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Low carbon, green, high quality refractories



Application of high-calcium magnesia with low silica & low ferric oxide and its purification effect on molten steel

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win-win cooperation

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1. Background

1. Background

















Clean steel technology:

The type, quantity, size, and distribution of inclusions in steel are required to have no adverse effects on product processing and usage performance.



The clean steel has higher requirements for refractory materials:

Reduce the type, quantity, size, and distribution of inclusions in steel



1. Background



> Problems with ladle lining



Mechanical scouring



Chemical erosion



Thermal shock damage





New requirements of clean steel for ladle lining materials





2. Application of high-calcium magnesia in magnesiacarbon brick

2. Application of high-calcium magnesia in MgO-C brick



Tab.1 chemical compositions of magnesia

	chemical composition ω/%					
Magnesia	CaO	MgO	SiO ₂	Fe ₂ O ₃		
Ordinarymagnesia A	1.76	97.05	0.58	0.61		
Tibetan high-calcium magnesite B	6.03	92.85	0.51	0.42		



Aluminum powder, silicon powder and silicon carbide powder as antioxidants and phenolic resin as binder, respectively, after mixing, molding and drying, and their physical and chemical properties were tested. The results are shown in Table 2.

2	chemical composition ω/%					physical properties	
Brick	CaO	MgO	С	SiO ₂	Al ₂ O ₃	B.D. (g/cm ³)	CCS (MPa)
Α	1.88	86.37	8.01	2.02	2.03	2.99	35.9
В	5.01	83.43	8.01	2.01	2.02	3.01	35.7

Tab.2 Properties of two kinds of magnesia carbon bricks



3. Purification effect of high-calcium magnesia-carbon brick on molten steel

3. Purification effect of high calcium MgO-C brick on molten steel



3.1 Effect of high calcium magnesium carbon brick on sulfur in steel



Compared with traditional magnesiacarbon brick, high calcium magnesia-carbon brick has obvious desulfurization effect.

Fig.1 Effect of magnesia-carbon brick on sulfur in steel under different melting conditions

Under the melting condition of 1550°C, the highest desulfurization rate is only 2.17% when using traditional magnesia-carbon brick A, while that is 5.38% when using high calcium magnesia-carbon brick B. Under the condition of melting at 1600°C, the highest desulfurization rate is only 7.29% when using traditional magnesia-carbon brick A, while that is 14.58% when using high calcium magnesiacarbon brick B.



3.2 Effect of high-calcium magnesium carbon brick on phosphorus in steel



Compared with traditional magnesiacarbon brick, high-calcium magnesiacarbon brick has obvious dephosphorization effect.

Under the melting condition of 1550°C, the highest dephosphorization rate is only 9.7% when using traditional magnesia-carbon brick A, while that is 14.5% when using high calcium magnesia-carbon brick B. Under the condition of melting at 1600°C, the highest dephosphorization rate is 16.1% when using traditional magnesia-carbon brick A, while that is 19.4% when using high calcium magnesia-carbon brick B.

3. Purification effect of high calcium MgO-C brick on molten steel



3.3 The distribution of inclusions in steel





Fig.3 Banded distribution of typical inclusions in original steel samples

The selected 45 steel is with low cleanliness and high inclusion content. So many banded inclusions can be observed, and the distribution is relatively dense as a whole.





Fig.4 Distribution of Inclusions in Steel Samples after Melting (1600°C×40min) With new magnesia-carbon brick B, it can be seen that the number of inclusions in steel is obviously reduced and the inclusion distribution transformed into sporadic point distribution after melting.

Compared with the traditional magnesia-carbon brick, high calcium magnesiacarbon bricks can significantly change the distribution of inclusions in steel, transforming them from dense distribution to sporadic distribution.

3. **Purification effect of high calcium MgO-C brick on molten steel**



3.4 The change of inclusion quantity in steel



Compared with the traditional magnesia-carbon brick, the high calcium magnesia-carbon brick significantly improves the reduction ratio of the number of inclusions in steel. The effect of removing inclusions in steel is stronger.

ratio of the Inclusion quantity in steel is 28.3% when melting with traditional magnesia-carbon brick A, while that is 29.7% when melting with high calcium magnesia-carbon brick B.

Under the melting condition of 1550°C, the reduction Under the melting condition of 1600°C, the reduction ratio of the Inclusion area in steel is 25.1% when melting with traditional magnesia-carbon brick A, while that is 29.1% when melting with high calcium magnesia-carbon brick B.

Purification effect of high calcium MgO-C brick on molten steel 3.



3.5 Change in size distribution of inclusions in steel



Compared with the traditional magnesia-carbon brick, when high calcium magnesium carbon brick is used for smelting, the size of inclusions in steel is obviously reduced; while the reduction ratio of small particle inclusions in steel is basically the same, but the reduction ratio of large particle inclusions is obvious.

Under the melting condition of 1550°C, compared Under the melting condition of 1600°C, compared with the traditional magnesia-carbon brick A, the **with the traditional magnesia-carbon brick** A, the reduction ratio of small particle inclusions in steel is **|** | reduction ratio of small particle inclusions and basically the same, but the reduction ratio of large particle inclusions in steel is significantly improved.

I large particle inclusions in steel is basically the same.



4. Conclusions



The new high-calcium magnesia-carbon brick produced with high-calcium fused magnesia has a CaO content of about 5wt%, and its physical properties are equivalent to those of traditional magnesia-carbon brick;

The purification of S and P elements in steel by the new high-calcium magnesia-carbon brick is obviously higher than traditional magnesia-carbon brick, and the removal rate of S and P can separately reach 14.58% and 19.41% under the melting condition of 1600°C×40min.

The new high-calcium magnesia-carbon brick has obvious removal effect on the number and size of inclusions in steel.





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THANKS!

Collaborate with you for a win-win situation