

# KALCRET HARD COMPOUND

USER HANDBOOK VERSION 9



# KALCRET HARD COMPOUND

KALCRET protects plants and pipe systems from abrasion and erosion



## TAKE ADVANTAGE OF MANY BENEFITS:

- high wear-resistant
- seamless lining
- easy workability
- high temperature resistance up to 1,200 °C / 2,152 °F
- lining of complex geometries



KALCRET for trowelling, casting or spraying

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## NOTE ON APPLICATION

This brochure and all other technical data submitted by us are meant for your information and advice.

All technical data have been based on the evaluation of tests made on specific samples. They cannot be interpreted as a guarantee for which we assume legal liability. Material data sheets and safety data sheets must be observed.

Technical changes and errors to be expected.

Please let us know if you need assistance.

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# 1. WHAT IS KALCRET?

KALCRET is a hard compound made of high-performance particles in a cement-bonded matrix that provides maximum wear resistance. The scientifically determined equilibrium between selected hard particles and the matrix uses the best properties of the individual components to create a new material with the best properties for the specific purpose.

The mixture includes defined additives and is made up of:

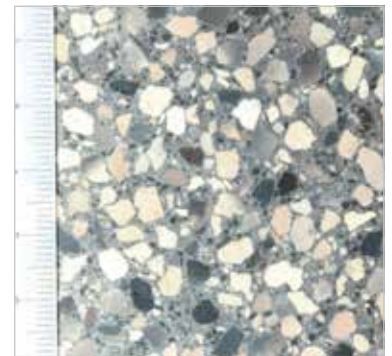
- hard aggregate materials
- cement binder
- micro- and nano-silica

Modified fibre components can be added up to a certain percentage to enhance the structural strength.



Kalcret, wear protection material out of a bag

		KALCRET
Hard material particle size	mm	0.1 - 4
Density	g/cm <sup>3</sup>	2.4 - 3.1
Ultimate compressive strength	MPa	135 - 190
Ultimate bending tensile strength	MPa	15 - 26
Max. application temperature	°C	450 / 1.200
Percentage of hard material	%	70

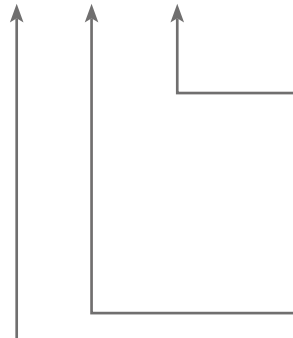


Structural composition of KALCRET: high strength cement matrix, hard aggregate materials 0.1 - 4 mm size (basalt, bauxite or corundum)



Kalcret, wear protection material out of a bag

KALCRET



## Application

- X = applied by trowelling
- Y = applied by casting
- S = applied by spraying

## Temperature limits

- N = up to 450 °C / 752 °F
- T = up to 1,200 °C / 2,152 °F

## Wear stress

- A = basalt hard material, etc.
- B = bauxite hard material
- C = corundum hard material

## KALCRET trowelled compound

This compound allows for protection of horizontal, vertical, canted and curved surfaces. Compound can also be safely applied overhead.



## KALCRET cast compound

KALCRET poured mix is the material of choice when flat surfaces are to be protected from wear or when it is possible to use formwork.



## KALCRET sprayed-on compound

KALCRET sprayed-on compound allows large surfaces to be lined in a minimum of time.

Spraying can be done horizontally and vertically.

Overhead working is feasible without problem.



## ADVANTAGES OF KALCRET

- high strength and abrasion resistance to sliding friction
- excellent abrasion values
- large surface lining
- varying lining thickness depending on the stress due to wear
- can be used after 24 hours
- suitable for temperatures up to 1,200 °C / 2,152 °F
- high thermal shock resistance
- even complicated geometries are feasible
- easy overhead working
- ideally suited for repairs
- can be installed at the site by locally available staff

## 2. PREPARATORY WORK – GENERAL

### CHECK LIST

- clarify installation requirements
- select suitable working machinery and tools
- check correct power supply and connections
- confirm sufficient supply of compressed air for sprayable KALCRET
- pay special attention to the ambient conditions for both installation and storage of KALCRET

#### Conditions for application

In preparing for a KALCRET installation, the specific installation requirements at the site need to be checked and measures adapted accordingly.

#### Preparing the installation

After the specific installation requirements have been determined, details of the installation procedure will be planned accordingly.

#### Tools and accessories for working KALCRET

Special tools and accessories are required for installing KALCRET. It is recommended to use the tools and accessories tested by Kalenborn for KALCRET installations.

**For more information see chapter 6. Accessories and tools for KALCRET material**

#### Packaging

Standard packaging for **KALCRET** hard compound is in **25 kg / 55.1 lb bags**.

The **curing liquid** is available in **10 or 20 kg / 22 or 44 lb** containers.

#### Storage and shelf life

The minimum shelf life for **KALCRET** products is **12 months** after production. KALCRET should be stored dry at **5 - 30 °C**. This has to be taken into consideration for inventory stocking and also for job site storage.

The application of **KALCRET** in case of longer shelf life or other storage conditions is possible after clarification with Kalenborn.

The minimum shelf life for the **curing liquid is 12 months** with unopened containers stored at 5 - 30 °C / 41 - 86 °F and without allowing it to freeze.

#### Shelf life facts

Batch number and production date are printed onto the KALCRET bags. The production date is printed on the curing liquid container.

**The minimum lining thickness is 15 mm / 0.59 inches.**

**The recommended lining thickness  $\geq$  25 mm / 0.98 inches.**

Kalcret materials	Bulk density (g/cm <sup>3</sup> )	Consumption (kg/m <sup>2</sup> ) at lining thickness		
		20 mm / 0.78"	25 mm / 0.98"	30 mm / 1.18"
Kalcret ANX	2.4	48	60	72
Kalcret BTX	2.7	54	67.5	81
Kalcret BNX	2.7	54	67.5	81
Kalcret BTS	2.7	54	67.5	81
Kalcret BTY	2.7	54	67.5	81
Kalcret CTX	3.0	60	75	90
Kalcret CNX	3.0	60	75	90

The consumption quantity for the curing liquid is 0.25 kg/m<sup>2</sup>.

