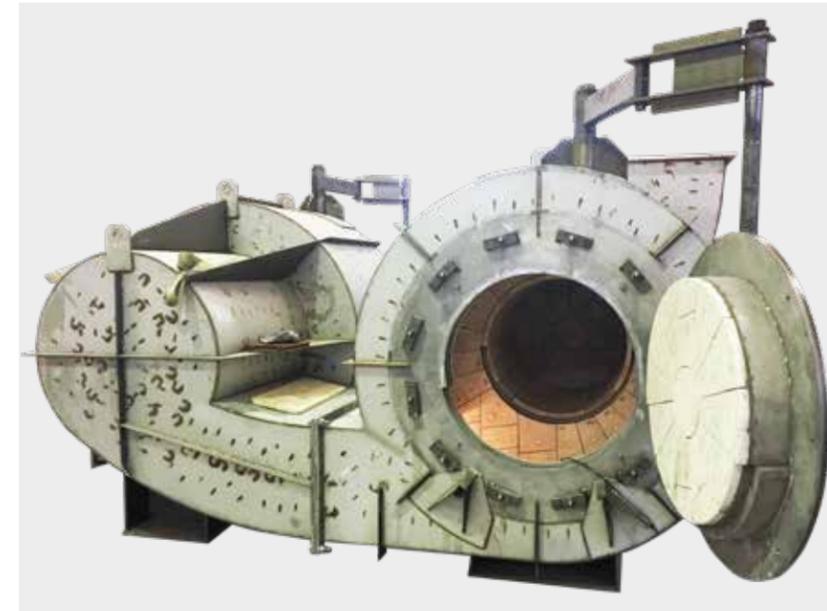
Pipe branching in pneumatic conveying pipe lined with KALCOR



Pulverized coal distributor with reliable KALCOR lining to ensure trouble-free continuous operation



Pulverized coal bends lined with KALCOR zirconium corundum and welded-on unlined transition sections



KALCOR protects the convex dryer of a chemical company against abrasion by fine-grained aluminum silicate at high temperature differences



Convex dryer inlet with KALCOR-lined tiles



Transition to the inlet of the convex dryer



Sintered KALCOR enables tiles, shaped components and cylinders with thin wall thicknesses



Asymmetric cross-section of a pipe

EXTREME ABRASION RESISTANT HIGH ALUMINA CERAMICS

KALOCER is a member of the oxide family of ceramics, with aluminum oxide as the main component. Extremely high abrasion resistance is achieved by careful selection of the particle size and distribution.

Most tiles or cylinders are formed by pressing a dry powder of the ceramic. Machining of ceramic prior to kiln firing or slip-casting allows the manufacture of components with geometrically difficult shapes.

KALOCER can be manufactured in very thin tiles. This is an advantage when existing plant components have to be lined and space or weight are of critical importance.



KALOCER

High alumina ceramics for plant components with extreme wear and/or temperature conditions. For thin linings or for smooth surfaces.

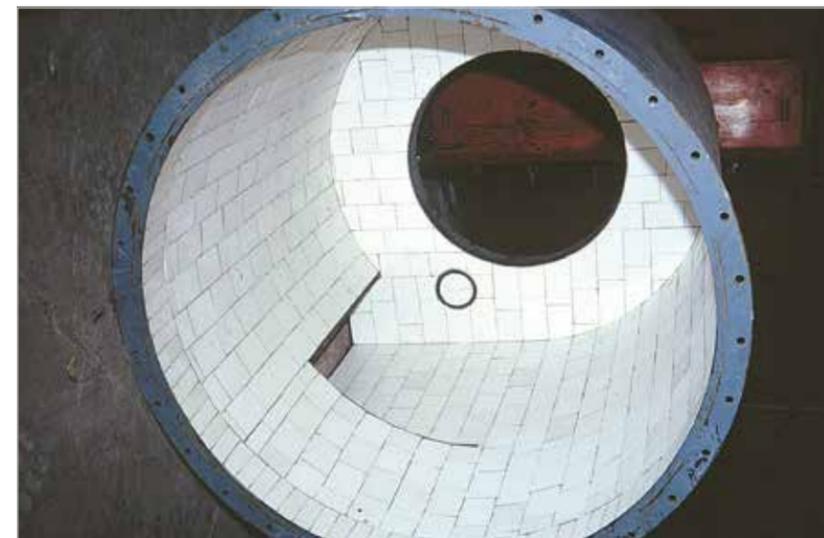
Installation: pipes, shaped components, or thin tiles laid in KALFIX synthetic mortar. KALOCER tiles vulcanized into rubber mats for installation by gluing are available. Mechanical fixing by welding is also possible.

Application temperature: up to 1,200 °C / 2,192 °F depending on application and geometry.

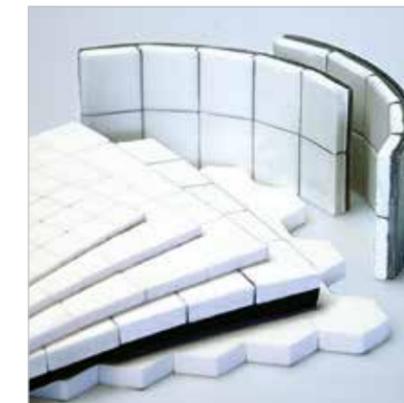
Advantages: highly wear resistant, smooth surface that lasts, no corrosion, available from 1,5 mm thickness.



Mechanically fixed special tiles of KALOCER protect the cone against wear even in case of thermal shock stress



Lining of a cyclone handling diatomaceous earth lined with 6 mm thick KALOCER tiles; the epoxy setting is resistant up to 180 °C / 356 °F



Kalenborn offer KALOCER mosaics in different sizes: square, hexagonal or special design from 1,5 mm to 12 mm thickness. Mosaics can be supplied with book ends. Vulcanized solutions are available.



Skip collection chute with KALOCER lining installed at a European blast furnace plant; the shaped elements are up to 50 mm thick and have been cut three-dimensionally to fit the component.



Agitators and mixers subject to extreme wear can be durably protected with KALOCER tiles shaped to the specific equipment design

OXIDE CERAMIC APPLICATIONS



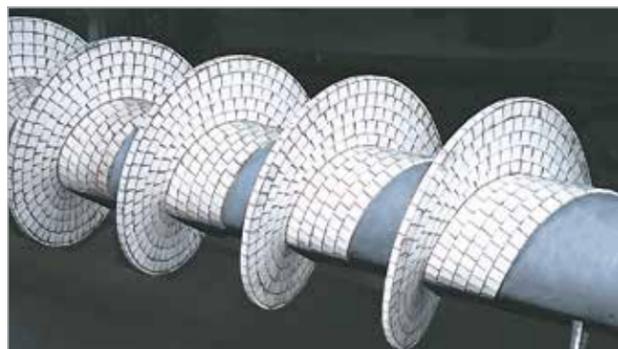
Chute for blast furnace lining in a European plant; the KALOCER lining is 50 mm thick



Octagonal hopper in a steel plant; the 50 mm thick KALOCER tiles have been three-dimensionally shaped and cut



Highly abrasion resistant KALOCER pipes to transport ore sludge in a mine in the Far East



