

## Refractories - Product groups

PRODUCT	CHEMICAL BASIS	MAIN APPLICATION
<b>Setting accelerator</b>		
SILUBIT BL 05	Silicate preparation	Cement-bonded bodies
<b>Chemical binders</b>		
LITHOPIX AS 21	Silicate preparation	Cement-free gunning mixes
LITHOPIX AS 85	Phosphate -silicate - preparation	Neutral, cement-free vibration bodies
LITHOPIX P 1	Monoaluminiumphosphate solution	Bodies and bricks
LITHOPIX P 2	Monoaluminiumphosphate solution, hyperacidic	Storable, workable bodies
LITHOPIX P 4	Sodium polyphosphate	Acidic ramming and gunning mixes
LITHOPIX P 5	Phosphate preparation	Basic vibration and casting bodies
LITHOPIX P 6	Sodium polyphosphate	Basic brick, ramming and gunning mixes
LITHOPIX P 8	Sodium polyphosphate	Basic brick, ramming and gunning mixes
LITHOPIX P 9	Phosphate preparation	Neutral brick, ramming and gunning mixes
LITHOPIX P 15	Aluminium phosphate	Neutral bodies and mortars
LITHOPIX P 33	Phosphate preparation	Neutral brick, ramming and gunning mixes
LITHOPIX P 56	Phosphate preparation	Gunning mixes for hot repairing
LITHOPIX P 91	Phosphate preparation, alkalifree	Bodies and mortars from neutral raw materials
LITHOPIX P 92	Phosphate preparation, acidic	Ready-for-use mortars
LITHOPIX S 2	Sodium disilicate	Mortars, gunning mixes and core sands
LITHOPIX S 3	Sodium trisilicate	Mortars, gunning mixes and core sands
LITHOPIX S 12	Silicate preparation	Tundish gunning mixes
LITHOPIX S 66	Sodium disilicate, water-free	Bodies and mortars
LITHOPIX ST 5	Silicate preparation	Insulating tundish gunning mixes
LITHOSOL 1530	Colloidal silicic acid dispersion	Fibre parts
LITHOSOL 1540	Colloidal silicic acid dispersion	Fibre parts
SILUBIT FB 10	Silicate preparation	Binder and thixotropic agent for vibration bodies
SILUBIT FB 17	Alumina preparation	Binder and thixotropic agent for SiO <sub>2</sub> -free vibration bodies
SILUBIT H 19	Silicate preparation	Low-cement gunning mixes

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<b>Flocculants</b>		
<b>KERAFLOC AL FLÜSSIG</b>	Organically modified aluminium salt	Flocculant for colloidal silicic acid dispersions
<b>KERAFLOC AL PULVER</b>	Organically modified aluminium salt	Flocculant for colloidal silicic acid dispersions
<b>KERAFLOC A 4067</b>	Polycarboxylic acid preparation	Flocculant for colloidal silicic acid dispersions
<b>KERAFLOC K 4060</b>	Modified starch	Flocculant for colloidal silicic acid dispersions
<b>Wetting agents</b>		
<b>GLYDOL N 109 NEU</b>	Polyglycoether	Incorporation of carbon, increase of plasticity in clay containing bodies
<b>GLYDOL N 193</b>	Ester, anionic	Wetting agent and plasticizer in clay containing bodies
<b>GLYDOL N 1003</b>	Alkylbenzene sulfonate	Wetting agent and plasticizer in clay containing bodies
<b>GLYDOL N 1055</b>	Polyaryl sulfonate	Wetting agent for clay and/or carbon containing bodies
<b>GLYDOL N 2002</b>	Alkylbenzene sulfonate	Blast furnace taphole bodies, carbonic ramming and extrusion bodies
<b>Plasticizers</b>		
<b>ZUSOPLAST C 28 NEU</b>	Cellulose derivative	Pressing, ramming and extrusion bodies; mortars
<b>ZUSOPLAST PS 1</b>	Polysaccharide, high polymer	Pressing, ramming and extrusion bodies
<b>Porosity inducing agents</b>		
<b>CELLOTIN PP 6</b>	Polypropylene	Dewatering aid
<b>CELLOTIN ZZ 8/1</b>	Cellulose	Insulating tundish gunning mixes, also used as separating inhibitor
<b>PORLAT K 85</b>	Acryl glass	Targeted adjustment of pore size, pore volume and pore distribution
<b>PORLAT K 86</b>	Acryl glass	Targeted adjustment of pore size, pore volume and pore distribution
<b>PORLAT K 87</b>	Acryl glass	Targeted adjustment of pore size, pore volume and pore distribution
<b>PORLAT K 88</b>	Acryl glass	Targeted adjustment of pore size, pore volume and pore distribution
<b>PORLAT K 89</b>	Acryl glass	Targeted adjustment of pore size, pore volume and pore distribution
<b>PORLAT K 90</b>	Acryl glass	Targeted adjustment of pore size, pore volume and pore distribution
<b>SCHÄUMUNGSMITTEL W 53 FLÜSSIG</b>	Fatty alcohol sulfate preparation	Foam ceramics

