NO CHANCE FOR ABRASION.

CERAMIC WEAR PROTECTION MATERIALS FOR ANY TYPE OF WEAR.

MATERIALS // APPLIED TECHNOLOGY // PRACTICAL EXAMPLES

INNOVATION: EARLY WARNING LEAK DETECTION SYSTEM

TH. SCHOLTEN GMBH & CO.

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THE COMPANY TH. SCHOLTEN GMBH

SC-WEAR PROTECTION MANAGEMENT: NO CHANCE FOR ABRASION.

The company Th. Scholten GmbH represents more than 6 decades of experience in the field of abrasion protection and wear management of plant systems.

We ensure professional protection against damage through wear, one of the main risks in the bulk handling industry.

OUR CUSTOMER SERVICE:

Our customer services reach from A to Z. Following a comprehensive analysis of all wear factors, we can support and advise already during the as-is-assessment of your existing plant systems. With an innovative 3D-Scan, for example, details/dimensions which are missing in drawings can be determined and used directly for the planning, production and installation of the new plant components.

To avoid time- and cost-intensive leakages is increasingly becoming a central issue, which Th. Scholten counter with their specially developed early warning leak detection system which monitors the plant components online and signals any leak in its early stages.

Our aim is to develop the most suitable wear protection system both from a technical and a cost-efficient point of view. Our integrated approach allows the development of a durable, efficient and individually tailored wear protection solution for our customers world-wide.

OUR RANGE OF SERVICES COMPRISES:

- Precise analysis of all sources of wear
- Individual project planning with a preventive wear factor analysis
- Development of the most suitable wear protection measures
- Assignment of our specialist fitters for quick-response repair and maintenance or the installation of new wear protection materials - seven days a week
- The experienced staff of our technical and jobsite departments is available to help you by phone or with personal assistance with any wear problems you may encounter

This brochure will provide you with a detailed survey of our materials and their practical applications. Further detailed information is also available on our website: **www.scholten-gmbh.de**

YOUR PARTNER FOR ALL SOLUTIONS

SC-WEAR PROTECTION MANAGEMENT: YOUR PARTNER FOR CUSTOMIZED WEAR PROTECTION SOLUTIONS TO COMBAT ANY TYPE OF WEAR.

Th. Scholten GmbH offers their customers all from one single source. On request, we take over the complete project handling. A reliable protection against damage through wear is essential for a trouble-free production. Apart from the "classic" wear protection material cast basalt and the lower-budget hard ceramic, we are offering a wide range of modern ceramic wear protection materials for any kind of wear and bulk material. Our materials can be selectively chosen or combined to generate advanced and cost-efficient wear protection systems.

We manage your wear, from A for alumina to Z for zirconia ceramic.

EXAMPLES FOR MATERIALS AND THEIR AREAS OF APPLICATION:

- Average abrasion: cast basalt, hard ceramic and SC-WearStop®
- Severe abrasion: alumina ceramic, zirconia ceramic and silicon carbide ceramic

TH. SCHOLTEN GMBH'S RANGE OF SUPPLIES AND SERVICES INCLUDES:

- Supply of complete, wear resistant lined plant components including steel casings, e.g. piping, cyclones, chutes etc.
- Supply of wear protection linings - precut-to-shape – for local installation on site
- Installation on site by Th. Scholten's specialist fitters or assignment of supervisors to supervise installation work carried out by the customer's staff.

THE SC-LEAK DETECTION SYSTEM

THE "NO-WORRIES" PACKAGE FOR YOUR SAFETY – DAY AND NIGHT.

Every year, leakages create enormous costs in plants. Professionals estimate for example that a small leak in a pneumatic pipe system alone may incur annual costs to 10.000 EUR. Abrasion particularly affects bends and subsequent straight sections, e.g. those transporting highly abrasive solids such as foundry sand. Repairs and shutdown times additionally increase these expenses.

In addition to their wear resistant system solutions, the company Th. Scholten GmbH has developed a highly efficient integrated leak detection monitoring system: a ceramic lining, combined with an early-warning system, constitutes a safe help against wear and the resulting consequential losses.

For early detection and signaling of penetrating damages, the ceramic is equipped with a signal cable in all areas prone to abrasion. This will immediately signal the wear of the ceramic lining. Signals of this sensor system can be transmitted by cable or wireless LAN, to be displayed at a desktop monitor.

In the pneumatic foundry sand feeder unit of one of the most modern foundries world-wide, the BMW Landshut plant, Th. Scholten GmbH's complete package, consisting of the alumina ceramic lining of all pipes and bends complete with leak detection system including visualization, was installed.

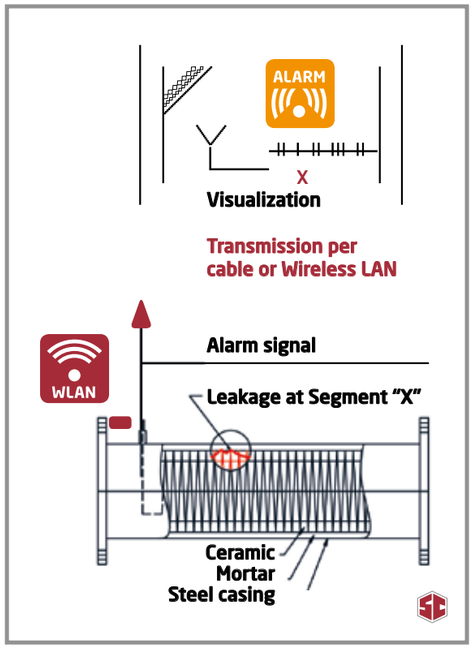
THE ADVANTAGES OF THIS EARLY WARNING SYSTEM:

- Malfunction sources and alarms are communicated online - day and night - via wireless LAN and can be displayed and analyzed at a desktop monitor
- Possible damage can be immediately averted or restricted
- Required spare parts can be displayed instantly, e.g. quicker replacement of parts at a convenient, planned time slot before any material is released
- Frequently, a repair is possible in stand-by mode, i.e. no shutdown, no loss of time and production
- Environmental protection and industrial safety: any emissions that are released can be stopped within the shortest of time

AREAS OF USE OF THE HIGH-TECH MONITORING SYSTEM:

- Straight pipes, bends, hoses, hopper and plant components which are subjected to increased wear and which are difficult to access or to monitor

The specialists of Th. Scholten GmbH produce, supply and install this safety package as an integrated solution: piping with wear protection, wiring up to the system cabinet unit and the visualization with hardware and software – all from one single source.