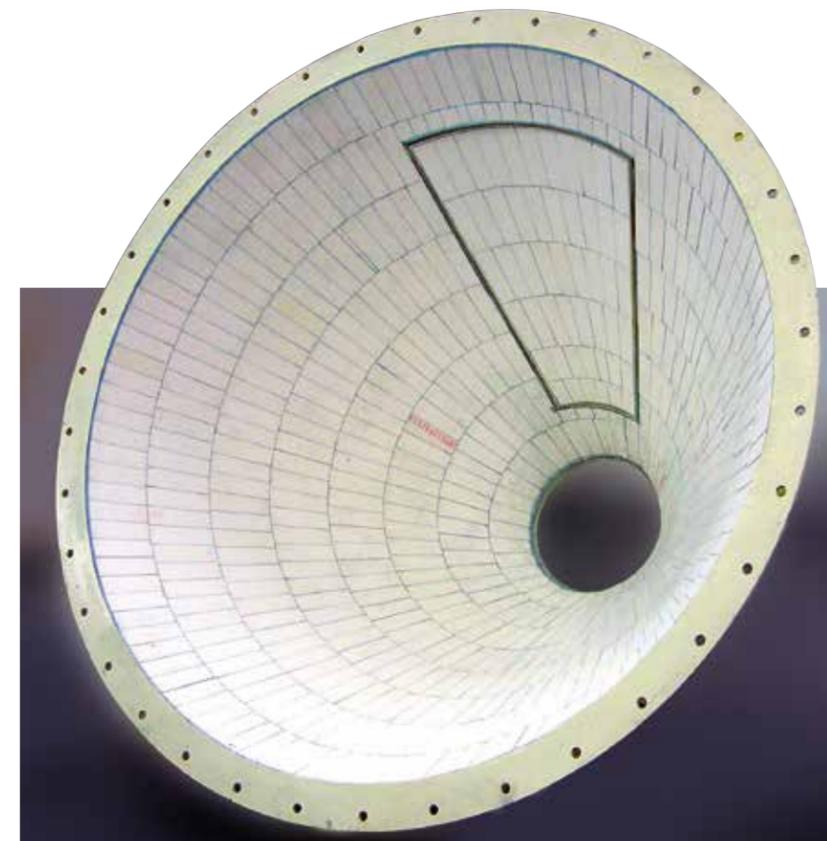
Screw lined with high alumina ceramics operated in a potash plant



KALOCER lining of a mill for superfine grinding of coloured pigments



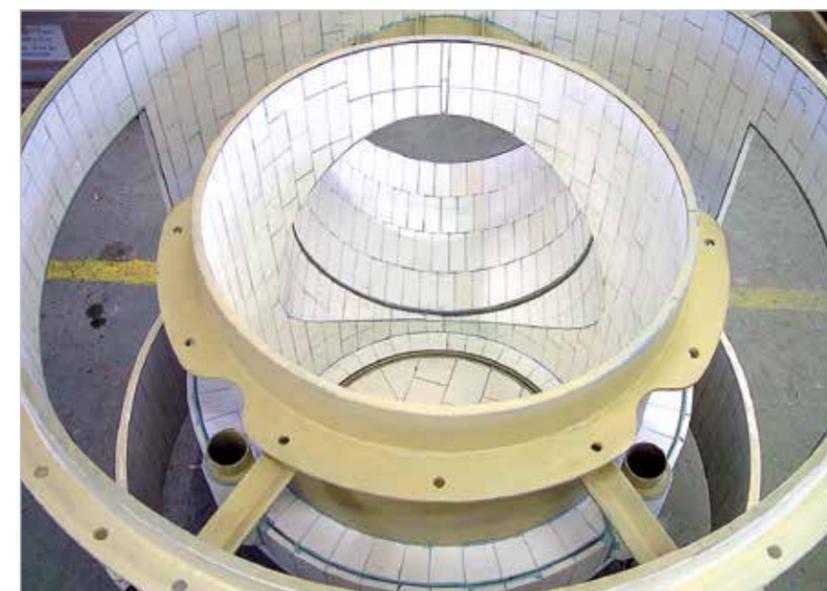
KALOCER pipe bricks are an economical alternative for lining pipes and bends.



Solid protection of an outlet cone with precise fitting of the manhole



Lining a cyclone inlet with KALOCER; the vaulted form makes it possible to fix radial shaped elements in KALFIX setting compound whereas the headwall requires mechanical fixing by means of weld sleeves and ceramic caps.



Precisely cut and fitted KALOCER lining in a separator system assures trouble-free operation



Cascade chute with wear blocks made of 100-mm-thick KALOCER oxide ceramic. The ceramic is fixed to the impact plates in KALFIX setting compound. The impact plates are fastened to the chute with an angle bracket.

SILICON CARBIDE CERAMICS WITH EXTREMELY HIGH TEMPERATURE ABRASION RESISTANCE

Outstanding resistance against wear and thermal shock is achieved with KALSICA.

KALSICA is part of the silicon carbide ceramics group and available in different qualities.

High precision can be achieved in manufacturing KALSICA shapes, formed by pressing or casting, then sintering in a reactor kiln.

Wall thickness from 2 mm for the shaped components is another advantage of using KALSICA wear protection linings.

KALSICA

Silicon carbide ceramics for plant components for extreme wear, high temperature and/or thermal shock.

Installation: individual shapes and components laid in mortar on synthetic resin or mineral base or in temperature and acid resistant based mastics. Mechanical fixing is also possible.

Application temperature: up to 1,500 °C / 2,732 °F depending on application and geometry.

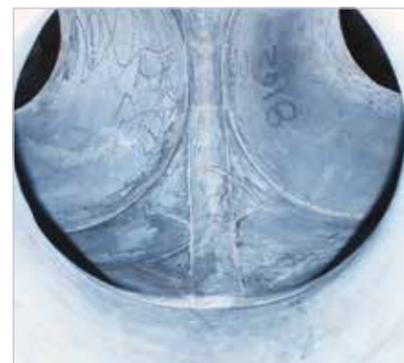
Advantages: highly abrasion resistant, resistant to thermal shocks and manufactured to close tolerances.



Hydrocyclone for magnesite processing operation comprising complex shaped components made of KALSICA



For extreme wear in pneumatic transport



KALSICA lined pipe transition

1,200 mm diameter KALSICA cyclones guarantee reliable operation: the system separates silicon sand at temperatures up to 300 °C / 572 °F



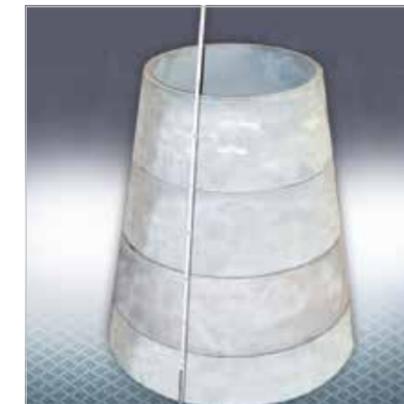
Pulverized coal distributor made of KALSICA installed in a power station



Guide vanes of a separator made of KALSICA operated within a coal pulverizer



Burner cone for a power station made of KALSICA



KALSICA lining for a cyclone handling silane dust; major cone diameter 1,200 mm; wall thickness 30 mm



HARD COMPOUND FOR A JOINTLESS LINING OF PLANT COMPONENTS



Trowelling

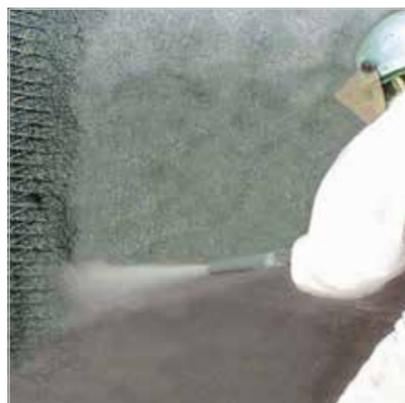
KALCRET hard compound is the general term for cement-bonded wear protecting materials. These are made from inorganic materials of high hardness and good wear resistance. The high density is attained by a well balanced particle size distribution of the individual components. The pores between the cement particles are filled with superfine particles of micro and nano silica.

