ANNALS OF THE FACULTY OF ENGINEERING HUNEDOARA
2004, Tome II, Fascicole 2

RESEARCHES CONCERNING DEPHOSPHORIZATION PROCESS AT ELECTRIC FURNACE EBT

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ABSTRACT

This paper shows the results of researches concerning the steel dephosphorization processed in electric furnace EBT at steel shop no 2, SC Siderurgica Hunedoara.

During researches it was recorded the phosphor content at each fabrication stage and the technological parameters. Processing the results it was obtain a series of correlations between the dephosphorization ratio and the technological parameters, presented both graphical and analytical.

Knowledge of these correlations allow in the given stage limitation of final phosphor content at max 250ppm.

KEY WORDS:
electric furnace, EBT, steel, phosphor content, dephosphorization process

1. INTRODUCTION

The reduction content of phosphor content from steel it was and will remain a concern of steel makers, indifferent of steel processing method.

In Romanian steel industry are operating four main producers of electric steel for long products (sections, bars, wire rod etc). All this steel makers have steelshoops equipped with EBT electric furnaces (I.S. Campia Turzii, C.O.S. Targoviste, S.C. "Siderurgica" S.A. Hunedoara and C.S. Resita), at Hunedoara and Targoviste being continuous steel cast plants. On an other side a steelshop modernised in 1996-1998 is for the moment closed (Siderca Calarasi).

Share electric steel has major increase since EBT furnace was introduced. The technological aims that were predominant for the specialists from steelshops, starting from the commissioning of these new furnaces have been to regulate the tapping targets for [C], [P], temperature and the technological way.

The present paper shows the results of steel dephosphorization made Siderurgica Hunedoara.

2. EXPERIMENTS AND RESULTS

Specialised in the fabrication of a varied range of long products and facing to the customers requirements concerning for putting into operation band exploitation, the Siderurgica Hunedoara steelshop started a policy to limit the content of residual elements, including the P concentration for which, in a first stage it was established a maximum target of 200 ppm.

The main technological approaches were oriented to:

- control of the metallic charge quality;
- control of the quality and quantity of admixtures (lime, fluorite and dolomite;
- slag conditions in the electric furnace EBT ;
- practice to use some iron-alloys for alloying and correction in ladle (at tapping and LF) witch known and limited P concentration;
- technologically justified limitation of refining time.

The technological results presented here were obtained for a number of 40 experimental heats carried out in EBT furnace from Otelaria Electrica no.2, Siderurgica Hunedoara.

From the point of P concentration in steel, recorded in different stages of the technological, recorded in different stages of the technological process, the results performed during the trials for the 40 heats are presented in the frequency diagrams from figure 1, 2 and 3. The results recorded according to the moment: melting, start LF and final (cast sample) are emphasising the performances obtained, that means:

- at melting end in EBT furnace we succeeded to reach a P concentration, in a percent of 85%, under the limit of 100ppm;
- at the starting moment of LF treatment, due to the inherent rephosphorisation in ladle with the slag and alloying additions, the P concentration increased, the level of setting under the limit of 100ppm decreasing up to 73% but succeeding a setting in a percent of 97 %under the final aim that we had in mind, of max. 250 ppm;
- as concerns the final P concentration in steel (casting sample), the final aim of 250 ppm was reached in 95% of the heats.