WEAR IN INDUSTRIAL PLANTS

WHICH INDUSTRIES AND PLANT COMPONENTS PARTICULARLY ENCOUNTER WEAR PROBLEMS, AND WHAT ARE THE CAUSES?

INDUSTRIAL BRANCHES AT RISK OF WEAR:

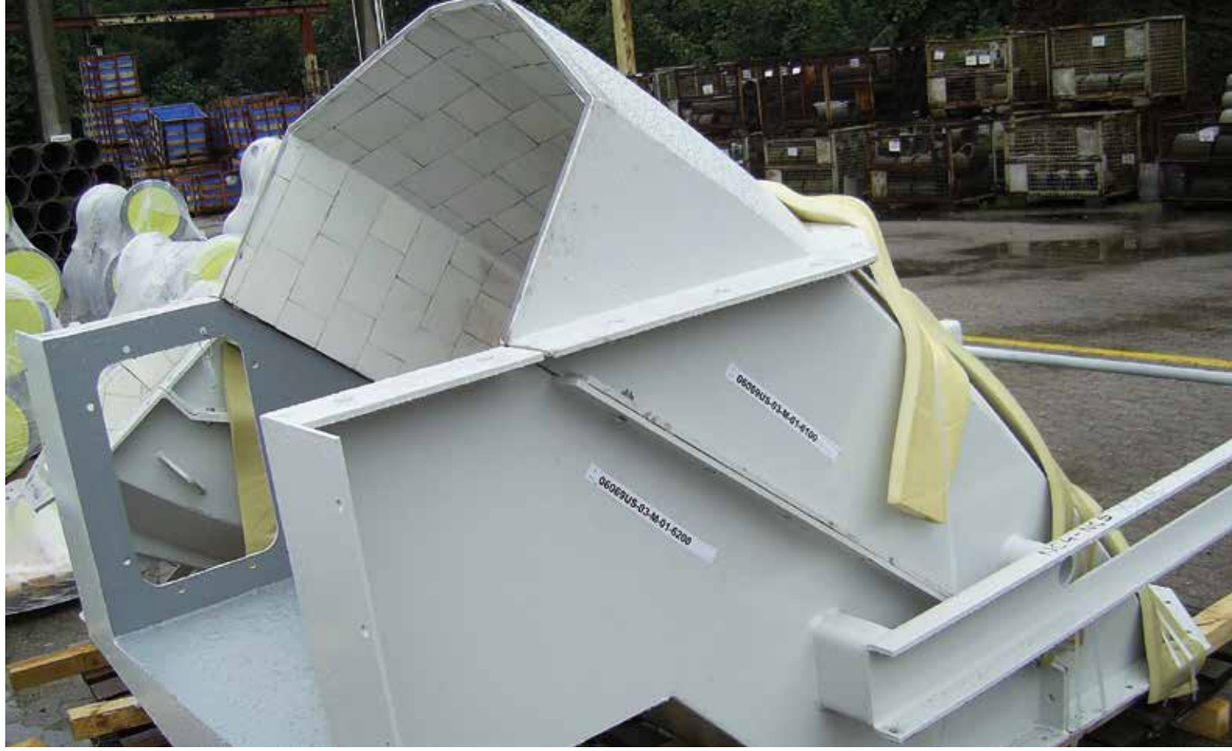
- Concrete factories
- Breweries, malt houses
- Chemical industries
- Gasworks
- Foundries
- Glassworks
- Metallurgical plants, steel rolling mills
- Lime, sand, potash plants
- Coal and ore mining
- Coking plants
- Power stations
- Waste incineration plants
- Paper mills
- Scrap recycling plants
- Quarries
- Cement and gravel plants
- Sugar factories

PLANT COMPONENTS AT RISK OF WEAR:

- Separators
- Bucket conveyors
- Hoppers
- Bunkers
- Nozzles
- Feed hoppers
- Mixers
- Pumps
- Trenches
- Piping
- Chutes
- Classifier
- Silos
- Cyclones

BULK SOLIDS CAUSING WEAR:

- Ashes
- Ores
- Cereals
- Gypsum
- Lime
- Gravel
- Coal
- Coke
- Sand
- Slag
- Sinter
- Chipping
- Cement
- Cinder



DEFINITION OF THE TYPES OF WEAR:

- Abrasive wear (also known as abrasion or sliding wear): The scratching effect of the conveyed medium gliding or streaming parallel to the component surface
- Impact wear: the conveyed medium strikes onto a surface, due to gravitational or centrifugal forces, and rips out material particles
- Wear through mechanical abrasion and corrosion: permanent material erosion may lead to a steady reduction of the component's wall thickness. Main factors of influence on the degree and speed of this material erosion are the type of material and the constructive design of the component, bulk solids properties (e.g. grain size and sharpness, humidity content and chemical aggressiveness), service conditions (e.g. flow speed, throughput rate or height of fall)

As the properties of the bulk solids cannot be influenced, a reduction of the wear can mainly be achieved via the factors "material", "constructive design" and "service conditions". The latter factors are often customer specified, hence the aim should be to realistically optimize these already during the planning stages of a new plant.

REDUCTION OF WEAR VIA THE FACTOR "MATERIAL"

As wear and corrosion always emanate from the component surface, the following two properties are reviewed during the constructive design of the plant component:

- The material's mechanical properties with regard to the absorption of static, dynamic and thermal stresses
- The material's surface properties with regard to countering abrasion and corrosion

In practical service life, the combination of two different materials for the two different functions has proved most effective:

- One structural material provides the necessary mechanical properties and
- Simultaneously functions as support for a special wear protection material with the required surface properties

The combination of support and wear protection material has frequently proved to be a very cost-efficient solution.

