RIO TINTO IRON & TITANIUM INC.
Sorelmetal
Suggestions for Ductile Iron Production

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MAGNESIUM CORED WIRE TREATMENT ADVANTAGES AND DISADVANTAGES VIS-À-VIS OTHER PROCESSES

by
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During the last decade, the cored wire technology has been intensively promoted for the magnesium treatment of Ductile Iron to become a recognized processing technique. In Western Europe, this technique is utilized for the spheroïdization of about 15% of the Ductile Iron produced while, in North America, its use is continuously growing. This broadsheet, although not "exhaustive", describes the most common Mg treatment methods used, with an emphasis on the cored wire process, and outlines some of their advantages and disadvantages with the objective of helping the foundryman in the selection of the most convenient technique for his operation.

Opened Ladle-Sandwich Process

This simple process, in which the spheroïdizing alloy is either placed in a cavity or on the bottom of the ladle, is often used in foundries manufacturing heavy section castings, or in foundries that produce Ductile Iron occasionally. The Mg recovery, which is usually low and variable, ranges typically between 25 and 40% (amount of alloy introduced in the melt: 1.2 to 2% of the weight of the metal to be treated). In order to improve the yield, the foundryman can place the alloy in dry, perforated cans when he manufactures heavy section castings or, more generally, mix the alloy with "croning sand". (Note: the latter should not be mixed up with the trigger technique which required the foundryman to break the croning sand layer covering the alloy at the bottom of the ladle. This process has been abandoned for safety concerns).