Prefabricated shaped elements

KALCRET has performed extremely well in practical applications as prefabricated shaped elements. Tiles and shaped elements are fabricated with poured compound and equipped with standard fastening hardware, such as weld studs.



Casting



Spraying



Prefabricated shaped elements made of KALCRET allow short installation times

KALCRET

Cement bonded hard compound for a jointless lining of plant components where high wear and temperature occur.

Installation: by trowelling, casting or spraying.

Application temperature: up to 1,200 °C / 2,192 °F depending on application and geometry.

Advantages: highly wear resistant, strong and jointless lining, highly temperature resistant.

KALCRET allows wear protection of components with complicated geometry.

Prefabricated pipes and bends

Pipes and pipe bends lined with KALCRET can be produced with an inside diameter of 40 mm or more.



KALCRET pipe bend – prefabricated – with asymmetric cross section

Scrubber inlet in a steel plant lined with sprayed-on KALCRET hard compound



Separator of a cement mill lined with KALCRET, up to 3,200 mm diameter



Clinker dust line in cement plant



Reliable protection of the dust collecting pipe of a clinker cooler with KALCRET fitted as prefabricated shaped elements with integrated insulation

KALCRET is produced in-house. Variants are adapted to specific abrasion and impact wear protection requirements as well as operating temperature.



HARD CERAMICS WITH GOOD SLIDING PROPERTIES

KALCERAM hard ceramic is a particularly attractive option where abrasion is only moderate and therefore does not justify the expense of other protective materials.

For this reason KALCERAM is used in some system components in coal fired power stations, refuse incineration plants, coking plants, processing plants, potash mines, steel works, chemical plants, quarries, ceramic factories, glass works, cement works, lime plants, etc.

KALCERAM

Hard ceramics for plant components subject to moderate wear, e.g. coal bunkers and chutes, fine coal troughs, thickeners and chain conveyors.

Installation: made-to-measure tiles are laid either in cement mortar or KALFIX synthetic mortar.

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

Advantages: average abrasion resistance, smooth surface, KALCERAM also shows good temperature resistance.



Even conical surfaces can be lined as required with cut KALCERAM tiles

High temperature KALCERAM chute in a coking plant provides good sliding properties even at high temperatures



Chutes lined with KALCERAM are a solution that lasts, e.g. for bag loading systems in cement plants



POLYUREA-BASED SPRAYABLE WEAR PROTECTION

KALEA is a polyurea-based high-performance plastic characterised by excellent wear resistance.

It is used wherever abrasive bulk materials such as ore, sand, gravel, shale, sinter, etc. are transported or stored and where they subject plant components and pipe systems to wear due to friction and impacts. This newly developed material is characterised by outstanding wear resistance and features a high rebound resilience. The weather-resistant and temperature-resistant surface protection also provides noise insulation.

KALEA is sprayed on and cures very rapidly. It can be applied to several base materials, including steel, aluminium and concrete. No separate corrosion protection is required.

As a result, the material is particularly well suited for the seamless lining of plant components with large surface areas, such as coal, ore and sand bunkers, as well as for silo and tank linings, chutes and slides. Moreover, this wear-resistant material can be used to line pipes with an inner diameter of 150 mm or more. KALEA is also recommended for use in combination with other Kalenborn materials.

Spraying on even a thin, seamless protective layer is all it takes to significantly extend the maintenance intervals of your plant components and pipes.

KALEA

Polyurea-based high performance plastic for extreme wear and impact loading, very stretchable, elastic and tear-resistant.

Installation: Spray-on application.

Service temperature: up to approx. 130 °C / 266 °F, depending on operating conditions.

Advantages: High wear and impact resistance, seamless lining up to 10 mm coating thickness, very short processing time, ready for use after 4 days, resistant to corrosion, chemicals, acids and UV.



Wear-resistant pipe with KALEA high-performance plastic



Seamless lining of a dump truck bed



THE METALLIC MATERIAL FOR SPECIAL IMPACT AND ABRASION RESISTANCE

For particularly harsh operating conditions we have developed special KALCAST hard castings. Alloy components such as chromium and carbon ensure especially high hardness and abrasion resistance. Manganese provides particularly good impact resistance quality. Our KALMETALL material, from which we manufacture components which can weigh as much as several tons, consists of steel plates armoured with special hard metal alloys. It exceeds the service life of common steel several times over.

The program:

- KALCAST hard casting
- KALMETALL hard surfacing



Manufacture of KALCAST hard castings



KALMETALL hard overlay welding



KALCAST

Hard castings of varying alloys and properties matched to the specific abrasion and impact wear requirements.

Installation: made-to-measure shaped elements in setting compounds; mechanical fixing and self-supporting structures are also possible.

Application temperature: up to approximately 350 °C / 662 °F depending on application and geometry.

Advantages: high wear resistance with satisfactory impact strength or high impact strength with satisfactory wear resistance, economic in case of series production.

VARIOUS ALLOYS OF KALCAST HARD CASTING



Asphalt mixers are subject to significant wear; they are effectively protected by KALCAST



Shaft flight of KALCAST proven in use for hard coal mining



Pulverized coal pipe armored with hard casting KALCAST



Rotors for turbines

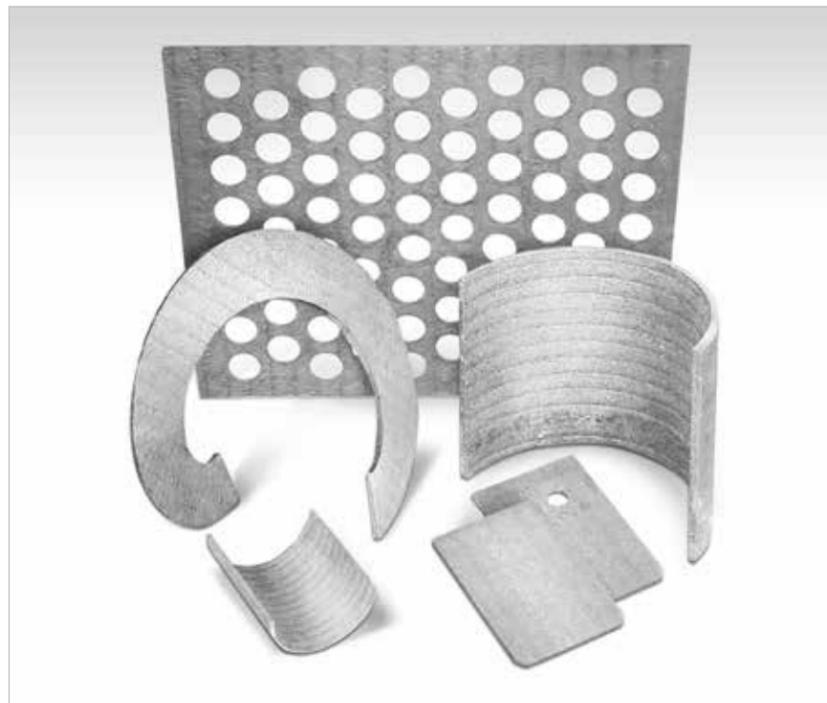


Typical applications of KALCAST hard casting are pipe systems; here a pulverized coal pipe of a power station in South East Asia