## Loss rate

A specific loss rate has to be taken into account when working with KALCRET.

**For applied and poured KALCRET losses are about 5 - 10%.**

- up to 10 m<sup>2</sup> / 108 ft<sup>2</sup>: 10%
- up to 100 m<sup>2</sup> / 1,080 ft<sup>2</sup>: 8%
- from 101 m<sup>2</sup> / 1,087 ft<sup>2</sup>: 5%

For sprayed KALCRET losses are about **5 - 20 %**.

The curing liquid required is 0.25 kg/m<sup>2</sup> / 0.05 lb/ft<sup>2</sup>.

## Fibre components

Specific fibre components are offered depending on the application; typical qualities include: steel or plastic.

The choice of fibre components depends on the particular application and its requirements.

Major criteria include the following:

- workability
- temperature (plastic fibre up to 80 °C)
- chemical stress
- etc.

The hard compound mixture either contains fibre components or they are delivered in standard packages (normal: 1 bag of KALCRET – 1 small bag of fibre components).

## Working temperature environment / structural components

The optimal working temperature ranges between 10 °C / 50 °F and 30 °C / 85 °F.

Working at temperatures below 5 °C / 41 °F requires heating of the system to be lined.

## CHECK LIST

- provision for sufficient quantities of KALCRET including the fibre components
- safe supply of clean water (potable quality)
- water temperature 10 – 25 °C / 50 – 77 °F; to be cooled/heated if necessary
- installation tools and accessories available
- protected working zone
- no direct sunlight
- confirm required working temperature
- provide surface sealing system
- personal protection (gloves, helmet, goggles, mask)
- observe safety data sheets
- closely observe working instructions
- follow instructions given on KALCRET bags

# 3. SURFACE PREPARATION

## CHECK LIST

- clean surfaces, free of loose particles
- sandblasting not required
- concrete surfaces shall be free of forming oil, loose particles
- concrete surfaces to be wetted

- provision for reinforcement system, e.g. wire mesh
- check and provide for tools to fasten the reinforcement system
- make sure the correct materials have been selected
- mounting the reinforcement system
- glue in indicator stones, if necessary

- check drawings for data concerning the working sections
- plan provision of working sections if necessary
- maximum dimension of working sections: 1,000 x 2,000 mm (approx. 2 m<sup>2</sup>/ 21.52 ft<sup>2</sup>)

### Cleaning

The use of KALCRET hard compound requires a careful preliminary treatment of the surfaces to be lined:

Steel surfaces require cleaning (metallically pure and free of residues). Sandblasting is not necessary.

Concrete surfaces require cleaning (they must be free of forming oil and loose particles) and shall be wetted (as it is standard practice for the application of the cement-bonded materials).

### Reinforcement system

All KALCRET materials, whether applied on a steel base or concrete, require the installation of a suitable reinforcement system. The standard system uses an appropriate type of wire mesh, providing a very good attachment to the surface being lined. The materials shall be matched to the specific application.

With KALDETECT visual KALCRET wear monitoring, the indicator stones are fixed through the wire mesh on the base of the component. The position is based on the desired laying plan for the stones.

### Working sections

Larger areas should be subdivided into working sections no larger than 1,000 mm x 2,000 mm (approx. 2 m<sup>2</sup> / 21.52 ft<sup>2</sup>) each.

In case of overhanging lining areas, smaller working fields can be useful. The working sections are established by mounting separating strips, e.g. made of plastic, on the wire mesh with the thickness of the lining to be applied.

The strip between the completed section and the next working section is removed before filling the next section, resulting in a jointless lining. This process is repeated for each new section.



## Expansion joints

When operating temperatures exceed **100 °C / 212 °F**, the selective provision of expansion joints may be necessary to equalize the varying temperature expansion coefficients. This arrangement will prevent stress from building up and reduce the risk of cracks in the lining.

Expansion joints are mounted with due regard to the particular conditions of operation and components. Normally, they consist of 5 mm thick rigid foam strips. The wire mesh should be interrupted along the direction of the expansion joints. If appropriate, the expansion joints can be installed at the boundaries of the working sections.

Expansion joints should also be arranged transverse to the material flow, if possible. After completion of the lining work the rigid foam strips should be removed.

## Retaining strips

Steel retaining strips are necessary at transitions and lining ends. The lining may be thinned at the end within zones not exposed to load.

## CHECK LIST

- check selective provision of expansion joints at operating temperatures above 100 °C / 212 °F
- plan installation of expansion joints or check existing drawings
- prepare sufficient number of rigid foam strips
- fasten rigid foam strips
- fill sections with KALCRET hard compound
- remove rigid foam strips after lining has been completed

- check drawings for data concerning retaining strips
- plan mounting of retaining strips as needed
- steel retaining strips shall be fastened by dowels (concrete surface) or welded (steel)
- take running out zones into account, if needed

# 4. WORKING KALCRET

## 4.1 TROWELLED COMPOUND

### CHECK LIST

- provision for sufficient quantity of all materials including KALCRET and fibre components
- for KALCRET-X a loss rate of approx. 5 - 10 % has to be taken into account
- confirm that a forced circulation mixer is available – if required with wear protected mixing tank
- necessary bricklayer tools and equipment
- graduated flasks for measuring water

- provision for reinforcement system, e.g. wire mesh
- check and provide for tools to fasten the reinforcement system
- make sure the correct materials have been selected
- mounting the reinforcement system

### JOB PREPARATION

This compound allows protection of horizontal, vertical, canted and curved surfaces. Overhead working is easily done.