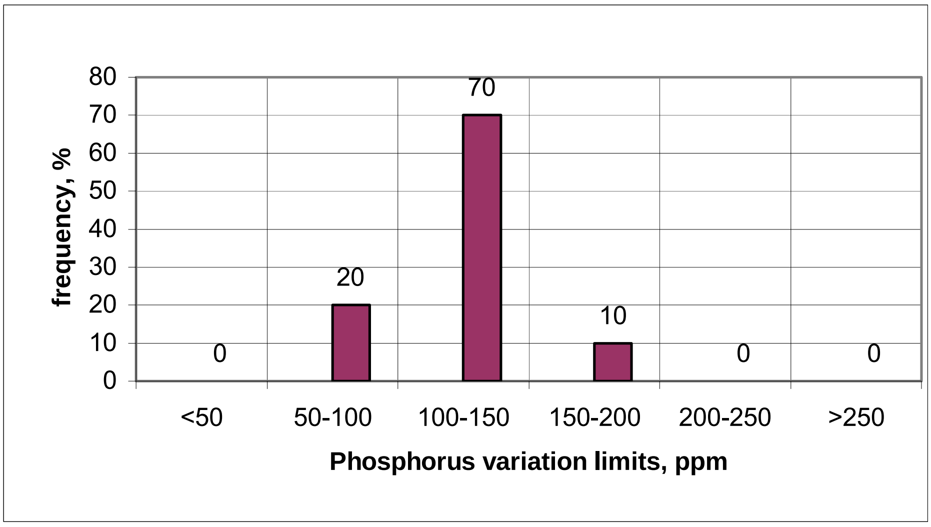

Fig. 1. *Variation limits of phosphor content at melting*

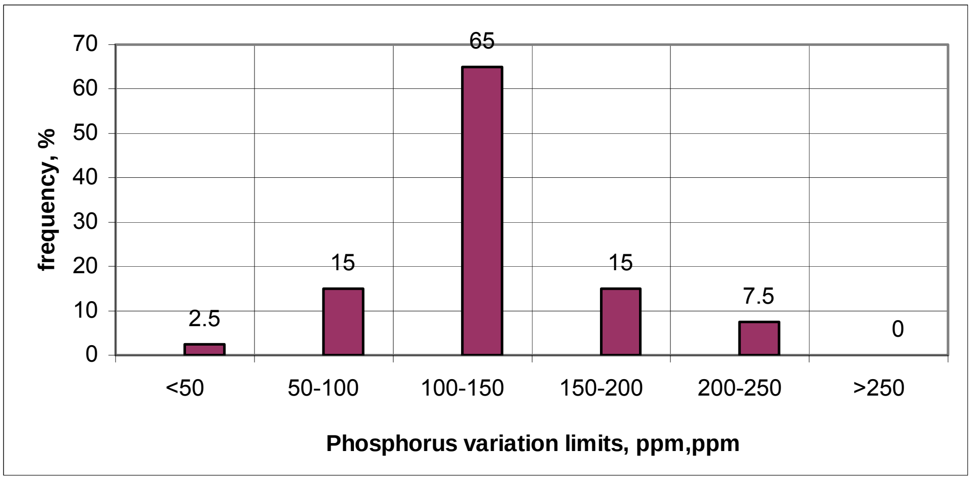

Fig.2. *Variation limits of phosphor content at start of LF treatment*

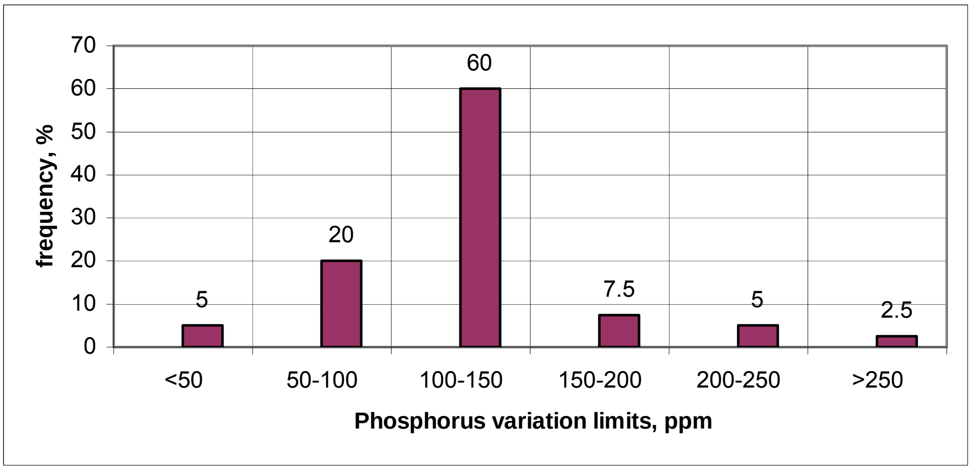

Fig.3. *Variation limits of phosphor content at casting*

- at melting end in EBT furnace we succeeded to reach a P concentration, in a percent of 85%, under the limit of 100ppm;
- at the starting moment of LF treatment, due to the inherent rephosphorisation in ladle with the slag and alloying additions, the P concentration increased, the level of setting under the limit of 100ppm decreasing up to 73% but succeeding a setting in a percent of 97 %under the final aim that we had in mind, of max.250 ppm;
- as concerns the final P concentration in steel (casting sample), the final aim of 250 ppm was reached in 95% of the heats.
- synthetically speaking, having in mind that the lower value of P concentration at melting end was of 60ppm, and the higher at final was of 260 ppm it results that that succeeded to control the rephosphorisation process as well on the whole, limiting it by 40% as in the most sensible stage, technologically speaking , which follows the tapping where4 the rephosphorisation was limited at about 24%;
- the trials emphasised once more that the start condition, meaning the melting end concentration is very important for the phosphorus control in steel making process, as well technologically as economically.
- the slag quality at melting end was characterised by the variation of parameters mentioned in table 1.

Table 1. Quality indicators for slag at melting end

Quality indicators	Slag composition, %				$I_B = CaO/SiO_2$
	CaO	$FeO_{Echiv.}$	MgO	Al_2O_3	
Minim value	21,82	20,86	4,21	2,76	1,36
Maxim value	39,73	38,97	15,64	6,54	5,21
