# Typical applications
Specific applications need custom made solutions

## Automotive

### Sophisticated ferrous metal treatment leads to better metallurgical performance

The automotive industry requires castings with higher mechanical properties along with weight reduction. In addition, more complex casting design is a challenge for automotive foundries and needs individual solutions for the ferrous metal treatment. Our products are developed not only to meet those requirements, but also to optimize the processes and production costs of our customers. Hand in hand with the foundry industry worldwide, our R&D and technical team develop custom made solutions to optimize our customers' competitiveness in the casting market.

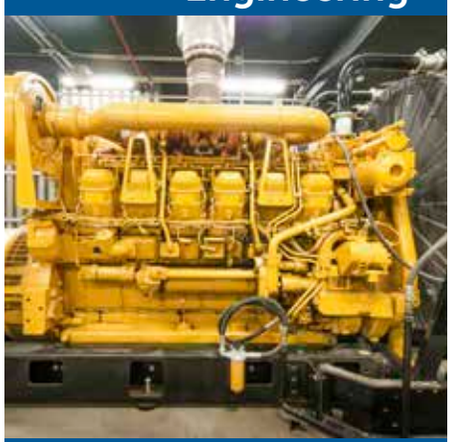
## Cast Pipe

### Inopipe - the key to produce high quality ductile iron pipes

The ductile iron pipe industry is challenged by increasing competition from more inexpensive nonferrous options. In order to compete, the trend has been to thin down the pipe wall thickness, increasing the propensity for scrap. As the leading worldwide supplier of mould powders to the ductile iron pipe industry, we have taken this challenge head on; designing Inopipe compositions that provide better surface quality and microstructure in critical conditions.

Furthermore, the high thermal insulating effect of Inopipe leads to longer mould life.

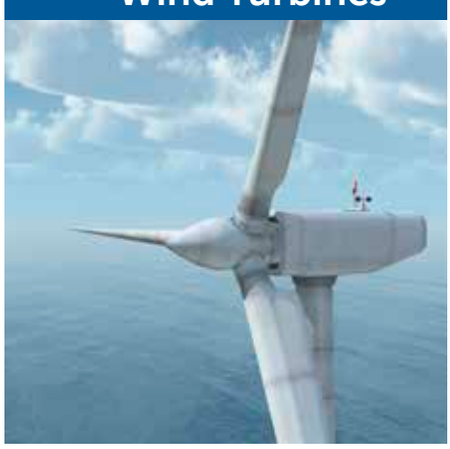
## Engineering



### Engineered casting – needs individual solutions

Engineered castings do not tolerate flaws. In order to achieve a high success rate, avoiding casting defects like Chunky Graphite, Inverse Chill etc., Ferroglobe offers a wide range of inoculants and nodularizers to enable foundries to produce economically sound castings.

## Wind Turbines



### Renewable energy is in our focus

Wind turbines – especially those used in offshore wind farms – are exposed to extremely rough and often rapidly changing weather conditions. Corrosion resistance and low temperature performance are key factors for wind energy castings. Very often an optimized combination of inoculation and magnesium treatment is necessary to obtain the requested casting specification. Ferroglobe provides special metallurgical solutions for heavy section castings.

Ferroglobe

**FerroPem**
517 Avenue de la Boisse
73025 Chambéry
FRANCE
Tel: +33 479 683 100

**Globe Metales S.R.L.**
Globe Metales S.A. Main Office
Pico 1641 Piso 8 „A" (C1429DWA)
Buenos Aires
ARGENTINA
Tel: +54 114 704 2200

**Globe Metallurgical, Inc.**
Beverly Plant
P.O. Box 157
County Road 32
Beverly, Ohio 45715
U.S.A.
Tel: +1 800 845 6238

**Contact:**
service.foundry@ferroglobe.com
www ferroglobe.com

Ferroglobe

Advancing Materials Innovation.