#### Reinforcement system

All KALCRET materials, whether applied on a steel base or concrete, require the installation of a suitable reinforcement system.

The necessary hardware is used to mount the wire mesh to the surface at a distance of 3 - 5 mm / 0.12 - 0.19 inches from the wall being lined. With open areas, a distance of approx. 250 mm / 9.75 inches between attachment points is sufficient. With complex geometries, more attachment points may be necessary. The attachment of the wire mesh must be stiff and rigid.



Welding the wire mesh to the surface: spacing approx. 250 mm / 9.8 inches



Stiff and rigid fastening – distance to the wall to be lined: about 5 mm / 0.19 inches



Attachment of wire mesh to concrete – distance to the wall to be lined: 5 mm / 0.19 inches

#### Forced circulation mixer



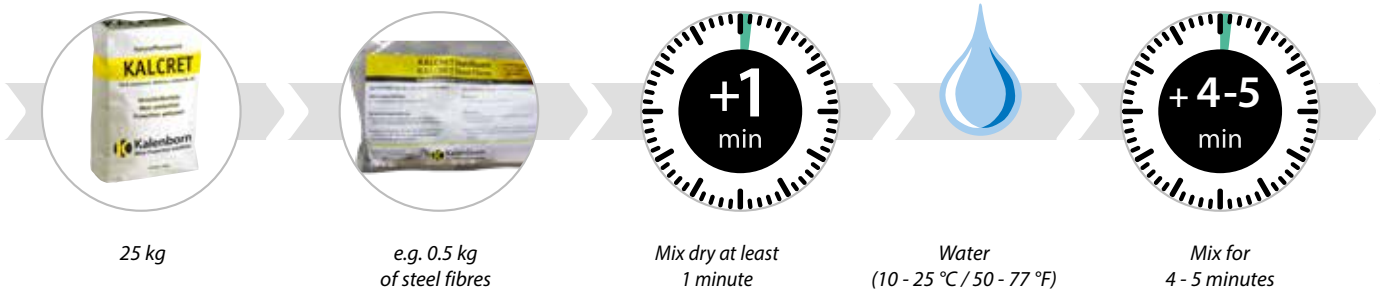
Material feeding into the forced circulation mixer



Wear protected tank of the Kalenborn forced circulation mixer

## PREPARE COMPOUND

Approx. 5 - 8 minutes (standard temperature 10 - 30 °C / 50 - 85 °F)



Empty the bag of KALCRET hard compound in the mixer



## CHECK LIST

- place KALCRET in a clean forced circulation mixer
- 1 bag of KALCRET yields approx. 9 litres / 549 in<sup>3</sup> of compound
- remove or breakup any lumps in the fibres



*Fibre components matched to the specific application are available*

### Adding fibre components

- We recommend that steel or PP fibres be added for reinforcement.
- The fibre components are added during the mixing period.
- Gradually add the fibre components slowly to avoid clogging.



*Add fibre components slowly and continuously and mix dry for about 1 minute*

- add 0.5 kg / 1.1 lb of steel fibres per bag of KALCRET (25 kg / 55.1 lb)
- or**
- add 5 g / 0.18 oz. of plastic fibres per bag of KALCRET (25 kg / 55.1 lb)
- make sure the correct materials have been selected
- store fibres in a dry environment
- remove or breakup any lumps in the fibres
- add fibres slowly and continuously
- mix fibres and hard compound dry for about 1 minute
- carefully observe the mixing process

# CHECK LIST

- the mixing period and the required water quantity may vary within narrow limits depending on the ambient conditions and the product properties
- if the KALCRET compound is too dry, add water in increments of 25 ml / 1.52 oz each per 25 kg / 55.1 lb KALCRET
- all standard data are valid for an ambient temperature range from 10 - 30 °C / 50 - 85 °F
- in case of higher temperatures contact Kalenborn

## Adding water

- Closely observe water dosing rate as specified in the working instructions.
- Exactly measure the required water quantity and slowly add it during mixing.

## Adding water for KALCRET material

KALCRET materials	Adding water
KALCRET ANX	1,625 - 2,125 ml / 99.1 - 129.6 in <sup>3</sup>
KALCRET BTX	1,625 - 2,125 ml / 99.1 - 129.6 in <sup>3</sup>
KALCRET BNX	1,750 - 2,625 ml / 106.7 - 160.2 in <sup>3</sup>
KALCRET BTY	1,300 - 1,800 ml / 79.3 - 109.8 in <sup>3</sup>
KALCRET CTX	1,400 - 1,800 ml / 85.4 - 109.8 in <sup>3</sup>
KALCRET CNX	1,550 - 2,050 ml / 94.5 - 125.0 in <sup>3</sup>

- Make sure only clean potable water of a maximum temperature of **25 °C / 77 °F** and a **minimum temperature of 10 °C / 50 °F** is used.
- The desired stiff / plastic working consistency will be reached after 4 - 5 minutes mixing.



Add water as specified in the working instructions



Mix for 4 - 5 minutes and check result

## KALCRET compound ready for use

- ensure stiff / plastic working consistency
- finished KALCRET compound shall be free of lumps



The compound should have a stiff / plastic consistency



The stiff / plastic KALCRET compound (X) to be applied by trowelling with the aid of simple bricklayer tools

## Applying trowelled compound

Following homogeneous mixing, KALCRET hard compound can be applied with the appropriate tools to the prepared surface. To begin with, the wire mesh should be filled completely. Depending on the lining thickness, the material is applied by layers, i.e. successively on the freshly applied layers. Normally, the layer thickness ranges **between 20 and 40 mm / 0.78 and 1.56 inches**. The surface is subsequently smoothed.

