4th International Conference on Molten Slags and Fluxes, 1992, Sendai, ISIJ

PHYSICAL AND CHEMICAL PROPERTIES OF FERRUGINOUS LIME

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SYNOPSIS: The estimation results of metallurgical properties of ferruginous lime (FL) for intensification of slag forming process in BOF operation are represented in this article. The ferruginous lime is characterized by high mechanical strength, low sulphur content, low melting point. When changing the converter lime by FL the technical and economic data of BOF process are being improved and the conditions for arranging the efficient way of zink containing converter slime utilization are being created.

Key words: ferrugionous lime, ferrite shell, calcination loss, regular lime, cooling effect, melting temperature.

The FL production process by co-calcination of lime stone and converter slime in tube kilns has been developed in Novolipetsk Iron & Steel Works. Beside the arrangement of an efficient technique of converter slime utilization, the high quality flux for BOF melting has been produced.

The FL is a two layers piece product: the heart is lime with high reactivity, ferrite shell 3-10 mm thick with melting temperature 1320-1390°C. The low-melting-point ferrite layer enables to avoid the forming the high-melting-point film of calcium orthosilicate on flux pieces and to intensify the film assimilation with forming the active lime-ferruginous slag at low temperatures of the start melt period. At test melts in 160 t converters with using the FL, the slag basicity reached CaO/SiO_2= 1,8 within 3 minutes, while when forming the slag only by lime this level was reached in the 6th minute.

Comparing to the regular lime, the FL is characterized by lower calcination loss, lower sulfur content and higher iron oxides content (Table 1).

Table 1. Chemical composition of products after calcination

Product type	Percentage of elements						Reactivity
	CaO	MgO	SiO_2	Fe_2O_3	S	Calcination loss	
Converter lime of NLMK	90-91	0,9-1,0	1,0-2,0	0,4-1,0	0,1-0,4	4,0-5,0	3'25"
Ferruginous lime (FL)	86-89	1,5-3,5	1,5-4,5	4,0-7,0	0,005-0,015	0,6-3,0	no reaction
Calcium-ferrite shell of FL	67-82	1,0-5,0	3,5-5,0	8,0-12,0	0,025	-	no reaction
FL's inside	91-93	0.9-1,0	1,0-2,0	0,8	0,004	2,0-3,0	1'57"
FL particles over 10 mm after 1 month storage	82,1	4,08	1,54	6,0	0,010	4,0	not determined
FL particles 5-10 mm after 1 month storage	79,1	4,9	1,86	9,03	0,010	4,7	not determined

It is clear from the Table 1 that the heart of FL has reactivity as twice higher as regular lime.Studying the microstructure of FL by raster electronic microscope has shown that the lime heart has a definitively pronounced scaly structure.The scale size is several times bigger than the size of the grains forming these scales.At the scale boundaries d=(8,1-15,0) 10^{-6}m the system of large pores with d=(3,1-8,0) 10^{-6}m is well propagated.

The cooling effect of FL is by 8,2% lower than of regular lime due to reduced calcination loss.Therefore,the full replacement of lime by FL without converter melt heat balance deterioration is possible.

When using FL the sulfur content in converter was reduced in average by 0.191 t and the iron oxide content was increased by 0.435 t comparing to melts with regular lime.

The calcium ferrite shell promotes increasing the mechanical strength,reducing the transport crushability and increasing the storage time of the product in bunkers of lime burning plant.(Table 2).

Table 2. Grain size analysis and mechanical strength of regular and ferriginous lime

Characteristics of material	Fractions content (mm), %			
	10	10-5	5-0,5	0,5
Grain size analysis of lime after shell-and-tube cooler:				
regular lime	58,0	9,5	32,5	32,5
ferruginous lime	64,94	12,37	22,7	22,7
Mechanical strength (GOST 5137-69) of lime 20-40 mm (%):				
regular lime	69,4	69,4	6,9	23,7
ferruginous lime	82,4	82,4	5,1	12,5

Special study has shown that after one month storage of FL outdoors the calcination loss has been increased only by 1,5-2,0%.

Conclusions: The results of studying allow to make the following conclusions:
- the cooling effect of FL is lower than this of regular lime;
- the ferrite shell increases mechanical strength,moisture resistance and promotes the slag forming intensification,
- the FL enables the reduction of sulfur entering into converter bath and the increase of yield.