11-13 September / Eylül 2014
TÜYAP Fair, Convention & Congress Center, İstanbul
7th International Ankiros Foundry Congress
7. Uluslararası Ankiros Döküm Kongresi

«How To Make Good Ductile Iron Using MgFeSi In An Optimized Ladle Treatment Combined With Preconditioning"»

«Ön İşlemli Pota Uygulamaları ve MgFeSi Katkısı İle Duktil Dökme Demir Kalitesini Arttırma»

Cathrine Hartung
(Elkem, Expert Müm.)

2.Oturum: Döküm Teknolojileri Demir - Çelik

2nd Session: Casting Technologies Iron - Steel

Oturum Başkanı/Session Chairman: Hüseyin Yumak (Trakya Döküm San. Tic. A.Ş.)

How to make good ductile iron

Ankiros 2014

Cathrine Hartung

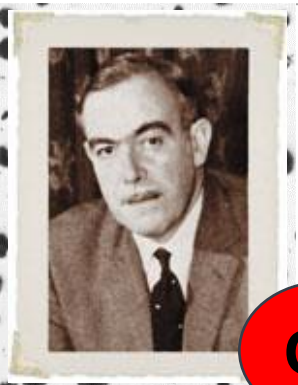
Elkem
A Bluestar Company

CONTENT

- Short recap of history of ductile iron
- Ladle treatment and MgFeSi – then and now
- Current state of industry
- Optimised ductile iron process – what are your options
- Case study
  - Optimised ladle treatment and MgFeSi
  - Preseed™ preconditioner
  - Topseed® Cover Alloy
  - Treat & Pour
- Summary

INVENTİON OF DUCTİLE IRON

1948



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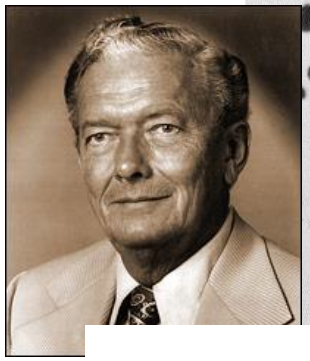
1943



Mg

Global production of DI ≈ 28MTons
Annual growth rate ≈ 7%

UNITED STATES PATENT OFFICE

2,485,760

CAST FERROUS ALLOY

Keith Dwight Millis, Rahway, Albert Paul Gagnebin, Red Bank, and Norman Boden Pilling, Westfield, N. J., assignors to The International Nickel Company, Inc., New York, N. Y., a corporation of Delaware

Application November 21, 1947, Serial No. 787,420
In Great Britain March 22, 1947

200 µm

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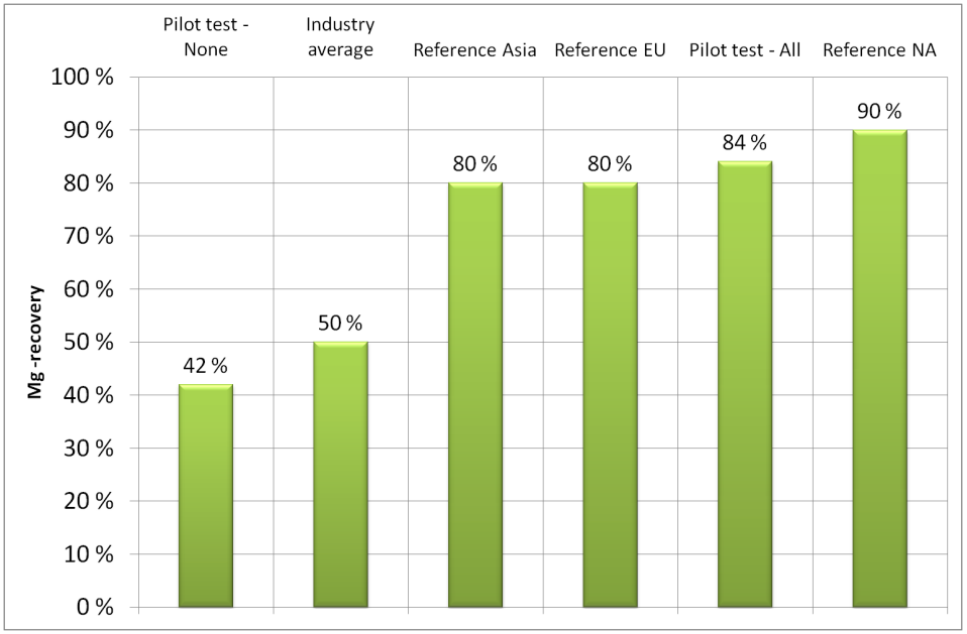
THEN AND NOW



