Suppressing ferrite in shell-moulded grey iron castings

Occurrence of ferrite

Shell-moulded grey iron castings often contain large quantities of ferrite, particularly near their cast surfaces. This ferrite occurs in association with local areas of finer graphite, and in severe cases it can occur throughout the section of a casting. The greatest quantities of ferrite occur when the shell mould is supported by rails, or on a pallet, or lightly bedded onto sand. In addition, there may be a pronounced ferritic surface rim, particularly in castings of relatively heavy section, if the moulds are bedded onto moist or warm sand. The two forms of ferrite are shown above.

Significance of ferrite

Ferrite in shell-moulded castings causes surface hardness values to be as low as HB 130-150, whereas fully pearlitic castings would have hardnesses of HB 180-220. Surface-hardness measurements on shell-moulded castings are, therefore, often unrepresentative of the hardness below the cast surface. The presence of ferrite will lessen the wear resistance of the castings, and can lead to tool chatter during machining and a poor machined finish. Consequently, it is becoming increasingly common for users to specify that grey iron castings should have fully pearlitic structures right up to their cast surfaces.

Suppression of ferrite

The quantity of ferrite occurring in shell-moulded grey iron castings can be reduced in the following ways:

1. Use an iron with the lowest possible carbon-silicon contents, while ensuring that chilling is avoided.
2. Ensure that the iron is well inoculated, and that there is a minimum of delay before pouring the castings.
3. Add 0.1% tin.
4. Back the mould with cast iron shot, or moist or dry sand. If the ferritic surface rim is to be avoided, a dry backing material should be used.
5. Control the shell-mould thickness. A thick mould is recommended for thin castings; a thin mould supported by a backing material is the most suitable for heavy-section castings.
6. Ensure that the manganese and sulphur contents are accurately balanced according to the formula 1%Mn = 1.7x%S, or raise the manganese content of the iron to a level approximately 1% in excess of that required to balance the sulphur. Many grey-iron foundries use manganese contents of about 0.2-0.8% in excess of that required to balance the sulphur, and this leads to the occurrence of maximum quantities of ferrite.
7. Use a mould wash containing tin.
8. Spray the moulds with water after the casting has solidified, or knock the castings out of the moulds at temperatures above 750°C and allow them to air-cool. These two methods are suitable only for castings of fairly uniform thickness.