Proceedings of the 72nd World Foundry Congress
21-25th May 2016, Nagoya, Japan

A new metallurgical process for the ductile iron foundry

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Abstract: There are limitations in the sandwich or tundish methods of producing ductile iron. The new INITEK process, which includes a unique converter system and INODEX initializer alloy that produces exceptional metal quality with significant reduction in magnesium use. INITEK gives 2 major options for the ductile iron foundry. Firstly cost savings in charge metal, treatment and refractory costs. Secondly to improve casting quality with specific casting defect reductions such as shrinkage cavities, inclusions, misruns, or abnormal graphite.

Keywords: *INITEK, converter, initializing, ductile*

1. Introduction

FOSECO's recently developed nodularizing and inoculating treatment process "INITEK" consist of

1. A specially designed converter ladle which has a high thermal efficiency, reducing temperature losses and increasing the recovery of magnesium. (Fig. 1)
2. Initializing treatment of the iron with INODEX initializer which has the effect of neutralizing the Oxygen and Sulphur activities, and nucleating the iron before the addition of magnesium. (Fig. 2-B)
3. Treatment with magnesium. (Fig. 2-C)
4. Controlled timing of all the process steps to ensure that reactions are complete and independent.
5. Late inoculation for a final adjustment of the metallurgy, if needed.
6. Process control using thermal analysis.

The efficiency of the process results in magnesium recovery of around 70%, meaning that lower Mg additions are needed and the inoculation step is reduced. The economics of the process are greatly improved.

The problems resulting from too high magnesium additions, i.e. carbide tendency, risk of shrinkage, non-metallic inclusions and high cost are reduced and the metal produced by this process has exceptional mechanical properties, with a greater tendency to ferrite and high elongation values. Foundries are able to use raw materials which are less pure and cheaper (higher Mn%) and still get the specified properties. They can work with lower amounts of pig iron and cheaper grades of steel scrap.

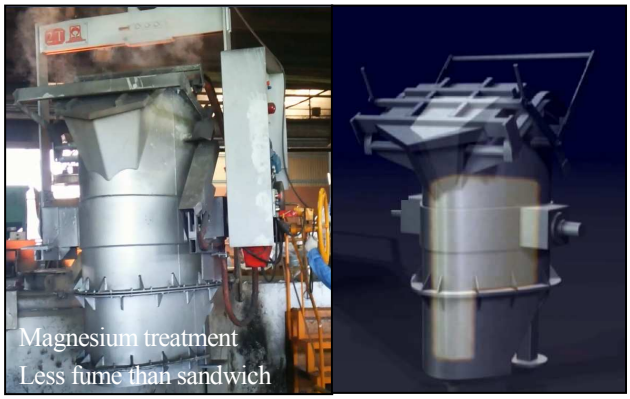

Fig. 1 FOSECO Converter

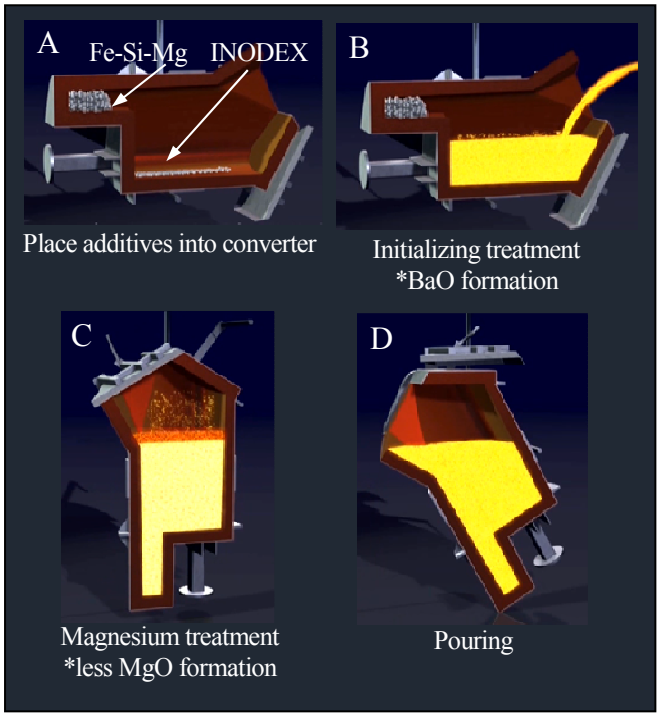

Fig. 2 INITEK process flow

2. Own studies

2.1 Comparison test

INITEK process was compared to Sandwich process using conditions outlined in Table 1.