## Working temperature and setting time

- The optimal working temperature is **10 - 30 °C / 50 - 86 °F**.
- Direct sunlight should be avoided.
- KALCRET should not be applied at temperatures **below 5 °C / 41 °F**.
- The working time after mixing is up to **1 hour at 20 °C / 68 °F**.
- The working time may be shorter at higher temperatures.
- The **minimum setting time** is **24 hours** at an ambient temperature of 20 °C / 68 °F. Lower temperatures will require longer setting times.

## CHECK LIST

- make sure the surfaces are clean
- securely fasten the reinforcement system
- prepare a good stiff / plastic KALCRET compound for trowelling
- make sure the correct water quantity is added and mix for at least 4 - 5 minutes
- check whether the mixture is free of lumps; if not, mix again
- apply KALCRET
- completely fill the reinforcement system
- check layer thickness
- smooth KALCRET surface as needed



1. Overhead working is feasible without problem

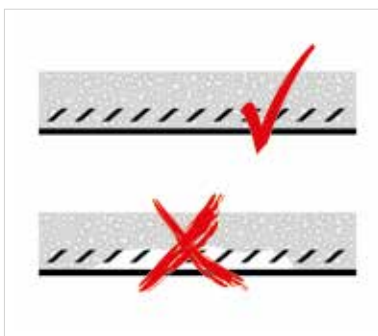


2. After trowelling, easy to make smooth



Optimal working temp.:

**10 - 30 °C /  
50 - 86 °F**



3. Ensure complete filling of the reinforcement system



4. Check layer thickness and equalize it, if necessary



Working time:  
1 hour

## 4.2 CAST COMPOUND

### CHECK LIST

- provision for sufficient quantity of all materials including KALCRET and fibre components
  - for KALCRET-Y, a loss rate of approx. 5 - 10 % has to be taken into account
  - confirm that a forced circulation mixer is available – if required with wear protected mixing tank
  - necessary bricklayer tools and equipment
  - graduated flasks for measuring water
  - vibration unit
- 
- provision for reinforcement system, e.g. wire mesh
  - make sure the correct materials have been selected
- 
- carefully prepare formwork and use release agent
  - make sure surfaces are clean

### Job preparation

KALCRET cast compound is particularly useful for protecting flat surfaces. Also prefabricated products (e.g. lining elements, pipes and components) can be made with the KALCRET cast compound. The material is thixotropic, i.e. shaking changes its viscosity from solid to liquid with subsequent return to the solid state. For this reason, the cast compound must be processed with vibrators or a vibration table.

### Reinforcement system

KALCRET materials require the installation of a suitable reinforcement system. The standard system uses an appropriate type of wire mesh, providing a very good attachment to the surface being lined. The materials shall be matched to the specific application. The wire mesh is mounted at a **distance of approx. 5 to 20 mm / 0.19 to 0.78 inches** to the substrate to be lined, depending on the lining thickness.

A distance between the attachment points of **approx. 250 mm / 9.75 inches** is sufficient.

### Formwork

KALCRET cast compound is particularly effective in lining flat surfaces. Normally simple formwork will be made for vertical and canted surfaces; that formwork will then be backed. The formwork should be as smooth as possible on the KALCRET side.



Prepare formwork, attach reinforcement system

### Forced circulation mixer



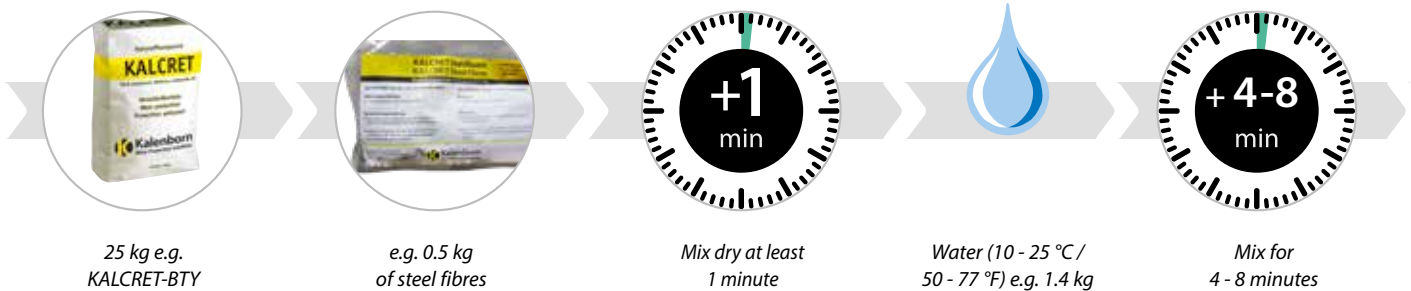
Material feeding into the forced circulation mixer



Wear protected tank of the Kalenborn forced circulation mixer

## Prepare KALCRET compound

Approx. 5 - 8 minutes (standard temperature 10 - 30°C / 50 - 85°F)



## KALCRET



Empty the bag of KALCRET hard compound in the mixer

## Adding fibre components

- We recommend that steel or PP fibres be added for reinforcement.
- The fibre components are either included in the hard compound or added during the mixing period.
- Gradually add the fibre components slowly to avoid clogging.



Fibre components matched to the specific application are available



Add fibre components slowly and continuously and mix dry for about 1 minute

## CHECK LIST

- place KALCRET in a clean forced circulation mixer
  - 1 bag of KALCRET yields approx. 9 litres / 549 in3 of compound
  - remove or breakup any lumps in the fibres
- 
- add e.g. 0.5 kg / 1.1 lb of steel fibres per bag of KALCRET (25 kg / 55.1 lb)
  - or**
  - add e.g. 5 g / 0.18 oz. of plastic fibres per bag of KALCRET (25 kg / 55.1 lb)
  - make sure the correct materials have been selected
  - store fibres in a dry environment
  - remove or breakup any lumps in the fibres
  - add fibres slowly and continuously
  - mix fibres and hard compound dry for about 1 minute
  - carefully observe the mixing process