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<b>Pressing agents</b>		
ZUSOPLAST 91/11	Polyoxyethylene preparation, non-ioni	High-alumina dry pressing bodies
ZUSOPLAST 109/2	Polyoxyethylene preparation	Dry pressing bodies from SiC, chrome magnesite and chamotte
ZUSOPLAST 126/3	Fatty acid preparation with non-ionic emulsifier	Dry pressing bodies and extrusion bodies
ZUSOPLAST 5012	Oil preparation, emulsifiable	Basic dry pressing bodies, also water-free
<b>Dust binding agent</b>		
ZUSOPLAST S 13 SPEZIAL	Oil preparation, emulsifiable	Gunning mixes
<b>Temporary binders</b>		
LITHOPIX LCA	Calciumligninsulfonate	Increase of green strength and dry modulus of rupture
OPTAPIX AC 15	Polycarboxylic acid preparation	Increase of green strength and dry modulus of rupture
OPTAPIX CS 59	Starch preparation	Carbonizing binder especially for carbon containing parts
OPTAPIX CS 76	Starch preparation	Carbonizing binder especially for carbon containing parts
OPTAPIX PA 4 G	Polyvinylalcohol	Increase of green strength and dry modulus of rupture
OPTAPIX PAC 60	Polyvinylacetate preparation	Mortars
OPTAPIX PAF 35	Polyvinylalcohol preparation	Increase of green strength and dry modulus of rupture
OPTAPIX PS 37	Polysaccharide	Increase of green strength and dry modulus of rupture
OPTAPIX PS 94	Polysaccharide preparation	Increase of green strength and dry modulus of rupture
OPTAPIX PS 202	Polysaccharide preparation	Increase of green strength and dry modulus of rupture
<b>Release agents</b>		
TRENNEMULSION W 165	Emulsion of tensio-active agents and mineral oils	Release agent for refractory parts
ZUSOPLAST O 59	Low-hazardous hydrocarbons	Clay containing pressing, squeeze and extrusion bodies
<b>Deflocculants / Dispersants</b>		
DOLAPIX CE 64	Carboxylic acid preparation	Oxidic bodies, also cement-bonded
DOLAPIX FF 1	Polycarboxylic acid preparation	Oxidic bodies, also cement-bonded
DOLAPIX FF 7 SPEZIAL	Synthetic polyelectrolyte	Oxidic bodies, also cement-bonded
DOLAPIX FF 26	Polycarboxylic acid preparation	Oxidic bodies, also cement-bonded
<b>Water glass hardener</b>		
LITHOPIX P 26	Aluminium phosphate	Controlled, irreversible precipitation of the silicic acid

## Setting accelerators



### SILUBIT BL

#### Application

Long setting times can lead to problems in the use of cement-containing mixes. For the **manufacture of large numbers** of prefabricated shapes many moulds would be required or in some situations, the time that must elapse before the templates could be removed would be too long. **Short setting times** are also required for gunning mixes, so that the **repair times** can be kept as **short** as possible and furnaces, ladles etc. can be brought back into production quickly.