Cyclone used in a soil decontamination system – effectively protected with KALCAST

WELDED HARD SURFACING FOR HIGH RESISTANCE TO IMPACTS AND WEAR



KALMETALL

Hard overlay welded steel systems that consist of a tough basic body and the hard overlay welding.

Installation: by overlay welding or use of standard plates to fabricate complete structures.

Application temperature: up to approximately 750 °C / 1,382 °F depending on application and geometry.

Advantages: high wear resistance and high impact strength combined with optimal adaptation to the customer's requirements.

KALMETALL incorporates several hard overlay welded steel systems that consist of a tough basic body and hard overlay welding.

Depending on the application case, the base material can be either a standard or a special plate.

The hard overlay welding is the wear layer. It consists of a C-Cr-Fe system with primarily chromium carbides.

The carbides provide the extreme hardness of the overlay welding. Depending on the composition of the alloy, the hardness may be up to 820 HV.

Welding Service

Kalenborn offer individual overlay welding for a variety of elements and components. KALMETALL allows Kalenborn to be a specialist in the regeneration of grinding systems.

Hard Overlay Welded Plates

Standard plates are offered at varying qualities, thicknesses and dimensions. Special components can be custom fabricated any time. Components of self-supporting structure are characterized by low weight and high economy.



Kalenborn welding service, regeneration of a grinding table



Hard overlay welded standard plates



Separating cones of cement classifiers made of KALMETALL as self-supporting structures



For a steel manufacturer in North Africa, a bucket wheel as a custom KALMETALL welded construction



Pulverized coal burner lined with KALMETALL



Sieves for hot sinter



Pipe armored with KALMETALL installed in a dust collecting system; inside diameter 400 mm, system thickness 8 + 5 mm



Screw conveyor protected with KALMETALL, diameter up to 2,000 mm, up to 10,000 mm length

HARD-MATERIAL-RUBBER COMPOSITE FOR HEAVY IMPACT AND ABRASIVE WEAR

KALIMPACT KALOCER



Mosaic mats

- low impact strength
- flat angle of impact
- abrasion-resistant
- adaptable to convex and concave shapes
- thin walls
- easily cut to size
- bondable
- noise reduction

Rectangles

- moderate impact strength
- flat angle of impact
- outstanding abrasion resistance
- mechanical or magnetic fastening
- noise reduction

Squares

- very high impact strength
- steep angle of impact
- highly abrasion-resistant
- mechanical or magnetic fastening
- noise reduction

KALIMPACT ABRESIST



Plates

- low impact strength
- flat angle of impact
- very abrasion-resistant
- mechanical or magnetic fastening
- noise reduction

KALIMPACT KALMETALL



Plates

- outstanding impact strength
- flat and steep angle of impact
- abrasion-resistant
- mechanical fastening
- noise reduction

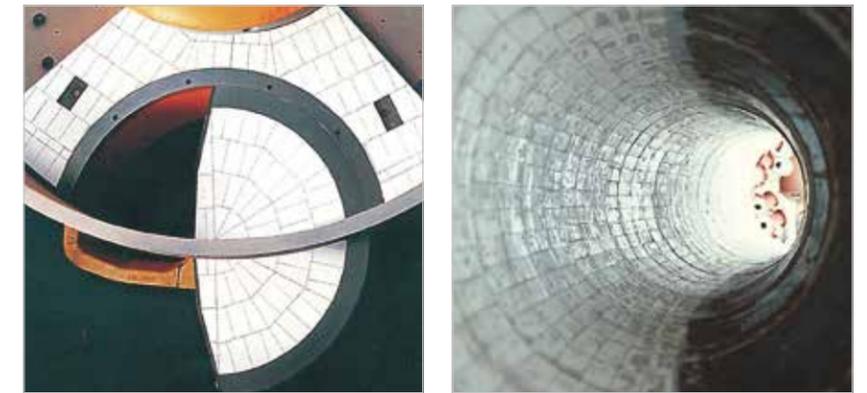
As a hard material composite formed with rubber, KALIMPACT is primarily used where high impact loading occurs in combination with heavy abrasion. The wear protection is vulcanised in rubber.

Depending on the specific abrasion and impact resistance requirements, KALIMPACT comprises either fused cast basalt ABRESIST, oxide ceramics KALOCER or welded hard surfacing KALMETALL.

Depending on the version KALIMPACT is glued, fixed on a metal plate with bolts, or magnetical.