The optimum wear protection system: The plant components subjected to wear receive a protective lining with a wear resistant material which is individually chosen in accordance with the respective operational conditions. The services rendered by Th. Scholten GmbH are based on decades of practical experience and ensure that our customers are always on the safe side with any kind of wear protection problem:

- Precise analysis of the interaction of different wear factors
- Decades of practical experience with solutions to comparable problems (wear and tear cannot be mathematically calculated, as too many factors and mutual interconnections influence each other)
- Individual concepts, developed on the strength of understanding materials and their systematic use

We are using the following ceramic materials to protect plant systems against abrasive wear:

- SC-cast basalt
- SC-hard ceramic
- SC-alumina ceramic
- SC-zirconia ceramic
- SC-silicon carbide ceramic
- SC-WearStop®

The choice of ceramic lining is made in accordance with the existing conditions.

WE FIGHT A WAR ON WEAR – BECAUSE IT REDUCES YOUR PROFITS.

Your benefits from an innovative early-warning leak detection system, the use of highly efficient wear protection materials and more than 60 years of experience:

- Extended service life
- Reduced down times
- Substantially lower maintenance and repair costs
- A cost-efficient production

The following pages will provide you with a detailed survey and outline of the materials individually chosen and used by us.

OVERVIEW OF SC-MATERIALS

SC-CAST BASALT

Applications
- protection against wear during transport, preparation, processing and storing of medium and rough bulk materials with high abrasive stress and a service temperature up to 350°C
- e.g. piping, chutes, trenches, chain conveyors, cyclone separators, silos, tanks, bunkers

Shapes and sizes
- rectangular tiles, 80 – 300 mm
- hex. tiles SW 200, thickness 30 – 60 mm
- radial tiles, formpieces, formpiece linings, thickness 30 – 40 mm
- solid piping DN 32 – 600, thickness 20 – 30 mm; cylinder 500 mm long
- pipe bends, radii 400 – 3.000 mm

Methods of attachment
- installation in mortar layer
- bonding with one- / two-component adhesive
- bolting

SC-HARD CERAMIC

Applications
- protection against wear caused by finely granulated bulk material with medium-level abrasive stress and a service temperature up to 500 °C
- e.g. flotations, chutes, trenches, chain conveyors, cyclone separators, silos, tanks, bunkers

Shapes and sizes
- standard tiles: 150 x 150 mm
- pre-cut tiles: thickness 10 – 25 mm
- special sizes possible

Methods of attachment
- installation in mortar layer
- bonding with one- / two-component adhesive

SC-ALUMINA CERAMIC

Applications
- protection against wear with high abrasive stress, for any type of bulk solids, service temperature up to 1.550 °C
- e.g. piping, flotations, chutes, chain conveyors, cyclone separators, silos, tanks, bunkers

Shapes and sizes
- standard tiles, edge length 150 – 250 mm
- thickness 6 – 50 mm, with/without drilling/threaded bolt
- platelets 20 x 20 and 25 x 25 mm
- thickness 3 – 10 mm
- hex. platelets SW 20 and SW 32, thickness 3 – 25 mm
- formpieces, thickness 5 – 30 mm, straight pipes and bend segments, thickness 8 – 25 mm

Methods of attachment
- installation in mortar layer
- bonding with one- / two-component adhesive
- bolting
- welding

SC-ZIRCONIA CERAMIC

Applications
- protection against abrasive and impact wear with high abrasive stress, for any type of bulk solids, service temperature up to 1.000 °C
- e.g. separators, cyclones, piping, silos, tanks

Shapes and sizes
- standard tiles square/rectangular, edge length 150 – 500 mm, thickness 20 to 100 mm, with/without drilling, radial tiles, formpieces
- straight pipes and pipe bend segments ID 50 – ID 300, thickness 17 – 25 mm

Methods of attachment
- installation in mortar layer
- bonding with one- / two-component adhesive
- bolting
- welding

SC-SILICON CARBIDE CERAMIC

Applications
- protection against strong abrasive and impact wear with extreme abrasive stress and high service temperature up to 1.700 °C as well as extreme temperature fluctuations, for any type of bulk solids
- e.g. special piping, PF piping, blower linings, melting flumes, hydro-cyclones, nozzles

Shapes and sizes
- standard tiles square/rectangular, thickness 10 – 75 mm, in some cases 6 mm possible
- formpieces, main sizes 6 mm to 1.200 mm, pipe and bend segments DN 50 – DN 200 in 20 mm thickness

Methods of attachment
- installation in mortar layer
- bonding with one- / two-component adhesive
- bolting
- welding

SC-WEARSTOP®

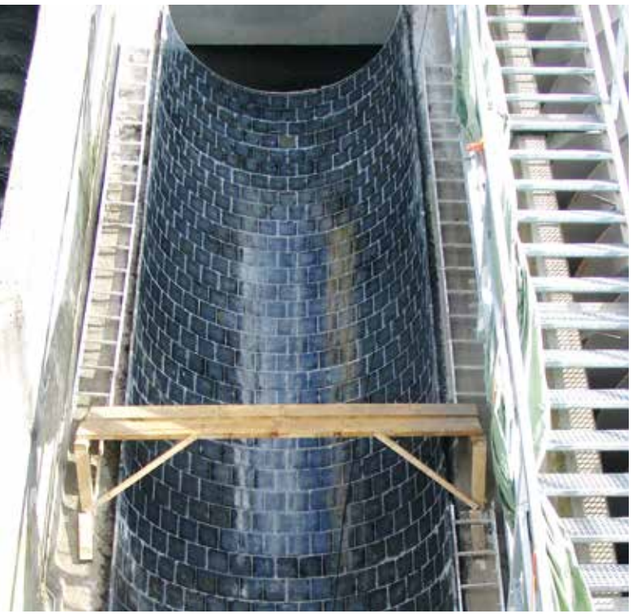
Applications
- protection against abrasive wear with frequent temperature fluctuations, service temperature up to 1.200°C, for any type of bulk solids
- e.g. separators, cyclones, mechanical conveyors, piping systems

Shapes and sizes
- supply in bags of 25 kgs each, for a castable or pasty mortar mass, thickness after installation usually ranging from 10 to 60 mm

Methods of attachment
- casting
- trowelling
- plastering

SC-CAST BASALT

OUTSTANDING COST EFFICIENCY, OWING TO EXTREME HARDNESS.



