QS-9000 ISO 9001 ISO 14001

SUPERSEED® EXTRA INOCULANT

Elkem

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- Maximum chill reduction in grey cast irons
- Promotes evenly distributed random type A graphite
- Neutralises nitrogen
- Promotes a small graphite flake size, thus minimising graphite pull-out during machining
- Low aluminium content reduces risk of hydrogen pinholes
- Effective in grey irons of all sulphur contents

Superseed Extra inoculant is a ferrosilicon based inoculant especially designed for use in grey cast irons. The inoculant contains balanced additions of strontium and zirconium which are powerful in promoting type A graphite and reducing the risk of nitrogen blowholes respectively. By producing the inoculant with a deliberately low aluminium and calcium content, the likelihood of hydrogen pinholes and slag generation are minimised.

Superseed Extra inoculant is produced at the Elkem Bremanger plant in Norway which is ISO 9001 , ISO 14001 and QS 9000 certified.

Superseed® inoculant is recognised all over the world as the leading inoculant for medium to high sulphur grey irons. Elkem realised that a natural development of the Superseed inoculant technology was to extend the range of sulphur levels at which the inoculant could be used, hence the development of Superseed Extra inoculant. The addition of zirconium to the alloy gives the additional advantages such as the ability to combine with dissolved nitrogen in the iron to reduce the potential for nitrogen blowholes and the promotion of a refined type A graphite. This leads to a reduction in the promotion of harmful kish graphite often associated with the use of some other powerful proprietary inoculants and to the type D graphite associated with Ti containing inoculants.

The excellent chill removal properties of Superseed inoculant have been retained in Superseed Extra inoculant and even enhanced to include good chill removal in irons of low base sulphur content, irons notoriously difficult to inoculate under normal circumstances. An example of the chill removal characteristics is shown as Figure 1.

Superseed Extra inoculant is produced to the following specifications;

Silicon	73 - 78%
Strontium	0.6 - 1.0%
Zirconium	1.0 - 1.5%
Calcium	0.1% max
Aluminium	0.5% max
Iron	balance

Figure 1 .
Chill removal with 0.1% Superseed Extra inoculant (left) as ladle addition compared to 0.1% F.G.FeSi (right) in 0.04% sulphur base iron

Advantages of Superseed Extra Inoculant

This shows a set of chill wedges cast with Superseed Extra inoculant at low sulphur level compared to a conventional FeSi inoculant.

Features of Superseed Extra inoculant.

Superseed Extra inoculant is a unique and patented formulation which requires a small amount of reactive elements to give the maximum effect. This compares favourably to more conventional inoculants which generally contain much higher levels of reactive element and may be prone to slag formation.

Promotion of randomly distributed type A graphite.

In addition to the excellent chill control, even at low sulphur levels, Superseed Extra inoculant promotes the formation of an evenly distributed type A graphite. This is because the strontium/zirconium combination activates a high number of nuclei, thus providing a high number of eutectic cells within the iron, and which has the effect of promoting an even distribution of small graphite flakes. This is achieved with a minimum amount of undercooling and thus the tendency to promote type B and D graphite is reduced. These two effects lead to good mechanical properties as shown in the case study.

An example of the graphite structures obtained with Superseed Extra inoculant compared to another "nitrogen neutralising" inoculant are shown in Figure 2 and are based on work carried out by the Casting Development Centre in UK.
The refined graphite structure obtained with Superseed Extra inoculant has proven beneficial in minimising graphite pull-out during machining and thus give a smooth surface finish.

Nitrogen control.

Many foundries produce medium to high nitrogen contents in the base iron. These tend to be either cupola melted irons or electrically melted irons made from high steel scrap charges with large amounts of recarburiser added to the furnace. Nitrogen may also be generated in highly cored castings as a result of breakdown of the core binders.