The setting time depends on the type and quantity of the hydraulic binder used and on the amount of setting accelerator added.

#### Mode of action

The raw material base of the setting accelerators supplied by Zschimmer & Schwarz are **silicate preparations**.

The hydration of the cement is accelerated by **doping with foreign ions in combination with silicate compounds**.

## Chemical binders



## LITHOPIX, LITHOSOL, SILUBIT

### Application

Chemical binders are used in moulding bodies, gunning mixes, castables and ramming mixes **to improve the processing properties and final physical properties**. They can also have a **positive influence on the resistance to scorification and attack by aggressive gases or acids**.

Chemical binders with **thixotropic effects** are used in mixes which are mainly **compacted by vibration**. These additives allow a **reduction of the cement proportion** or the **preparation of cement-free blends**.

On account of the **reduced cement content** and the **partial replacement of the hydraulic bond** through a **chemical binding** the typical "strength hole" of cement containing mixes occurring **between approx. 500 and 1000  C** can be **weakened or even avoided**. The **reduced cement content** however **makes it necessary to reduce the quantity of the preparation water** as well as **to reduce the quantity of crystalline bonded water**.

There is additionally the possibility to optimize the de-watering during the first heating up by means of polypropylene fibres available from Zschimmer & Schwarz.

During the preparation of **cement free vibration mixes** a **specific chemical hardening** can be achieved through special preparations. Contrary to the hydraulically bonded mixes these preparations do not show a loss of strength between 500 and 1000  C. In order to make **the binder components react completely together** only **compact raw materials** are allowed. Some individual components dissolved in the preparation water could otherwise diffuse into the particles and would subsequently no longer be available for the setting reaction.

The reason for using a chemical binder is to **avoid the firing process when manufacturing shaped refractory ceramic products** or to ensure that monolithic products retain their **high quality properties** until the sinter temperature is reached **increasing the service life of both bricks and monolithics in use**. The higher the quality of the final product the greater the demands made on the binder. Therefore, the precise requirements should be described before selecting a suitable chemical binder.

The **phosphate bond has particular advantages** compared with the use of other binders, such as for example cement, clay or silicates. Phosphates can be used to bind practically all refractory raw materials **at room temperature or at low temperatures**. The phosphate bond is characterized by **high strength** and an **increased slag and melt rejection**.

It is possible to use **silicate bonding** to fulfil different demands on various refractory products. The **main field of application** is the **whole field of gunning mixes**. Here, in addition to defined silicates, it is also possible to use silicate preparations whose composition allows a **targeted modification of the processing properties**, for example **better adhesion in cold and hot repair** and a **reduction of rebound**.

The use of chemical binders can make it possible to **reduce or eliminate the clay components of the mix** and hence to **reduce the drying sensitivity of the body**. It is also possible to **improve the hot properties and the resistance to temperature variations** of the refractory materials.

### **Mode of action**

The raw material base of the chemical binders supplied by Zschimmer & Schwarz for the refractory sector are **phosphates** and **silicates**. The thixotropic and binding agents available from Zschimmer & Schwarz for bodies that are low in cement are based on **micro filler preparations**. The additives for **chemical hardening of cement free vibration mixes** are **phosphate-silicate-preparations**.

**Chemical reactions of phosphate with the raw materials as well as polymerization and poly-condensation of the phosphates** take place in refractory bodies with **phosphate bonding**. Further detailed information on this topic is given in our **Special information "Phosphate bonding"**.

**Silicate binders** act by **adhesive forces** coupled with the formation of insoluble silicate complexes, that are produced by reaction with multivalent metal ions. In addition, **the silicates show adhesion due to their melting during heating**. The course of the reaction and the type of bond formed depend on many factors, such as the type of silicate used, body composition, conditions of preparation and others.