Cast basalt is a mineral material which, thanks to its special characteristics, is superbly suitable as wear protection:

- Exceptionally high wear resistance
- Unlimited resistance to humidity
- High compressive strength and resistance to nearly all acids and alkalis
- Complete corrosion resistance
- Maintaining a permanently even and smooth surface (favorable friction values for bulk solids)
- Excellent price/efficiency ratio (preventive and economical)

MANUFACTURE AND PROPERTIES

Cast basalt is produced by melting selected natural basalt – broken into sizes of 20 – 50 mm – in shaft furnaces at temperatures around 1.300 °C, followed by casting into the desired molds. Of significant importance is the following tempering process, in the course of which the molten basalt forms uniform, spherulitic crystals which contribute to its physical properties such as extreme hardness and abrasion resistance.

Cast basalt reaches a value of 8 on the Mohs hardness scale. (For comparison: the highest value of 10 is only attained by diamonds). However, it is marked by a certain sensitivity to impact. Cast basalt can be used within a temperature range from approx. +350 °C to approx. -40 °C.

PRODUCT RANGE AND FORMATS

Cast basalt wear parts are produced as:

- Tiles
- Formpieces
- Straight pipes and bends

Monolithic straight cylinders are available up to a bore size of 700 mm, with the wall thickness ranging between 20 and 30 mm, and a standard single length of 500 mm.

AREAS OF APPLICATION

Cast basalt is the wear protection material most frequently used.

The main areas of application are the wear resistant lining of:

- Piping
- Mechanical conveyor systems such as chutes, trenches, chain conveyors
- Bunker systems, silos, tanks and unloading ramps
- Cyclones, separators, classifier and reducer

CAST BASALT LINED PIPING

The transport of abrasive media, in fact of virtually all granular materials, in enclosed pipelines poses the advantage that it is non-polluting, generates neither dust nor smell, and saves valuable space. Cast basalt lined piping is extremely wear resistant and is used wherever highly abrasive materials are to be conveyed pneumatically or hydraulically, e.g.

- Fine ores
- Fly-ash
- Furnace dust
- Lime
- Coal and pulverized fuel
- Coke
- Sand
- Slag
- Backfill
- Cement

PIPE LENGTHS

Complete-lined pipes can be manufactured with the following maximum lengths:

- Straight pipes: up to 6.000 mm
- Pipe bends: up to approx. 2.000 mm

BUNKERS, SILOS, TANKS

The walls and outlets of bunkers, silos and other tanks used for the storage of bulk materials are subjected to strong abrasion. Strong friction wear is caused during emptying, compounded by impact wear during the filling process.

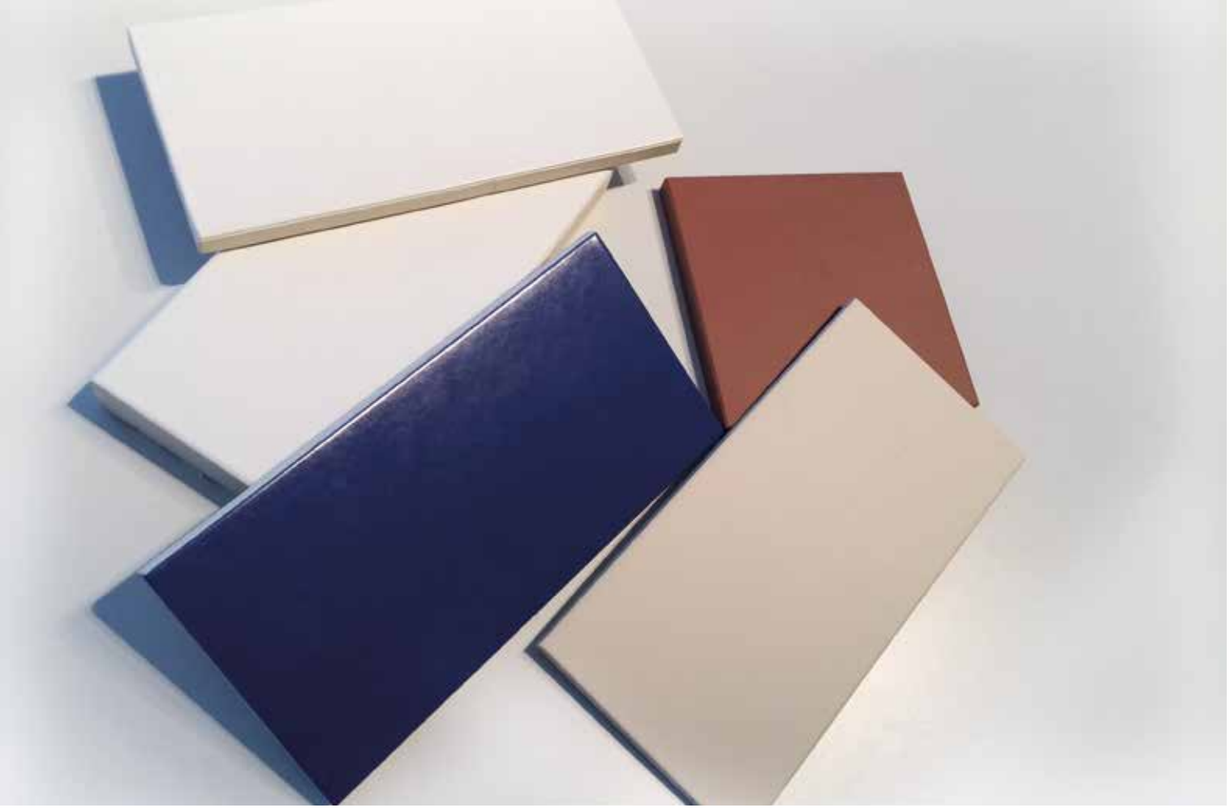
A wear resistant lining with hexagonal or rectangular cast basalt tiles has proved to be a successful and economical solution. Special formpieces are manufactured for the flutes and the bunker saddles. Circular bunkers and silos are lined with radial, rectangular or hexagonal formpieces which precisely match the individual circumference.

To improve adhesion, corrugated wire mesh is spot-welded to the vertical steel walls.

CYCLONES, SEPARATORS AND CLASSIFIERS

Screening, separating, grading, classifying – increased abrasive wear is frequently encountered during these procedures. Cast basalt linings are often already a standard supply.