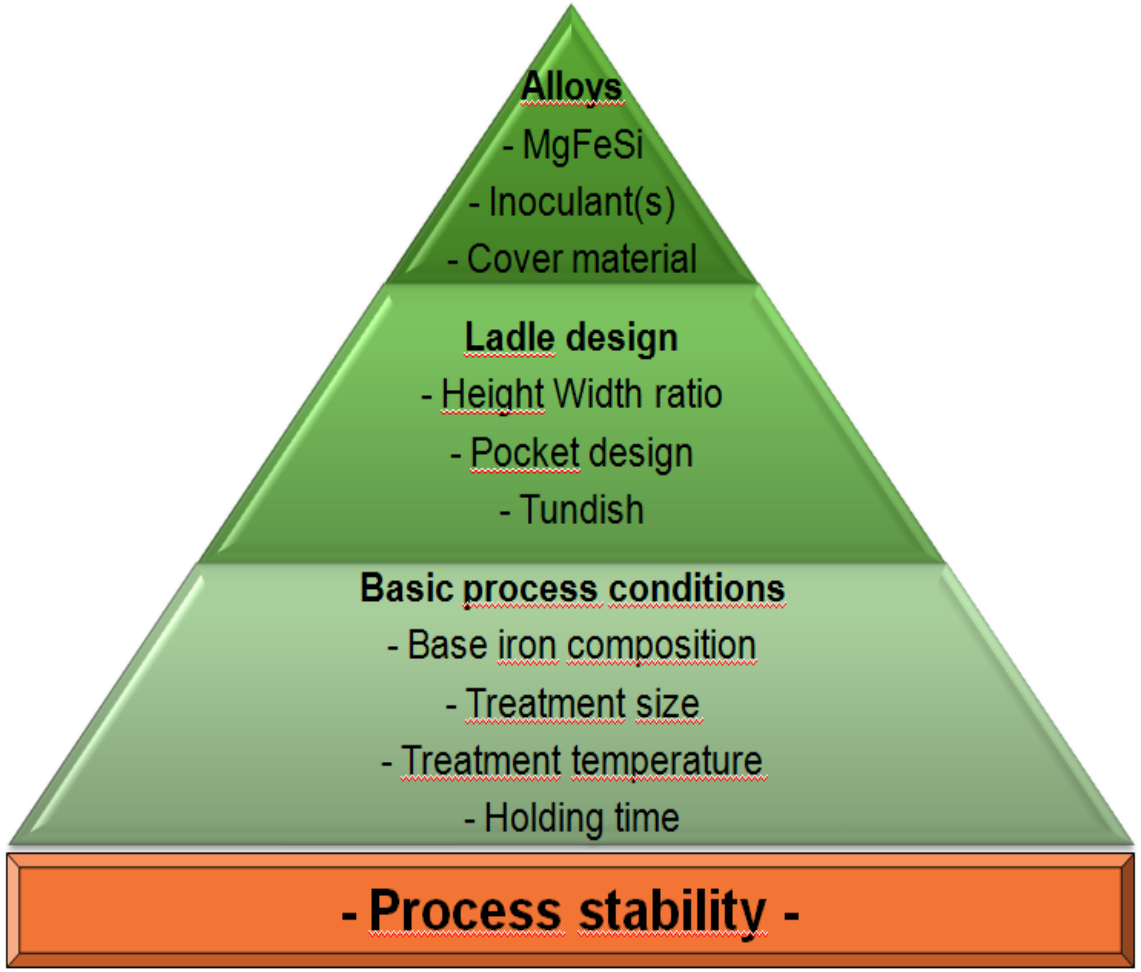
- Base iron S-level typically 0.14%
- A lot of treatment alloys in use
- Same ladle for all operations
- Typical Mg-recovery in the range of 20 to 50%
- Amount of Mg added 2-10 kg