# Innovative Foundry Products

FerroPem

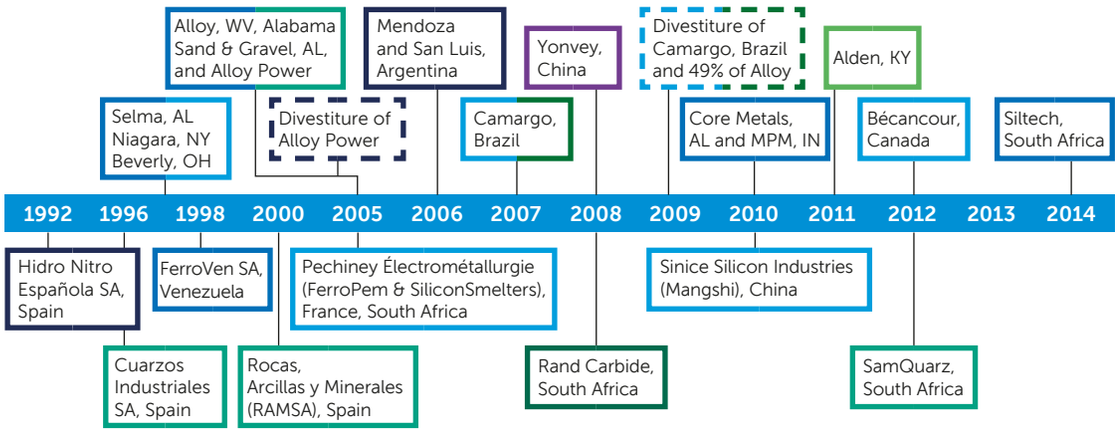
GLOBE SPECIALTY METALS

GLOBE METALES

# Ferroglobe

Created by the merging of the two industry leaders with complementary profiles

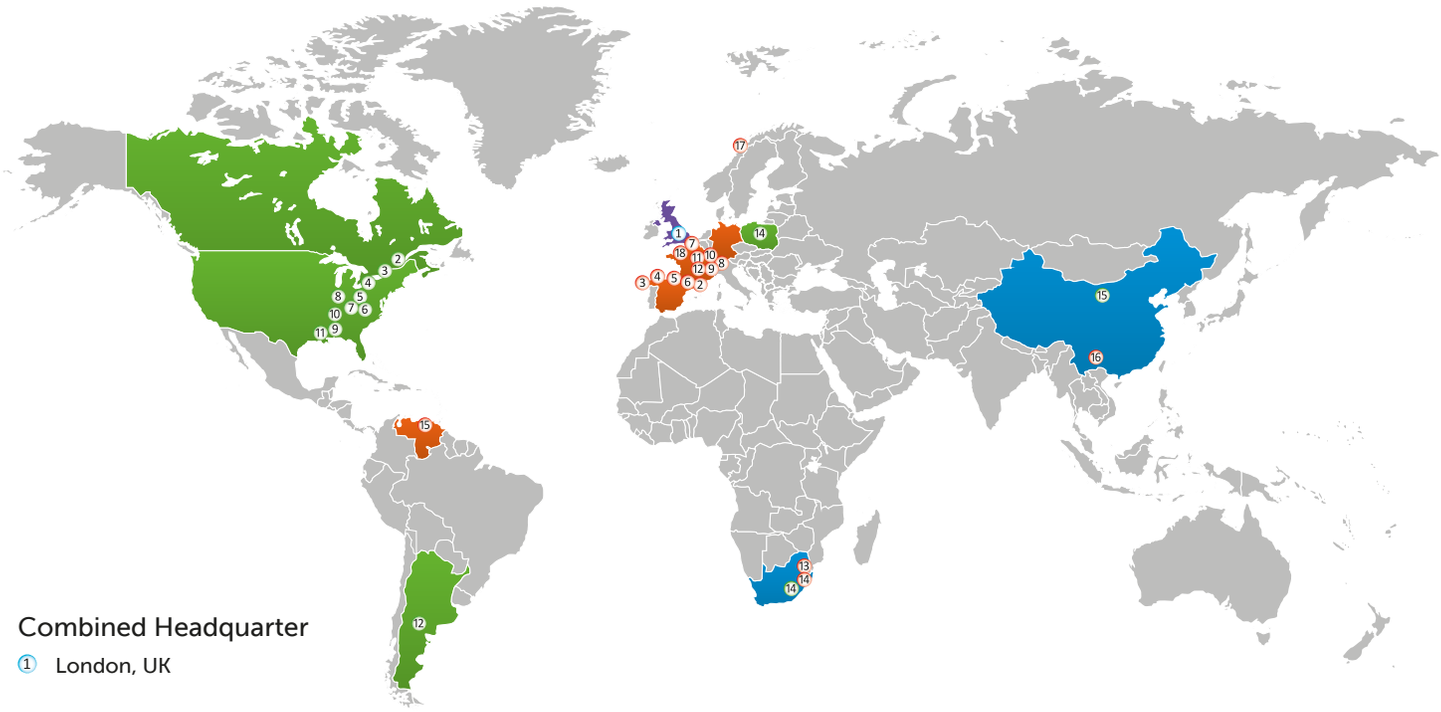
## Acquisitions, Divestitures and Selected Investments Over Time




**2015** Merger of GSM & FerroAtlántica

## Worldwide Ferroglobe representations

With 28 facilities in 10 countries Ferroglobe is the world's largest western silicon metal and silicon alloys producer. A global production base to supply our customers with the most efficient logistics and just-in-time deliveries.



