

Processing instructions V 1.1

REFRACAST[®] regular CG

Note: Please read the product information sheet first, to ensure that these are the right processing instructions for your product. This document describes the application procedure for dense **REFRACAST[®]** refractory concretes with normal cement content, and marked with "CG". It does not apply for the **REFRACAST[®]** concrete types **MC, LC, ULC, Claybond, or Hydrobond**.

The instructions contained in this document must be complied with during processing and installation of the respective refractory concrete. Modification of or deviations from the processing instructions can lead to major problems during installation, and possibly to total failure of the installed refractory material. These instructions provide general guidelines for storage, processing, and installation of the specific refractory material. If, due to specific site conditions, it appears necessary to deviate from the procedures described here, please consult Refratechnik Steel GmbH before starting work.

Storage

- In general: Store under cool, dry, and frost-free conditions.
- The shelf life stated in the product information sheet is valid from the production date, and only if storage is in accordance with our recommendations. The production date is stated on the packaging label.
- Under certain circumstances, material that has been properly stored may still be usable even after expiry of the stated shelf life. In such a case, conduct a setting test with a sample before using the material. In case of doubt, the expired material can be checked by Refratechnik Steel GmbH.
- Incorrect storage can greatly reduce shelf life, and can impair product quality.
- The original pallet wrapping foil should be left intact for as long as possible to protect the product. However, the foil is not a substitute for storage under cover.

- Also standing water, e.g. due to inadequate drainage of the storage area, can damage the material.
- Stacking of the goods supplied by us (in sacks, Big Bags, etc.) is done under the sole responsibility of the shipping company or customer. Refratechnik Steel GmbH accepts no liability for possible consequential damage (damaged packaging, personal injury, etc.).

Health and safety

- Always wear suitable safety goggles, dust mask, protective clothing, and working gloves.
- Always wash thoroughly after working with the material.
- Observe the information in the safety data sheet.

General information

- This product is a hydraulically setting refractory concrete. Delivered dry in 25 kg sacks or in Big Bags, it is mixed with

water on site, and then cast. Curing occurs at room temperature.

- The following installation methods can be used for this material type designated «CG»:
 - processing as cast concrete
 - processing as gunned concrete.
- Always mix complete packaging units (1 sack or 1 Big Bag). The use of partial quantities can lead to demixing and changed material properties.
- Only use clean drinking water, as otherwise the setting behaviour may be affected.
- Low temperatures can retard or even stop the setting process. Therefore, the temperature of material and mixing water must be at least 5 °C. In some cases, it might be necessary to heat the installation area.
- On the other hand, the setting process may be significantly accelerated at temperatures above 25 °C.

- Please take the expansion of the refractory material for your specific furnace application into account. The reversible and irreversible expansion values and the respective material properties are given in the product information sheet. Depending on the furnace operating conditions and the specific characteristics of the refractory material, any arising stresses and pressures must be compensated by suitably designed expansion joints.
- During installation of the monolithic refractory material, please ensure correct anchoring to the existing furnace structure and/or to the existing or adjacent refractory material (e.g. with steel anchors, ceramic anchoring systems, etc.).
- Suitable measures must be taken to ensure that the water or water vapour generated during the drying & heat-up process is removed from the refractory lining without pressure build-up.
- With certain kiln structures and refractory linings, the drying process can cause the generated water or water vapour to diffuse outwards in the direction of the furnace shell instead of inwards to the hot side (kiln chamber). Therefore, suitable measures must be taken to ensure that the water or water vapour can escape to atmosphere. For this purpose, 10-mm holes drilled into the kiln's outer steel shell (at least 5 per m²) have proved to be successful.
- Regarding the build-up of water vapour pressure, attention must be given to the entire wall structure of the lining (wear lining/permanent lining/insulation). In the area behind the wear lining, it must also be ensured that only such materials are used, which provide an adequate (highest possible) permeability to the steel shell.
- If the permanent lining/insulating layers are used several times and only the wear lining is replaced, they can become clogged in the course of time due to moisture transport with dust contamina-

tions, salts, etc., thereby also impeding moisture transport. Consequently, multiple use of such layers must be seen as counterproductive in terms of dewatering performance. It might even be safer also to replace the permanent lining, in order to ensure perfect flowthrough to the cold side.

- To ensure a continuous drying process, the complete kiln chamber must always be flushed with an adequate amount of fresh air during the entire drying and heat-up procedure. The air circulating in the kiln chamber may never be saturated with moisture.
- During heat-up, it is essential that flames do not impinge on the refractory lining only in small areas. Local overheating can result in severe damage of the refractory material. Therefore, it must be ensured that the entire lining surface is heated uniformly and without significant temperature differences.

Processing as cast concrete

- Mixer, tools, conveying equipment, etc. must be clean and free from any form of contamination.
- We recommend the use of a positive mixer, but this is not essential. In some cases, use of a gravity or «standard» concrete mixer may require an increased quantity of mixing water, resulting in poorer general mechanical properties.
- Mix only as much material at a time, as can be processed within about 20 minutes.
- Data on the maximum and minimum amounts of water to be added is given in the product information sheet or on the packaging label.
- First, briefly mix the dry material for about 30 seconds to restore the consistency after any demixing that might have occurred during transport.
- Next, add the minimum amount of water while continuing to mix the material. Continue mixing for about 2 minutes until a thorough mix is obtained.
- Frequently, the required consistency is obtained only at the end of the mixing period, because the fine portions in the product must be broken down first. Therefore, you should wait until the full mixing time has elapsed, and don't try to obtain the required consistency in a shorter time by adding more water. The material's consistency can change quite abruptly from "too dry" to "exactly right". If necessary, the remaining amount of water can be added until the required consistency is achieved. Hereby, the maximum amount of water may not be exceeded.
- Then continue mixing for about 2 more minutes.
- If using formwork, make sure it is sufficiently stable, and that its surfaces are smooth. Use formwork release oil.
- While casting the concrete, no moisture may be drawn out of the material by adjacent dry and absorbent surfaces. Therefore, any existing refractory lining should be pre-wetted. Any moisture-sensitive materials, such as insulation, should be covered with foil.
- While casting the material, or shortly afterwards, the concrete must be compacted by rodding or vibration (e.g. with an internal vibrator).
- If an internal vibrator is used, continue the vibration only until no further compaction is evident. To prevent air inclusions, withdraw the vibrator slowly from the concrete.
- Depending on layer thickness and heating-up time, it may be advisable to provide evaporation holes (not in areas subjected to the liquid phase).

