



SMOOTH SOLUTIONS  
FOR STEEL LADLES

# THE PRODUCTS

Alumina-spinel monolithic refractories are used in the steel ladle since the beginning of '90's, but only nowadays the utilization of those materials is becoming more and more extended". These concepts give an answer to the different pattern of wear due to their individual peculiarity in terms of chemical and physical properties.

Seven Refractories formulated several optimized products for the different steel ladle zones depending of the dominant wear mechanism:

- vibrating castables
- self-flowing castables
- shotcrete castables

Our solutions are based on high alumina spinel containing or spinel forming castables.

Spinel containing or spinel forming castables have quite different final properties and their use is related to the application where mainly high mechanical strength or highly elastic behaviour is demanded.

| Brand name                | Type of product                     | Al <sub>2</sub> O <sub>3</sub> | MgO  | Fe <sub>2</sub> O <sub>3</sub> | CaO  | 110°C |      | 1600°C |      |
|---------------------------|-------------------------------------|--------------------------------|------|--------------------------------|------|-------|------|--------|------|
|                           |                                     |                                |      |                                |      | ccs   | bd   | ccs    | bd   |
| Seven Cast 90 NR 09 W -10 | spinel forming vibr. castable       | 92,8%                          | 4,9% | 0,1%                           | 1,0% | 40    | 2,95 | 140    | 2,85 |
| Seven Cast 95 NR 08 W -10 | spinel containig vibr. castable     | 95,6%                          | 2,2% | 0,1%                           | 1,5% | 110   | 3,1  | 180    | 3,10 |
| Seven Flow 92 NR 08 Z -10 | spinel containig self flowing cast. | 92,1%                          | 4,9% | 0,1%                           | 1,8% | 70    | 2,98 | >140   | 2,88 |
| Seven Flow 90 NR 09 W -10 | spinel forming self flowing cast.   | 92,8%                          | 4,9% | 0,1%                           | 1,0% | 35    | 2,96 | >140   | 2,88 |
| Seven Shot 92 NR 08 Z     | spinel containig shotcrete cast.    | 91,7%                          | 5,2% | 0,1%                           | 2,0% | 80    | 2,98 | 150    | 2,92 |
| Seven Shot 87 NR 83 H     | spinel containig shotcrete cast.    | 87,2%                          | 4,8% | 0,1%                           | 1,9% | 45    | 3,06 | 125    | 3,10 |
| Seven Shot 88 NR 08 Z     | spinel containig shotcrete cast.    | 86,9%                          | 5,2% | 0,1%                           | 1,9% | 90    | 2,98 | 150    | 2,92 |

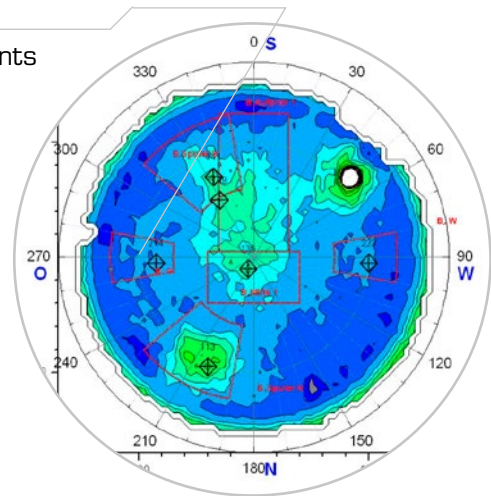
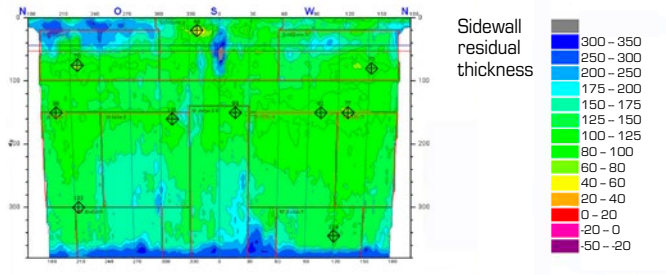
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# PERFORMANCE

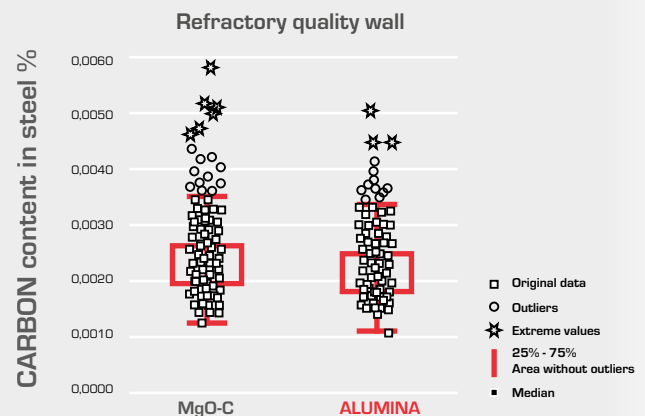
## Low wear speed and higher performance

Regular monitoring through accurate laser scanning measurements enables effective control of the wear lining, more effective ladle management and safety. Beside that it helps to understand the wear speed which to our experience is 0,8-1 mm per heat, in average with a performance up to 150 heats campaign.