### Combined Headquarter

① London, UK

### Globe Operations

② Bécancour, QC, Canada
③ La Malbaie, QC, Canada
④ Niagara Falls, NY, USA
⑤ Beverly, OH, USA
⑥ Alloy, WV, USA
⑦ Corbin, KY, USA
⑧ Aurora, IN, USA
⑨ Billingsley, AL, USA
⑩ Bridgeport, AL, USA
⑪ Selma, AL, USA
⑫ Mendoza, Argentina
⑬ New Castle, South Africa
⑭ Police, Poland
⑮ Shizuishan, China

### FerroAtlántica Operations

② Boo, Spain
③ Cee, Spain
④ Dumbria, Spain
⑤ Sabón, Spain
⑥ Monzón, Spain
⑦ Pierrefitte, France
⑧ Anglefort, France
⑨ Les Clavaux, France
⑩ Montricher, France
⑪ Château Feuillet, France
⑫ Laudun, France
⑬ Polokwane, South Africa
⑭ Rand Carbide, South Africa
⑮ Puerto Ordaz, Venezuela
⑯ Mangshi, China
⑰ Mo i Rana, Norway
⑱ Dunkerque, France

# Inoculants
## Effectiveness without side effects

| Product | Active Element | Features |
|---|---|---|
| **LMC®<br>INOCAST® 175** | **Ba** | Universal inoculants for general use |
| **ZL 80®<br>INOCAST® 125<br>ZIRCOGRAF®<br>ZIRCOBAR®** | **Zr** | Universal inoculants, fade resistant, appreciated for medium and heavy sections |
| **INOCARB®** | **Graphite** | Avoids chill in grey iron castings, re-activating nucleation |
| **INOCAST® 100** | **Al** | Avoids chill |
| **SPHERIX®** | **Bi + RE** | High nodule count, reduces chill in thin wall castings, reduces chunky graphite in heavy sections |
| **SPHERIX® Plus** | **Sb + RE** | High nodule count, reduces chunky graphite in heavy sections |
| **AMERINOC®** | **Bi + RE** | High nodule count, reduces chill in thin wall castings, reduces chunky graphite in heavy sections |
| **CERINOC®** | **Ce** | Minimizes the risk of shrinkage, improves nodularity, recommended for compacted graphite iron |
| **FESILA®** | **La** | Against micro shrinkage |
| **WIN 4®** | **Bi + La** | High nodule count, reduces micro shrinkage |

All our inoculants are available in the standard sizes 2-7 mm, 0,5-2 mm, 0,2-0,7 mm. Other sizes are available upon request.
Packing: Big bag, drum, paper bag

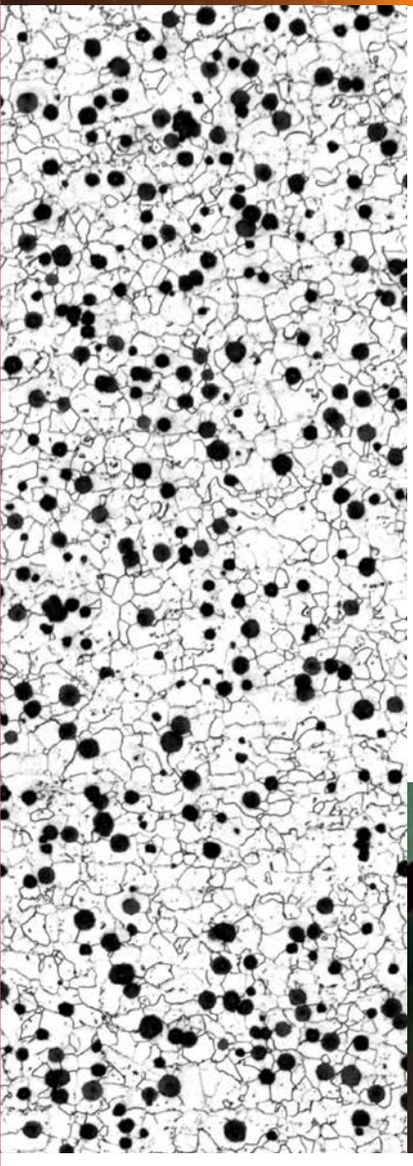
# Inopipe® and Inotube® inoculant powders
## For the production of cast iron pipes

Our Inopipe® inoculant powders were specially developed for centrifugal casting machines using water cooled moulds.

