Foundry Alloys

QS-9000 ISO 9001 ISO 14001

SUPERSEED® INOCULANT

Elkem

www.elkem.no

SUPERSEED® INOCULANT

- *Gives maximum chill reduction in cast irons*
- *Promotes less shrinkage than other inoculants*
- *Low reactive element content gives less dross*
- *Very low aluminum content minimises risk of promoting hydrogen pinholes*
- *Cost effective due to small additions*

Superseed inoculant is a specially formulated grade of ferrosilicon which has become recognised throughout the world as the most effective inoculant for the elimination of eutectic carbide or 'CHILL' in grey cast irons. The inoculant's powerful action is obtained through the presence of small amounts of strontium in its composition.Unlike most other ferrosilicon inoculants it does not require the presence of aluminium and calcium to develop its full effect. In fact small amounts of aluminium, and particularly calcium, seriously reduce the inoculating efficiency of Superseed inoculant and are therefore kept at very low levels during its manufacture.

Superseed inoculant is produced by a special process at the ELKEM Bremanger plant in Norway, which is ISO-9001, ISO 14001 and QS 9000 certified. Superseed 50 inoculant is also produced at ELKEM's ISO-9001 and QS 9000 certified plant in Chicoutimi, Canada.

Si	73-78%
Sr	0.6-1.0%
Ca	0.10% max
Al	0.50% max

The Origin of Superseed inoculant

Superseed inoculant is a classic example of fundamental research by an independent organisation and development by an experienced manufacturer into a major product with world - wide sales.

The original work, carried out by BCIRA in England, showed that the presence of a small amount of strontium in an otherwise high purity ferrosilicon alloy produced an inoculant which was far more effective for the elimination of chill in cast iron than any other inoculant. It also showed that traces of calcium and, to a lesser extent, aluminium, markedly reduced the inoculating efficiency of the strontium alloy.

Figure 1 illustrates the superior chill suppression produced by the strontium ferrosilicon compared with inoculating grade 75% ferrosilicon in 3mm thick plates at a 0.25% Si addition level.

Extensive tests at other independent laboratories and in iron foundries throughout the world confirmed the original results at all typical inoculant addition levels. The strontium ferrosilicon alloy, soon to become known as Superseed inoculant, was more effective than other inoculants in eliminating chill in thin sections and at corners and edges of castings, thus avoiding the risk of expensive tool breakage during high speed machining.

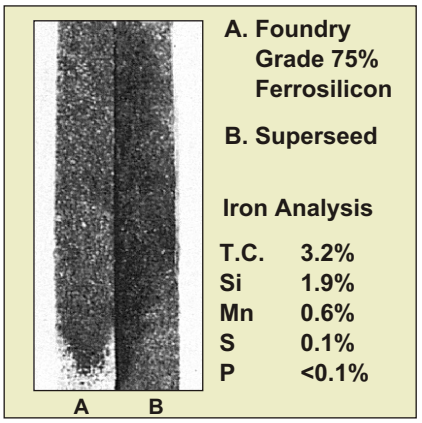

Figure 1: *Superior chill suppression by strontium ferrosilicon compared with foundry grade 75% ferrosilicon.*

More recently, chill measurements on test pieces from almost 150 ladles of grey iron at the ELKEM Research and Development laboratories in USA showed that Superseed inoculant was more effective in reducing chill than foundry grade 75% ferrosilicon or a proprietary barium/calcium inoculant at all levels of addition and that, at heavier additions of Superseed inoculant, the chill could be reduced to much lower levels than is possible with the other inoculants. This is illustrated in Figure 2.

These tests also indicate that, when changing from 75% ferrosilicon to Superseed inoculant, about half as much Superseed inoculant is required to give a similar level of chill control thus offsetting the additional cost of the Superseed inoculant.

