

ANALYSIS OF THE LIME PRODUCTION DEVELOPMENT
FOR NEEDS OF RUSSIAN IRON AND STEEL INDUSTRY

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Synopsis: The current problems of lime production and the trends of industrial branch are mentioned. Technical and economic indices of lime production by lime calcination facilities and the application range of lime in the home steel industry are represented. New methods of lime stone processing are proposed. The experience in synthetic flux production on basis of steel making wastes and application of this experience in steel making are reviewed.

Key words: Lime stone, lime calcination facilities, lime, rotary kilns, ferrite complex fluxes.

1. Introduction

The plants producing non-ore carbonate raw materials for steel industry of the Commonwealth of Independent States are based on large and well prospected deposits close to the regions with developed steel industry.

The carbonate deposits can be divided in three large groups according to geological conditions as follows:

- horizontal or gentle slope deposits of relatively small thickness,
- large slope and steep deposits,
- mountainous deposits.

Most deposits are characterized by complex structure: there are surface and internal karst spaces with clay, sand and fragments of other overburdens. The deposit character requires an arrangement of complex primary lime stone processing.

Lime stone mining and processing is performed on 26 deposits with explored and block-out, prospected, extrapolated and inferred reserve amounting 3.57 bln.t including 618 mln.t for converter production.

2. Structure and trends of the home lime burning production

The growth of converter production and increasing the requirements on lime in sinter production caused the annual deficiency of lime stone in Russia and Ukraine in amount of 4.2-5.6 mln.t. This disproportion is based on the following causes:

- exhaustion of existing quarries,
- insufficient equipment of mining works,
- unefficient use of lime stones of various sizes.

According to DONNII CHERMET the following measures would enable the elimination of lime stone deficiency:

- increasing the use of small size lime stone by the pre-burn treatment,
- optimizing the relationship between different types of lime production facilities.

Many years of experience of Novolipetsk Iron & Steel Works in production of synthetic fluxes on base of utilization of iron containing wastes and of small size lime stones have shown that the problem of providing the steel industry with the lime can be successfully solved by arrangement of ferrite complex fluxes production. The analysis of

BOF heats with using the ferrite complex fluxes in NLMK has shown that the use of these fluxes in amount of 13-20 kg/t steel causes reducing the lime consumption by 20-25%, saving 3-4% oxygen, increasing the liquid steel yield by 0.5-1.0%, reducing the blowing time by 3%, full removal of fluor spar and increasing the lance life.

In 1988, 1989 and 1990 the steel making plants produced 112082, 11412.6 and 11051.4 mln.t lime accordingly. The data of lime production in various facility types are represented in Table 1.

Table 1 Steel Making Lime Production Structure, 1989

Unit type	Fuel type	Nr of kilns	Percentage of lime produced	Spec. consumption per 1t lime	
				Fuel eqt, kg	El. power, kWh
Rotary kilns	Nat. gas	47	38.1	$\frac{202-417}{259}$	$\frac{46-107}{55}$
Shaft gas furnaces	Nat. gas	82	29.1	$\frac{97-264}{165.8}$	$\frac{14-56}{27.7}$
	BF gas				
	Coke gas				
Batch type shaft kilns	Coke	109	15.1	167	8.0
Fluidized-bed roasters	Nat. gas	2	4.1	189	53
	Cond. gas				
Maerz type kilns	Nat. gas	1	0.4	130	33.0
Other types	Coke breeze	27	13.2	-	-
Total:		268	100		

The most lime is being produced in rotary kilns, this number steadily increases. This is connected with development of BOF production.

3. The data of lime burning kilns

The technical and economic data of some groups of lime burning kilns are represented in Table 2.

By now, 55.3% of total amount of 4341.7 thous.t of BOF lime are being produced in rotary kilns, 36.0% - in shaft gas kilns, 2.8% - in batch type shaft kilns, 4.6% - in fluidized-bed roasters and 1.3% - in ring-type kiln.

3.1. The shaft gas kilns

The existing shaft gas kilns do not ensure the high and homogeneous quality of lime. Shaft gas kilns are characterized by low technical and economic data which is caused by insufficient condition of kilns, lack of automatic process control system and deviation of actual grain composition from the recommended one.

3.2. The batch type shaft kilns

15.1% lime are produced in batch type shaft kilns, though the number of such kilns accounts for 40.67%. These are the oldest ones and they have the lowest capacity. The maximum capacity of a batch type shaft kiln with coke is 204 t/day with low lime quality. The low lime reactivity, high percentage of sulphur and coke deficiency do not allow to consider these kilns promising for the steel industry.

