Instructions for Installing Basic Ramming Mixes in Induction Furnaces

1. Before installation, the inside of the furnace and the work area shall be kept free of any contaminations, such as cigarette butts and other foreign materials. The induction coils shall then be inspected to ensure that they are in good condition. Where the coils are to be coated with a refractory lining, the necessary lining operations shall first be completed, after which the insulation boards shall be installed.

2. In general, the installation of a dry ramming mix requires greater care than that of a wet ramming mix. Therefore, the particle-size distribution of the ramming mix shall be such that the required degree of compaction can be achieved during ramming while minimizing dust generation. For this purpose, it is recommended that the required quantity of the ramming mix be placed in a large metal tray to a depth of approximately 15–20 cm. The material should then be thoroughly mixed with a shovel to ensure uniform distribution of the particles and subsequently dried in a drying oven at 50–70°C.

3. Ramming shall begin at the bottom of the furnace. Depending on the furnace capacity and the available equipment, compaction may be carried out using a hand rammer, a manual electric vibrator, or a plate-type floor ramming vibrator. The compacted bottom lining should be made slightly thicker than the required final thickness so that, after leveling, the excess material can be removed to obtain the specified thickness. The previously drilled and cleaned ramming mold shall then be positioned on the furnace bottom in full contact with the compacted bottom lining.

4. The sidewall ramming mold used for dry ramming mixes is generally disposable type and is usually manufactured in several sections. After the required clearance between the mold and the furnace shell has been set, the mold shall be firmly secured with wooden wedges to prevent movement and loss set of compaction during the ramming operation. In some cases, the mold be may intentionally positioned slightly off-center. This arrangement is commonly used for furnaces that are frequently operated in a tilted position during tapping. Since refractory wear is generally more severe on the spout side, this method allows the lining thickness in that area to be increased. The sidewall may be rammed either directly using a hand rammer or a manual electric vibrator, or indirectly (from inside the mold) using a swing-arm vibrator, a fixed vibrator, or a pneumatic hammer.

دفتر مرکزی: اصفهان، خیابان بزرگمهر، نبش بن بست ۱۲، ساختمان پارتیکان
طبقه ۲، شماره ۲۱
تلفن: ۳-۳۲۶۶۴۲۱۱-۰۳۱
کد پستی: ۸۱۵۳۸-۵۵۸۳۱
فاکس: ۰۳۱-۳۲۶۶۴۲۱۰

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The following requirements shall always be observed during ramming. First, the thickness of each layer of material placed before compaction depends on the ramming method and the equipment used. Second, before placing the next layer, the surface of the previously compacted layer shall be uniformly roughened by scoring to ensure a continuous bond throughout the lining and to prevent the formation of laminated layers.

Under normal conditions, each uncompacted layer should be 50–75 mm thick, and be compacted to approximately 50% of its original thickness.

At the beginning of the operation, serrated ramming heads are recommended. In the later stages, smooth ramming heads measuring 25 × 50 mm or 75 × 100 mm (to increase installation efficiency) should be used.

5. Above the molten metal level, the use phosphate bonded plastic refractory is generally recommended. Since a large proportion of the radiant heat is not absorbed in this area during the initial heat-up, the same basic ramming mix may also be used after adding 3–4% wt sodium silicate to enable the material to air-set. The refractory lining in this area should be shaped manually to form an outward projection from the inner surface. The use of phosphate bonded plastic refractory is particularly recommended in the spout area.

6. Since dry ramming mixes contain no moisture that must be removed, the initial heat-up may be carried out at a relatively high heating rate. Heating should begin at approximately 150°C/h and continue until deformation and melting of the disposable mold begins. The heating rate should then be reduced to 40–60°C/h, while ensuring that the molten bath remains stable and that no washing or erosion of the lining occurs. For the first melt, it is recommended that the operating temperature be slightly higher than normal in order to promote stronger bonding between the grains at the working surface and thereby improve its resistance to attack by the molten metal. Heating should be continued up to 1595°C or approximately 10°C above the normal operating temperature. It is further recommended that the first melt be held at this temperature for approximately one hour to promote deeper sintering of the lining. Alternatively, the maximum temperature may be reduced slightly, provided that the holding time is increased accordingly.