

The

Refractory BEAT

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Dalmia OCL



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SPOILT FOR CHOICE

FOR LADLE LININGS

Find out about the multiple options that only Dalmia-OCL offers as far as ladle lining choices go

From the CEO's desk



Dear Partner,

It gives me great pleasure to present to you, *The Refractory Beat*. It's your window into the world of Dalmia-OCL and its associated businesses, including the well known GSB Group and the all-new Dalmia Seven, our joint venture in India with Europe's monolithic specialist, Seven Refractories.

Some of you may already know what Dalmia-OCL is and what it brings to steelmakers across the world. Capabilities spanning refractory design, manufacturing, application and management. And a product range as wide and diverse only a few refractory companies in the world are able to offer. With a total of 700+ SKUs, Dalmia-OCL offers shaped and unshaped refractories of all kinds for a variety of equipment and processes - coke ovens, blast furnaces, transportation (all types of ladles), primary and secondary steel making, flow control and casting. Be it a fresh installation, or refractories for repair and maintenance, Dalmia-OCL works with leading steelmakers & OEMs in both India and across the world, to ensure its refractories provide the critical lining support steelmakers expect from the best around the world.

Dalmia-OCL is the lead brand representing the refractories business of India's \$1.7 billion Dalmia Bharat Group. Our facilities span five raw material mines, seven manufacturing plants in India, China and Germany, and a specialised refractory R&D Centre in India which even collaborated with India's ISRO (Indian Space Research Organisation) for development of rocket ceramics at one stage. Dalmia-OCL caters to multiple industrial segments such as Cement, Glass, Non-Ferrous metals, Power & Petrochemicals, aside from Iron & Steel of course. Refractory business I feel is more a people business than anything else, a fact vindicated by long buying, testing, application and performance cycles. Human resource is the glue that keeps it all together. Dalmia-OCL currently has a talent pool with 6,000+ man-years of diverse, rich and proven refractory experience, which is rapidly growing thanks to its global expansion, via both organic and inorganic means. Over the last 70 years or so, Dalmia-OCL has worked

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LANCE INNOVATIONS FROM A EUROPEAN CHAMPION



By Kumar Subramaniam

INTRODUCTION

Refractory lances are an integral part of clean steel making, being used in both primary and secondary metallurgy. These have come a long way today from the time of its first development. The first lance designs were essentially a steel pipe surrounded by refracto-

ry ring shaped bricks fixed with mortar. GSB Group takes pride in the fact that they were one of the first during the 1970s to produce monolithic lances in continental Europe, meanwhile having emerged as a true global leader in terms of quality and quantity in the field of lance technology.

IRON LANCES

One of primary steps in improving the quality of steel is to reduce its sulphur content, as sulphur is one of the most detrimental impurities in steelmaking process, affecting both internal and external qualities. Classical de-sulphurisation process involves injection of a range of fine powders like lime, calcium carbide and magnesium, which are chosen depending on local conditions with a refractory lance immersed into an open ladle or a torpedo ladle car. The most suitable vessel for hot metal de-sulphurisation are the iron transfer ladles, because of its shape, which makes it much easier to de-slag compared to a torpedo. From the refractory lance

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AS FAR AS STEEL LADLE LININGS GO DALMIA-OCL SPOILS YOU FOR CHOICE



India's fastest growing refractory company gives you up to 5 options including bricks, monolithics or a mix of both to choose from for deploying an optimal lining for higher performance and benefits associated with it such as ladles remaining in circulation for a longer time, shorter downtimes and reduction in overall costs.

Traditionally steelmakers have relied on MagCarbon bricks for lining up ladle bottoms, metal zone and slag zone. With advancements in monolithics, steelmakers can now expect more than just repair and maintenance from castable. Automation is slowly creeping into these new practices and monolithics can now be used for restoring, even building ladle bottoms and metal zone sidewalls for longer campaign cycles. What's more, these new monolithic options allow for additional benefits such as the ability to make cleaner steel and very low carbon pickup. Dalmia Seven goes on to promise an endless lining through its products and services portfolio. Read on to learn more.