- Expertly manufactured formpiece linings, precisely adapted to the steel casing of the plant component (frequently: radial hexagonal linings)
- Cyclones and separators: manufacture to customer drawings, complete with steel and built-in wear protection lining
- Larger separators and cyclones: lining to manufacturers' steel construction drawings



SC-HARD CERAMIC

WEAR PROTECTION, CONVENIENT AND BUDGET-PRICED.

SC-Hard ceramic is a ceramic product which was not only developed for the purpose of wear protection: It is also used in areas where a particularly smooth surface is essential.

MANUFACTURE AND CHARACTERISTICS

Base materials for the manufacture are high-grade clays, kaolins, feldspars and pure quartz sand.

These materials are finely ground and mixed to a specific recipe to form a ceramic mass with very high wear resistance properties. Subsequently, the ceramic mass is pressed into steel molds and sintered at approx. 1.300 °C. The resulting material is absolutely dense and free of porosity (accuracy grade ±0,5 mm).

The controlled production process safeguards the excellent properties of the SC-Hard ceramic, such as:

- High abrasion resistance
- High compressive strength and resistance to nearly all acids and alkalis (with the exception of hydrofluoric acids and their compounds)
- Very good resistance to temperature fluctuations
- Temperature resistance up to +500 °C
- Frost resistant and corrosion free
- Extremely smooth surface, thus preventing caking, bridging and clogging of bulk materials

In addition to wear resistance, a smooth surface is frequently important. For these applications, the SC-Hard ceramic tiles are provided with a supplementary, special glazing. This achieves a high smoothness factor which prevents caking, bridging and clogging of materials.

The technical properties of the SC-Hard ceramic tiles far exceed the minimum requirements specified for hard ceramic tiles in DIN 18 155.

PRODUCT RANGE AND FORMATS

Standard-wise, hard ceramic is available in the shape of square or rectangular tiles, with the wall thickness ranging from 10 to 25 mm. Tailor-made linings are cut from these tiles for the installation into reducers, hopper and chutes. Special dimensions are available upon request.

AREAS OF APPLICATION

We recommend the use of SC-Hard ceramic tiles for all cases of medium-level abrasion joint with the requirement of high smoothness and lower weight of the wear protection material. Furthermore, SC-Hard ceramic offers economic advantages as opposed to alternative, more expensive ceramic materials.

- Preparation plants and dressing floors
- Fine coal bunkers of thermal power plants
- Bunkers, silos, chutes, trenches and bunker outlets wherever fine-granulated bulk materials are stored and conveyed

SC-ALUMINA CERAMIC

ONLY DIAMONDS ARE HARDER.

The term ‚alumina ceramic' defines ceramic materials with an aluminium oxide (Al_2O_3) content above 80 %. (Generally, only ceramics with a minimum Al_2O_3 content of 92 % should be used as high-quality wear protection.)

Basically, this is a single-phase and single-component oxide of corundum crystals, bonded by solid phase reaction during the sintering process.

Alumina ceramic is among the hardest technical materials available, and is currently the most important member of the group of oxide ceramic materials both from a technical and a cost-efficient point of view.

Densely sintered, it is characterized by:

- High strength and hardness
- High temperature and corrosion resistance

MANUFACTURE AND PROPERTIES

The starting point of the manufacturing process is a highly pure, synthetic (alpha-) aluminium oxide powder. The higher the Al_2O_3 content, the better the mechanical values and the lower the glass phase, leading to an even higher density and higher wear resistance.

Shaping procedures:

- Pressing (highest wear resistance)
- Slip casting (complex geometries)

These procedures produce the so-called "green compacts", whose texture is comparable to that of chalk. They can now be machined with conventional equipment such as turning or sawing, in order to create certain shapes or dimensions. After the subsequent sintering process at approx. 1.560 °C, the parts are dense and without porosity. The mechanical values remain virtually unchanged up to 1.000 °C.

AREAS OF APPLICATION

Owing to its substantial hardness and temperature resistance, alumina ceramic is used in areas subjected to most extreme wear stress, frequently combined with high service temperatures. Its availability with a very low wall thickness allows for thin-wall wear protection linings which still achieve a sufficient service life, especially in areas where weight or construction limitations do not permit the installation of a thicker wear protection lining.

The production variety of this material permits the lining of any kind of plant component subjected to extreme abrasion and high temperatures, e.g. separators, bunkers, diffusers, nozzles, hydro-cyclones, chain conveyors, reducers, mixer, pumps, trenches, piping, chutes, troughs, cyclones.

PRODUCT RANGE AND FORMATS

Thanks to the variety of possible shaping procedures, the product range is manifold.

Available are:

- Tiles (standard products in various sizes, with or without center holes for fixing)
- Very small tile platelets, vulcanized onto support material or rubber mats (generally, square and hexagonal platelets). Advantage: wear protection of surfaces of any curvature
- Straight pipe cylinders and pipe bends (up to an inner dia. of 300 mm, wall thickness ranging from 8 to 25 mm)
- Any kind of special formpiece such as nozzles, reducers, inlets, pump casings, diffusers, etc., can be supplied in accordance with customer drawings (frequently incurring tooling costs)

MORE FLEXIBILITY WITH VARIABLE CONNECTIONS

In addition to the standard design, all kinds of steel casings, inside and outside surface treatments, flanges as well as preparations for other coupling systems can be supplied after review of the manufacturing possibilities.

To offset elongations of long pipelines by temperature fluctuations, special expansion joints are manufactured which are equally lined with SC-Cast basalt or SC-Alumina ceramic.

As alternative option to the expansion joints (also called compensators), flexible tubes are more and more frequently used, into which a ceramic, e.g. alumina ceramic, is vulcanized as wear protection. They can also be equipped with a signal cable for the leak detection system.

The flexible tubes have the advantage that, unlike expansion joints, they can compensate movement in several axes. This completely abolishes the high risk of sticking or caking on the gliding surfaces.

MECHANICAL CONVEYOR SYSTEMS

Bulk solids are transported mechanically through chutes, trenches, chain conveyors or spiral troughs. Mechanical transport always incurs frictional wear. The cast basalt lining can be manufactured with precise fit by means of cast formpieces and/or standard sizes in accordance with the individual conveyor system. The smooth surface prevents caking, is corrosion-free and does not require any maintenance.

