SAINT-GOBAIN

SILICON CARBIDE IN METALLURGY

NEW APPLICATIONS

Apart from its well-known use in the manufacture of grinding wheels and Refractories, silicon carbide (SiC) today finds extensive applications in the field of ferrous metallurgy.

Silicon carbide is a unique combination of silicon and carbon, the two elements recognized for their importance in controlling the quality of cast iron and steel – the basic products in ferrous metallurgy.

Over the world, Silicon carbide is being used extensively in metallurgical applications in countries like USA, where more than 60% of their SiC Production goes into metallurgical applications. In India Grindwell Norton, through extensive trials both in-house and in the field, have successfully introduced SiC in steel plants and iron foundries.

SILICON CARBIDE: Dissociation Chemistry

A simple dissociation reaction that takes place when silicon carbide comes in contact with molten iron makes it extremely useful at different stages in melting steel and cast iron.

(Dissociates into)

SiC……..Si + C

Under the oxidizing conditions of the melt, the dissociated silicon and carbon, now in nascent stage, react with oxygen exothermically thus deoxidizing the melt.

(Breaks up into)

SiC + 2FeO……Fe + Si +CO

C + FeO……Fe + CO

Hence, the following overall reaction takes place

SiC + 3FeO……3Fe + SiO2 + CO + 4430 Kcal/kg

TYPICAL CHEMICAL ANALYSIS-SiC Met 85

COMPOSITION	%
SiC	85
SiO2	8
Free Carbon (min)	3.5
Al2O3	0.7
Free Si	1
Others	1.8

ADVANTAGES OF SILICON CARBIDE

- Improved Microstructure of Cast Iron due to pre inoculating effect of SiC
- Reduced Pin-hole porosity and chilling tendency due to dissociation of Si and C in melt.
- Reduced Melting losses due to the formation of a film of SiO2 over each grain of SiC
- Reduced Microporosities due to very low content of Sulphur.
- Deoxidization of melt with dissociated Si and C reacting with FeO and deoxidizing it, hence reducing its effect on the erosion of lining life. Thus, Sustained usage of SiC improves lining life.
- Production of cleaner Iron/Steel due to presence of very low level of trace elements in SiC.
- Easy storage and Access of SiC due to its unique characteristic of Inertness to the Atmosphere

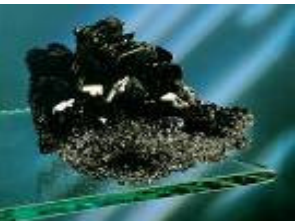
FOR STEEL MAKING

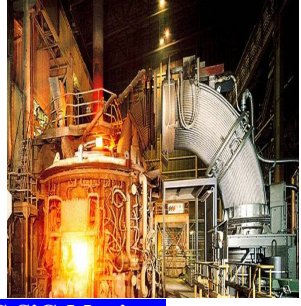
As a deoxidizer and an alloying additive in ARC Furnaces silicon carbide has been found to be very useful. It effectively replaces conventional deoxidizers and acts as a source of Carbon and Silicon.

The Dissociation of Silicon carbide under oxidizing conditions leads to evolution of tremendous amounts of heat, 18,606 Kj/kg. This property makes it suitable for use as an auxiliary fuel for oxygen steel making process, where intense oxidizing conditions prevail.

TYPICAL HARACTERISTICS

Melting Point	**2700°C**
Silicon Content	**60%**
Carbon Content	**25-28%**
Density	**3.2 g/cc**
Nitrogen Content: less than	**300 ppm**
Hydrogen Content: less than	**100 ppm**
Sulphur Content: less than	**0.0%**





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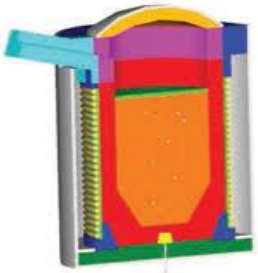
A TYPICAL WORK-OUT FOR SiC-Met in INDUCTION FURNACES

Given here is a typical work-out for use of SiC in an induction furnace of 3 MT capacity. Calculation-oriented Assumptions are as follows:

- 1 MT of metal is tapped at a time and 2 MT is left behind as heel.
- Fresh charges are steel scrap only.
- Silicon and carbon are made up by addition of SiO and Raw petroleum Coke (85% Fixed carbon)
- Average recovery of silicon and carbon is 90%
- Final metal chemistry aimed at: Si – 1.95%. C-3.5%



SILICON CALCULATIONS

Amount of Si Required for 1 T of Steel Scrap: **19.5 kg**
Si Content of silicon carbide……..**60%** Si
Recovery from SiC……...**90%** SiC
Required for 1 Kg of Si……..**1.85 kg** SiC
Required for 19.5 Kg of Si……..**36 kg**

CARBON CALCULATIONS

Amount of carbon required for 1 T of Scrap……**35 kg**
'C' content of silicon carbide……**26%**
'C' recovery from silicon carbide……**90%**
Amount of carbon contributed
by addition of 36 kg of SiC……..**8.4 kg**
Balance 'C' to be contributed from pet. coke....**26.6 kg**

With SiC	Without SiC
Quantity of SiC: **36 kg**	Quantity of FeSi: **28.3 kg**
Quantity of coke: **35 kg**	Quantity of coke: **46 kg**
1 kg of SiC equivalent to	**0.79 kg** of FeSi + **0.31 kg** coke

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A TYPICAL WORK-OUT FOR USING SiC-Met in ARC FURNACES

Silicon carbide can be added during reducing period on the bare bath as well as on the slag after line fusion. The recovery of silicon will depend on:

1. The oxygen present in the metal at time of slag
2. Basicity of slag
3. temperature at time of addition

In a particular steel making plant making carbon and alloy steels, silicon carbide was added in the reducing period on the bare bath as well as on slag after line fusion.

In addition to the silicon recovered from SiC, a lot of carbon is recovered too. During our experiments, we have absorbed that recoveries of silicon and carbon are at par or even better than those when ferrosilicon and petroleum coke are used.

For process control the following calculations could give you an idea about consumption of SiC vis-à-vis ferrosilicon in petroleum coke.

Si contents of FeSi : **72.5%** (average)

Si content of SiC Met 85 : **60%**
Therefore, to obtain 1 kg of Si
FeSi to be added : **1.4 kg**
Or
SiC to be added : **1.7 kg**

Since 1 kg of SiC MC85 contains 0.27 kg of Carbon, 1.7 kg of SiC will yield : **0.45 kg** of C

Generally Petroleum coke (85% Fixed Carbon) is used for picking carbon in the melt.

Therefore, for picking up **0.45 kg** of carbon in the melt, **0.54 kg** of petroleum coke is required (assuming 100% recovery)

Therefore,

1 kg of SiC MC85 is equivalent to 0.79 kg of FeSi PLUS 0.31 kg of petroleum coke

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Manufacturing Locations: -
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