Inopipe® and Inotube® inoculants provide:
- **Protection of the steel mould against thermal shock (increased mould-life)**
- **Improved pipe stripping**
- **Reduction of surface defects**
- **Reduction of carbides**
- **Optimization of the thermal treatment**

# Nodularizers

## Changing microstructures – improving mechanical properties



Ferroglobe produces a wide range of nodularizers in 3 different plants on 3 continents to give our customers safety in supply and quality. Below we have listed some standard grades. We use thin casting technology, avoiding segregation, improving the FeSiMg microstructure and performance. Furthermore we take pride in working one on one with customers designing nodularizer compositions to optimize individual foundry operations. Our quick just-in-time manufacturing allows for rapid composition changes thereby rapidly reducing foundry scrap and optimizing treatment and overall process.

| Reference | Mg | Si | Ca | Al | RE |
|---|---|---|---|---|---|
| **FeSiMg 522** | 5 | 45 | 2 | < 0,8 | 2 |
| **FeSiMg 610** | 6 | 45 | 1 | < 0,8 | < 0,25 |
| **FeSiMg 611** | 6 | 45 | 1 | < 0,8 | 0,5 |
| **FeSiMg 611A** | 6 | 45 | 1 | < 0,8 | 1 |
| **FeSiMg 731** | 6,5 | 45 | 3 | < 0,8 | 0,5 |
| **FeSiMg 731A** | 6,5 | 45 | 3 | < 0,8 | 1 |
| **FeSiMg 931** | 9 | 47 | 3 | < 0,8 | 1 |
| **FeSiMg + La** | 6 | 45 | 1 | < 0,8 | 0,4 (La) |

Available sizing: 0,6-6 mm, 2-10 mm, 5-25 mm; Packing: Big Bag, drum, paper bag

# Inoculant ingots and cored wires
Sophisticated metal treatment for process control

## MOLDINOC® inoculant ingots
For late inoculation

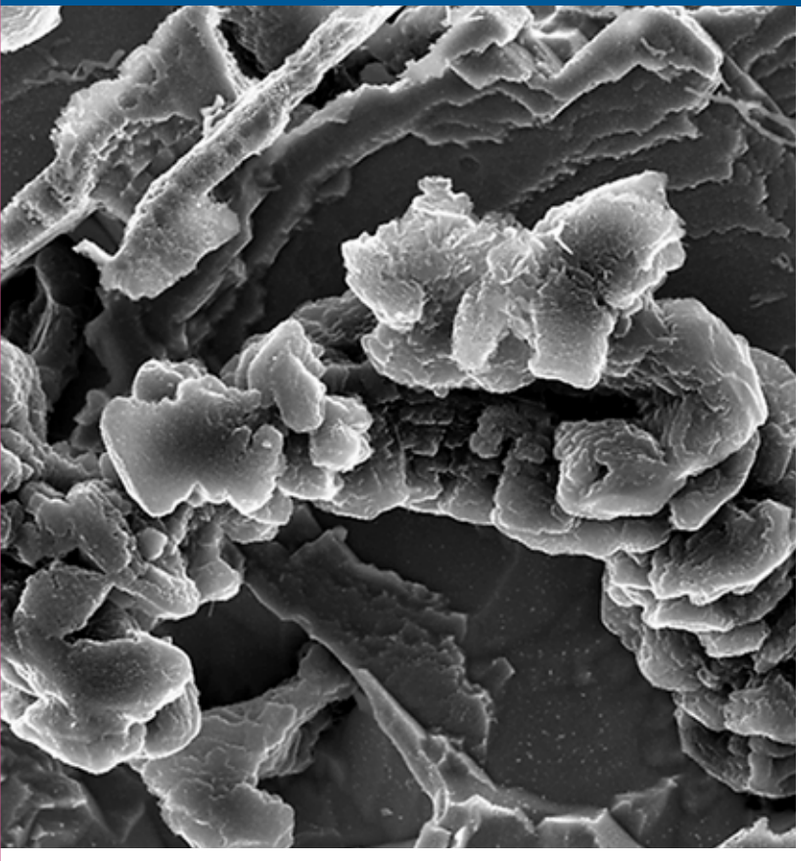
The use of MOLDINOC® inoculant inserts placed in a mould is a method of late inoculation in which the fading phenomenon is virtually eliminated. For heavy castings we produce mould inserts with different weights up to 10 kg.