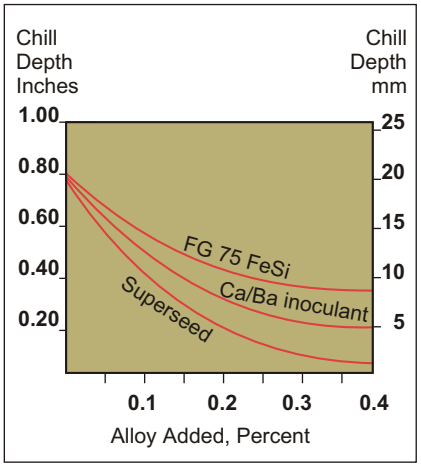

Figure 2: *Chill reduction from various inoculants in laboratory grey iron with 3.3% C, 2.0% Si, and 0.08% S.*

Unique features of Superseed inoculant

Superseed inoculant differs from other ferrosilicon inoculants in that it requires a very small amount of only one reactive element to obtain its full inoculating effect. This low total reactive element content of Superseed inoculant imparts several valuable features, some of which are unique.

Low Dross - Free and Ready Solution

When an inoculant is added to molten cast iron a small amount of dross forms, most of which originates from oxidation of the reactive elements in the alloy. The low content of reactive elements in the Superseed inoculant creates less dross, giving cleaner ladles and reducing the risk of defects occurring in the castings. The almost complete absence of dross also allows Superseed inoculant to dissolve readily at relatively low temperatures down to 1300°C.

Reduces risk of Pinhole Formation

Hydrogen pinhole defects can occur when a trace of aluminium is present in the iron and levels as low as 0.004% Al can cause pinholes in critical castings. Most ferrosilicon inoculants have aluminium contents sufficient to give almost twice this level at normal ladle addition rates. The very low aluminium content of Superseed inoculant and the smaller additions required, add only the smallest trace of aluminium, thus minimising any risk of hydrogen pinhole formation provided no aluminium arises from any other source.

Fewer Eutectic Cells for the same level of Chill Control

Chill occurs when insufficient nuclei are present in the iron to prevent it from undercooling below the 'metastable' or 'white' eutectic temperature during solidification.

Inoculants reduce chill by creating sufficient nuclei to prevent the iron from undercooling so much. Most inoculants contain aluminium and one or more other elements which are instrumental in creating the increased level of nucleation. However, a trace of aluminium in the iron can also be counter - productive in that it will encourage the iron to pick up hydrogen which is a very powerful element for promoting undercooling and chill formation. Most inoculants therefore need to create large numbers of nuclei, and hence eutectic cells, in order to counteract this additional tendency to undercool.

Because Superseed inoculant is almost free from aluminium it has no adverse effect due to increased hydrogen content and therefore less nuclei need to grow into eutectic cells to give the same reduction in undercooling and chill formation. This is illustrated in Figure 3.

This imparts two unique advantages to Superseed inoculant:

1. LESS SHRINKAGE

Irons with high eutectic cell numbers have a marked tendency to form shrinkage porosity and this often occurs as a result of inoculation. Because irons inoculated with Superseed inoculant to the same chill level have lower eutectic cell numbers, there is less tendency for shrinkage to occur in these irons. This is illustrated in Figure 4 which shows two plate-with-boss test castings inoculated with Superseed inoculant and ferrosilicon to the same chill level.

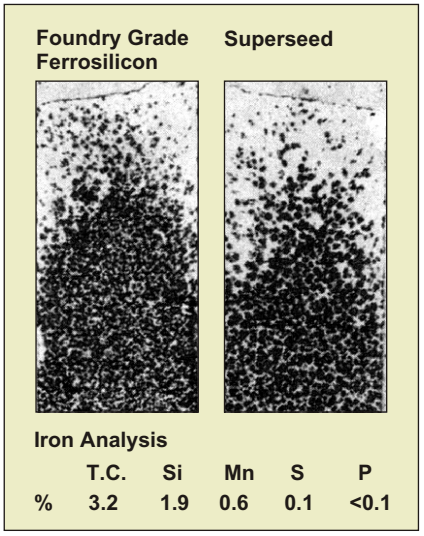

Figure 3: *Polished sections of 5mm chill test plates illustrating how, for a given chill reduction, the use of Superseed inoculant reduces the formation of eutectic cells.*