The **micro filler preparations contain** among others **dispersants** to **decrease the water requirement**, as well as **mullite building compounds**, which **improve the properties** of sintered articles.

The additives for **chemical hardening of cement free vibration mixes** are **phosphate silicate preparations**. Chemical hardening is effected by **ion exchange**. The binders for the replacement of cement are **cold hardeners**. Temperature here is of high importance as it is for all chemical reactions. The setting is slower at low temperatures and a setting **acceleration** can be achieved even at a **small increase in temperature**.

## Flocculants



## KERAFLOC

### Application

Flocculants are used for the production of **vacuum-moulded fibre components**. The silicic sols usually used for the fibre suspensions are brought to a defined flocculation if applied at an optimum ratio.

### Mode of action

**Organically modified** aluminum salts and **modified starches** with **anionic or cationic characteristics** are the raw material base of the flocculants from Zschimmer & Schwarz.

**Flocculants dispose of reactive groups** in aqueous solutions, which are **absorbed** by the surface of dispersed parts and finest particles. The **interaction** between polymer chains of the flocculant and the solid components is **based on a charge exchange** and entailing de-stabilization. Between the different components increasing cross-links are built-up resulting in a flocculation.

## Wetting agents



## GLYDOL N

### Application

Various carbon sources, e.g. carbon black and graphite, are used in the manufacture of some refractory products, in order to increase the corrosion resistance and thermal shock resistance of the materials. The use of a wetting agent can **make possible** or **improve** the **incorporation of the carbon source** in the body.

In addition, the **plasticity of clay-containing ramming mixes or extrusion bodies can be increased for the same quantity of preparation water** or the quantity of preparation water can be decreased while maintaining the same plasticity. Wetting agents contribute to **making the process of extrusion even**, over the whole cross-section. They also find application in the **extrusion of refractory light-weight insulation bricks**.

In addition, the use of wetting agents can **improve the sliding properties** of a body so that **friction at mould walls and die rings is reduced** and **wear becomes less**.

The use of these additives also **improves the pumping properties of insulating slurry gunning mixes**. They can also be used for **pore production** in gunning mixes.

### Mode of action

Wetting agents for refractory ware, supplied by Zschimmer & Schwarz, are based on **alkyl-benzenesulphonates, polyarylsulphonates** and **polyglycol ethers**.

These are **interfacially active substances with a high surface affinity**. They are anionic or combined non-ionic / anionic. The addition of wetting agents reduces the surface tension of the preparation water. This effects a **reduction of repulsion forces between the batch components** and hence a **better penetration** of the water within the silicate lattice layer of the clay. It leads to homogeneous distribution of the **carbon components which are difficult to wet**.

## Plasticizers



## ZUSOPLAST C, ZUSOPLAST PS

### Application

Plasticizers **increase** the **plasticity** of a body, which makes it possible to **reduce the proportion of clay**.

Thus, the **resistance to temperature variations** and the **hot strength** of refractory bodies can be **improved**. The **drying sensitivity** can be **reduced** simultaneously.

Plasticizers are also used in **moulding bodies**, **ramming mixes** and in **extrusion bodies**. **Anhydrous liquid products**, that make possible **plastic deformation**, are available for special application fields.

### Mode of action

The plasticizers supplied by Zschimmer & Schwarz for the refractory sector are **based on polysaccharides** and **highly polymerized cellulose derivatives**.

They utilise some of the water content and **increase the ductility of the body because of their swelling capacity**. **Polysaccharides** and **cellulose derivatives** have a secondary effect of **improving the green and dry breaking strength** so that they also act as temporary binders.

**Polyoxyethylene preparations with surface-active substances** are products used as **anhydrous plasticizers**. They are added as **make-up fluid** and thus also plasticize, besides their **wetting effect**.