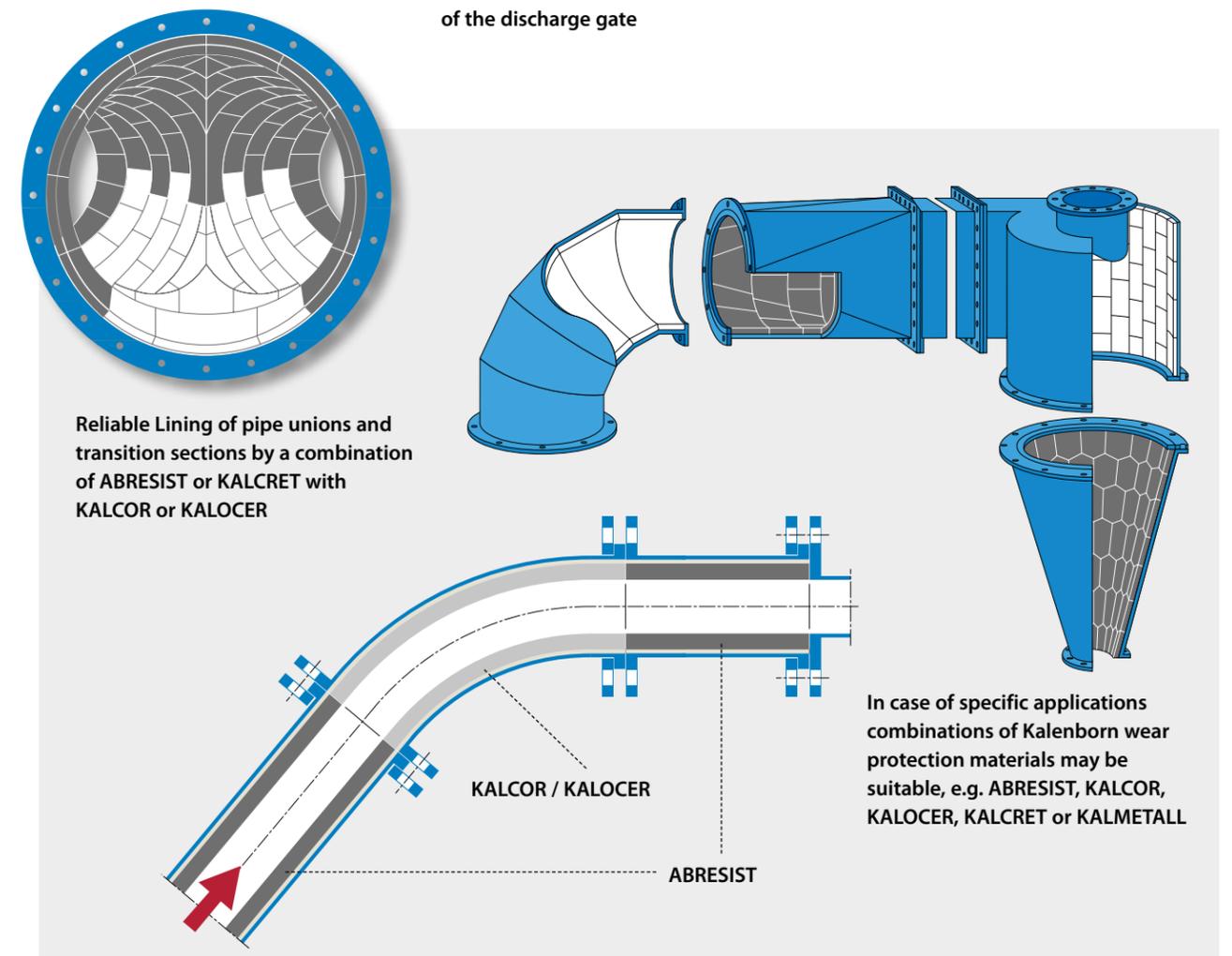
COMBINED LININGS: SIMILAR LIFETIMES FOR ALL PLANT COMPONENTS

High conveying speeds and abrasive materials cause wear in material handling systems. However, the wear is of varying intensity in different areas. This is where a combination of the different wear resistant linings proves successful. Designed on the basis of prior successful experience, components can achieve similar lifetimes without some failing prematurely or other excessively protected.



KALOCER bottom of a concrete mixer for extreme stress, KALMETALL in the area of the discharge gate

Pipe bend with ABRESIST and KALOCER combined lining

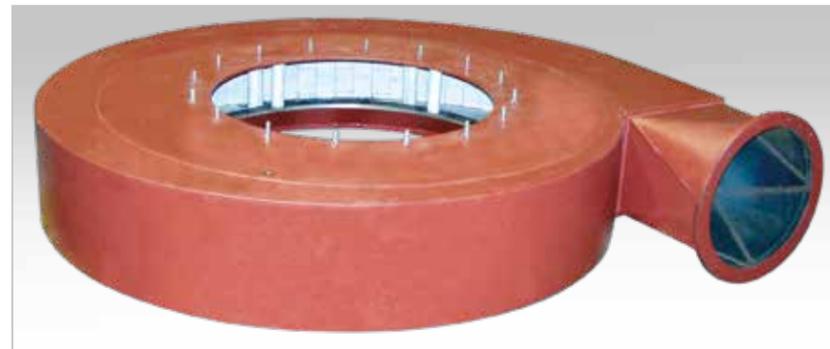


COMBINED LININGS APPLICATIONS

Use in a shredder system for plastic waste: KALCAST and KALCRET



Immersion pipe of a cyclone for separating granulated blast furnace slag in the cement industry; KALCRET and KALMETALL



Separator inlet housing designed as self-supporting structure made of KALMETALL and KALOCER subject to extreme stress



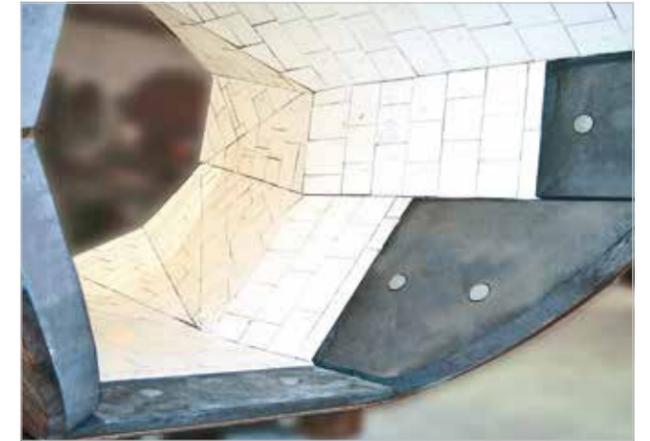
Pulverized coal distributor boxes protected with KALCOR for large surface lining and KALOCER to offer maximum wear resistance



Drum mixer for concrete lined with KALOCER high alumina ceramics; mixer tools made of KALCAST hard casting and/or KALEN PU plastics



Effective protection of a cyclone processing silica sand: KALCOR and KALSICA



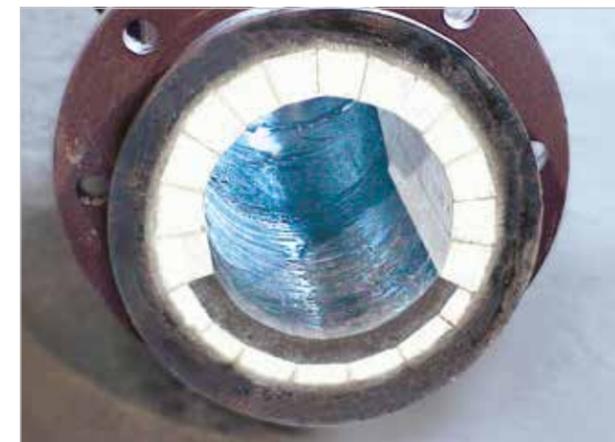
Octagonal hopper subjected to impact stress lined with three-dimensionally cut KALOCER shaped elements as well as KALCAST shapes, each 50 mm thick



Kalenborn deviation pot with ABRESIST and KALOCER – the badly worn parts can be replaced



Coke wharf protected with KALCERAM K on the sliding surface, with KALSICA N in the zone of high wear and with KALCAST in the area of impact stress



Impact protection along the outside of the bend: KALMETALL combined with KALOCER in a pipe brick configuration

KALFIX SETTING COMPOUND, SYNTHETIC RESIN PUTTIES AND CEMENT MORTARS

Installation and Erection

A precondition for effective wear protection is proper installation.

Appropriate installation and erection of the lining depend on material conveyed, application, equipment, design and installation position. It also depends on whether sliding or impact wear prevail, temperature or thermal shock stress, corrosive or acid exposure is present.

ABRESIST, KALCOR, KALOCER and KALSICA normally are laid in cement mortar or special setting compounds.

Higher temperatures require additional measures like mechanical fixing, f.e. especially if the subsurface has different thermal expansion than the wear protection lining.

Special fixing systems have to be used for KALMETALL. Details are available in the relevant brochures.