ADVANCED MONOLITHIC SOLUTIONS FOR STEEL LADLES

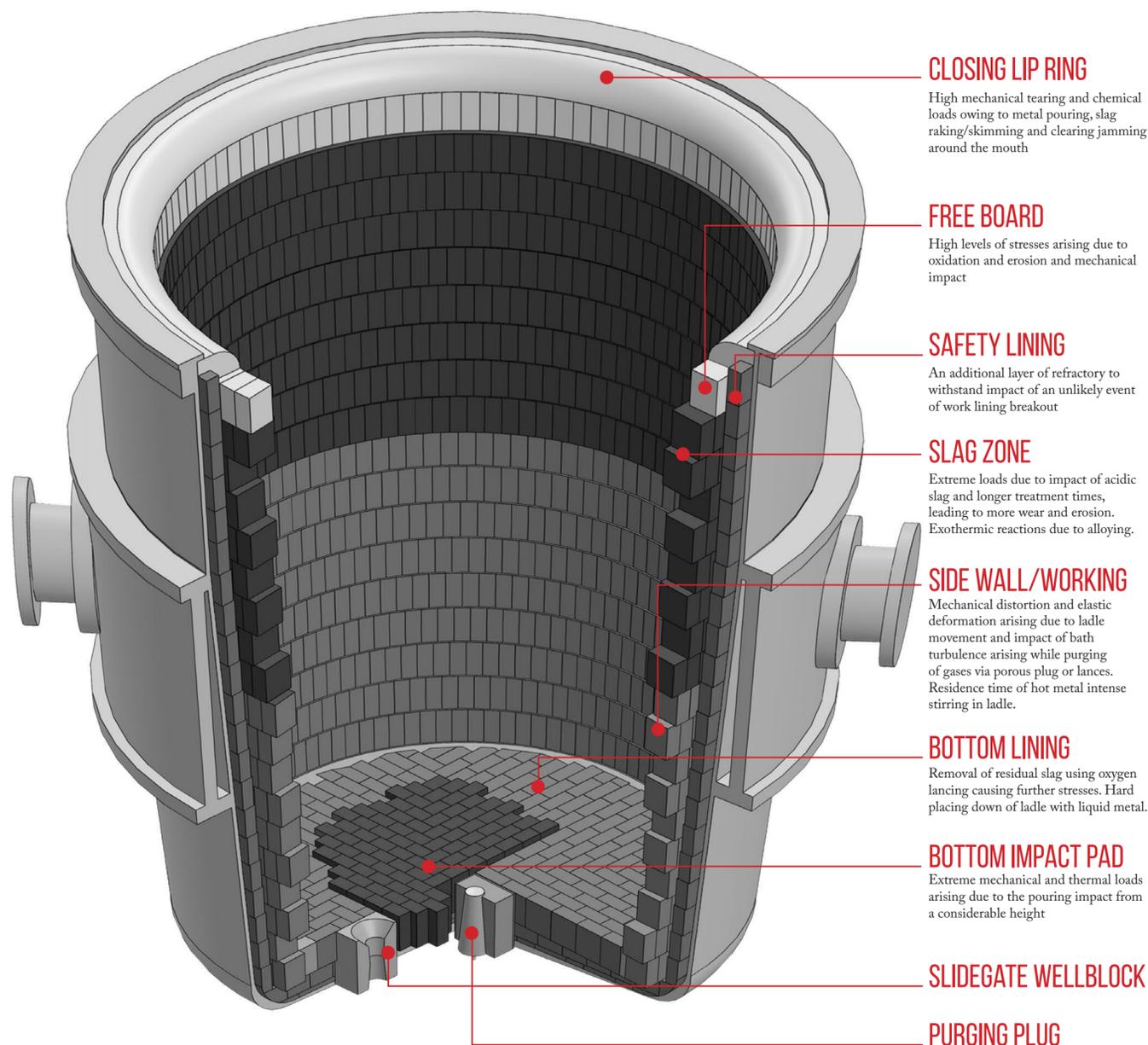
Dalmia Seven offers steelmakers multiple monolithic approaches as an alternative to classical steel ladle brick linings. The transition to a progressive adoption of a monolithic solution brings several advantages in terms of performance, consumption and most importantly, the economics of the entire steel production cycle.