Average value	30,22	32,88	8,98	4,82	2,63

Processing the obtained dates using EXCEL program it results the following technological aspects:

- From the point of view of the slag composition we worked in a kinetic conditions favourable as a rule, determined by the concentrations of the major compounds (CaO, FeO, Al_2O_3, MgO), in the same time favourable for a higher fluidity;
- The relative high (FeO) concentration, reaching 38,97%, was in many cases higher than (CaO) concentration, determining the bordering of CaO/FeO ratio in limits closed to one (0,85-1,25);
- The relationship between the distribution ratio $L_P = (P_2O_5)/[P]$ and the (CaO), (MgO), (Al_2O_3) concentration emphasis in accordance to figures 4,5 and 6 the following:

a. the (CaO) concentration reached the optimum in the in the range 30-35%, which statistically corresponded to a lime consumption of 30-32kg/t;
b. in the recorded range, the (Al_2O_3) concentration kept a favourable trend, preserving the fluidisation ability;
c. as we expected, the growth of dephosphorisation performance, in our trials especially over the limit of 8%. So, we must to review the melting conditions in order to limit it concentration;

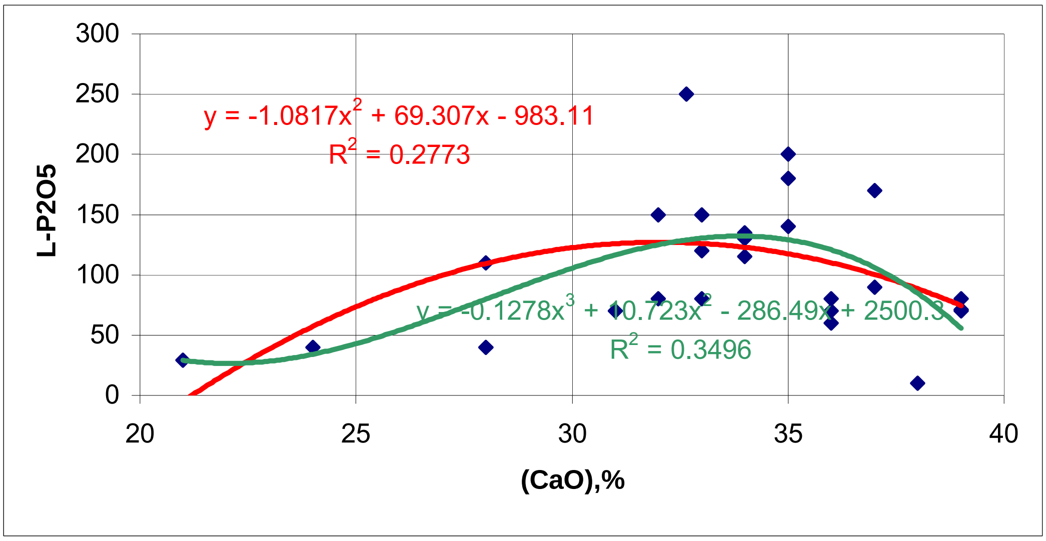

Fig.4. *Correlation between dephosphorization ratio and content of CaO from slag*

As concerns the (FeO) concentration and the slag basicity index, two of the main technological parameters which determine the dephosphorisation performance during melting, we must to have in view that they are conditioning also the foaming process and as these in the electric furnace. The relations hip between L_P and (FeO) determined for our trials and high lighted in figure 7 emphasises an optimum in the range 25-35% (FeO). In the same time, diagram from figure 8 shows that the best performance was recorded for I_B =2-3.