Kalenborn offer a complete program of proven KALFIX setting compounds



Setting in cement mortar



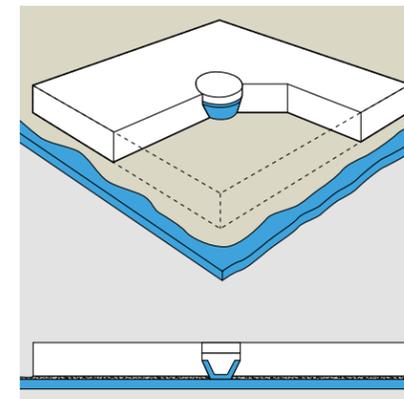
Lining with KALOCER mosaic mats in KALFIX setting compound



Lining and fixing with synthetic resin putties

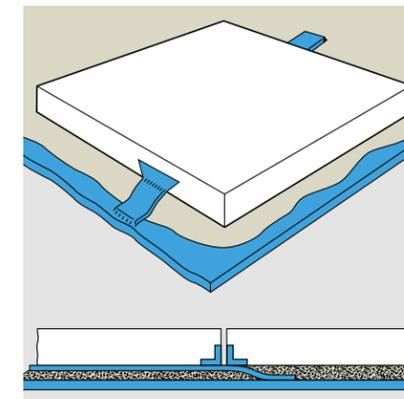


MECHANICAL FIXINGS AND HIGH TEMPERATURE APPLICATIONS



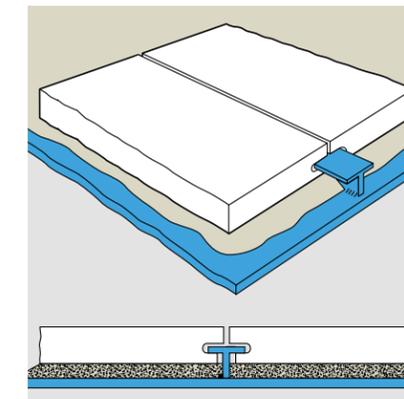
Tile with Hole

These are usually fastened to vertical and overhanging steel surfaces by means of countersunk bolts, conical weld sleeves or weld studs.



Tile with Steel Corner Inserts and Weld Straps

This mechanical fastening method enables installing the lining to steel surfaces by welding.

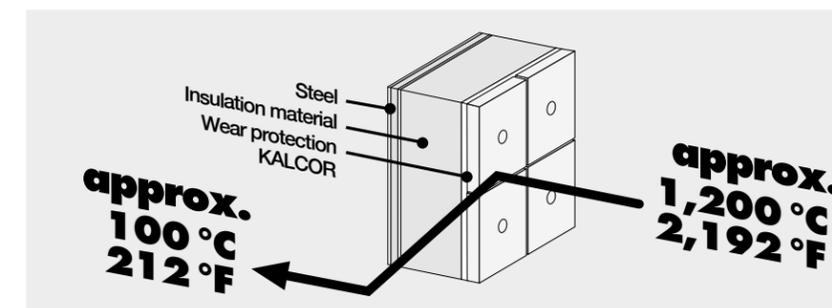


Tile with Groove

This method has proved useful as well and allows the fastening of linings to steel surfaces by welding.

High Temperature Applications up to 1,200 °C / 2,192 °F

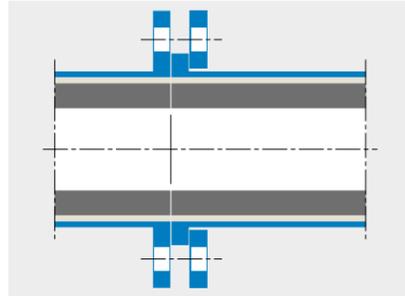
KALCOR, KALOCER and KALSICA are wear protective materials capable of withstanding high temperatures. A wide range of mechanical fixing methods and design details permit finding cost effective wear protection for any application. Moreover, KALCRET hard compound can be installed by casting, trowelling or spraying.



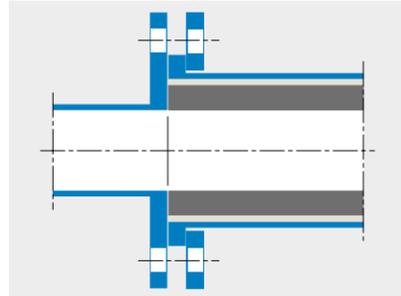
FLANGES AND OTHER JOINTS

Flange Joints

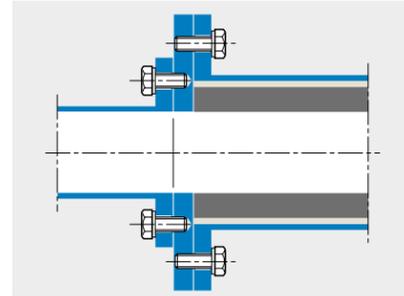
The connection of wear resistant pipes to each other or to regular steel pipes can be done with fixed and/or loose flanges.



Lined pipes can be connected to each other easily with a fixed collar and a loose turnable flange on one end.



A weld-on counter flange with larger bolt circle diameter on the unlined pipe is a proven solution to connect pipes.



Unlined pipes, pumps or fittings can be connected with a lined pipe using an adapter flange.

Gaskets

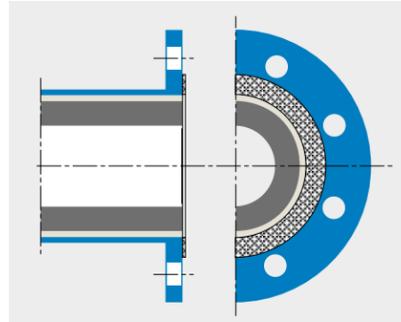
The recommended dimensions of pipe gaskets are as follows:

- outside diameter \triangleq outside diameter of the collar
- inside diameter \triangleq outside diameter of the steel pipe

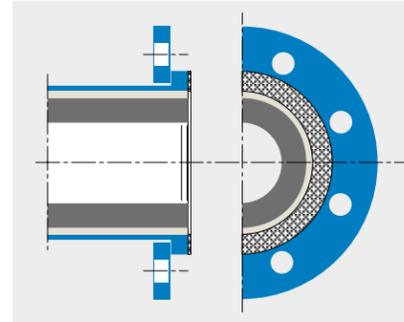
Minimum gasket thickness: 2 mm.

The material depends on the specific conditions. All known gasket materials can be used.

Other sealing systems are possible.



ABRESIST pipe with a fixed flange



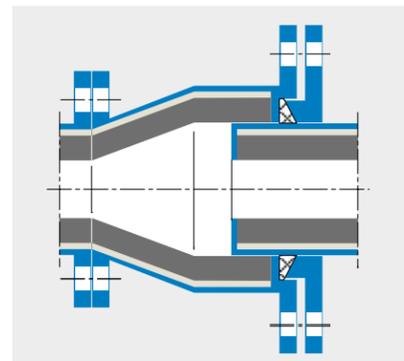
ABRESIST pipe with a fixed collar and turnable flange

Expansion Joint Sections

For longer pipelines wear resistant lined expansion joints of various designs are available to compensate for changes in length.

