USE OF SILICON CARBIDE IN THE INDUCTION FURNACE
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Silicon carbide has only recently been used outside of steel works. Its appearance in cast iron/Ductile Iron foundry goes back only a few decades. It is not always used advisedly and it could be used more frequently especially complementing Sorelmetal in the charge. Indeed, one of its principal aspects is its nucleation ability. In the following we will attempt to show the characteristics and give some advice for using SiC.

The silicon carbide is obtained by electromelting high purity silica sand with petroleum coke, also of good quality. This “melting” takes place at high temperature (about 4000°F (2200°C)) and requires a large quantity of energy to produce. It also requires energy for it to dissociate into about 2/3 Si and 1/3 C in the induction furnace. The better quality raw materials produce better quality SiC, which is lower in nitrogen, sulphur, hydrogen and other trace elements. The Al content also varies according to the final purity of SiC (see table).

SiC does not melt, it actually dissolves since its melting point is ~2700°C (~1480°C); its behavior in the molten metal is similar to sugar dissolving in coffee. This aspect is very important for the use of SiC. In order to be sure of a perfect dissolution it would be necessary to wait approximately 20 minutes at 2650°F (1450°C) to obtain stable carbon and silicon levels. See below the results of the study done in France in an induction furnace. The ideal is to introduce it at about half way in the metallic charge, to be sure that it has time to dissolve. Dissolution will be improved by the electromagnetic stirring of the bath. Moreover and in order to guarantee good dissolution it is strongly advised to limit additions to a maximum of 1%. Beyond this, it would be necessary to increase the melting time and temperature in the furnace. SiC should never be added in the ladle or as cover material for Mg treatment, unless high temperature is used (>2750°F (>1510°C)).

Another risk coming from a large addition is that of affecting the furnace lining, reducing its life. SiC is a very good deoxidizer: it reduces oxides of Fe and Mn as well as the silica refractory.
See chart of amount of energy required to form and reduce various oxides.

However, before reducing the silica, SiC will reduce these other oxides and the amount of slag, such as fayalite and spinel which have a low melting point, that is formed. It then follows that an improvement of the lining life will occur, but also a different slag will form. This slag will be more viscous and thus easier to remove from the furnace. There will also be less build-up crust at the slag line in the furnace. Moreover this slag being less oxidized would have a larger capacity to absorb some sulphur from the melt if necessary.

Of all the items already presented, probably the most important is the role of SiC on nucleation and preconditioning of the iron. As Sorelmetal does, SiC also generates more seeds in the liquid cast iron and improves graphitization! For the graphitization, Benecke(1) presents the following explanation: Si and C coming from the dissolution of SiC would be concentrated on a micro level in the liquid iron and would thus give locally an hyper-eutectic character which naturally promotes graphitization. This of course reduces the chilling tendency and amount of undercooling. In the same way, during long holding times following stopping of moulding lines or after holding over a weekend, an addition of 2 lb (1 kg)/ton of SiC on the cleaned bath with 15 lb (7 kg)/ton of Sorelmetal, will reduce chill values and make it possible to maintain an acceptable level of graphitization.

The ideal charge composition and charging order for a coreless induction furnace would be as follows:

**Bottom of furnace:**
1) A light raw material cover in small pieces (to protect the bottom of the furnace)
2) Half of the Sorelmetal
3) The steel scrap portion of the charge (40% maximum)
4) 0.5% of SiC plus recarburizing materials, if necessary
5) The returns (maximum 50%)
6) The balance of Sorelmetal

By applying all what has been stated above, your base cast iron will be ready to produce parts that have a lower tendency to form carbides and present a smaller risk to having micro porosity.

For more information you can always contact any of the Sorelmetal Technical Services staff.

(1) T. Benecke : “Solubilité et effet pré-inoculateur du SiC dans les bains de fonte” – FFA n°81 janvier 1989

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