- Base iron S-level typically 0.014%
- MgFeSi and high Mg-containing alloys/alternatives
- Specialized ladle for treatment and pouring
- Typical Mg-recovery industry average 50%
- Amount of Mg added <1kg

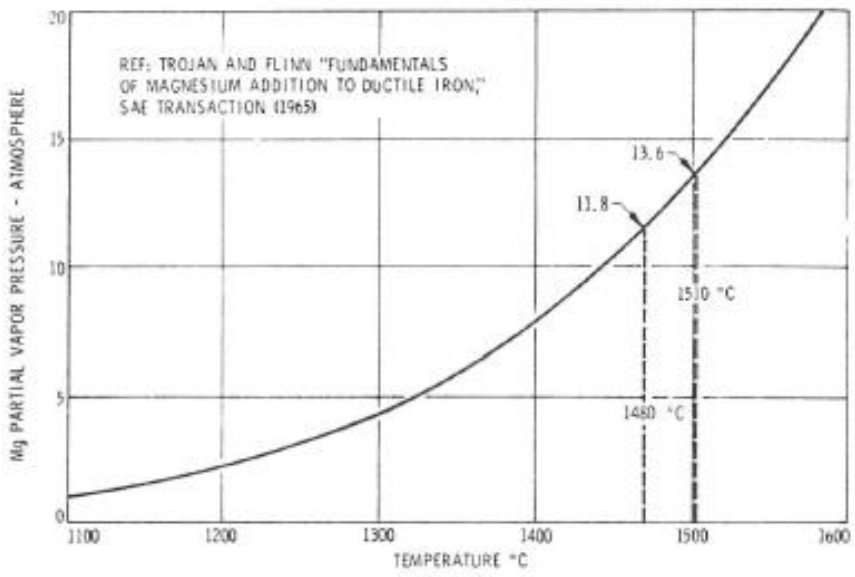
CURRENT STATE OF İNDUSTRY

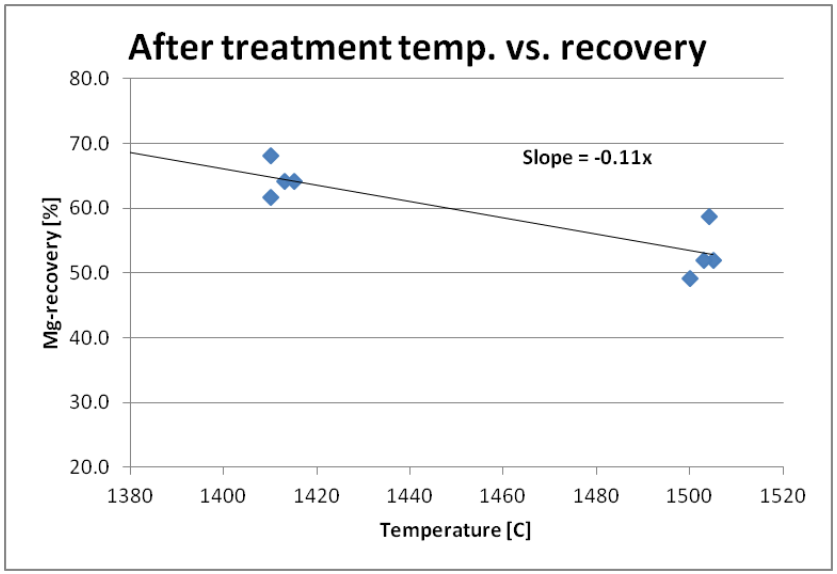
- Higher demands
  - Strength
  - Elongation
  - Impact properties
  - Surface finish
- More unique grades
- Improved process control
  - Tighter specifications
  - Better precision
- More Environmentally friendly production
- Improved quality
- Improved machinability
- Reduced production cost