| Product | Available Weights |
|---|---|
| **MOLDINOC 65®** | 25, 50, 70, 90, 180 gr |
| **MOLDINOC 75®** | 20, 40, 60, 80, 150 gr |

## Composed for your special needs
For magnesium treatment and inoculation

Our FILCAST® guarantees a treatment with very high reliability. All wires are made according to customer specification or designed to solve specific technical problems at our clients. The quality of our wires is ensured by continuous monitored process control.

## Ferroglobe's R & D
Innovation, expertise and advice



More complex castings along with higher mechanical properties increase the need for custom made solutions in foundries.

In order to achieve this goal together with our customers, the technical sales team, that consists of metallurgical and foundry engineers, is supported by Ferroglobe's R & D department. Our latest laboratory technology and high precision analytical equipment enable us to analyze almost all quality relevant active elements and investigate casting defects.

Our goal is to offer you the best technical solution along with cost efficiency and process improvement.

Consequently we do not stop there, as we have understood that the foundry industry needs more innovative products. Our R & D is closely involved in new product developments as we are able to produce Inoculants and Nodularizers in a laboratory scale, including crushing and sizing. These new materials serve us for testing directly in our R & D foundry equipped with induction furnaces, magnesium treatment and test-moulds. These new product developments respond to raising requirements from the foundry industry.

Furthermore, as a leading manufacturer of Mould powders for the ductile iron pipe industry, we are not only able to produce the mould powders in the laboratory, but also to test them with our own horizontal pipe spinning machine.
Close cooperations with universities and external R & D facilities allow us to go head to head with the latest requirements of the foundry industry.

Your satisfaction is our responsibility!

# Effects and behavior

Typical effects of Ferroglobe inoculants

| Product | Grey Iron | Ductile Iron | Universal | Thin Wall | Heavy Section | Various Sections | Against Chill | Nodule Count | Against Shrinkage | Fading Time | Preconditioning | High Dissolution | Porosities N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GRAFIDIN® | | ● | ● | | | ● | ● | ● | | ● | ● | ● | |
| INOBAR® | ● | ● | ● | | ●● | ● | ●●● | ●● | ●● | ●●● | ●●● | | |
| INOSTRONG® | ●●● | ● | ● | | | ● | ●●● | ●● | ●● | ●● | | | |
| INOSTRONG® 50 | ●●● | ● | ● | | | | ●● | ● | | | | | |
| LMC® | ● | ● | ●●● | | ● | | | ● | | | | | |
| INOCAST® 175 | ● | ● | ●●● | | ● | | | ● | | | | ●● | |
| ZL 80® | ● | ● | ●● | | | ●●● | ● | ●● | | ● | | | ●● |
| INOCAST® 125 | ● | ● | ●●● | | ● | ● | | ● | | | | ● | ●● |
| ZIRCOGRAF® | ● | ● | ● | | | ● | ● | ● | | ● | | ●● | ●●● |
| ZIRCOBAR® | ● | ● | ● | | | ● | | ● | | ● | | | ● |
| INOCARB® | ● | | | | | | ●●● | ●●● | | | ●● | ● | |
| INOCAST® 100 | ● | ● | ●● | | ● | | | ●● | | | | ● | |
| SPHERIX® | | ●●● | | ●● | ●●● | ● | ●●● | ●●● | | | | | |
| SPHERIX® Plus | | ●●● | | | ●●● | ● | ●●● | ●●● | | | | | |
| AMERINOC® | | ●●● | | ●● | ●● | | ●●● | ●● | | | | | |
| CERINOC® | ● | ● | ●●● | | | | | ● | ●●● | ● | | | |
| FESILA® | | ● | | | | | | | ●●● | ● | | | |
| WIN 4® | | ●●● | | ●● | ● | | ●● | ●● | ● | | | | |
| MOLDINOC 65® | ● | ● | ● | | | | ● | ● | | | | | |
| MOLDINOC 75® | ● | ● | ●● | | | | ● | ● | | | | | |