# CHECK LIST

- Caution: closely observe the working instructions (bag imprint)
- the mixing period and the required water quantity may vary within narrow limits depending on the ambient conditions and the product properties
- if the KALCRET compound is too dry, add water in increments of 25 ml / 1.52 oz each per 25 kg / 55.1 lb KALCRET
- all standard data are valid for an ambient temperature range from 10 - 30 °C / 50 - 85 °F.
- in case of higher temperatures contact Kalenborn

- the KALCRET compound is ready for use as soon as it has a plastic working consistency
- the finished KALCRET compound shall be completely free of lumps

## Water addition

- Closely observe water dosing rate as specified in the **working instructions**.
- Exactly measure the required water quantity and slowly add it during mixing.
- Make sure only clean potable water of a maximum temperature of **25 °C / 77 °F** and a **minimum temperature of 10 °C / 50 °F** is used.
- The desired plastic working consistency will be reached after 4 - 8 minutes mixing.
- When following the wet mixing procedure, the material should slump down slightly, but not run off easily and no water should collect on the surface.

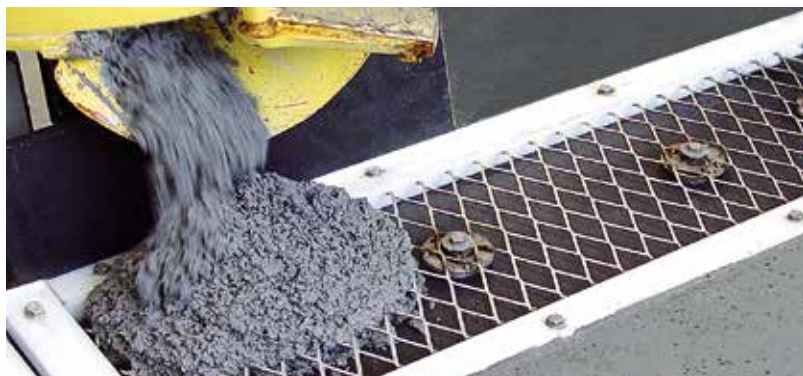


Add water as specified in the working instructions



Mix for 4 -8 minutes and check result

## KALCRET compound ready for use



The compound should have a plastic consistency



## Applying cast compound

The KALCRET cast compound is mixed as specified, filled in the prepared formwork and compacted with the aid of a vibrator. Slow admission and compacting of small quantities at a time will ensure uniform wear protection.

## Working temperature and setting time

- The optimal working temperature is **10 - 30 °C / 50 - 86 °F**.
- Direct sunlight should be avoided.
- KALCRET should not be applied at temperatures **below 5 °C / 41 °F**.
- The working time after mixing **is up to 1 hour at 20 °C / 68 °F**.
- The working time may be shorter at higher temperatures.
- Surfaces supported in formwork can be stripped after about 12 - 20 hours (depending on the layer thickness) at an ambient temperature of 20 °C / 68 °F. They shall be protected afterwards against quick evaporation of the residual moisture. This can be done either by means of a surface sealing spray or by covering with polyethylene sheeting.
- After stripping the formwork, the minimum setting time at an ambient temperature of 20 °C / 68 °F is 24 hours.

## CHECK LIST

- carefully prepare formwork
- make sure surfaces are clean
- use a proper reinforcement system
- prepare a good plastic KALCRET compound for casting
- duly observe correct addition of water
- mix for at least 5 - 8 minutes
- make sure the mixture is free of lumps; if not, mix again
- cast and compact KALCRET
- use vibrator
- check filling
- establish smooth KALCRET surface
- have surface sealed after casting or
- cover with polyethylene sheeting



1. Preparing formwork



2. Prepare cast compound as instructed

Optimal working temp.:

**10 - 30 °C /  
50 - 86 °F**



3. Carefully fill formwork



4. Use external vibrator for compacting

**60  
min**

Working time:  
1 hour

# 4.3 WORKING KALCRET SPRAYED-ON COMPOUND

## General working instructions

KALCRET sprayed-on compound is a cement-bonded hard compound for the dry shotcreting. It is advisable not to apply KALCRET sprayed-on compound without prior technical consultation with Kalenborn.

## CHECK LIST

- provision for sufficient quantity of all materials including KALCRET and fibre components
- for KALCRET a loss rate of approx. 15 - 20% has to be taken into account

- provision for reinforcement system, e.g. wire mesh
- check and provide for tools to fasten the reinforcement system
- make sure the correct materials have been selected
- mounting the reinforcement system

## Job preparation

**KALCRET sprayable hard compound is used to line large surfaces in a relatively short time with installation rates of more than 5 m<sup>2</sup> / 53.8 ft<sup>2</sup> per hour** (at 25 mm / 0.98 thickness). This requires a maintaining a minimum distance of 800 – 1200 mm from the surface to be lined. Shotcreting is less suitable for lining very small areas < 0.5 m<sup>2</sup> and < radius R = 200. In general, the material is sprayed on walls and canted surfaces. It can even be worked overhead and enables the lining of complex surfaces, including floors, provided certain rules are followed. It is forbidden to overspray accumulated rebound and reintegrate it into the compound.

In the spraying process, it is advantageous to divide surfaces into working sections (approx. 2 m<sup>2</sup> / 21.5 ft<sup>2</sup>) for better control of the desired lining thickness. For this purpose, wire or cable ties are typically used to fasten a plastic strip to the fixed wire mesh, forming the overall thickness (example: wire mesh spacing 5 mm / 0.2 inches + wire mesh 8 mm / 0.3 inches + strip 17 mm / 0.7 = lining thickness 30 mm / 1.2 inches).