OPTİMİZİNG THE LADLE TREATMENT – WHAT ARE YOUR OPTİONS



BASİC PROCESS CONDİTİONS





1. Base iron S-level
2. Treatment temperature
3. Holding time
4. Raw material control

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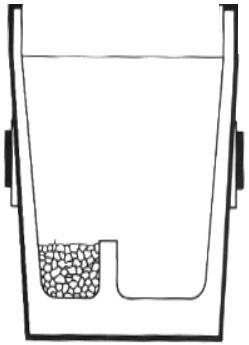
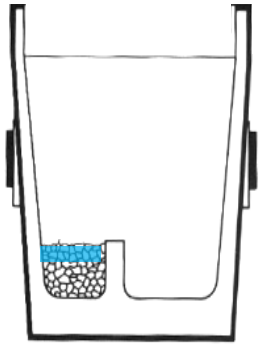
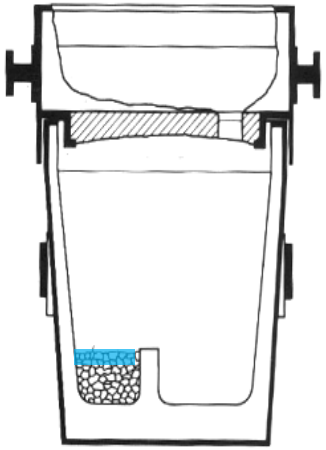
LADLE DESİGN