Processing as gunned concrete

- Low temperatures can retard or even stop the setting process. This can result in a risk of the material slipping. Therefore, the temperature of material and mixing water must be at least 5 °C. In some cases, it might be necessary to heat the installation area.
- Processing is done with suitable gunning equipment operating either with the rotor principle or a two-chamber system. Common to both processes is that they use compressed air to convey the dry mixture through hoses into a jet mixer chamber. The amount of water required for the setting process is applied to the dry material as a fine spray via a separate hose connected to the mixer nozzle. Depending on the gunning requirement, the precise amount of water is set manually by the gun operator via a control valve on the nozzle.
- The gunning unit requires a constant supply of water and air at a sufficient pressure. For this reason, separate air compressors and water pumps should be used.
- For correct operation, the gunning unit requires an air pressure of at least 7.5 bar and an air quantity of 7.5 m³/min.
- The water pressure must be constant, and higher than the material pressure at the spray nozzle. Experience has shown that for short distances at ground level, a water pressure of 6 bar is sufficient, but if greater height differences must be overcome, pressures of 20...60 bar might be necessary.
- In order to avoid pressure drops, the gunning unit should be positioned as close as possible to the place of installation. However, to ensure as even a flow of dry mixing material as possible, the overall length of the delivery hose should not be less than 20 m, particularly for rotor gunning units.
- The design of the nozzle mixing chamber is decisive for obtaining a homogeneous and complete wetting of the dry material in the nozzle. We recommend an 18-hole water ring with hole diameters of 1.2 mm, and a spray angle of 45° in the gunning direction. For the most precise and sensitive control of water injection possible, we recommend using a needle valve. The mixing section (distance between the water ring and the nozzle outlet) should have a length of 60 cm to ensure the greatest possible internal mixing.
- If possible, the diameter of the mixing section should taper down from 32 mm at the water ring to 24 mm at the nozzle outlet.
- For optimum material compaction, combined with the least possible water content, and taking the spray characteristics (rebound, formation of dust etc.) into account, the gunning pressure should be as high as possible.
- The distance between nozzle outlet and the surface being gunned should not be greater than 1 m. Perform circular movements with the nozzle, keeping it perpendicular to the surface being gunned. This procedure minimizes rebound and achieves a uniform material structure.
- While gunning, no moisture may be drawn out of the refractory material by adjacent dry and absorbent surfaces. Therefore, any existing refractory lining should be pre-wetted. Any moisture-sensitive materials should be covered with foil.
- Only walls and ceilings may be gunned. If floors are gunned, the material compaction will suffer, because rebound material will inevitably be mixed in. If possible, rotate a floor section into an upright position.
- On no account may rebound material be reused.
- Prevent layering.

- In general, bays are gunned individually, whereby they are divided by means of partitioning formwork so that the bays are lined one by one. The surface of a bay can be touched up immediately after it has been gunned (caution: Do not seal the surface by trowelling it).
- Depending on layer thickness and heating-up time, it may be advisable to provide evaporation holes. Immediately after gunning, prick or drill evaporation holes into the lining (diameter 4 mm, spacing 120 mm, but not in areas subjected to the liquid phase).

Setting and curing

- Monitor the concrete's temperature during the setting process. To a greater or lesser extent, heat is always generated in the concrete during setting.
- Due to high heat generation, some of the water in the lining can evaporate, resulting in incomplete setting, thereby reducing the ultimate strength of the refractory concrete.
- To prevent high temperatures due to heat generation, the surface of the lining must be kept wet and cool. This can be achieved by covering the surface e.g. with jute, and lightly wetting it with a water spray at regular intervals.
- Generally, it takes between 6 and 12 hours before the concrete has cured sufficiently to permit removal of the formwork. Ambient temperatures in mid-summer may considerably shorten this time, while winter temperatures or the use of material stored in cold places may lengthen it.
- Of course, the formwork may only be removed after the material has fully cured. The right time to do this can be determined reliably by means of a «ring test»: Lightly strike the accessible face of the lining with a small hammer. As curing proceeds, the tone changes from «dull» to «bright». A bright tone, which no longer changes, is generally an indi-

cation that the formwork may be removed.

Caution: In some cases, the lining core may not yet be solidified, even though the outer face of the casting is fully set. If in doubt, always allow the full recommended curing time of 24 hours.

- Full setting of the refractory concrete requires at least 24 hours. Until that time, the concrete must be protected from frost.

Drying and heating up

- We recommend that drying or heating up is not started before 24 hours after the end of installation. In some cases, however, an earlier start of drying and heating up may be acceptable. Please contact Refratechnik Steel GmbH in such cases.
- Please check the product information sheet to ensure that you have the right heat-up instructions for your product.

- The heat-up instructions must always be followed precisely. Hereby, it must be ensured that the respective heating curve is followed, monitored, and recorded by means of several correctly-positioned thermocouples. Moreover, a homogeneous temperature distribution must be ensured throughout the refractory lining.