Options include

- A monolithic working lining of the ladle bottom (instead of the original brick lining) with the application of self-flowing castables. It is a very easy and comfortable technique accompanied by no vibrations, no moulds and no requirement of any specialized manpower.
- A full monolithic working lining of the steel ladle (bottom and sidewalls) with the application of self-flowing as well as vibrating castables. A complete and versatile solution, this option is highly reliable and has proven itself at multiple locations across the globe.
- Application of monolithic castables by shotcreting to form a protective layer on existing working brick lining. This is a very innovative approach where the progressive consumption of bricks, heat after heat, is stopped and sort of frozen after first hot repair of the ladle. This is theoretically an endless process as consumed castable can be constantly substituted by newer castable to reduce both downtime and costs.

Advantages

- Endless lining: continuous repairs instead of material substitutions
- Reduction in material consumption (in absolute as well as specific terms)
- Reduction in waste and its disposal
- Potential increase in steel ladle capacity (under specific circumstances)
- Total elimination of weak points in the lining, given the total absence of the gaps, joints etc.
- Achievement of the smoothest lining surface ever, with consequent reduction of any potential non-metallic inclusion in steel
- Reduction in delivery times with very fast (and easy) installations or repairs
- Reduction in space occupancy in the warehouse



CLOSING LIP RING

High mechanical tearing and chemical loads owing to metal pouring, slag raking/skimming and clearing jamming around the mouth

FREE BOARD

High levels of stresses arising due to oxidation and erosion and mechanical impact

SAFETY LINING

An additional layer of refractory to withstand impact of an unlikely event of work lining breakout

SLAG ZONE

Extreme loads due to impact of acidic slag and longer treatment times, leading to more wear and erosion. Exothermic reactions due to alloying.

SIDE WALL/WORKING

Mechanical distortion and elastic deformation arising due to ladle movement and impact of bath turbulence arising while purging of gases via porous plug or lances. Residence time of hot metal intense stirring in ladle.

BOTTOM LINING

Removal of residual slag using oxygen lancing causing further stresses. Hard placing down of ladle with liquid metal.

BOTTOM IMPACT PAD

Extreme mechanical and thermal loads arising due to the pouring impact from a considerable height

SLIDEGATE WELLBLOCK

PURGING PLUG

INDIA'S BIGGEST STEEL LADLE ATTAINS HIGHEST EVER LIFE WITH DALMIA-OCL SPINEL BRICKS

Plant: Tata Steel, Kalinga Nagar, Odisha
Ladle cap (heat size): 310 MT
Ladle route: BOF - CAS OB - TWIN STRAND SLAB CASTER

WORKING LINING CONFIGURATION OF TATA STEEL KALINGA NAGAR LADLE		
AREA	QUALITY	THICKNESS (MM)
Bottom	AMC	250
Bottom Impact	AMC	300
Metal Zone	Spinel	177.8
Slag Zone	MgO-C	177.8 / 152.4
Free Board	MgO-C	177.8 / 152.4

Background

Tata Steel's Refractory Engineering Department at their newly commissioned Kalinga Nagar plant in Odisha, India was tasked with attaining higher lining life for their steel ladles. Tata Steel worked closely with multiple refractory makers including Dalmia-OCL to find ways of improving lining life without compromising on safety, reliability and productivity.

