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REFRATECHNIK

Processing instructions V 4.0
REFRAJETCRETE® MC, LC, ULC

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, liquefied **REFRAJETCRETE®** refractory concretes with reduced cement content (types **REFRAJETCRETE® MC**, **LC**, and **ULC**).

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 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.).

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 material and the liquid accelerator.

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. Curing occurs at room temperature during gunning, and exclusively through the addition of an accelerator. If the material is cast, curing occurs at room temperature.
- The following application methods are possible:
  1. By means of the **JETCRETE®** process (shotcreting)
  2. By casting the compound (only after consultation with Refratechnik Steel GmbH)
- **REFRAJETCRETE®** concretes are two-component materials (dry material, delivered in 25 kg sacks or in Big Bags, plus the liquid accelerator, delivered in PE canisters).
- 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, mixing water, and accelerator 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 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.

Mixing

- **REFRAJETCRETE**® products are always delivered together with a liquid accelerator for the **JETCRETE**® gunning process (shotcreting). On no account may the accelerator be mixed with the concrete. The accelerator must always be stored at > -20 °C.

- Mixer, tools, conveying equipment, etc. must be clean and free from any form of contamination.

- Use of a positive mixer is essential.

- Mix only as much material at a time, as can be processed within about 30 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 obtained. Hereby, the maximum amount of water may not be exceeded.

- Then continue mixing for about 2 more minutes.

- Do not exceed the maximum permitted mixing time of 5 minutes.

- The temperature of the concrete mix may never be higher than +25 °C. If this critical temperature is exceeded, there is a risk of the material setting while it is still in the concrete pump.

- No foreign bodies or particles of concrete that have already set must be allowed to enter the freshly mixed concrete, as these can also cause premature setting.

Processing

1. Application with the JETCRETE® process (shotcreting)

- Basics of the **JETCRETE®** process: After mixing, the concrete is filled into the hopper of a dual-piston concrete pump, from where it is conveyed to the jet mixing chamber through pipes and hoses in a continuous stream of material. In the mixing chamber, a blast of compressed air and liquid accelerator breaks up and plasticates the material stream to such an extent that the concrete can be gunned horizontally and also vertically. By means of a control valve on the nozzle, the operator manually adjusts the precise amounts of compressed air and accelerator. Start with the lowest accelerator dosage, and then increase it until the material plasticizes on the installation surface. Avoid an excessive amount of accelerator liquid. The correct amount is between 0.2 and max. 0.7 percent by weight.

- The amount of mixing water specified in the product information is based on a standardized conveying distance of 30 m via dual-piston pumps (straight pipe run, diameter = 50 mm, horizontal path). Practical applications can be subject to different conditions, such as e.g.:
    - Conveying distance > 30 m
    - Noteworthy vertical paths
    - Use of hoses instead of metal pipes
    - Pipe diameter < 50 mm
    - Installation of pipe bends and pipe constrictions
    - Etc.

Therefore, it could be necessary to compensate the higher frictional resistance by correspondingly higher dosing of mixing water. Under these conditions, it is possible that the higher dosing exceeds the maximum values specified on the product information or bag labels. This is permissible under certain conditions, and if defined limit values are observed. In these cases, Refratechnik Steel GmbH should be contacted in advance.

- In the past, the equipment from Montanbüro, Allentown, and Pumpmore has proved to be suitable for processing **REFRAJETCRETE®** products.

- The accelerator pump must be capable of delivering a pressure of at least 20 bar.

- The compressor used for injecting the accelerator/air mixture must have a minimum capacity of 7.5 m^3 and 7.5 bar.

- The transport distance should always be kept as short as possible. Therefore, the machine should be located as close as possible to the installation site.

- Rigid pipes are preferable to rubber hoses for conveying the mixture, because their internal friction losses are less.

- Before starting work, pipes and hoses must be flushed out with a suitable lubricant.

- A continuous flow of material is a prerequisite for a homogeneous material structure. Therefore, an adequate amount of material in the hopper of the dual-piston pump must always be ensured.

- No moisture may be drawn out of the gunned material by adjacent dry and absorbent surfaces. Therefore, any existing refractory lining should be pre-wetted before gunning. Any moisture-sensitive materials, such as insulation, should be covered with foil.

- The distance between gunning nozzle and application surface must not be more than 30 cm.

- On no account may rebound material be reused.

- Individual bays (bay size about 1 m^2) should be gunned successively, taking care not to gun areas that have already stiffened or cured (risk of layer formation and spalling).

- The surface can be touched up immediately after gunning. Depending on layer thickness and heating-up time, it may be advisable to provide evaporation holes (not in areas subjected to the liquid phase).

2. Application as casting compound

- **REFRAJETCRETE®** concretes are intended primarily for gunning (shotcreting) applications. Within certain limitations, the material can also be processed like normal grouting concrete. Please consult Refratechnik Steel GmbH before processing the material as a casting compound.

- **REFRAJETCRETE®** products are always delivered together with an accelerator for the **JETCRETE®** process. Do not use the accelerator if the material is to be processed as a casting compound.

- 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 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).

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 gunned 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.

- The following applies for processing as a casting compound: Generally, it takes between 6 and 12 hours before the concrete has cured sufficiently to permit removal of the formwork. Ambient temperatures in midsummer 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 indication that the formwork may be removed.
  Caution: In some cases, the lining might not yet be solidified. Therefore, if in doubt, wait with removal of the formwork.

- 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.

- Refractory linings should be dried or heated up immediately after installation in order to expel the contained water. Freshly installed refractory linings should not be left undried for longer periods. In exceptional cases, please contact Refratechnik Steel GmbH beforehand.

- 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.