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RESEARCH ON THE DIAMETER ELECTRODES IN ELECTRIC ARC FURNACES

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ABSTRACT: Thermal metallurgical aggregates are now some of the largest energy in the national economy of any country. In this case justified the efforts made towards becoming fully aware of the possibilities of upgrading the building and optimizing their operation. Analysis of structural and functional variables of the electric arc furnace objective technical prerequisites for studying the evolution of this aggregate to increase the technology's performance.
KEYWORDS: electric arc furnace, optimizing, electrodes

❖ INTRODUCTION

Steel-making technologies, the most important metallic material in the construction industry, have had the technical support three types of units: type converter furnaces, electric furnaces and the furnace hearth.

In the case of electric arc furnace, one of the most important developments was the move to accelerate the melting of the load transformer using high power (UHP).

WE Schwabe, creator of modern UHP electric arc furnace has the merit of electric arc furnace demonstrated capability to produce large quantities of steel by using short arcs by applying a high index of power and wise use of time [1 -3].

For development in electric arc furnaces to be considered for 2015, strategic targets set out in table 1. For Romania, it is proposed that depending on the situation of each steelworks, to adopt the following levels [4]

- ☐ Consumption of electricity to CAE: up to 455kWh/t, which should be added: one for LF max. 40 kWh/t, a dust collection systems maximum 40kWh/t, a utility max. 15kwh/t; total up to 550kWh/t.
- ☐ Additional fuel consumption: about 25 Nm3/t,
- ☐ Consumption of electrodes about 2.5 kg/t,
- ☐ TC electricity consumption: maximum 40kWh/t.

For classification of values within the above indicators, each producer is required to perform specific actions.

❖ ANALYSIS AND DATA PROCESSING INDUSTRY

The data come from an industrial steel mill type electric furnace equipped with a 100 ton capacity EBT. The experimental data were processed in Excel and MATLAB program to obtain a correlation between the different technological parameters. Were considered: electrode diameter (mm), oven capacity (t) that the intensity of current (kA), and that the current in the electrode (A/cm2). Graphical and analytical correlations obtained are shown in Figure 1-6.

Tab.1. Development of production of steel EAF

Indicators	Current status		Stage 2015	
	consumption	value, $	consumption	value, $
Electrodes	2.04 kg/t	5.26	1.1 kg/t	2.92
Refractories	5.4 kg/t	7.09	<0.45 kg/t	2.00
Other inputs	9.345 kg/t	2.66	7.425 kg/t	2.66
Auxiliary fuel to preheat the load	7.42 Nm^3/t	0.18	32.67 Nm^3/t	0.78
Oxygen	16.3 Nm^3/t	1.82	30.0 Nm^3/t	3.64
Electric energy	375 kWh/t	12.00	250 kWh/t	9.60
Productivity	0.4 ore-om/t	4.46	0.4 ore-om/t	2.29
Total		34.07		24.07

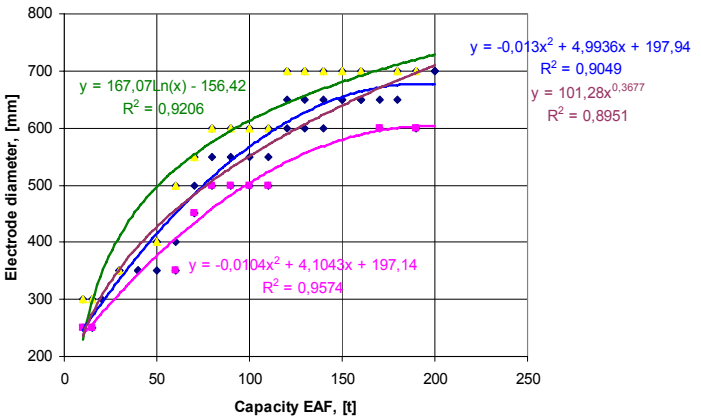

Figure 1. Electrode diameter vs. Capacity EAF

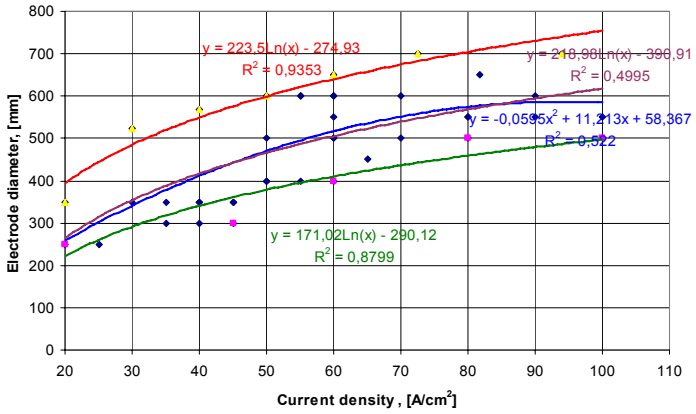

Figure 2. Electrode diameter vs. Current density

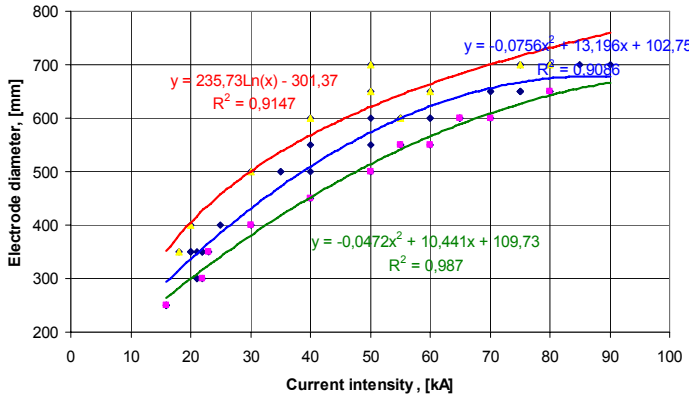

Figure 3. Electrode diameter vs. Current intensity

❖ RESULTS AND DISCUSSION

Analyzing the graphs presented in fig.1-3 shows that the range for the electrode diameter is well defined, both the upper and lower curves expressed as analytical equations with correlation coefficients representative. Correlation curves for the parameters analyzed and presented in fig. mentioned above are very much in the analysis, and are expressed as analytical equations as representative.