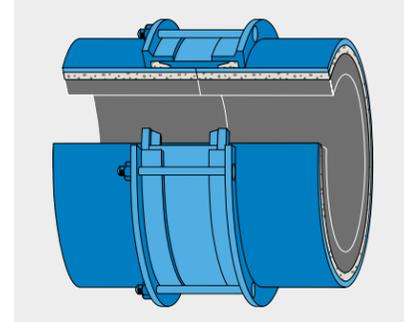


Expansion joints in a hydraulic bottom ash pipeline

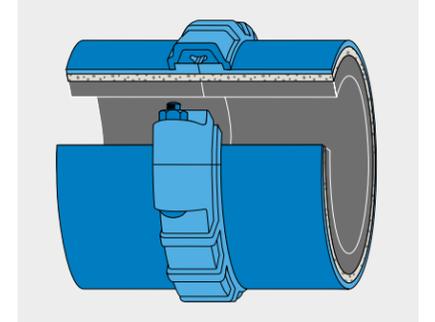


Couplings

Wear protected pipes can be connected by any known coupling system.



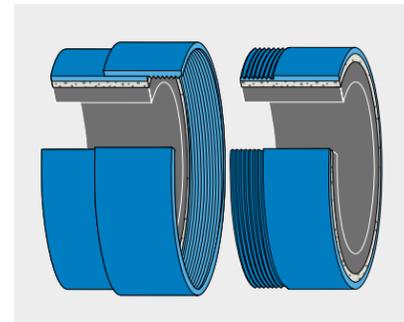
Coupling with radial restraint



Coupling with axial restraint

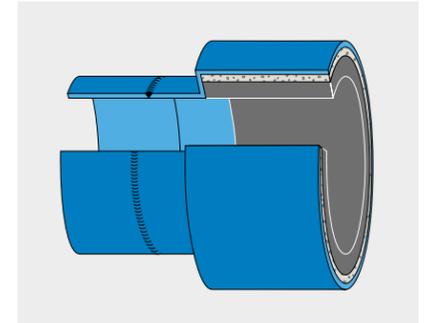
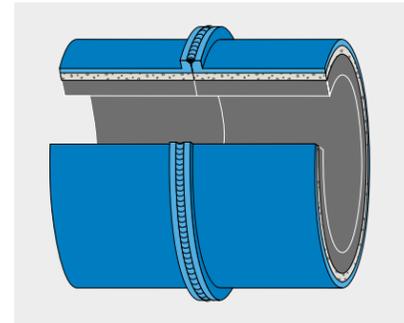
Threaded Joint

When a pipeline is stressed by tension, e.g. when vertically suspended, threaded joints can be used.



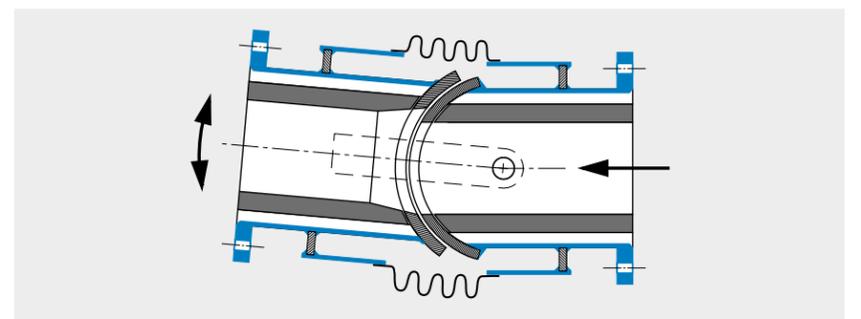
Welded Connections

When flanged connections and couplings are not the answer, it is possible to connect wear-resistant pipes by a welded connection.



Joint Couplings

Special joint couplings to compensate for difference in level and length.



KALFLEX – WEAR-RESISTANT FLEXIBLE HOSE SYSTEMS

KALFLEX is flexible piping that can be easily installed with flanges. The core elements of the system are abrasion-resistant tiles or segments.

The segments are enclosed in a rubber jacket containing a fabric insert, which ensures adequate stability and leak tightness.

Diamond-shaped ceramic tiles with KALOCER

They provide excellent protection against frictional wear and also make it possible to achieve the tight radius and sharp angles of fixed pipe bends in all directions. The inner diameter ranges from 50 to 200 mm.

Segments with KALOCER oxide ceramics

For applications subject to extremely harsh sliding wear conditions, the segments can be made of high alumina ceramics. The inner diameter ranges from 50 to 125 mm. For design reasons, collars and flanges are made of hard casting and/or steel.

Segments with KALCAST hard castings

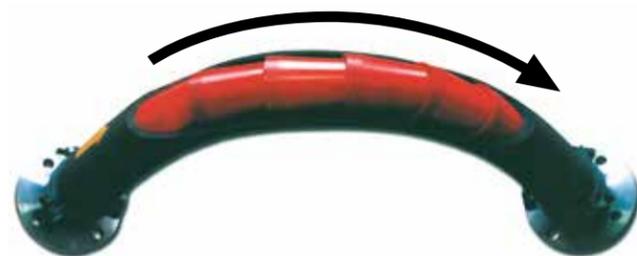
The wear-resistant KALCAST segments are made of hard castings that provide protection against both impact and sliding wear. Diameters range from 19 to 200 mm.

Advantages:

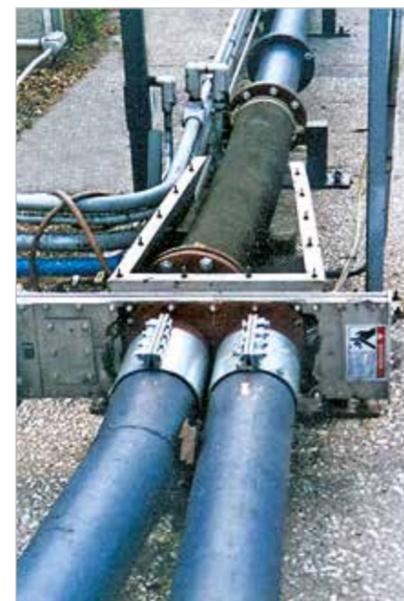
- inside diameter ranging from 19 to 200 mm
- maximum temperature 110 °C / 230 °F
- pressure up to 10 bar
- used in diverter valves
- used as vibration reducing element
- used as expansion joint
- well suited for use in tight spaces
- compensation of load cells
- rubber sleeving: weather-resistant and durable EPDM



Diamond-shaped arrangement of ceramic tiles for very tight bending radii



KALFLEX used as flexible pipe bend



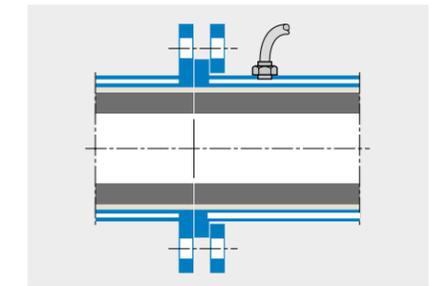
KALFLEX as part of a diverter valve in the USA

ELECTRICAL, MECHANICAL, PNEUMATICAL AND VISUAL SYSTEMS

For critical cases Kalenborn offer systems that monitor possible wear in the lining. This gives the operator early information for taking necessary action. Important and necessary, e.g. in pneumatic conveying lines to prevent toxic or environmentally harmful substances from being released.