## Reinforcement system

All KALCRET materials, whether applied on a steel base or concrete, require the installation of a suitable reinforcement system. Suitable hardware is used to mount the wire mesh to the substrate at a **distance of approx. 3 - 5 mm / 0.12 - 0.19 inches**. For steel, it is welded in place, and anchors are used for concrete. KALCRET does not adhere directly to steel or concrete. A distance between the attachment points of **approx. 250 mm / 9.75 inches** is sufficient. The attachment of the wire mesh must be stiff and rigid. In addition, other reinforcement systems may be used if needed. Lining surfaces must be free of oil and dust. In the case of concrete surfaces, they must be wetted before application.



Welding the wire mesh to the surface: spacing approx. 250 mm / 9.8 inches



Stiff and rigid fastening – distance to the wall to be lined: about 5 mm / 0.19 inches



Attachment of wire mesh to concrete – distance to the wall to be lined: 5 mm / 0.19 inches

## Kalenborn spraying system



*Kalenborn spraying system*

## Recommendations when using other spraying systems

### **Hose:**

- Hose length: at least 60 m / 200 ft
- Hose diameter: 32 mm / 1.3 inches
- Recommended water pressure 16 bar / 230 psi

### **Nozzle:**

- Use of conical spray nozzle made of Vulkollan 32 mm to 18 mm / 1.3 to 0.7 inches
- Nozzle with 16 holes (diameter 1 mm / 0.039 inches) for water addition
- Nozzle with needle valve for optimal water supply adjustment

Suitable spraying machines can operate with hose lengths of up to 400 m / 1300 ft. and pump to heights of up to 300 m / 980 ft

## CHECK LIST

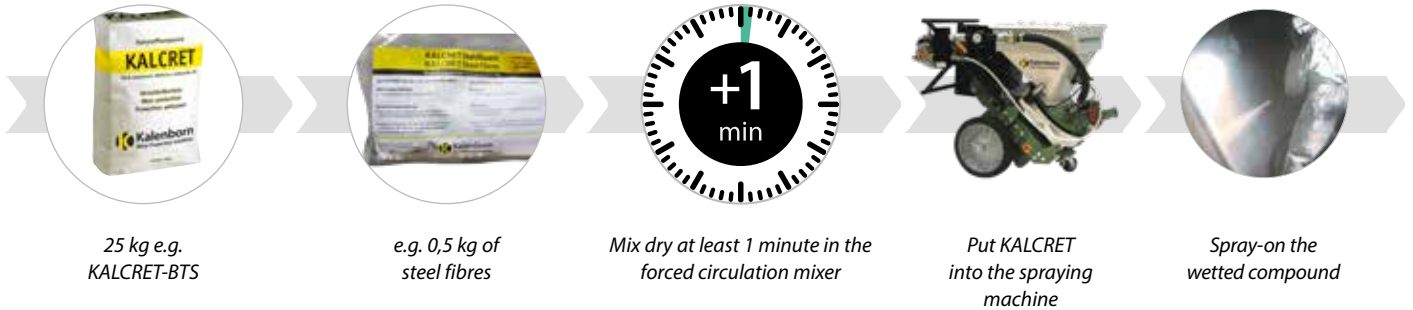
- spraying system specially developed for working KALCRET
- continuous and homogeneous delivery of the KALCRET compound up to the spray nozzle
- water amounts and timing of injection have been developed to ensure proper moisture level and distribution in KALCRET
- addition of steel or other fibres, if necessary
- spraying system, complete with materials and tools, can be containerized for installation on site
- working distance 800 - 1,200 mm / 31.5 - 47.3 inches from the surface to be protected
- delivery distance of the sprayed compound up to 100 m / 328 ft; vertically 40 m / 131 ft



*Wear protected tank of a Kalenborn forced circulation mixer*

## Prepare KALCRET compound

Standard temperature 10 - 30°C / 50 - 85°F



## CHECK LIST

- use only straight steel fibres
- add 0,5 kg / 1.1 lb of steel fibres per bag of KALCRET (25 kg / 55.1 lb)
- or**
- add 5 g / 0.18 oz. of plastic fibres per bag of KALCRET (25 kg / 55.1 lb)
- make sure the correct materials have been selected
- store fibres in a dry environment
- remove or breakup any lumps in the fibres
- add fibres slowly and continuously
- mix fibres and hard compound dry for about 1 minute
- carefully observe the mixing process
- put hard compound into the spraying machine
- spray-on the wetted compound

## KALCRET



Empty the bag of KALCRET hard compound in the mixer

## Adding fibre components

- We recommend that steel or PP fibres be added for reinforcement
- The fibre components are either included in the hard compound or added during the mixing period.
- Gradually add the fibre components slowly to avoid clogging.



Fibre components matched to the specific application are available



Add fibre components slowly and continuously and mix dry for about 1 minute

## Applying sprayed-on compound

After adding the appropriate fibres in the dry mixing process, KALCRET hard compound is loaded into the spray machine. The material is transported through special hose by compressed air to the spray nozzle where the water is added.

An ideal consistency of the hard compound material will be reached by the precise addition of water. Water content should be about 5 to 7.5 %. The wet KALCRET hard compound is then systematically sprayed on the prepared area to be lined. If fines run out (drip) from the spray nozzle, the nozzle diameter is too large or the spraying pressure is too low. This results in increased spray losses and impairs the quality of the compound. Spray losses range from 5 to 20 %, depending on the situation. In general, the thicker the lining, the less spray loss. To begin with, the wire mesh should be filled completely. Depending on the lining thickness, the material is applied by layers, i.e. successively on the freshly applied layers. Minimum application thickness is 20 mm / 0.8 inches. Recommended application thickness is 20 mm / 0.8 inches to 50 mm / 2.0 inches.

If possible, the nozzle should be directed perpendicular to the surface being lined. Use a mesh trowel to level sprayed surfaces and a finishing trowel to smooth them after application. An spray additive can be used to extend the working time. The maximum dosage is: 1 package of additive for 25 kg KALCRET. Mix the additive dry into the compound. After the surfaces set, use curing agent or polyethylene sheeting to protect them from drying out too rapidly.