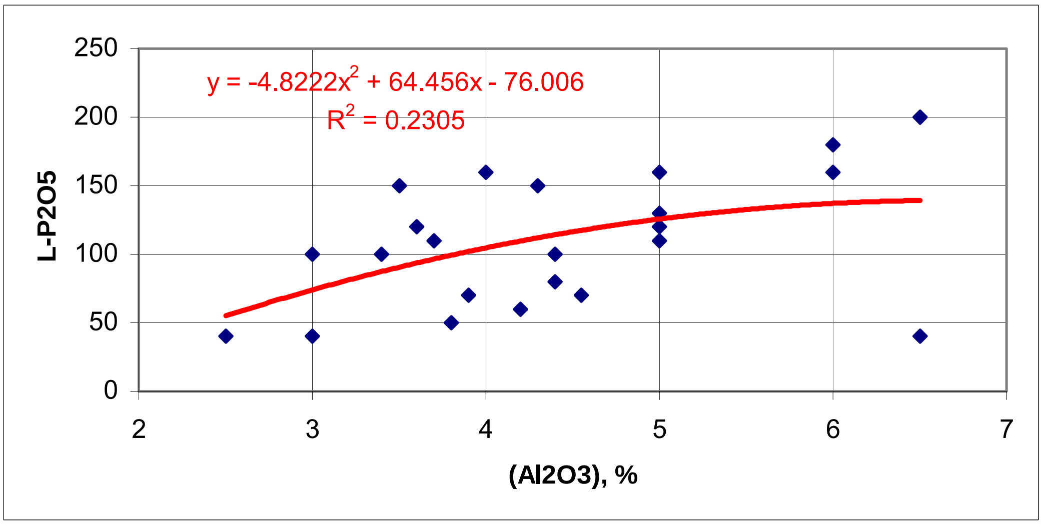

Fig.5. *Correlation between dephosphorization ratio and content of* ***Al_2O_3*** *from slag*

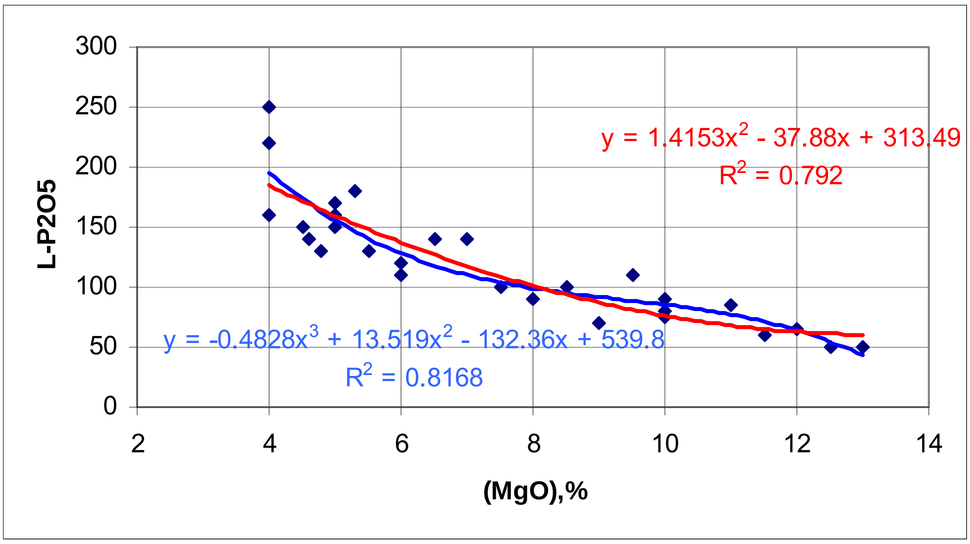

Fig.6. *Correlation between dephosphorization ratio and content of MgO from slag*