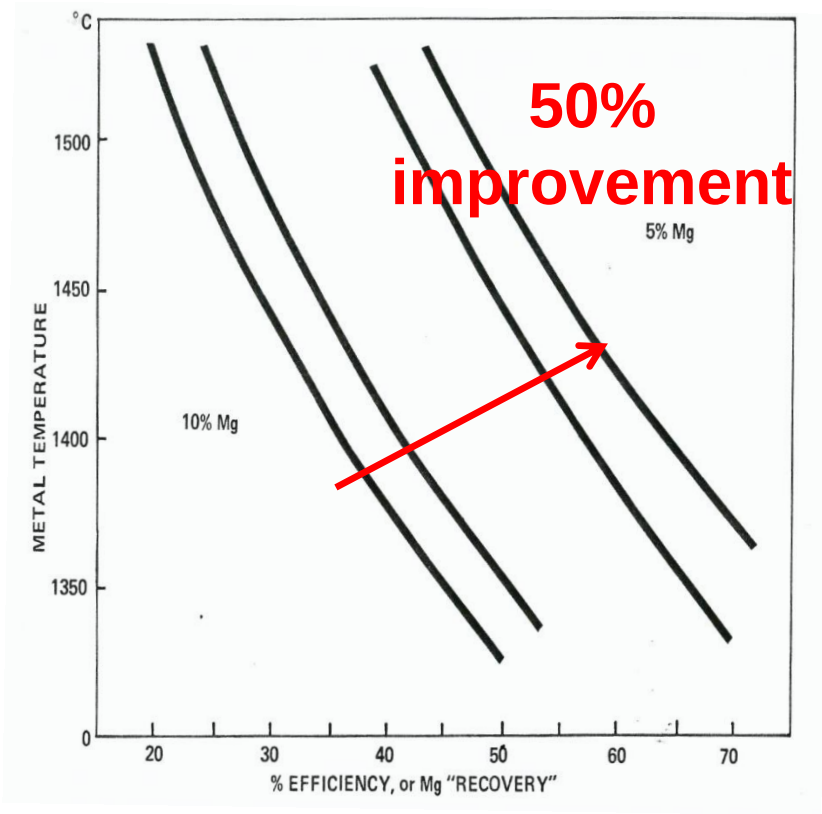




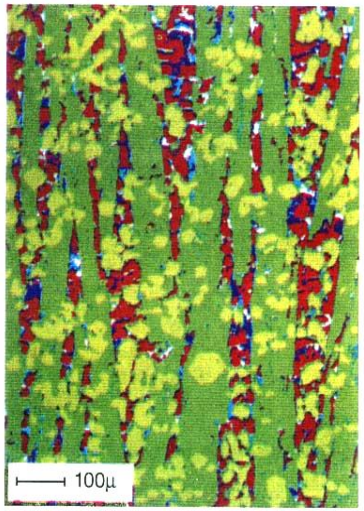


1. Height to width
2. Alloy pocket
3. Tundish lid

ALLOY DESİGN



With decreasing Mg-content Mg-recovery increases



FeSi
$FeSi_2$
Mg_2Si
$(RE,Ca)Si_2$
$CaMgSi_2$
Si
RE = Ce, La, Pr, Nd, etc.

- Add as little Mg as possible
- Find the composition for your needs
  - Reaction control
  - Shrinkage control
  - Trace element control

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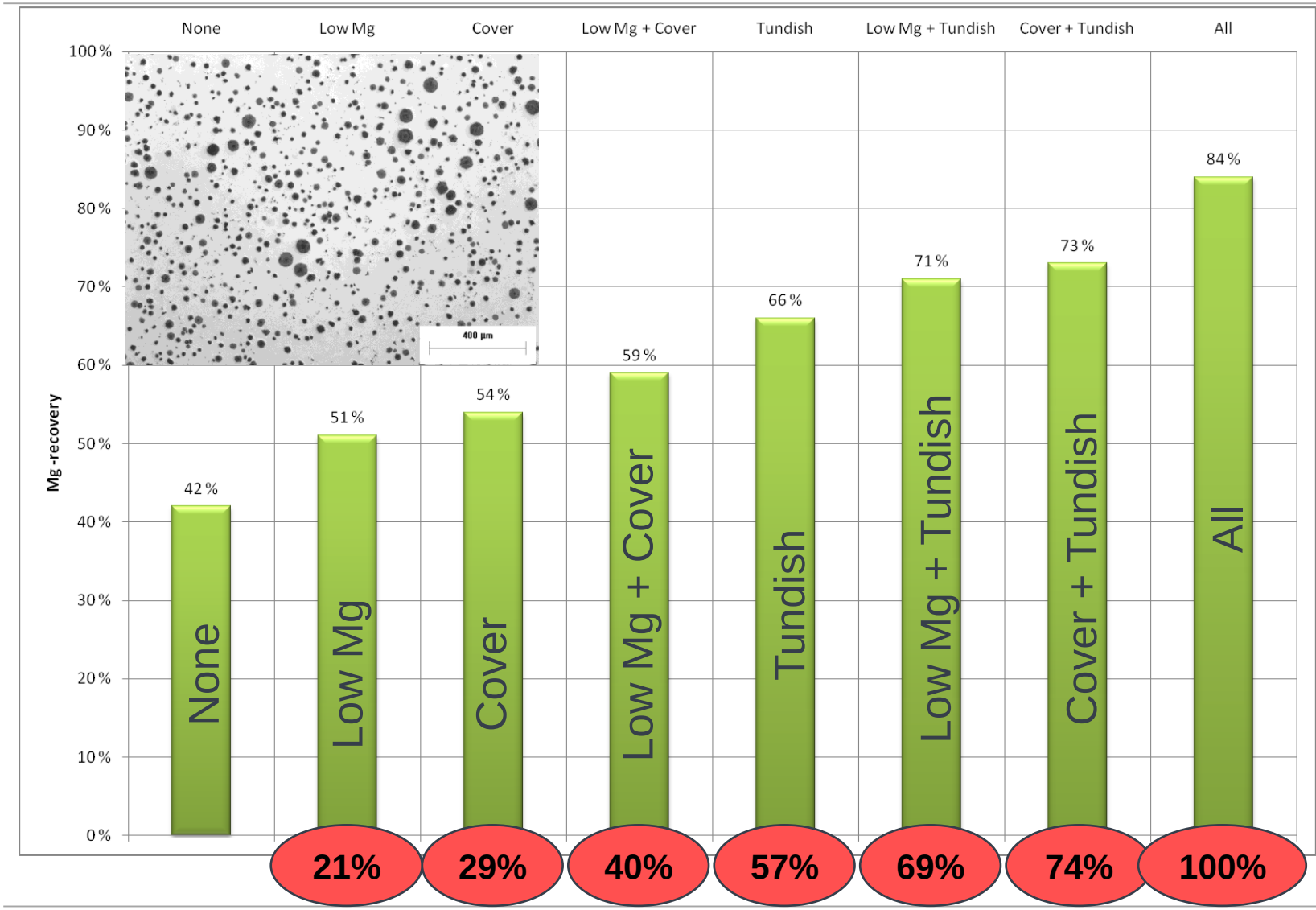
CASE STUDY - EFFECT OF İNTERPLAY WİTH İMPROVEMENT OPTİONS