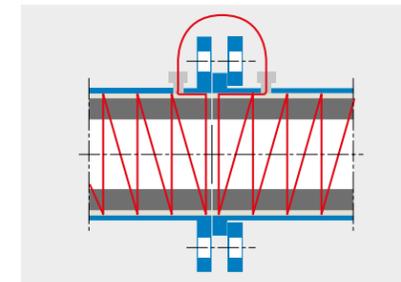
KALDETECT installed in a German waste incineration plant



KALDETECT PNEUMATICAL

The steel casing is twin-walled. Changes in the pressure level in the space between the two parts caused by a leak will activate an indicator or alarm or the plant can be shut down – similar to the electrical wear detection.

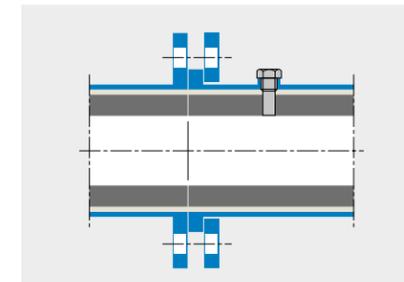
This system can be used for single pipes, complete pipelines or any mechanical plant.



KALDETECT ELECTRICAL

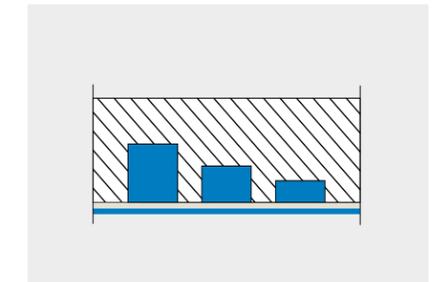
The wear resistant lining is fitted on the OD with a low voltage electrical circuit. If the wear resistant lining wears through due to abrasion in the pipeline, the electrical circuit will be interrupted. This will sound an alarm and – combined with a suitable evaluation system – will indicate the pipe section concerned or the plant can be automatically shut down.

The electrical wear detection is available for all of the wear resistant materials of Kalenborn.



KALDETECT MECHANICAL

The support structure and wear resistant lining are fitted with a bore hole. The length of the indicator pin monitors the thickness or condition of the protective lining when removed and inspected.



KALDETECT VISUAL

Indicator stones are integrated at different heights in a ceramic wear protection lining. Increasing wear reveals the colour of the stones, thereby indicating the condition of the protective lining and how much material has worn away. Visual wear detection is suitable for individual parts or complete plants.

A WIDE RANGE OF MATERIALS PRODUCED IN-HOUSE

Mineral materials



➤ 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 KALFIX synthetic mortar or potassium silicate based mortar for higher temperatures.

Service temperature: up to approximately 350 °C / 662 °F.

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

Ceramic materials



➤ 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.

Service temperature: up to approximately 1,200 °C / 2,192 °F.

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



➤ KALOCER oxidceramic

Special high alumina ceramics for system components exposed to extreme wear and/or thermal stresses for which thin linings or smooth surfaces are required, such as in circulating air separators, cyclones, screw centrifuges, 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.

Service temperature: up to approximately 1,200 °C / 2,192 °F.

Advantages: high abrasion resistance, high temperature stability, resistant to impact and corrosion. Available in thicknesses from 1,5 mm.



➤ KALSICA silicon carbide ceramic

Ceramic material that provides outstanding frictional wear resistance in high temperature applications. In different grades for plant components subject to extreme wear loadings at high temperatures or cyclical temperature loadings. Typical applications include: pulverized coal distributors, cyclone linings, coke wharfs. High-precision custom components, even for complex geometries, are used as wear-protection fittings in pumps, fans or hydraulic cyclones.

Installation: In mineral or synthetic resin-based adhesives or in heat- and acid-resistant putties. Can also be fastened by mechanical means.

Service temperature: up to approx. 1,500 °C / 2,732 °F.

Advantages: High to extremely high wear resistance, very high resistance against thermal shock. Can be manufactured to close dimensional tolerances.



➤ KALCERAM hard ceramic

Ceramic material that protects plant components against moderate frictional wear and caking problems at higher temperatures – e.g. for coal bunkers, chutes and drainage channels in coking plants, chutes for loading sacks in cement works, as well as in cyclones, separators and sifters.

Installation: Cut-to-size tiles in cement mortar or KALFIX plastic mortar.

Service temperature: up to approx. 1,000 °C / 1,832 °F.

Advantages: Hard ceramic with moderate wear resistance and good temperature resistance, smooth surface for good anti-friction properties.

Metallic materials



➤ KALMETALL welded hard surfacing

Metallic wear protection with excellent impact and abrasion resistance for large surfaces. Overlay welded steel systems comprising a tough carrier material and welded hard surfacing – e.g. for ventilator housings, cyclones and separators, mixer linings, piping components, screens, troughs and transport channels.

Installation: Self-supporting combinations are possible as needed.

Service temperature: up to approx. 750 °C / 1,382 °F.

Advantages: Depending on the alloy composition: high abrasion resistance, high impact strength and/or high temperature resistance, low weight and highly economical self-supporting structures.



➤ KALCAST hard castings

With KALCAST metallic material, alloy components such as chromium and carbon ensure especially high hardness and abrasion resistance. Manganese provides particularly good impact resistance qualities. Typical applications for this include bunker entrances, coke ramps, screw conveyors for granulation of slag, asphalt or concrete mixers, and crushers, grinding rollers and plates in a vertical mill, as well as for coal dust piping in power stations.

Installation: Made-to-measure shaped cast elements can be fastened mechanically or laid with mortar or adhesives.

Service temperature: up to 350 °C / 662 °F.

Advantages: Optimally matched wear protection material, also for high impact wear resistance, inexpensive in the production of series components.

Compounds



➤ 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.

Service temperature: up to approximately 1,200 °C / 2,192 °F.

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



➤ KALPOXY hard compound

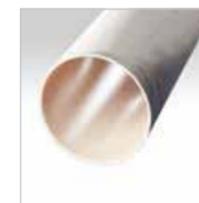
Highly wear-resistant epoxy resin-bonded hard compound, rapid, effective and with a short curing time, for use in repair operations and to line plant components.

Installation: surface application.

Service temperature: up to 150 °C / 302 °F.

Advantages: high wear resistance, can be used in chemically demanding environments, easy and seamless lining of geometrically complex surfaces.

Technical plastics



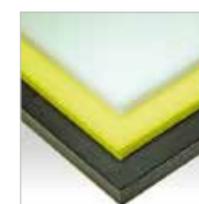
➤ KALEA high performance plastic

Polyurea-based high performance plastic to protect against high wear loading on large surfaces, for rapid, seamless application of thin linings on plant and piping components, e.g. for coal, ore and sand bunkers, as well as for silo and tank linings, chutes and slides.

Installation: Spray-on application with Kalenborn spray technology and pipe coating unit.

Service temperature: up to approx. 130 °C / 266 °F.

Advantages: high abrasion and impact wear resistance, seamless, coating thickness from 2 mm, resistance against corrosion, chemicals and acids.



➤ KALEN thermoplastic

Technical plastic for corrosion-free wear protection which promotes sliding – e.g. for bunkers, chutes, troughs and similar equipment used to convey and store bulk materials.

Installation: Mechanical fastening with different forms of threaded fasteners, anchor methods and special weld studs with special nuts.

Service temperature: up to 100 °C / 212 °F.

Advantages: Very good slide promotion with excellent corrosion protection, extremely smooth surface and low weight.

