

# Processing instructions V 3.7

## REFRAJET® Hybrid

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, REFRAJET® Hybrid refractory gunning concretes and the necessary liquid binding agent.

The instructions contained in this document must be complied with during processing and installation of the respective refractory concrete. These instructions provide general guidelines for storage, processing, and installation of the specific refractory material, as well as a description of the installation procedure and its individual components. If, due to specific site conditions, it appears necessary to deviate from the procedures described here, please consult Refratechnik Steel GmbH before starting work. 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.

### Storage

- Always store in cool, dry, and frost-free conditions.
- **The liquid binder and accelerator must always be stored at a temperature of > -20 °C.**
- 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.).

### Personnel 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 safety data sheets of the dry mixture and the liquid binding agent.

### General information

- This product is an inorganically-chemically setting refractory concrete for gunning applications. Delivered dry in 25 kg sacks or in Big Bags, suitable equipment on site is used to convey the dry material through a hose to the mixing nozzle. Here, the dry material is mixed with liquid binding agent before it is ejected from the nozzle under high pressure. Setting occurs at room temperature (~20 °C). The application of heat increases the material's green strength.
- **REFRAJET® Hybrid** products are two-component materials:
  - **Component 1:** Dry material
  - **Component 2:** Liquid binder
- Only use the supplied liquid binder for gunning the refractory material. Water may be used for flushing and cleaning the gunning equipment.
- For cleaning the gunning equipment, please observe the instructions under "Processing" below.
- The material may also be gunned onto hot surfaces (hot repair compound).
- Low temperatures can retard or even stop the setting process. Therefore, the temperatures of dry material and liquid binding agent must be at least 5 °C. It might be necessary to heat the installation site.
- On the other hand, the setting process may be significantly accelerated at temperatures above 25 °C.
- Please take the expansion of the respective 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 kiln 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 m<sup>2</sup>) 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 contaminations, 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

- Low temperatures can retard or even stop the setting process. This can result in a risk of the material slipping. Therefore, the temperatures of dry material and liquid binding agent must be at least 5 °C. It might be necessary to heat the installation site.
- If in doubt about the reactivity of the liquid binding agent (e.g. if its shelf life has expired or in case of undefined storage conditions, etc.), please contact the R&D Dept. of Refratechnik Steel GmbH before starting work.
- 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 mixing jet chamber. Via a separate hose connected to the nozzle, the amount of liquid binding agent required for the setting process is applied to the dry material as a fine spray. Depending on the gunning requirement, the precise amount of liquid binding agent is set manually by the gun operator via a control valve on the nozzle.
- The gunning unit requires a constant supply of liquid binding agent 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 a minimum air quantity of 12 m<sup>3</sup>/min.

- The liquid binding agent can be supplied by means of a normal water pump. If provided, the pressure boosting pump must ensure a constant supply pressure of >20 bar.
- We recommend using a dual-membrane pump operated with compressed air and with a 4-fold pressure increase. With a maximum compressed air supply of 7 bar, the self-priming pump generates a delivery pressure of 28 bar, which is adequate for most applications.
- The pressure of the liquid binding agent must be constant, and higher than the material pressure at the nozzle. Experience has shown that for short distances at ground level, a pressure of 20 bar is sufficient. If greater height differences must be overcome, pressures of 20...50 bar might be necessary.
- For conveying the liquid binding agent, only use hoses, connecting pieces, and couplings that can withstand the corresponding delivery pressure. Also use safety hose whip checks.
- To prevent pressure drops, the gunning unit should be positioned as close as possible to the place of installation. However, and particularly for rotor gunning units, the overall length of the delivery hose should not be less than 20 m to ensure an even a flow of the wetted material.
- The design of the nozzle mixing chamber is decisive for ensuring homogeneous and complete mixing of dry material and liquid binder in the injection nozzle at the end of the hose. 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 liquid binder injection possible, we recommend using a needle valve. The mixing section (distance between water ring and 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 liquid binder 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. All 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.
- 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).
- Even after short work interruptions, the nozzle and water ring should be cleaned with water. A large suitable container with water should be kept available for this purpose.
- At the end of work, all pumps and hoses must be thoroughly cleaned with water.

#### Setting and curing

- At least 24 hours are required for complete setting and curing of the refractory material. The material must be protected from frost until start of the drying/heat-up procedure.

#### Drying and heating up

- Compared with hydraulically bonded refractory concretes, hybrid bonded concretes are significantly less sensitive during heat-up.
- We recommend waiting 24 hours after gunning before starting with drying/heating up. However, an earlier start is also acceptable in special cases. Please consult Refratechnik Steel GmbH in such cases.
- The refractory material should be heated up 24 hours after gunning to ensure that all the contained water is removed. Drying/heating up should be started immediately after completing installation of the respective refractory concrete. In exceptional cases, please contact Refratechnik Steel GmbH beforehand.
- During the first heat-up, also make sure that no other materials are heated, which are not suited for fast heating up.
- 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 throughout the refractory lining must be ensured.