Concrete trenches are lined, just as steel chutes. To improve adhesion, we recommend welding wire mesh inside steel trenches and chutes.

Where required, we can also line chain conveyors with cast basalt hexagonal tiles with so-called herringbone pattern grooves, in order to ensure a proper and even water reflux.

SC-ZIRCONIA CERAMIC

MANIFOLD APPLICATIONS AGAINST EXTREME WEAR AND HIGH TEMPERATURES.

MANUFACTURE AND PROPERTIES

Zirconia ceramic is a material of the mixed ceramic type, made by the bonding of different oxides: aluminium, zirconium and silicon oxides are molten in an electric arc furnace at approx. 2.000 °C.

Mixed crystals form, which provide this material with its distinct characteristics:

- High strength and hardness
- Extremely high wear resistance
- 50% Al_2O_3 content (Al_2O_3 material classification)

Due to its mineralogical composition – approx. 50% corundum, 32% zircon and a glass phase content of approx. 18% - and its method of production, zirconia ceramic is frequently referred to as fused corundum, sometimes also as “zircon-reinforced alumina ceramic”.

PRODUCT RANGE AND FORMATS

The smelt fused in the electric arc furnace can be cast into a variety of molds:

- Standard tiles, edge length ranging from 150 to 500 mm and wall thickness from 20 to 100 mm

For mechanical fastening to the base structure of the plant component, these tiles can additionally be equipped with:

- A central drilling (e.g. for use with a bolt or clamp connection with the plant component to be protected; bolt welding or other)
- Firmly cast bolts
- Cast steel base at the lower side, for direct welding onto a steel structure
- Dovetail grooves on the back (for fitting correspondingly shaped steel platelets with weld-on bolt screws)

Furthermore, straight pipes and elbow segments are produced standard-wise, with the wall thickness ranging from 17 to 25 mm and the inner dia. from 50 to 350 mm. Radial tiles can be manufactured, as well.

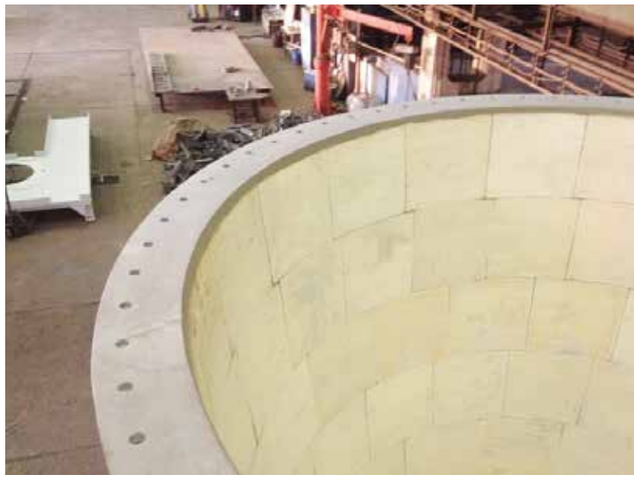
As the material is shaped by casting, special formpieces can be produced, e.g. for the lining of pumps, cyclones, etc. - The temperature limit is approx. 1.000 °C.

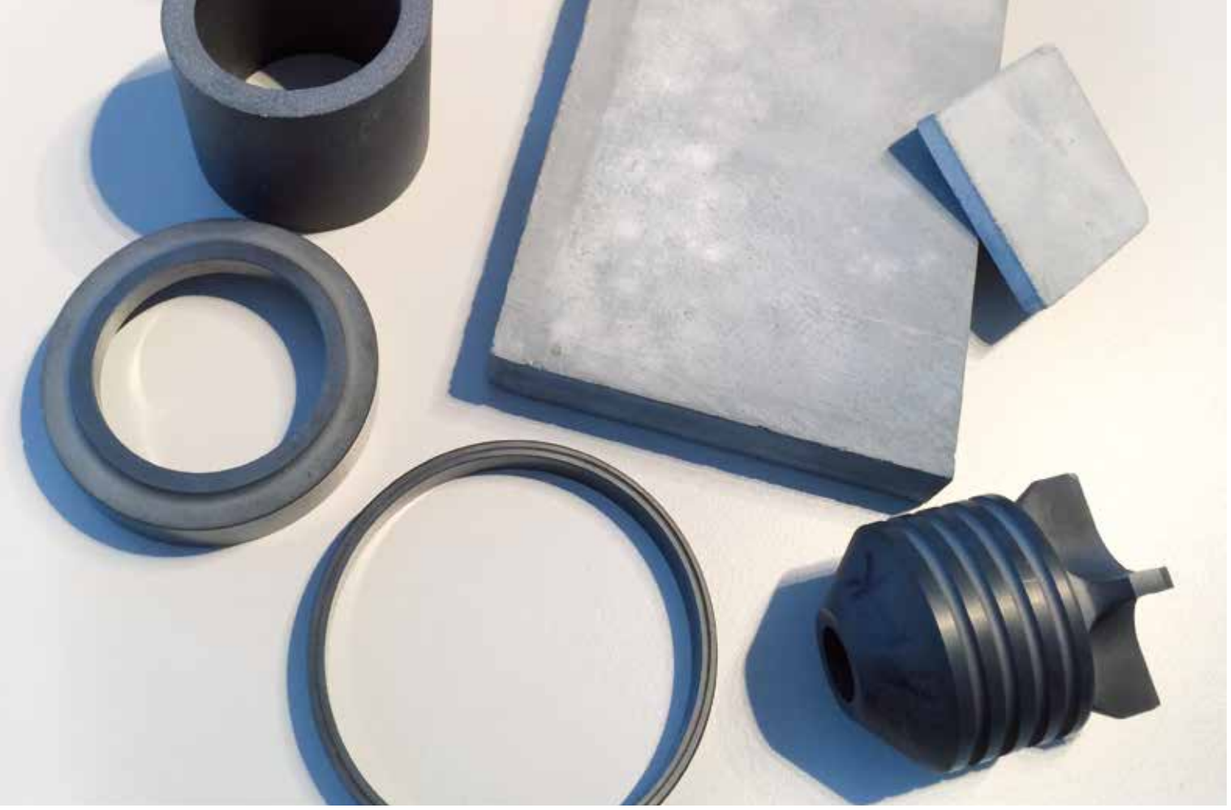
AREAS OF APPLICATION

Zirconia ceramic is characterized by its particular hardness, mainly owing to its corundum content. Hardness frequently entails a certain degree of brittleness, offset however by the zircon content of this material.