## Porosity inducing agents



## CELLOTIN, PORLAT K, SCHÄUMUNGSMITTEL W

### Application

The use of porosity inducing agents serve for a targeted adjustment of the **pore size, pore volume** and **pore distribution**. The manufacture of porous insulation bricks is a typical application.

Depending on their properties and each individual application, porosity inducing agents can lead to **reduction in cracking and shrinkage** or act as additives for an **even and/or more rapid dehydration**. The **dehydration on the initial heating** of cement-bonded mixes can be **optimized** by the addition of polypropylene fibres, in order to **avoid damage** as a result of steam tension.

### Mode of action

The porosity inducing agents supplied by Zschimmer & Schwarz **are made of acryl glass, cellulose fibres, polypropylene fibres or fatty alcohol sulfate preparations**.

The porosity inducing agents decompose with increasing temperature dependent on furnace atmosphere and time, leaving behind defined pores.

**Acryl glasses** do not **depolymerize** below a temperature of approx. 150 °C. This begins to take place at a relatively high rate at **temperatures above 180 °C**. In an oxidizing atmosphere the final result is **decomposition to H<sub>2</sub>O and CO<sub>2</sub> leaving no residues**.

The **cellulose fibres** are manufactured from secondary grown raw materials. In the drying process the water transport occurs along the interface between the fibre and solid material or through the fibre itself. The product operates by **forming dewatering channels**, that permit **fast and uniform drying** of the body from the inside through to the surface. Thus, distortion during drying because of partially differing shrinkage, and the possible destruction of the shaped body due to existing steam tension, **is avoided**. The microporosity induced by the cellulose fibres is favourable for the degassing of the crystallized water during subsequent sintering of the ceramic parts.

**Polypropylene fibres** are **products of crude oil refining**. **Since they have a special surface coating** the polypropylene fibres supplied by Zschimmer & Schwarz can be **mixed into** the bodies **without problems**. Thus, the **homogeneous distribution of the fibre** achieved in the dry mixture is also maintained after the addition of water.

**Fatty alcohol sulfate preparations** available from Zschimmer & Schwarz are **anion-active surfactants**. Their effect is based on the reduction of the surface tension of water allowing the **production of foam ceramics** by the casting process.

## Pressing agents



## ZUSOPLAST

### Application

Pressing agents serve as **pressure equalizing agents** and bring about a **homogeneous compaction** of refractory products. If the **particle size distribution is not optimal** it is possible to **increase the green density** in many cases.

The use of pressing agents endows the body with **good flow properties**. This means that **friction within the pressed body** and **between the pressed body and the mould wall** are reduced during the pressing process. **Mould life** is possibly **prolonged**. The **tendency** of some pressed bodies to **adhere** to the mould wall can be **reduced**.

### Mode of action

The raw material base of the pressing agents supplied by Zschimmer & Schwarz for the refractory sector are **polyoxyethylene preparations, fatty acids** and **oil products**.

The **pressing agents** are **water-miscible or emulsifiable liquids** that **form gliding planes within the raw material particles** and **between the body and the mould wall**, which leads to the reduction of both internal and external friction.

## Dust binders



## ZUSOPLAST S

### Application

For health and ecological reasons **dust building** during handling with powdery products should be **reduced or even avoided**. **Limit values** for a maximum dust concentration in the working environment and dust emissions **are regulated by law**. In order to **reduce the dust formation** when dealing with dry delivered **gunning mixes** a dust binder is already **incorporated** into the body **during the mixing process**. This application is possible in ceramic, chemical and hydraulically bonded bodies.

### Mode of action

Dust binders from Zschimmer & Schwarz are **emulsifiable oil preparations**.

The **mixing sequence** for the production of gunning mixes is also decisive for an **optimum efficiency** of the dust binder. If the **coarse raw material components are preliminarily premixed with the additive**, an **even coating** of the coarse particle with the fine sizes during the subsequent mixing is achieved.

