

# Is refractory inspection necessary prior to delivery?

MICHAEL HORSFIELD CONSIDERS THE PRE-DELIVERY REQUIREMENTS FOR THE INSPECTION OF PURCHASED REFRACTORIES FOR A GLASS MELTING FURNACE CONSTRUCTION PROJECT

**b**efore any furnace construction project can begin, refractory materials should be inspected at the manufacturer's premises. The inspection process must be considered in association with the overall project schedule and completion date, as well as the supplier's delivery timetable.

The length of the inspection process depends on the different types of refractory materials ordered and the number of different suppliers. The refractory inspection can be divided into two categories: fused cast and non-fused cast refractories.

## FUSED CAST REFRACTORIES

Because of the manufacturing process involved, the high value of the material and the amount of refractory subjected to glass contact once the furnace is in production, fused cast refractories must be of the best possible quality. If the materials delivered to site do not meet the required design criteria or are not fit for purpose, furnace construction work might need to be stopped until the problems can be rectified, seriously affecting the projected duration of the project.

Fused cast refractory manufacturers usually make pre-assemblies of the furnace structures to allow for all design factors to be taken into consideration and the overall dimensions and material quality of individual sections to be checked against design drawings and bills of material. It is vital that all joints of fused cast refractory blocks are tight, especially those that are to be in contact with glass, to prevent glass leakage and to reduce the risk of premature internal refractory wear.

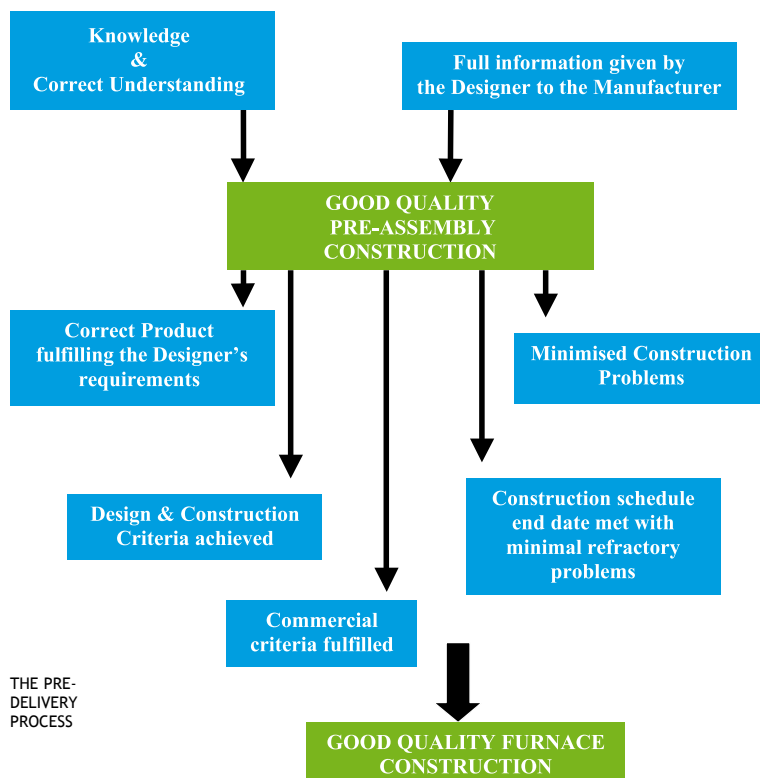
## ULTRASONIC TESTING

Most fused cast refractory suppliers offer to ultrasonically test manufactured glass contact blocks. This can be carried out on all blocks or on individual blocks after they have been weighed. This is to check the internal characteristics of blocks and to find any cavities that may be present and the magnitude of an identified cavity.

During the refractory inspection at the manufacturer's premises, ultrasonic testing may be requested and the process observed. The results can then be discussed with the supplier and decisions made prior to materials despatch. This is another facility offered by suppliers that helps reach optimum quality standards of the fused cast refractory shape.

## NON-FUSED CAST REFRACTORIES

Non-fused cast refractories can be built in multiple layers, where the overall depth or height must fulfil design criteria, or in an arch construction, where it is important to maintain the given span and rise. In each



case the blocks or bricks are required to have a tight joint to help prevent glass or gas leakage during furnace operation. The material quality and dimensional accuracy of all furnace refractory structures should be of the highest standards to help prolong the furnace campaign life.

## UNDERSTANDING MANUFACTURING CRITERIA

It is vital that both the furnace designer and the refractory inspector understand each supplier's manufacturing parameters in order to design the appropriate refractory structure within given tolerances. Any variations in manufacturing and pre-assembly standards can be discussed with the supplier to minimise any scope for misunderstanding.

Knowledge of appropriate manufacturing criteria makes it

easier to understand standard manufacturing tolerance. This can help with project budgeting, as non-standard requirements are generally more expensive. The manufacturer's tolerances for aspect properties generally encompass such factors as corner and edge spalls, shrinkage void, edge, surface face and wraparound cracking, warpage and bubble diameter.

Machining standards can include overall dimensional tolerance, surface quality, machine and hand-ground face and flatness, thickness, length and width. Pre-assembly dimensional limits include fixed points such as electrode, bubbler and thermocouple blocks, submerged wall, overall dimensions, alignment and joints. Manufacturers should also analyse materials' chemical, physical and geometrical properties and inform the refractory inspector of these.

**AIDING THE MANUFACTURER**

To help the manufacturer produce refractory materials precisely as required for pre-assembly, designers should specify their requirements clearly and concisely, including easily readable general arrangement and detail drawings as well as full details and assembly drawings that itemise all standard and special shapes.

A full set of the relevant Bills of Material should be provided, and the manufacturer should be advised of any subsequent design changes immediately. Regular and comprehensive communication should be maintained by the designer and / or purchaser with the manufacturer throughout the production process, from placing the purchase order, during the refractory inspection and until satisfactory site delivery.

**INSPECTION PERSONNEL**

In order to carry out a successful furnace refractory structure pre-assembly inspection, personnel should have a good understanding of the manufacturer's standards, tolerances and criteria for different types of pre-assemblies, as well as

a thorough knowledge of refractory materials, inspection techniques and usual on-site construction parameters. This will be vital if any part of a pre-assembly is rejected, as a detailed explanation would need to be given to the manufacturer.

Prior to the pre-assembly inspection by the customer and furnace designer, the manufacturer normally inspects the pre-assembly and rectifies any problems that have failed the quality control measures. This ensures a good primary inspection and minimises the need to change the pre-assembled refractory structure, thereby reducing the risk of items requiring re-manufacture or re-machining.

**PRE-ASSEMBLY INSPECTION**

In order to construct furnace refractories on-site, it is essential that brickwork quantities are checked and quality standards of bricks and pre-assembled refractories are inspected at the manufacturer's premises. Any necessary rectifications which need to be carried out on-site can be costly and disrupt the construction programme significantly.

If refractory blocks have to be taken off-site to be re-cut or machined, the additional handling increases the risk of damage or breakage. In this case, sourcing a substitute block during the construction phase of a furnace project can be problematic, and in many cases the substitute block has to be delivered from the manufacturer using air-freight, which is very costly.

In conclusion, the pre-delivery, pre-assembly inspection of purchased refractories at the manufacturer's premises is an essential part of any glass melting furnace project, as it can help minimise or eliminate construction problems, create optimum quality furnace structures, ensure that construction targets and milestones are met and contribute to reaching or even extending a design furnace campaign life.

Therefore, in the opinion of the author and to answer the title question, yes, refractory pre-delivery inspection is necessary and provides a significant role towards the successful construction of the furnace refractory structure. ■

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