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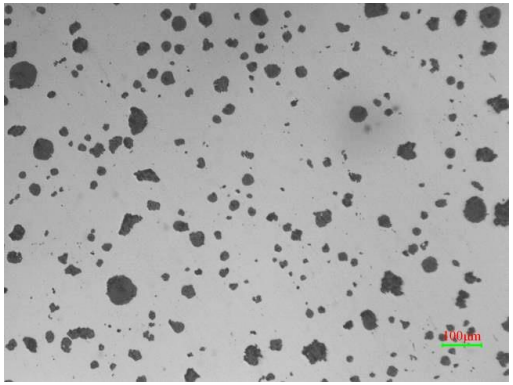
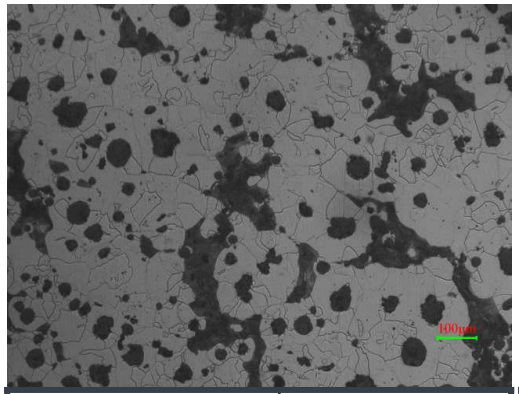
CASE STUDY – PRESEED™ PRECONDİTİONER

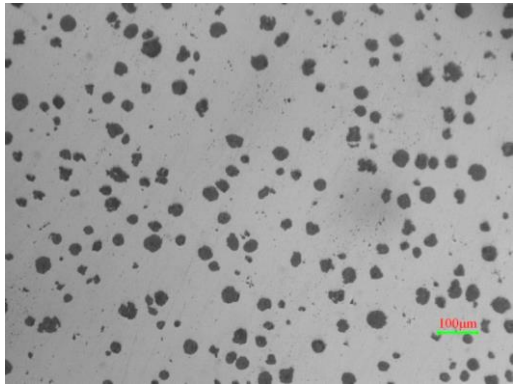
Normal Practice

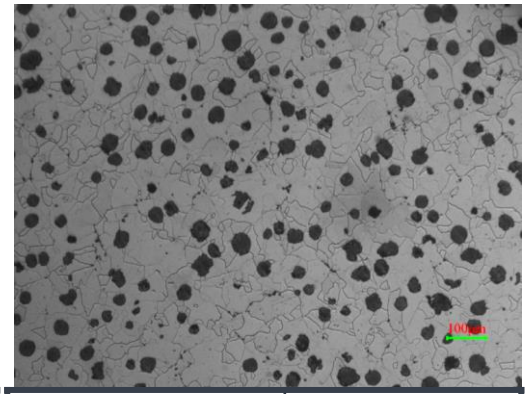




Nodularity	**90%**
No/mm²	**100**
Perlite	**20-25%**

Preseed™ and Elkem metal treatment products





Nodularity	**92%**
No/mm²	**150**
Perlite	**2%**

Material:EN-GJS-400-18U-LT

Changing to Elkem treatment solution and reducing pig iron content in charge with 78%.