## Working temperature and setting time

- The **optimal working temperature is 10 - 30 °C / 50 - 85 °F**. Direct sunlight should be avoided.
- KALCRET should not be applied at temperatures **below 5 °C / 41 °F**.
- The working time after mixing is up to **1 hour at 20 °C / 68 °F**.
- The working time may be shorter at higher temperatures.  
**The minimum setting time is 24 hours** at an ambient temperature of **20 °C / 68 °F**. Lower temperatures will require longer setting times.

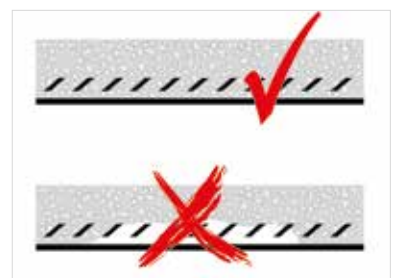


Optimal working temp.:

10 - 30°C /  
50 - 86°F



After spraying, easy to make smooth



Ensure complete filling of the reinforcement system



Kalenborn spraying system



Kalenborn spraying technology

## CHECK LIST

- provision for sufficient quantity of all materials including KALCRET and fibre components
- safe supply of clean, potable water, power and compressed air
- surfaces must be clean
- use a proper reinforcement system
- apply KALCRET by spraying
- working distance 800 - 1200 mm / 31.5 - 47.3 inches from the surface to be protected
- check layer thickness
- generate smooth KALCRET surface
- have surface sealed after spraying or cover with polyethylene sheeting

# 5. AFTER WORKING

## CHECK LIST

- determine sealing method to be used
- keep curing spray ready for use
- spray sealing liquid systematically and thoroughly over the surface
- rate approx. 250 ml/m<sup>2</sup> / 0.8 oz/ft<sup>2</sup>
- otherwise use polyethylene sheeting
- completely cover KALCRET surface with polyethylene sheeting

- min. setting time 24 hours
- earliest start of equipment after 24 hours
- longer setting times required at temperatures below 20 °C / 68 °F

- Micro cracks may occur
- these are not defects

- clarify plant operating conditions
- use KALCRET-T at operating temperatures above 450 °C / 842 °F
- carefully observe special start-up curves for operating temperatures above 50 °C / 122 °F
- **Caution:** Failure to follow these instructions may damage the lining

### Surface sealing

After installing KALCRET and following an initial drying phase of approx. 60 minutes, the surface needs to be sealed with **curing agent** or covered with **polyethylene sheeting**.

Otherwise, the KALCRET compound will dry too quickly. In that case neither strength nor proper setting of the material will be guaranteed.

### Shrinkage cracks

Micro cracks may occur during setting and hardening because of the product specification. These are not defects.

### Start-up curves

During the curing of KALCRET, only part of the mixing water is bonded in crystalline form. When operating temperatures of more than 50°C / 122°F are anticipated, the first heat up should be done slowly. Otherwise the lining may be damaged.

Procedures must differentiate between operating temperatures up to 150 °C / 302 °F and above 150 °C / 302 °F.

### Operating temperatures up to 150 °C / 302 °F

Maximum temperature change 40 °C/h (72 °F/h)

## Operating temperatures above 150 °C / 302 °F

**1. First start-up of the plant after application of KALCRET**, i.e. also after repairs: Allow minimum setting time of 24 hours. Afterwards start up plant. The maximum allowable rate of temperature rise is 40 °C/h (72 °F/h) up to a temperature of 150 °C / 302 °F. During first start-up after KALCRET application, maintain 150 °C / 302 °F for 12 hours. After that holding time, the maximum temperature rise can be 100 °C/h (180 °F/h) up to the operating temperature.

**2. Upon re-start of the system after a shutdown period** (longer than 24 hours, temperature below dew point, condensation of humidity, etc.): The maximum temperature rise is 40 °C/h (72 °F/h) up to a temperature of 150 °C / 302 °F. Beyond that level the maximum temperature rise is 100 °C/h (180 °F/h) until the operating temperature is reached.

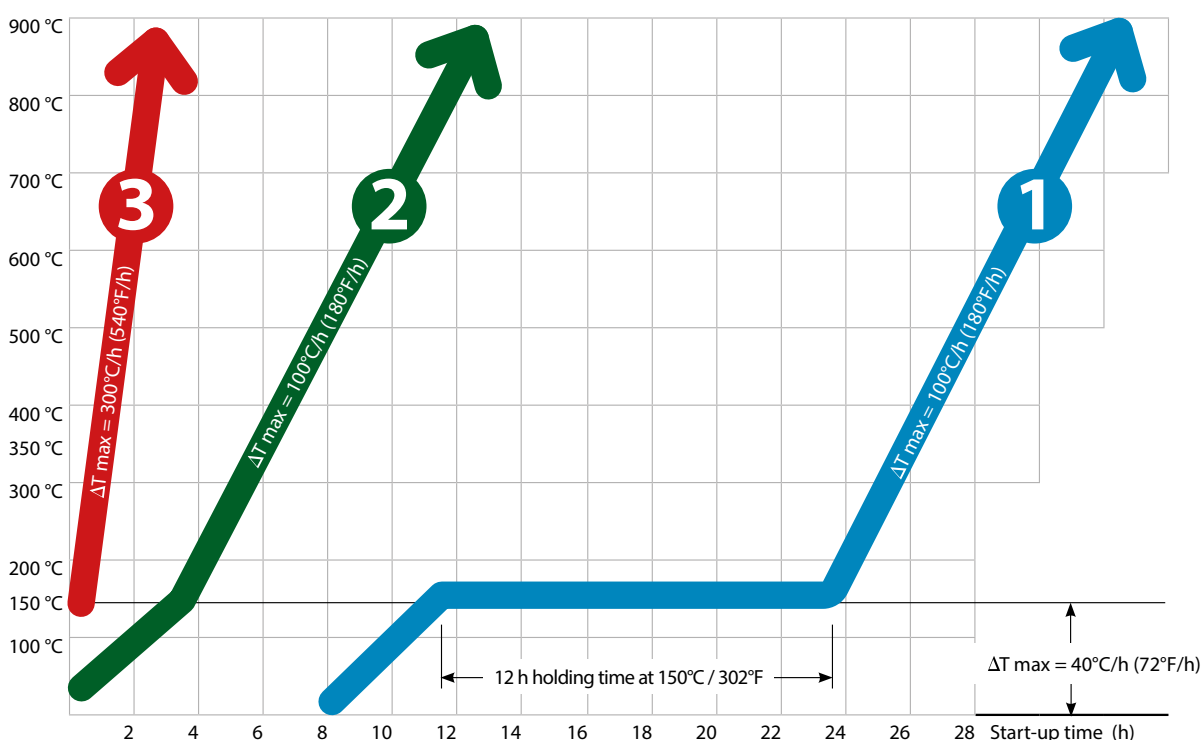
**3. In case of regular start-up and shutdown of the plant** without extended shutdown periods (less than 24 h) and without the temperatures falling much below 150 °C / 302 °F:

The maximum temperature rise is 300 °C/h (540 °F/h).

## CHECK LIST

- allow a minimum setting time of 24 hours upon first start-up after application of the lining; watch holding time; slowly run up system to operating temperature
- when re-starting, increase temperature slowly to 150 °C, then increase rapidly to operating temperature
- with regular running up and down of the system, quickly reaching the operating temperature is possible

## Starting curves for operating temperatures above 150°C / 302°F



## CHECK LIST

- carefully clean tools and machinery after completing the lining job
- the use of a pressure washer will be expedient
- **Caution:** failure to comply with this requirement may ruin tools and equipment
- the cleaning requirement also has to be observed when changing over to another type of KALCRET

- inspection of all tools and machinery for proper technical function

### Cleaning tools and equipment

All tools and machinery absolutely must be systematically cleaned during and after completion of work with KALCRET.

It is suggested that cleaning be carried out with a pressure washer normally used for cleaning mixing vessels.

Failure to observe that requirement may result in breakdown of tools and equipment.

This cleaning requirement has to be observed during and/or when concluding the job at the end of a shift or when completing the order, but especially when working with different types of KALCRET, e.g. when changing from KALCRET BNX to KALCRET BTX or from KALCRET BNY to KALCRET BTY.

### Technical check of tools and equipment

It is just as important that all tools and machinery are subjected to a technical inspection after completion of a job. Specifically, this also includes the following requirements:

- all tools and equipment shall be clean
- they shall be complete
- they shall be technically functional
- all electrical connections shall be checked
- worn down parts shall be replaced
- the state of wear shall be ascertained, e. g. that of tools and of the mixing vessel



## 6. ACCESSORIES AND TOOLS

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### 6.1. FOR KALCRET TROWELLED COMPOUND



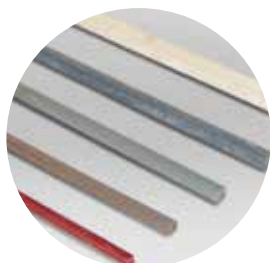
Forced circulation mixer  
with wear protected mixing tank, if required

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Various bricklayers tools  
trowel / plastering trowel / bucket

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Separating strips  
working sections / lining end

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Wire mesh

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Welding equipment /  
electrodes

## 6.2 KALCRET CAST COMPOUND



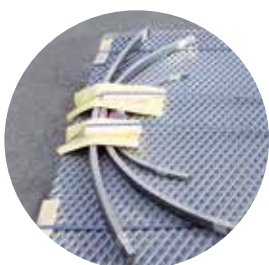
Forced  
circulation mixer  
with wear protected  
mixing tank, if required



Various  
bricklayers tools  
trowel / plastering  
trowel / bucket



Formwork  
material  
e.g. wooden plates or  
frame construction



Wire mesh  
including welding  
equipment and  
electrodes, if required



Outside vibrators

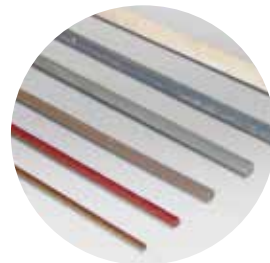
## 6.3 KALCRET SPRAYED-ON COMPOUND



Spraying machine  
with wear protected  
mixing tank, if required



Various  
bricklayers tools  
trowel / plastering trowel  
/ bucket



Separating strips  
working sections /  
lining end



Wire mesh  
including welding  
equipment and  
electrodes, if required



Spraying hose /  
spraying nozzle

## 7. QUALITY

### ASSURANCE SAMPLE

Compliance with the provided preconditions and handling requirements is crucial for a successful KALCRET installation. This KALCRET handbook version 7 provides all necessary information to ensure high quality installations.

**Please find the download of this handbook on our global Kalenborn website:**



To support your installation project, Kalenborn offers a surveillance and attestation of KALCRET product properties based on the analysis of a selected wear parameter. Our laboratory will focus on erosion resistance. The testing method is in accordance with ASTM C 704-15 for erosive wear resistance.

Kalenborn's laboratory is able to determine deviations from preconditions and handling requirements using product samples that were produced under on-site conditions during the installation.

Standardised plastic sample forms 320 x 300 x 40 mm are being provided within the scope of the extended quality program.

Test methods exceeding this standard package can be arranged and ordered from our laboratory. Further details concerning sample quantities, handling instructions, sample archiving and costs will be provided in the proposal and its accompanying contractual documentation. All further elements to be coordinated with Kalenborn.

### CUSTOMER'S BENEFITS:

- Increased overall quality control
- Proof of correct material handling and installation based on a key performance indicator.
- Increased quality control of installation companies



*Plastic sample form:  
320 x 300 x 40 mm*