Dalmia-OCL proposed using AluSpin 95 for the ladle's metal zone. And the results were fantastic. AluSpin 95 checked all the boxes as far as the objectives of this exercise went, including:

- 1) Achievement of higher lining life leading to reduced down time, faster turnaround (owing to second slag zone repair in lieu of re-lining), fuel economy (on account of less pre-heating duration) and utilization of each segment of lining to its fullest potential
- 2) Better volume stability and lower conductivity resulted in slower temperature drops and most importantly in delivery of a high-purity lining system

In the process, the ladle attained its highest-ever life of 168 heats with AluSpin 95 lining up its metal zone, a current record for the shop. Subsequent benefits included improvement in different metrics such as lesser number of ladles in circulation, more heats per ladle per day, less refractory salvage generation due to lower specific consumption of refractory, better inventory management and reduction in overall refractory cost.

Further development

The technology and product development team at Dalmia-OCL, has now introduced an intermediate quality brick for the Slag Zone - Metal Zone interface. Initial results are encouraging. Moreover, with rationalisation of lining quality, optimization of working thickness in various zones like purging, non-purging side and improvement at interface zone, AluSpin 95 is all set to scale newer heights in crossing even higher benchmarks.



CASTABLE BEING DROPPED TO LINE UP THE LADLE BOTTOM



TECHNICIAN GIVING FINISHING TOUCHES TO THE BOTTOM SURFACE



FINISHED LADLE WITH NEW MONOLITHICS BOTTOM & METAL ZONE LINING



MOULD READY TO BE PLACED INTO THE MAIN STEEL LADLE



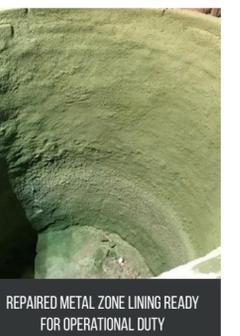
MOULD BEING LOWERED INTO THE STEEL LADLE



FINISHED LINING INSIDE THE STEEL LADLE



TECHNICIANS CARRYING OUT RESTORATION OF METAL ZONE LINING



REPAIRED METAL ZONE LINING READY FOR OPERATIONAL DUTY

EMAIL US AT COMMS@DALMIAOCL.COM OR INFO@GSB-GROUP.DE TO
LEARN MORE ABOUT LADLE LINING SOLUTIONS OFFERED BY US.
WE LOOK FORWARD TO HEARING FROM YOU.

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perspective, torpedo ladle lances have always achieved lower performance levels compared to open ladles, as in case of the former, the method involves immersing the lance at an angle, which results in severe thermo-mechanical stresses and localised wear.

A North American steel mill approached GSB Group to improve performance of their iron de-sulphurisation lances that happens in a Torpedo Ladle car through a single straight hole. GSB Group successfully designed a twin port 'T' hole which resulted in almost 60% percent refractory performance improvement as well as 25% improved operational efficiency in terms of reduced consumption of re-agents, and reduction in injection time per heat.

STEEL LANCES

Clean steel necessitates different characteristics depending on the need and properties required for the final product. Some secondary metallurgy steps like de-oxidation, prevention of re-phosphorisation, deep de-sulphurisation are carried out using a refractory lance for two main purposes. Firstly, for the homogenization of bath composition and temperature, in order to facilitate better interactions between slag and metal. Secondly, for introduction of specific solid or gaseous elements into the molten steel bath. Considering the criticality of the operational demand, GSB Group has de-

veloped a special endoscopic method to check the lances.

GSB Group has closely monitored seven different steel mills in Europe over a period of nine months to investigate reasons for removing the stirring lance from service. Survey results showed that around 21% of the lances were failing prematurely due to blockages of exit ports. As a result GSB Group has developed an alternative exit port arrangement like the slit lance as well as lances fitted with purging plugs. These newly developed systems display multiple advantages as below:

- Elimination of blockages during course of the process
- Improved lance performance
- Smaller and finer bubble size for process efficiency
- Lower consumption of injection gases

CONCLUSION

Increased quality requirements and demands continue to drive steelmakers to refine their processes to produce better and cleaner steel. The role of different types of refractory lances is of high significance in the world of steel making. The contributions of GSB Group in terms of continuous innovation has led to the development of Slit lances and Purging Plug fitted lances, which guarantee enhanced performance and operational reliability providing a cutting edge to global steel makers.

