Ductile iron is particularly prone to formation of primary carbides during solidification. A primary reason for this is that the graphite forms into a spherical shape, which is the lowest surface area-to-volume ratio for the graphite. The limited surface area available for graphite precipitation during solidification increases the carbide forming tendency. In addition, the principal element added for nodulizing treatment is magnesium, a known carbide stabilizer.

Another factor is that the sulfur content in ductile iron is purposely lowered to less than 0.02% to facilitate the formation of spherical graphite nodules. Therefore, inoculation is crucial to successfully cast ductile iron without carbides. Even after effective inoculation, fade can occur and result in the formation of primary carbides. Figures 1, 2 and 3 illustrate primary carbides in a ferritic ductile iron. Figures 4, 5 and 6 show primary carbides in a pearlitic ductile iron.

These carbides have several names including: ledeburite, chill, primary carbide, carbides, Fe₃C, iron carbide and cementite.

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Fig. 1. Ductile iron photomicrograph with a ferritic matrix containing primary carbides. The predominant white matrix structure is ferrite. The white angular constituents within the ferrite are primary carbides. (400X, Nital etch)

Fig. 2. Ductile iron photomicrograph with a ferritic matrix containing primary carbides. The predominant white matrix structure is ferrite. The white angular constituents within the ferrite are primary carbides. (400X, Nital etch)

Fig. 3. Ductile iron photomicrograph with a ferritic matrix containing primary carbides. The predominant white matrix structure is ferrite. The white angular constituents within the ferrite are primary carbides. (400X, Nital etch)

Fig. 4. Ductile iron photomicrograph illustrating primary carbides in a pearlitic ductile iron. The matrix is predominantly pearlite. The white angular constituents within the pearlite are primary carbides. (400X, Nital etch)

Fig. 5. Ductile iron photomicrograph illustrating primary carbides in a pearlitic ductile iron. The matrix is predominantly pearlite. The white angular constituents within the pearlite are primary carbides. (400X, Nital etch)

Fig. 6. Ductile iron photomicrograph illustrating primary carbides in a pearlitic ductile iron. The matrix is predominantly pearlite. The white angular constituents within the pearlite are primary carbides. (400X, Nital etch)