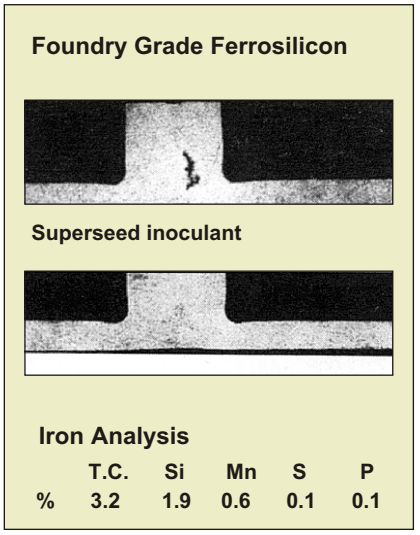

Figure 4: *Section of plate-with-boss shrinkage test castings - inoculated with different inoculants to give the same chilling tendency.*

II. LESS FADING

The increase in eutectic cell numbers created by inoculation may be regarded as a supersaturated condition which fades rapidly with time. Inoculants giving very high eutectic cell numbers will fade most rapidly and it is therefore necessary to cast the metal within a very short time after treatment in order to gain the full benefit of the addition. Because Superseed inoculant gives a lower eutectic cell number for the same degree of chill control, fading is slower and the properties of the treated iron remain more constant over a longer period of time. This is illustrated diagrammatically in Figure 5.

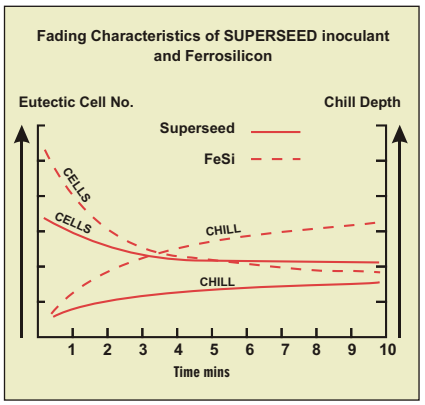

Figure 5: *Fading characteristics of Superseed inoculant and foundry grade 75% ferrosilicon.*

Limitations of Superseed inoculant

Superseed 75 and Superseed 50 inoculants are very effective in grey irons with base sulphur content above about 0.05%. At or below this level, other Elkem inoculants may be more effective.

Superseed inoculant is equally effective in ferritic ductile irons not containing cerium. Many foundries also find Superseed inoculant to be effective in ductile irons containing cerium, but on some occasions cerium has been found to reduce the effectiveness of Superseed inoculant. In these circumstances it is recommended that an alternative inoculant from the Elkem range is used.

Superseed inoculant in Ductile Cast Irons

Superseed inoculant is extremely effective for the inoculation of high purity ferritic ductile irons not requiring cerium to give good graphite nodularity. Eutectic carbide is eliminated from thin sections and thevery highnodule numbers produced promote the formation of fully ferritic structures as-cast, thus reducing the need for heat treatment.

Superseed inoculant may also be used to advantage in less pure ductile irons requiring a small addition of cerium, although there is some evidence to suggest that excess cerium might reduce the effectiveness of Superseed inoculant.

The Addition of Superseed inoculant

ELKEM supply the different ladle and metal stream inoculation (MSI) gradings of Superseed inoculant upon customer request and with certified analysis.

As to ladle inoculation, most foundries find the amounts of Superseed inoculant required to give adequate chill control lie between one-half and two-thirds of other inoculants. The alloy should be added to the tapping stream as the ladle is filled or, preferably, as the metal is transferred from a supply ladle to the casting ladles. Superseed inoculant should NOT be dumped into the bottom of a ladle before filling starts.

With metal stream inoculation, the powerful inoculating action and the clean solution characteristics of Superseed inoculant are ideally suited to this method of inoculation which is increasing in use in many larger mass production foundries. Addition rates are usually 0.1% or less for grey irons and around 0.15% for ductile irons.

This allows the silicon content of the base irons to be increased significantly with the associated advantages of better scrap utilisation and reduced lining wear in coreless induction furnaces.

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