3.3. The fluidized-bed roasters

According to the proposal of DONNICHHERMET, the BOF lime is being produced in fluidized-bed roasters. Two roasters have been installed: KS-1000 and KS-1200. The operation of KS-1000 did not confirm the promises by now. The high capacity of the roaster does not provide high lime quality and low fuel consumption (Table 2).

Table 2 Technical and Economic Data of Lime Burning Kilns

Kiln type	Nr of kilns	Cap'ty t/day (act.)	Spec.consumption per 1t lime		Percentage in lime	
			fuel,kg	el.pow.,	CaO+MgO	Calcination loss
1.Rotary kilns						
1.1.Kilns 3,6 X 75 with shaft counter heat exchangers	2	420-450	205	53	94-95	4-5
1.2.Kilns 3,6 X 75 with heaters of cross current type	18	380-420	235	56	92-93	4-5
1.3.Kilns 3,6 X 75 without heaters	10	290-300	280	64	89-91	6-9
1.4.Kilns 2,7 X 64 with heaters	5	250-260	270	42	95-96	3.0-4.0
1.5.Kilns 2,7 X 64 without heaters	4	220-230	312	56	89-90	7-8
1.6.Non-standard kilns without heat exchangers	8	200-210	271-310	58	89-90	7-8
2.Fluidized-bed roasters						
2.1.Roasters KS-1000	1	391	166-167		87-88	9- 9.5
2.2.Roasters KS-1200	1	140	199-200		88-89	8-9
3.Forward/counter current regenerating shaft kiln	1	159	130	33	95-96	1.5-2.0

3.4.The forward/counter current kilns

The only forward/counter current regenerating shaft kiln in steel industry is in operation over 6 years.The kiln has topped the designed daily capacity by 6.2% in average comparing to other kiln types.

A new forward/counter current kiln FALEK developed by Voest-Alpine is constructed and must be started up in the next future in Bielorusski Iron & Steel Works.In contrast to the Maerz kiln,the new kiln will be charged by lime stone and discharged through sluice hoppers.The kiln capacity is 150 t/day.A lime shaft kiln CIMSTATIC built by Danieli (Italy) has been started up in Volzhski Pipe Plant.Besides,two forward/counter current kilns are being designed according to computations of DONNIIICHERMET.The capacity of these kilns is to be 480-600 t/day and 150-180 t/day accordingly.

3.5.The rotary kilns

It is recognized that the rotary kilns are the most optimum lime burning kilns due to increasing the BOF production of steel in steel industry and to the high quality of the lime produced.The production of the most lime in rotary kilns (55.3% of total amount) is connected with high lime quality.Rotary kilns 3.6 X 75 m with heaters with vaporization cooling and with kiln gas cross flow.

In the last years the specialists of DONNIIICHERMET have developed and introduced counter current heat exchangers in two kilns of Cherepovets Iron & Steel Works.Analizing the operation of these kilns has shown that the producing capacity of the kilns has been increased by 16-20% comparing with similar kilns with cross flow heat exchangers.Specific fuel consumption has been reduced by 12-13% and resulted in 200-205 kg/t lime.

In NLMK,on the kilns Nr.5-10 some measures have been taken enabling increase of average kiln capacity by 16-20% and reduction of fuel consumption.The improvement of

technical and economic data of kiln operation has been achieved owing to allotting the soaking zones in the shaft cooler, changing the sequence of heated air delivery for burning and oxygen delivery to the flame in amount of 300-400 m³/hr.

The data of Table 2 show that the fuel consumption in rotary kilns does not correspond to the international one. For increasing the efficiency of rotary kilns it is necessary to replace outdated kilns by new ones, to improve the lime pre-burn processing and to introduce automatic process control systems.

Conclusions

1. Many plants with BOF production and all plants making quality steel are not provided with lime of proper quality.
2. The main cause of this is the obsolete lime burning kilns and the insufficient attention paid by the plants to modernization of kilns.
3. The best quality lime can be produced in steel industry for BOF production by rotary kilns 3.6 X 75 with shaft heaters and shaft coolers.
4. In order to achieve the higher technical and economic data of rotary kilns, a complex of measures must be taken in mining works on pre-burn lime stone processing.
5. The ferrite complex flux production has been developed for reduction of BOF lime production, rational use of small size lime stone and converter dust utilization.