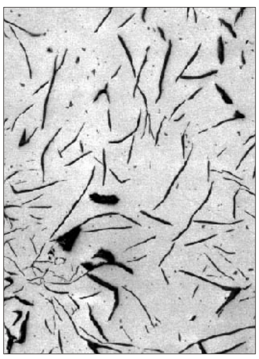
Nitrogen may be neutralised by the use of titanium or zirconium. Titanium is known to increase the number of nuclei available for graphite precipitation, but as the degree of undercooling is high compared to zirconium, there is a greater tendency for the formation of undercooled type D graphite and consequent ferrite formation. This is particulary relevant as titanium may be present in trace quantities from steel scrap used in the melting charge, thus exaggerating the effects. Titanium may also be cumulative in certain types of melting process.

When used to control nitrogen, titanium forms hard titanium carbonitride particles, Ti(C,N), which are known to be detrimental to the machinability of the iron. There is also a risk that, like aluminium, titanium can promote hydrogen pinholes.

Thus the use of zirconium has advantages over the titanium systems and no cumulative effects have been reported. Titanium promotes cell structure refinements by increasing undercooling compared to the strontium/zirconium refinement which is achieved by improving nucleation with minimum undercooling. The latter system gives much less risk of undercooled graphite formation, associated ferrite and thus the lack of strength.

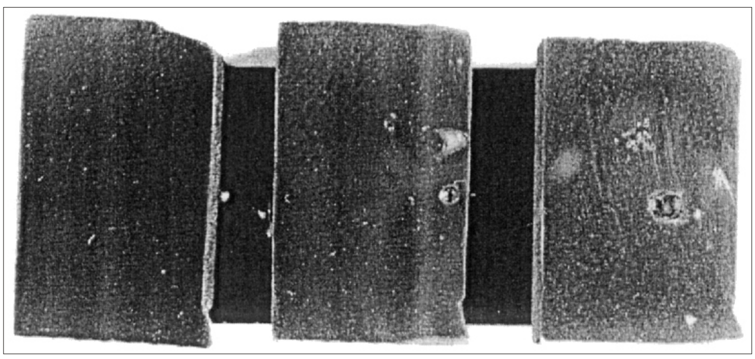
Figure 2. *The effect of Superseed Extra inoculant on graphite morphology compared to a nitrogen neutralising inoculant.*

Superseed Extra Inoculant



Nitrogen Neutralising inoculant

Figure 3 . *Comparison of nitrogen blowhole defects in 130ppm grey iron. Left to right, Superseed Extra inoculant, Ti bearing inoculant, F.G.FeSi*



An example of the nitrogen blowhole prevention is given in Figure 3. This shows a section through an artificially high nitrogen iron with both Superseed Extra inoculant, a titanium containing material and a commercially available FeSi based material.

Combined hydrogen and nitrogen gas holes.

It is very common to find gas holes which are not caused by either hydrogen or nitrogen alone and these are often attributed to being caused by a cumulative effect of the two gases. Superseed Extra inoculant not only contains zirconium to neutralise the nitrogen, but also has a low aluminium content compared to most inoculants to help prevent hydrogen related defects.

Methods of addition.

As with all inoculants, the effects of Superseed Extra inoculant will fade with time after addition to the iron. Superseed Extra inoculant shows the characteristics of Superseed inoculant in having a superior fade time to standard foundry grade ferrosilicons. Superseed Extra is available in both ladle grades and in-stream size. The low reactive element content of the inoculant give it excellent solubility in irons, even at low temperatures.

Case study.

This (northern hemisphere) foundry produces automotive castings for heavy trucks and tractors. They cupola melt grey irons at a base sulphur content of 0.1% and typically run a nitrogen blowhole susceptible iron of 110ppm nitrogen. They compared a high rare earth inoculant, a titanium containing material and Superseed Extra inoculant to achieve a blowhole free iron with a tensile strength minimum of 210 MPa. Over an extended test period, the high rare earth containing inoculant failed to achieve the desired chill levels and the titanium inoculant did not give the desired minimum tensile properties. With Superseed Extra inoculant , the foundry regularly achieved tensile results of 245 MPa in chill free iron. No nitrogen porosity

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