The main areas of application are those subjected to extreme abrasive wear and/or impact wear as well as high temperatures.

Thanks to the flexible shaping options and the variety of fastening methods, this material is suitable for the lining of nearly all types of plant components.





SILICON CARBIDE CERAMICS

THE IDEAL WEAR PROTECTION FOR COMPLEX WEAR PROTECTION APPLICATIONS.

MANUFACTURE AND PROPERTIES

According to the material classification for ceramic materials, silicon carbide ceramic forms part of the group of non-oxide ceramics.

Two types are available:

- Base materials are high-grade silicon carbide raw materials, silicon dioxide (SiO_2) and aluminium oxide
- Special quality, distinct by a silicon nitride compound (Si_3N_4)

SiC granules are mixed with temporary and permanent bonding agents. The manufacture is effected in a dry, semi-dry or compressing process. Formpieces are shaped by casting, followed by a sintering process.

Characteristics:

- Excellent resistance to temperature fluctuations
- High temperature resistance
- High degree of hardness
- High thermal conductivity
- Corrosion resistance
- Service temperature limit, depending on the quality, up to 1.700 °C

PRODUCT RANGE AND FORMATS

Depending on the production process, plain or complex geometric shapes (similar to cast metal elements) are possible, as are large-surface (1 m²) or smallest-scale parts.

- Tiles
- Formpieces and pipes (casting process)
- Wall thickness ranging from 10 to 75 mm (min. 6 mm)
- Possible formats of the formpieces:
  max. length 1.200 mm, max. width 1.000 mm, max. thickness 75 mm, min. thickness 6 mm (depending on the overall dimension)

AREAS OF APPLICATION

Silicon carbide ceramic differs from other wear protection materials in particular by its distinctly high resistance to temperature fluctuations. It is therefore used as protection against abrasive wear as well as impact wear in areas subjected to very high service temperatures combined with closely spaced temperature fluctuations.

Typical applications are, for example:

- Lining of aluminium pouring spouts
- Lining of pulverized fuel piping in the vicinity of the burner
- Nozzles
- Lining of fans in power station coal units
- Hydro-cyclone linings

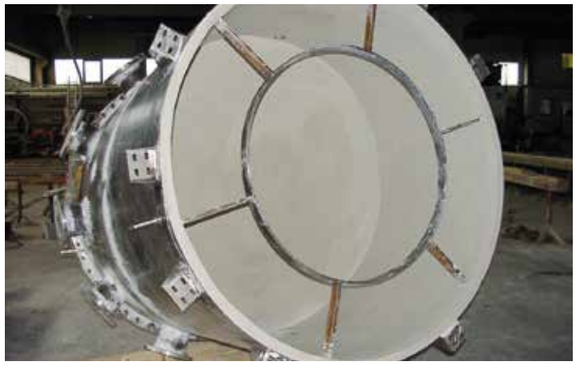
SC-WEARSTOP®

FLEXIBLE AND COST-EFFECTIVE.

SC-WearStop® is a completely new generation of ceramic wear protection materials: a mixture of very hard, wear resistant particles and a special binder.

It is a chemically bound ceramic material whose properties offer the following benefits:

- Flexible installation
- Very cost effective
- Lining without joints



PREPARATION AND PROPERTIES

SC-WearStop® is made up like cement mortar, i.e. mixed with water. Once made up, it can be adapted to any shape or form within the plant system, directly and individually, by applying it onto a support mesh (diamond mesh).

PRODUCT RANGE AND FORMAT

SC-WearStop® is available in 25 kg bags, to be used as mortar with pasty, castable or spraying consistency.

AREAS OF APPLICATION

- Large-surface plant components (separators, cyclones, hopper, bunkers)
- Mechanical conveyors
- Piping systems

MATERIAL COMBINATIONS

COMBINING DIFFERENT MATERIALS OFFERS ECONOMIC ADVANTAGES.

In order to meet different types of wear stress, the combination of several wear protection materials has proved to be a very economical solution.

The choice of material is pivotal: though the material costs for alumina, zirconia and silicon ceramic are several times higher than those of the standard wear protection materials cast basalt and hard ceramic, they usually improve the durability by around 2 – 8 times compared to that of the lower-budget materials.

Generally, the use of cost-intensive materials is economically justified only for those applications where extreme abrasive stress, high service temperatures and/or severe temperature fluctuations are encountered.

With material combinations, only those surfaces subjected to severe wear are protected with alumina or zirconia ceramic, whereas the areas less prone to abrasion are lined with cast basalt or hard ceramic.

EXAMPLES:

- Transition areas of trenches, chutes etc. (alumina ceramic in areas of impact wear, cast basalt or hard ceramic in the other areas)
- Use of alumina ceramic in narrow bends of pneumatic or hydraulic conveyor pipelines, cast basalt in straight pipeline sections
- Cyclones: inlet pipe lined with zirconia ceramic, cylindrical part lined with cast basalt, reducer lined with hard ceramic
- Chain conveyors: alumina lining of the chain guide rails and cast basalt lining of the remaining sections
- For larger inner diameters: combinations within pipe bends, i.e. protection of the outer curved “extrodus” section with alumina ceramic and of the less wear affected inner curved “introdus” section with cast basalt

That way, it is possible to match different service lives of various components and reduce the overall maintenance costs.

ASSEMBLY, FASTENING AND INSTALLATION MATERIALS

The solutions we are illustrating on the following pages with practical examples are based on the "two-material principle": the wear protection material is applied onto the base or carrier material which provides the mechanical and constructional strength.