About the Author

Kumar Subramaniam is Managing Director of GSB Group GmbH and is based in Bochum, Germany. Kumar enjoys delivering on tough business challenges and building solid high-performing teams. He has years of experience of partnering customers in diverse geographies. He established a greenfield manufacturing site in India for GSB's refractory business. Kumar can be reached at kumar@gsb-group.de.

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From the CEO's desk

with customers in over 40 countries. Our customers characterise us as a dependable and responsive partner with products that deliver a consistent performance. Investments we have made in recent years have ensured we are now much stronger in technical and delivery capabilities for our customers' unique needs.

The Refractory Beat is my team's initiative to stay regularly connected with you and bring you up to speed with what's new at our end and how it could mean 'more' for you and your business. This platform will allow us to share with you what goes on behind-the-scenes to

create bricks, monolithics and solutions that have helped us stay ahead of competition in many areas, for the longest time.

I hope you will enjoy The Refractory Beat as much as the team enjoyed putting it together. Do share what you liked and what you didn't. Email your feedback, comments and suggestions to ceo.refractories@DalmiaOCL.com. I'm looking forward to hearing your views.

Warm regards,

Sameer Nagpal
Group CEO

OPTIMAL OR SUB?

THE CASE FOR COLLABORATION BETWEEN STEELMAKERS AND REFRACTORY SUPPLIERS



By Tom Vert

Steel ladle refractory selection decision making can be done in three main possible ways: by the steel company only, by the refractory supplier only or by a collaborative team involving both parties with a common goal.

The question for many years has been how to get the best refractory ladle lining design that maximizes life, while minimizing risk to the steel plant and at the lowest cost/tonne.

If the steel maker takes on the lead role for this, they will naturally always tend to minimize risk to the steel plant to ensure zero ladle breakouts and no impact to steel product quality. This gives a good solution, but not necessarily optimal, as there may be different refractories that can yield a better solution, but they do not have the technical ability and/or design knowledge to execute this.

If one allows the refractory supplier to take the lead and put their trust in them only, then an aggressive approach of trials (and potential failures) that may affect the plant and/or product in the goal of driving to higher life and lower cost/tonne may ensue. Again, this would be a sub-optimal approach.

The best solution is a collaborative team made up of a steel operations process engineer, a steel plant refractory technologist, an installer representative, a refractory technical support person and a

refractory R&D person that would drive to the optimized solution and common goal.

This type of team can work on a customized solution since each plant and process route is different and there are no generic answers. Historically, plants with this approach have the following benefits:

- Larger heat sizes through safety lining redesign without increased risk to ladle breakouts
- Balanced ladle life whereby the slag-line, metal line, bottom and blocks all wear evenly and no refractory is wasted
- The ability to avoid ladle life drops due to new process changes by designing changes proactively and therefore always improving
- Partnerships that can increase life and decrease cost/tonne by 5% per year each year

As presented at COM2010 in Vancouver, BC, Canada. ArcelorMittal Dofasco showed improvement in ladle lining life from 50 heats to over 170 heats and cost/tonne savings of over 40%. (Advances in refractories V: 5th international symposium; The Michel Rigaud symposium; Mazzetti, V)

As the steel industry continues to drive for improved performance, the question for the steelmaker therefore is: do I want my refractory solutions to be optimal or sub?

About the Author

Tom Vert is the author of "Refractory Material Selection for Steelmaking" and a recognised world refractory expert with a demonstrated history of working in the Steelmaking industry. Tom Vert has led major successful improvements in safety, environmental, productivity, costs and quality performance through a team based approach using "our strength is people" approach.