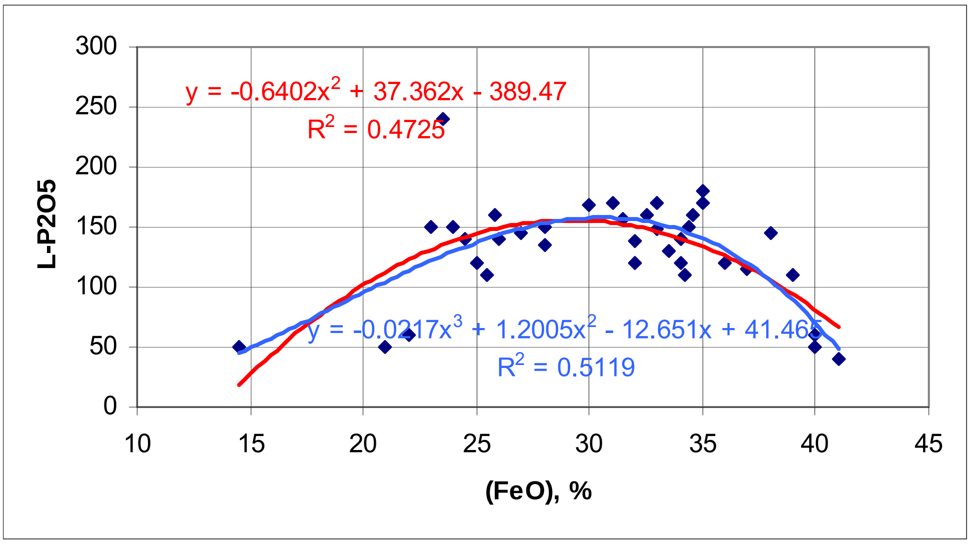

Fig.7. *Correlation between dephosphorization ratio and content of FeO from slag*

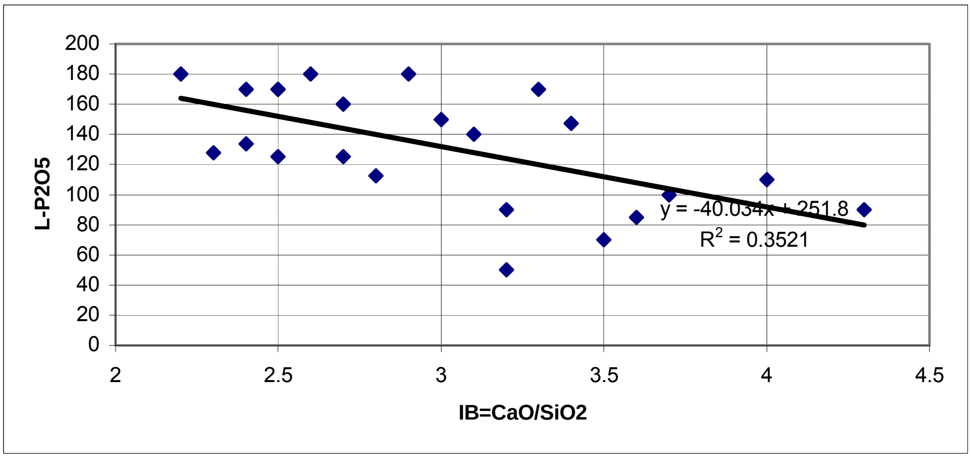

Fig.8. *Correlation between dephosphorization ratio and I_B from slag*

3. CONCLUSIONS

- the ultimate technological factors proved to be control of metallic charge and the slag quality (chemical composition, quantity and temperature);
- the P concentration at the melting end in decisive to reach the final purpose, the concentration under the threshold of 150 ppm in this stage being the stronger technological solution;
- dephosphorization process in EBT furnace fallow in good conditions, that is proof by the dephosphorization output value (average value is 60% on entire process and 70% at melting).
- the results of mathematical processing using EXCEL program are useful both for research and practical purposes.
- an extension of dates processing using MATLAB program it will fallow to the obtaining of some complex relation between dephosphorization ratio and different technological factors.

4. BIBLIOGRAPHY / REFERENCES

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