Contrary to the customary dust binders a **good wetting** is given during processing of the gunning mix.



## Temporary binders

### LITHOPIX LCA, OPTAPIX

#### Application

Temporary binders effect an **increase in the green and dry breaking strengths**, which is necessary in order to be able to **handle the moulded parts** during further processing and **during transport within the plant**.

The use of temporary binders permits a **reduction of the proportion of clay in the mix**, which can **increase the thermal shock resistance and the high temperature strength** of the body composition. At the same time the **drying sensitivity can be reduced**.

When used in **gunning mixes** the bodies acquire **greater plasticity** and there is **better binding between raw material particles**. This leads to a **reduction in rebound**.

#### Mode of action

The **raw material base** of the temporary binders supplied by Zschimmer & Schwarz for the refractory sector are **preparations of organic polymers**.

When temporary binders are added, **adhesive forces** are set up between the ceramic particles in combination with water. The contact with the binder takes place in the form of **coating the ceramic particles** or **point contacts between the particles and the binder**.

If the water content of the bodies is low, powder-form additives may not disperse properly. In such cases it is advisable to **prepare stock solutions** or to **employ ready-for-use preparations**.

**Homogeneous distribution** leads to the fact that the binder is present uniformly at all points of contact, which results in an **optimum temporary binding**.

## Release agents



# TRENNEMULSION W, ZUSOPLAST O

### Application

Release agents are used for the production of refractory parts and bricks to bring about an **easy separation** of the moulded parts **from steel, plastic and wooden moulds**.

The use of release agents, which are applied onto the surface of pressing moulds, permits a **reduction of the friction within the pressed body and the mould wall during the pressing process with a prolonged mould life possible**. The **tendency** of pressed bodies to **adhere** to the mould wall can also be **reduced**.

Odour contamination during the production process is much less with these release oils than it is with the mineral oils usually employed.

### Mode of action

The raw material base of release oils supplied by Zschimmer & Schwarz to the refractory industry are **oil preparations**. These are **water-miscible, emulsifiable and water-soluble** preparations.

**The paste-form release agents** from Zschimmer & Schwarz **guarantee good spreading** and a **good separating effect** with thin layers using a variety of application techniques. Our **liquid release agents** are particularly suitable for **spraying** since they have a **defined formation of atomized oil mists**.

Our special information **"Information about low-hazardous forming and pressing oils"** contains detailed information on this topic.

## Deflocculants and dispersants



### DOLAPIX

#### Application

In refractory applications, bodies are often used which have been prepared with a minimal water content (3 to 6%). The processing is carried out in the form of thixotropic vibratable bodies or as self-flowing castables. The **low water content** of these bodies leads to the following advantages:

- **increased density**
- **increased strength**
- **improved resistance to corrosion**

The conditions for a low mixing water requirement in such cases are dense raw materials, suitable fines (reactive alumina, amorphous  $\text{SiO}_2$ ), a low cement content, a suitable particle size distribution and a dispersing agent designed for the body type.

#### Mode of action

For the deflocculation of **oxide raw materials** such as aluminium oxide, zirconium oxide, spinel and others, Zschimmer & Schwarz offers deflocculants **based on polyelectrolytes or carboxylic acid esters**.

Deflocculation is the result of **electrolytic interactions**. The contact of the dissociated ions of the deflocculant with the particles of the refractory body leads to **equalization of charge on the surface of the raw material particles** in aqueous medium. **The particles** then all bear the same charge and thus repel each other so that they **slide easily past each other**. The result is a **reduction in viscosity** and hence, **improved flow properties** of the body **with low water content**.

## Water glass hardeners



### LITHOPIX P 26

#### Application

In **mixes containing water glass** the use of a hardener for water glass allows the **controlled precipitation** of silicic acid leading to a **hardening of the body**.

#### Mode of action

The water glass hardeners from Zschimmer & Schwarz are **aluminium phosphate preparations** which definitely **hydrolyse** in the **alkaline environment** of water glasses.