Table 1 Comparative test conditions (mass%)

	Sandwich	INITEK
Fe-Si-Mg addition rate	1.5% (4 % Mg/2% RE)	0.9% (6 % Mg/1% RE)
1st Inoculation	0.2% (Ca-Al-Ba) *with Fe-Si-Mg	0.4% (INODEX) *before Mg treatment
2nd Inoculation	0.05% (Ca-Al-Ba)	0.05% (Ca-Al-Ba)
Cover material	0.3%	nil
Total additives	2.05%	1.35%
Treatment temp	1773K	1773K
C	3.65%	3.70%
Si	2.35%	2.35%
Residual Mg	0.040%	0.035%

No cover material for INITEK and lower addition rate with Fe-Si-6%Mg against Fe-Si-4%Mg.
Little higher C%, lower residual Mg% are targeted.

2.2 Test result

Comparative test results are shown in Table 2 and Fig. 3, 4.

Table 2 Physical properties*

Parameter	Sandwich	INITEK
Nodule count (n/mm^2)	164	240
Nodularity	92.5%	94%
Elongation	17.1%	19.4%
Tensile Strength (MPa)	520	491
HB	179	171
Residual Mg (mass%)	0.039	0.037
Mg recovery	65%	69%

*Average value of 9 'Y' block samples

INITEK increased nodule count, nodularity and elongation. In addition, INITEK gave better Mg recovery without cover material than Sandwich.

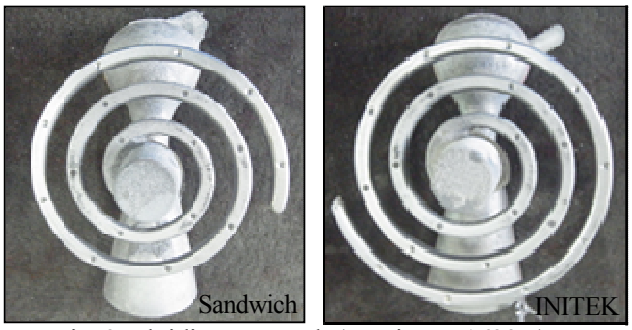

Fig. 3 Fluidity test result (pouring at 1623K)

Fluid distance of Sandwich was 440mm, INITEK was 560mm. INITEK improved fluid distance by 27%.

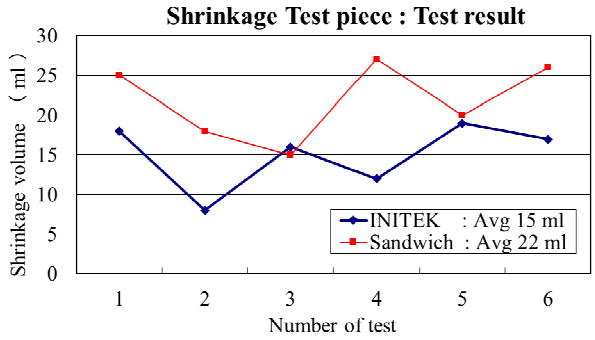

Fig. 4 Shrinkage cavity volume comparative result

The averaged shrinkage cavity volume of Sandwich was 22ml, INITEK was 15ml. INITEK reduced 32% of shrinkage volume.

3. Practical benefits

As Fig.5 shows, shrinkage cavity defect were eliminated for 19 castings manufactured in DCI 450.

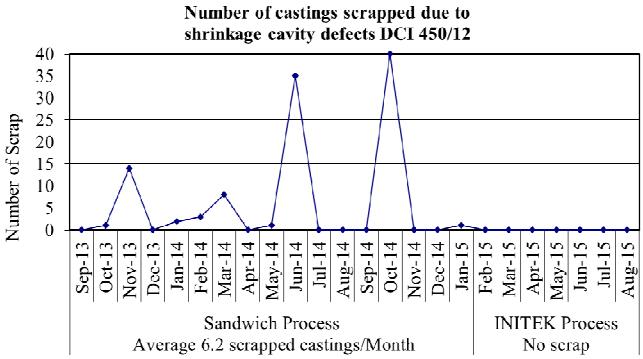

Fig.5 Shrinkage cavity defect occurrences over 2 years

4. Summary

INITEK process gave several benefits

1) Reduced additives which contributes less slag formation and better fluidity of the molten metal
2) Increased nodule count and elongation.
3) Better magnesium recovery
4) Reduced shrinkage cavity volume

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