



QS-9000 ISO 9001 ISO 14001

MAGNESIUM FERROSILICON

ALLOYS for DUCTILE IRONS



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Alloys for Ductile Irons

ELKEM MgFeSi alloys are specially produced to give:

- *Increased product consistency*
- *Improved environmental conditions*
- *Better graphite nodule numbers and structures*
- *Less wastage*
- *Cost effective treatments*

Why use MgFeSi Alloys?

Almost all ductile cast irons are made by alloying with a small percentage of magnesium which produces the required graphite structures. Magnesium is a highly reactive, volatile metal which boils at a temperature at least 200°C lower than that of molten cast iron and also has a very limited solubility in iron. It is therefore rarely possible to add magnesium as pure Mg without expensive specialised equipment.

The addition of magnesium is facilitated by diluting it into a carrier material which is acceptable and beneficial to cast irons and which, preferably, combines with the magnesium thus reducing its vapour pressure and hence its reactivity. Silicon and silicon-rich alloys such as 45% ferrosilicon fulfill both these requirements.

The present day availability of low sulphur charge materials and effective

desulphurising methods enable consistent, low sulphur base irons to be produced, thus reducing the amounts of magnesium needed to be added. This has enabled the magnesium content of MgFeSi alloys to be reduced, thus lowering their reactivity and increasing Mg-recovery still further. MgFeSi alloys containing 4-6% magnesium are now by far the most widely used sources of magnesium in ductile production.

Production of ELKEM MgFeSi Alloys

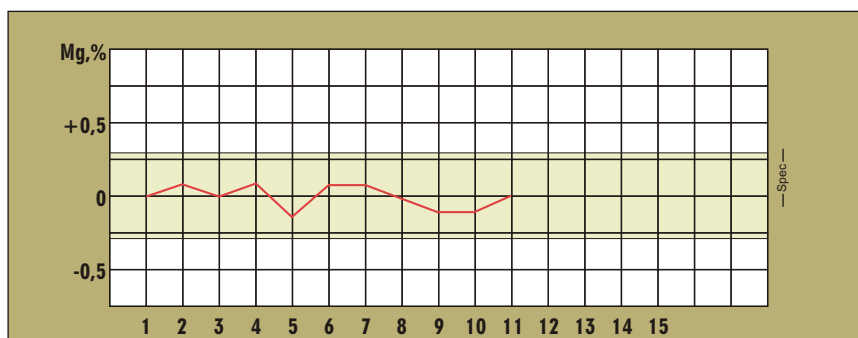


Figure 1: SPC is used in the production of MgFeSi. The above graph shows the reproducibility of Mg from charge to charge when applying the plunging technique.

ELKEM MgFeSi alloys are produced at the Bjølvefossen plant in Norway with varying contents of the critical elements, i.e. Mg 3-10%, Ca 0.2-4.0%, RE 0-3.0%. (Specifications to suit customer requirements.) These alloys are produced under ISO-9001 certification and with close analytical control using a production process designed to impart special advantages compared with most other MgFeSi alloys. The magnesium is added to the molten ferrosilicon by a plunging process, giving improved and more

reproducible yields of magnesium than the more common pour-over process. Figure 1 shows an SPC chart of the variations in magnesium contents over ten treatments using plunging. The liquid alloy is agitated by a specially designed system, from the start of plunging through to casting the last metal from the ladle, in order to ensure maximum homogeneity throughout the cast.

The alloy is cast on a modified pig casting machine which produces thin slabs which are water quenched a few seconds after casting, thus avoiding any risk of segregation taking place.

The resulting material is stronger, tougher and has a very fine structure with the various components uniformly distributed.