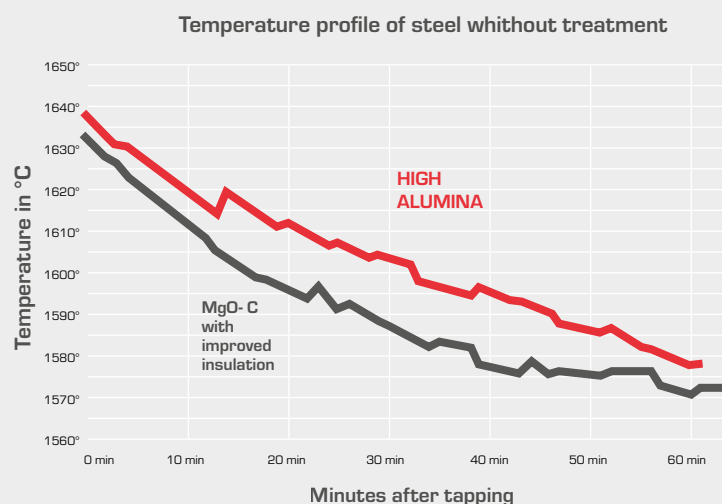
## Comparison of metallurgical results between different lining concepts

Classical steel ladle bricks lining often contain graphite for its desirable thermal shock and slag corrosion resistance. The graphite is a possible source of carbon increase in low and ultra-low carbon steels, promoting carburisation or formation of carbides inside the metal structure, this is also known as “carbon pick up”. Monolithic refractories based on alumina-spinel, applied in the sidewall of the steel ladle, help to reduce the carbon pick up.

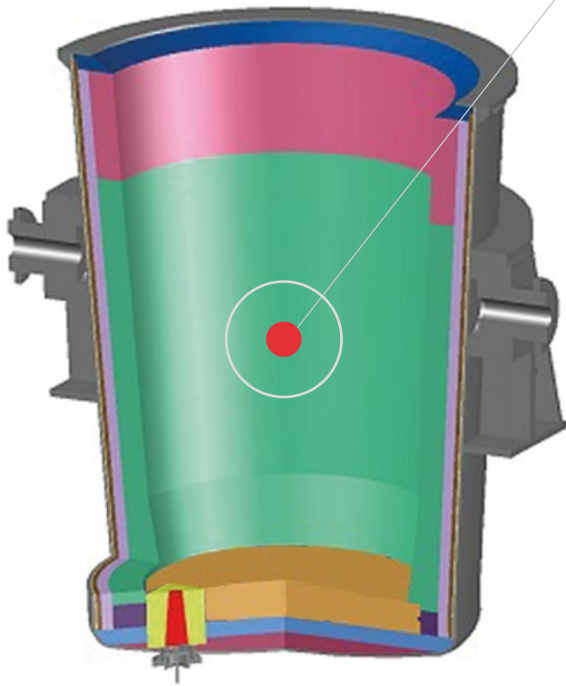


## Comparison of temperature profile between different wall lining concepts

Saving energy in steelmaking is a key factor for improving the process efficiency, reducing costs and the environmental impact. It is well known that thermal conductivity of alumina-spinel refractories is considerably lower compared the MgO-C refractories. This results in a significant lower heat loss during secondary metallurgy treatments and the option of using unshaped refractories to design a refractory lining that can optimise the capacity of the ladle.



## SMOOTH SOLUTIONS



### Seven Flow | Seven Cast | Seven Shot help to improve the following:

- Impact of intense stirring, in the vacuum degasser and secondary metallurgy processes
- Increased tapping temperature and exothermic reactions by alloying and hot spots by thermal heating
- Stability of the mineral oxides compounds against reduction or de-oxidation
- Resistance against corrosion and penetration of aggressive composition slags into the lining pores
- Elastic deformation of the steel shell by charging of liquid steel, transport movements and tilting
- Thermal shock in any eventuality or process
- Increased residence time of the liquid steel
- Ultra low carbon steel requirements preventing carbon pickup from the lining

### Benefits of a modern castables for the steel ladle linings:

- Enables 'endless repair' practices
- Helps safeguard the steel quality
- Ensure safety during operation
- Limitation of lining cracks and steel penetration to the back-lining
- High thermal and thermo-mechanical stability
- Increase of erosion and corrosion resistance
- Improved resistance to thermal spalling
- Enhanced the thermal cycling
- Reduction in refractory consumption
- Reduction in wastage material
- Helps to contribute to environmental protection



### COMPLETE CUSTOMER SERVICE

- Preliminary study and investigation for the entire project
- Design and architecture including bill of materials and thermal calculation
- Full range of products for lining and maintenance
- Supply of mixers, gunning machines, pumps, etc.
- Training on mixing, gunning and maintenance techniques
- Training on equipment usage
- Supervision and monitoring by experienced technicians
- Global research & development
- Technical advice by experts
- Monitoring and targeting of results