Available options for the connection of two materials are:

- Installation with cement mortar (a variety of cement types in accordance with the individual requirements, e.g. Portland, Sulfadur, blast furnace cement, acid cement, refractory high-alumina cement)
- Installation with water glass cement for acid and temperature stresses (service temperatures up to 350 °C in moist surrounding, 1.000 °C in dry surrounding)
- Use of resin-based adhesives (one-component and multi-component adhesive on the basis of different types of resin); also special resin adhesive for applications up to 150 °C
- Use of special silicon adhesives for temperatures up to 300 °C
- Mechanical fastening systems, e.g. assembly of materials by nuts, bolts, welding sleeves etc.
- Combinations of mechanical fastening with one of the other installation types

Steel mesh may be welded onto vertical or strongly inclined walls or in complex steel casings, in order to improve the adhesion of the cement mortar and bonding material. In some cases, the lining surfaces have to be equipped with support rods or trailing-edge rods.

The suitable laying material is chosen in accordance with the individual application.

Professional know-how and workmanship during the installation of the materials essentially influence the quality of the wear protective lining. Therefore, we recommend the installation of the wear lining by our specialist fitters. If the installation is carried out by the client or end user, we will be happy to provide installation drawings and instructions, or assign a company supervisor to supervise the installation work.

MAIN BONDING METHODS

	cast basalt	hard ceramic	alumina ceramic	zirconia ceramic	silicon carbide ceramic
cement mortar	■	■	■	■	■
water glass cement	■		■	■	■
one-component adhesive	■	■			
two-component adhesive	■	■	■	■	■
silicon adhesive	■	■	■	■	■
bolting	■		■	■	■
welding	■		■	■	■

PRACTICAL EXAMPLES FOR SUCCESSFUL WEAR PROTECTION RESULTS

EXAMPLE: PIPELINES

Case study:
A 1.000 MW power station required a suitable wear protection system for its several km long pipeline network.

Problem:
Conventional solutions: service life of only around 4 - 5 months, frequent repair and shutdown times

Solution:
- Replacement of the existing pipeline system against steel casing pipes with a 3 to 5 mm wall thickness, lined with cast basalt pipe cylinders of 25 mm wall thickness
- Connection of the up to 6 m long pipe elements with fixed flanges, rotating flanges or Viking Johnson and Victaulic couplings

Result:
Service life since installation: at present around 5 years, Estimated overall service life: approx. 10 years +.

EXAMPLE: BUNKER

Case study:
Bunker system of a metallurgical plant with extremely severe wear on concrete and steel walls, caused by hard and chemically aggressive conveyed substances.

Problem:
High repair costs, frequent down times

Solution:
A wear resistant lining with hexagonal cast basalt tiles.

Result:
Thanks to the outstanding hardness, high abrasion resistance and resistance to virtually all acids and alkalis, together with the added stability of the hexagonal lining, the repair costs and down times were substantially reduced for years.

EXAMPLE: CYCLONE SEPARATORS

Case study:
The aim was to reduce the extremely high wear encountered at the steel parts of the cyclone separator in a cement plant without changing the fluidic status quo, which would have affected the separator performance.

Problem:
The desired degree of dust extraction requires high flow speeds to separate highly abrasive dusts.

Solution:
Implementation of an efficient wear protection system with cast basalt pre-shaped formpieces, alumina ceramic and SC-WearStop®, all manufactured to drawings in accordance with the individual cyclone construction.

Result:
A perfect wear protection without negative modification of the fluidic status quo, multiplication of service life, substantial reduction of repair times. (In practice: throughput of cyclone precipitators and separators increased up to ten times).

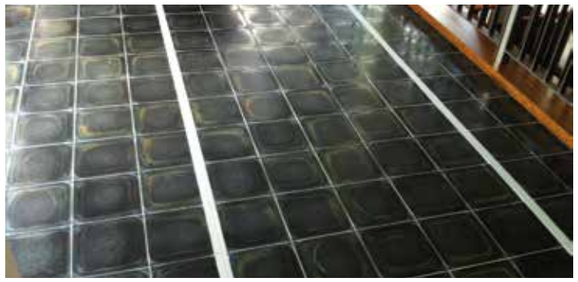
SPECIAL APPLICATIONS

The practical areas of use of our wear protection materials are manifold and include special applications. Some of these are illustrated below:

FLOORS, PRIVATE AND COMMERCIAL

Cast basalt floors provide numerous advantages and can be manufactured both for commercial as well as for private use. One example for commercial use: the Block House chain of restaurants is using visually attractive cast basalt tiles as floor tiles in some of their restaurants. Advantages:

- Appealing and eye-catching, owing to the blue shimmering surface fire
- Robust, due to its high abrasive resistance
- Easy to maintain, thanks to its chemical resistance



INDUSTRIAL FLOORS

Cast basalt tiles with diamond pattern on the surface are predominantly used in the chemical industry.

- Protection against increased wear through abrasion as well as stresses through acids or alkalis
- Physical strength, thanks to its high abrasion resistance
- Easy to maintain, thanks to its chemical resistance
- Non-slippery, thanks to the rhomboid pattern

WATER RESOURCES

- Use of cast basalt in creeks or different casings of the creek path: protection of the cement creek bed or cement pipes against abrasion caused by stones or pebble washed along in the water

SHIP UNLOADER

Lining of bends and straight pipes of the pneumatic grain unloading systems with cast basalt or alumina ceramic:

- Protection against abrasive wear by grain

SEWAGE TREATMENT PLANTS

Cast basalt has established itself as a renowned material for the lining of spiral troughs in sewage treatment plants. For example, after many years of positive experience in a major sewage treatment plant near Cologne, six further spiral troughs were lined with our patented system:

- A cost-efficient and durable answer to wear, corrosion and chemical stresses

TEST TRACKS FOR ANTILOCK BRAKING SYSTEMS

- Development of a special cast basalt tile format (high hardness and abrasion resistance, very smooth surface) with the format 200 x 200 x 40 mm + 4 squares of 90 x 90 mm each; after laying: grinding with diamond-tipped grinding discs, to ensure the same coefficient of friction (<0,3) for each tile
- Target: identical coefficients of friction and thus comparable braking conditions for all tests of antilock braking systems and anti-slip systems

SUGAR INDUSTRY

- Lining of the beet dumping ramps and rinse trenches with cast basalt or hard ceramic: protection of the cement surfaces against premature damage caused by soil, gravel and sand

NO CHANCE FOR ABRASION.

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