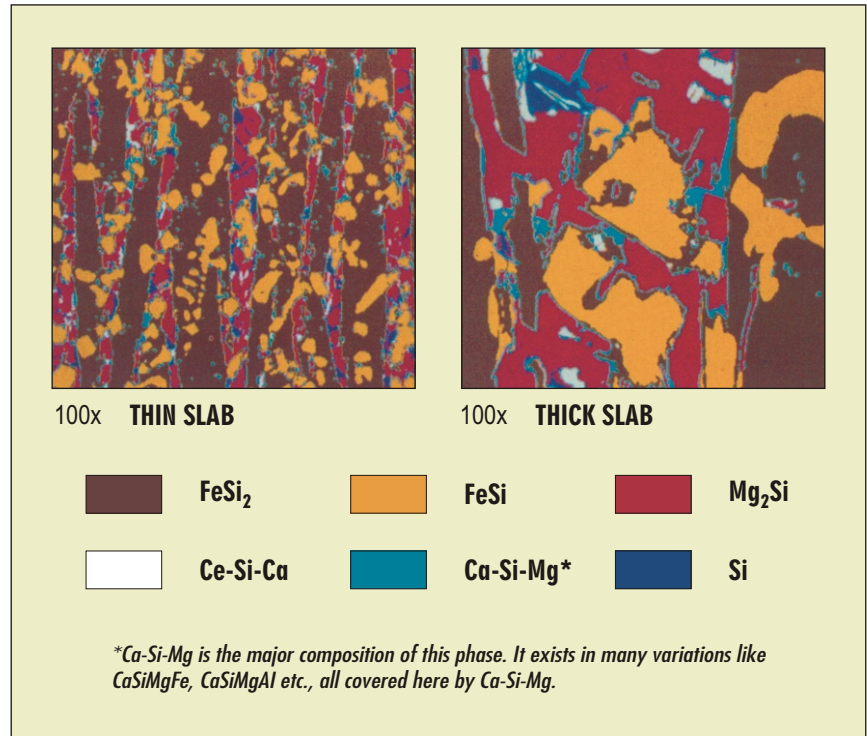


Figure 2: Phases in cerium grade 45% ferrosilicon with 5% Mg, 1% RE and 0.3% Ca, cast in thin slabs and in thicker slabs.

Advantages of Using ELKEM MgFeSi Alloys

1

MORE COST EFFECTIVE

Ferrosilicon is the most economic carrier for magnesium in cast irons. The carefully controlled magnesium levels and the fine structure of ELKEM MgFeSi gives higher magnesium recoveries allowing smaller additions to be used.

2

INCREASED PRODUCT CONSISTENCY

The fine structure and carefully controlled contents of magnesium, calcium and cerium in ELKEM MgFeSi minimises reactivity and gives more consistent results.

3

IMPROVED ENVIRONMENTAL CONDITIONS

The controlled reactivity of ELKEM MgFeSi alloys, arising from their fine structures, reduce smoke and flare. The size grades available for the Tundish process and in the mould nodularising remove the need for expensive extraction equipment.

4

BETTER NODULE STRUCTURES

The carefully balanced calcium and cerium contents in ELKEM MgFeSi alloys and their uniform distribution throughout the structure gives higher nodule numbers and thus can reduce the amount of post-inoculant required.

5

LESS WASTAGE

The fine structure produced by the special casting process gives a stronger material minimising losses due to attrition during transportation.

Additional Elements in MgFeSi Alloys

Cerium (Rare Earths)

Trace amounts of antimony, lead, bismuth or titanium can occur in the charge materials used by iron foundries and these elements can prevent the formation of nodular graphite by magnesium. Their adverse effects can be neutralised by including a very small amount of cerium or rare earths with the treatment and many foundries do this as an insurance against any occasional contamination. Appropriate amounts of rare earth mixtures may be incorporated in the MgFeSi alloys thus avoiding the need to make separate additions (in Elkems case these are normally mischmetal-based). These are known as 'cerium-bearing MgFeSi alloys'.

There is evidence to indicate that the additions of rare earths through the MgFeSi alloy promotes higher nodule numbers after post-inoculation. However, with the modern specialist inoculants available, this factor may be influenced to a greater extent by the choice of inoculant and the procedure being used.

Foundries using high purity charge materials such as those producing as-cast ferritic ductile iron, do not require the presence of rare earths and these plants will gain both technical and economic advantages from the use of ELKEM MgFeSi alloys to which no deliberate addition of rare earths has been made.

Calcium

The presence of a small amount of calcium in MgFeSi alloys reduces the reactivity of the magnesium thus minimising fume emission and improving the yield of magnesium. Calcium also partly offsets the carbide promoting action of magnesium by encouraging nucleation during the nodularising process.

Calcium contents of about 1% are normally sufficient for this purpose although higher Ca content materials are available for open ladle processes where excessive reactivity and metal splash are to be prevented.

When necessary, ELKEM alloys are available with calcium contents down to 0.2% for use in situations where dross formation is critical, such as when nodularising in the mould.

Aluminium

Aluminium occurs in small amounts in most ferrosilicon alloys unless deliberately avoided by careful charge selection or by refining after smelting.

The presence of aluminium in MgFeSi alloys confers no particular advantage to the alloy and it can cause a noticeable increase in the dross formation. In some circumstances it can also promote the formation of hydrogen pinhole defects.

Many foundries find they can tolerate up to about 1.5% aluminium in the alloys with no serious problems occurring.

However, ELKEM MgFeSi alloys are available with aluminium contents down to 0.3% for use when required. The low aluminium alloys are of particular value when the treated iron is transferred to a channel holding furnace where a trace of aluminium in the iron can cause a build-up of spinel slag in the throat of the channel loop.

Chemical composition of some nodularisers

Product	Si	Mg	RE	La	Ca
Elmag 6112	44-48 %	5,80-6,40 %	0,50-0,80 %		1,80-2,30 %
Elmag 5801	44-48 %	5,50-6,00 %	0,80-1,00 %		0,50-1,00 %
Elmag 5836	44-48 %	5,50-6,20 %		0,35-0,55 %	0,80-1,20 %
Elmag 4620	44-48 %	4,30-4,80 %	4,30-4,80 %		0,50-1,00 %



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