	Normal	Elkem
Yield	**285**	**290**
Tensile	**404**	**404**
Elongation	**23.3**	**25.7**
Impact	**12.2**	**16.3**

TOPSEED® COVER MATERİAL

1.1% MgFeSi
0.7% FeSi75
1.5% Steel cover + Flux

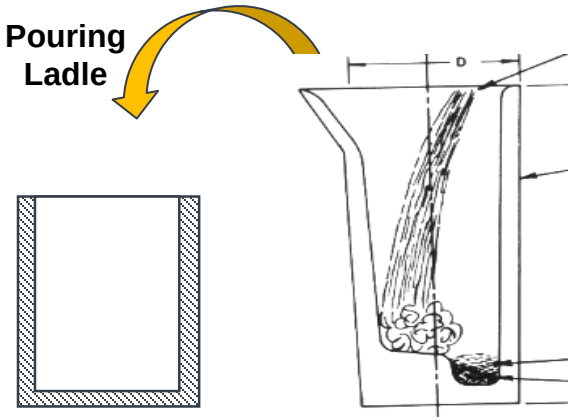
1.1% MgFeSi
1.0% Topseed® Cover

Advantages:

- Optimised Mg recovery
- Nucleation effect
- Slag conditioning
- Process stability

- 50% Si based material with high density
- Sizing provide an even layer of the alloy on top of the MgFeSi.
- High density and endothermic properties provide a slow burns through
- Giving a good ferrostatic head before the cast iron/Mg reaction starts.

CASE STUDY – TREAT & POUR FROM SAME LADLE



MgFeSi: 5.8 % Mg + 1%TRE

Addition rate: 1.5 wt%

Residual Mg: 0.040 – 0.045%

Mg-recovery: 46 - 52%

Average recovery: 49%

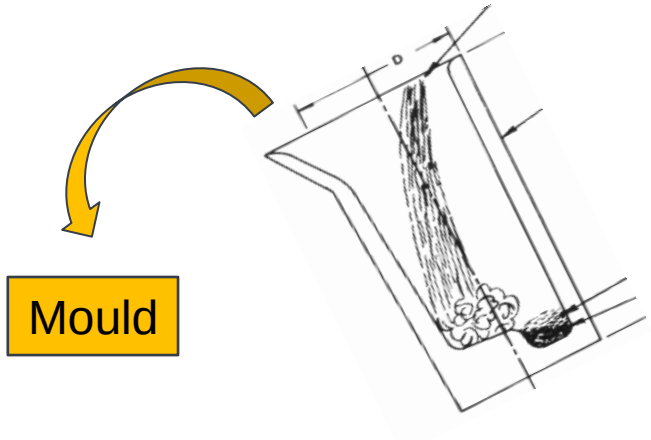
Treatment temp: 1427°C

Ladle filling time: 40-60s

Process Data:
Base S 0.015 – 0.020%
Tap size: 1360 kg

General observations when switching:

- ✓ faster treatment
- ✓ lower temperature
- ✓ less problems with fade
- ✓ reduced temperature loss during treatment
- ✓ potential for reduced power consumption



MgFeSi: 3.5% Mg + 0.5% La

Addition rate: 1.35 wt%

Residual Mg: 0.042 - 0.045%

Mg-recovery: 89 - 95%

Average recovery: 92%

Treatment temp: 1371°C

Ladle filling time :10-15 s

83% improved Mg-recovery & 10% reduced MgFeSi addition

SUMMARY

- To make good ductile iron you should use as little Mg as possible.
- Ladle treatment and MgFeSi:
  - is a cost efficient, simple and flexible solution for making ductile iron.
  - can be adjusted to fit your needs.
  - offer many options for process improvements.
  - can be moved close to pouring.
  - can be optimised to give a Mg-recovery in the range of 80-90%.
- Topseed® Cover Alloy and Preseed™ preconditioner can help you:
  - Improve your Mg-recovery.
  - Improve your irons nucleation potential.
  - Condition the slag.

THANK YOU!

If you have questions or want to learn more contact us:

EXPERT

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