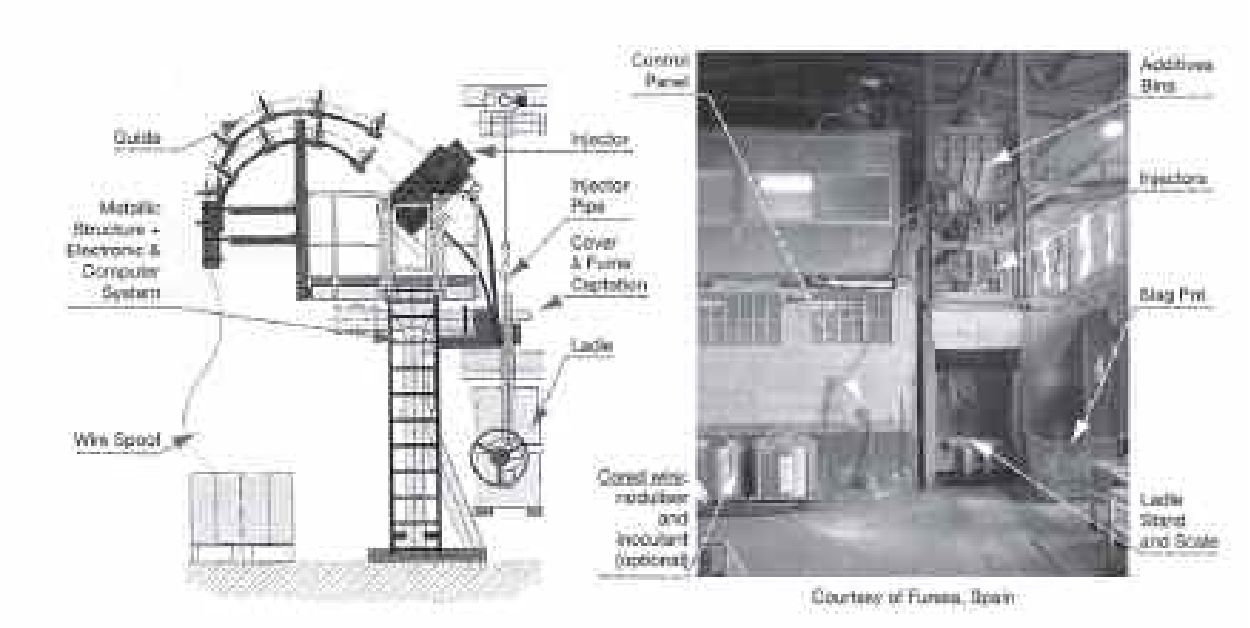
Tundish Ladle Process

This technique, promoted by the **Sorelmetal** Technical Services staff, offers many advantages: easy to use, good metallurgical quality of the iron and low cost. This process is an extension of the open ladle-sandwich process, a cover being placed on the ladle for the Mg treatment. Depending on the seal between the cover/ladle junction, alloy recovery varies between 40 and 70%. The spheroïdizing alloys used are typically Fe-Si-Mg containing 4 to 10% Mg and, oftentimes, small amounts of Ca, Al and rare earths.

Depending on the ladle size, the castings produced and the alloy composition, the amount of added FeSiMg may vary between 0.9 and 1.6% of the weight of the treated metal. Like in other processes, the Mg recovery is a function of the metal temperature and of the initial sulphur content of the liquid iron. In all cases, the foundryman needs to know the composition of all in-coming materials, particularly the recarburizers, to control the sulphur content of the metal. An easy and effective way to maintain and control sulphur within the recommended range (0.008 – 0.015%) in the base iron is to use **Sorelmetal** in the charge. For more information on the tundish ladle process, refer to Rio Tinto published literature.

Cored Wire Process

In the 1950's, injection of desulphurizing materials enclosed in cored wire (or rod) was introduced in steelmaking. Producers of Ductile Iron rapidly noticed the opportunity to use the technology to introduce magnesium or magnesium alloys in the liquid Ductile Iron base metal. Today, the cored wire process for magnesium treatment of Ductile Iron has demonstrated its viability, producing high quality Ductile Iron with very good reproducibility. This user friendly, easily automated process is found in automotive foundries as well as in foundries manufacturing heavy section castings. However, the amortization of the equipment cost makes it sometimes difficult to justify. Moreover, in order to adequately control the process, various sensors are required. In the early days of the process, slow injection speeds were used, e.g. 20 m/minute. However, improved design of the system and experience allow feed rates up to 40 to 50 m/minute. The next step is then to install a second injector to reduce the injection speed while maintaining a short treatment time. An alternative is to use the second injector as "inoculant carrier"; the use of the second injector for inoculation is particularly beneficial for producers of heavy section castings, ensuring an efficient inoculation of the metal. The use of two injectors also favors the economics of the process.



However, as for any other process, the liquid metal must have the appropriate chemical composition, and a particular attention must be paid to sulphur content. Cupola foundries may desulphurize and "nodulize" the iron with the cored wire process by using an alloy containing Mg and Ca. Contact your supplier to select the appropriate material for your iron composition: he will be able to recommend the wire size and alloy composition meeting your requirements.

What treatment should you select for your foundry: cored wire or tundish ladle?
The cored wire process offers the following advantages:

- Less slag/dross formation (less cleaning and longer ladle refractory life).

- Easy to automate and to keep track of data, better reproducibility (less human interventions).

- Process capability better than that of other processes (means lower Mg concentration required).

- Possible to Mg-treat and inoculate simultaneously (same wire, two wires or two injectors) for heavy section castings.

However, the tundish ladle process is and will remain a viable process for the following reasons:

- The iron is Mg-treated with high silicon alloys (FeSiMg) that minimize the carbide promoting effect of magnesium; the spheroïdization and inoculation of the liquid metal with high silicon alloys at the end of the manufacturing process enforce the graphitizing tendency of the iron.

- The optimization of the process ensures low cost (0.9 to 1.2% $FeSiMg_5$ alloy) and reduced temperature losses.

- The initial investment cost is low and fume capture can be performed with the available furnace exhaust system.

The selection of the Mg treatment process strongly depends on the foundry operation itself. Cored wire ensures a better process control, which is key to produce high quality castings. However, lower cost and high graphitization potential favor the tundish ladle process. Whatever the process selected, do not hesitate to contact the **Sorelmetal** Technical Services for more information, either directly or via our website (www.sorelmetal.com) or your **Sorelmetal** agent.