The correlations presented in fig. 1 shows that with increasing electrode diameter increases furnace capacity. To determine the diameter of the electrode can use any of the two correlation equations (obviously has to be very close correlation coefficients, and the fact that the two curves almost overlap).

On the basis of the relationship obtained, that for a 100t capacity furnace, electrode diameter varies between 500-600mm.

In fig. 2 shows the correlation between current density and electrode diameter, well represented by two curves: polynomial of degree 2 and logarithmic.

Given the very close values of correlation coefficients and the fact that the two curves are almost overlapped, we believe that you can use either equation to determine / verify the electrode diameter.

It is normal in terms of technology as an increase in current density result in an increase of the diameter of the electrode, thus avoiding a loss by burning (skin effect). The data presented in fig. 3 shows that between the current intensity of the electrode and its diameter is a direct correlation representative polynomial form (grade 2). The correlation that ensures employment, current density, within acceptable practice.

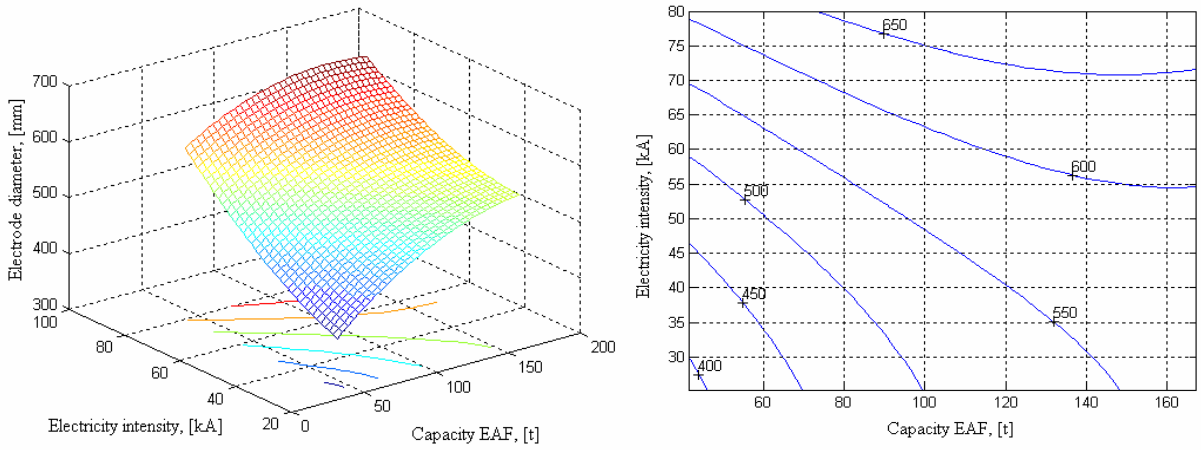

Figure 4. Electrode diameter vs. Capacity EAF

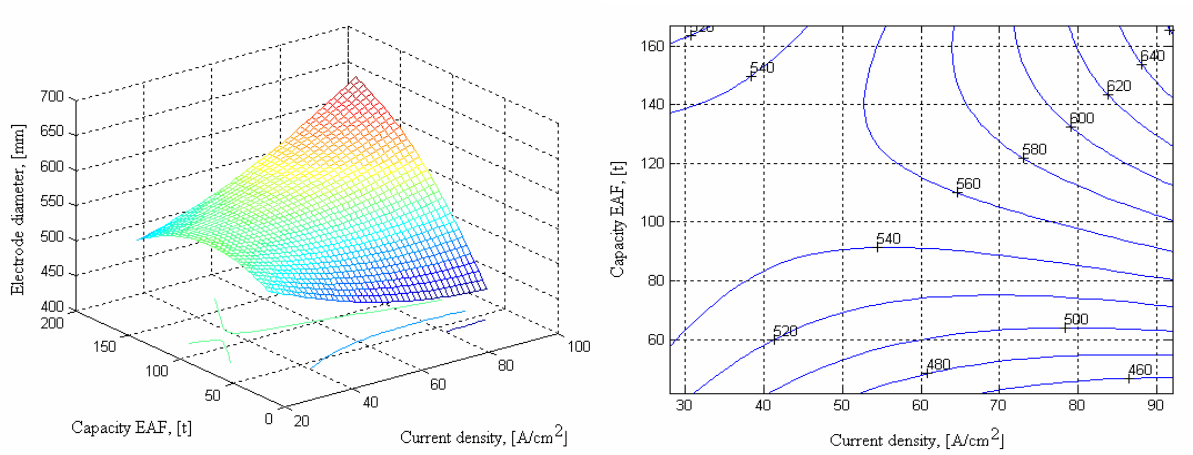

Figure 5. Electrode diameter vs. Capacity EAF vs. Current density

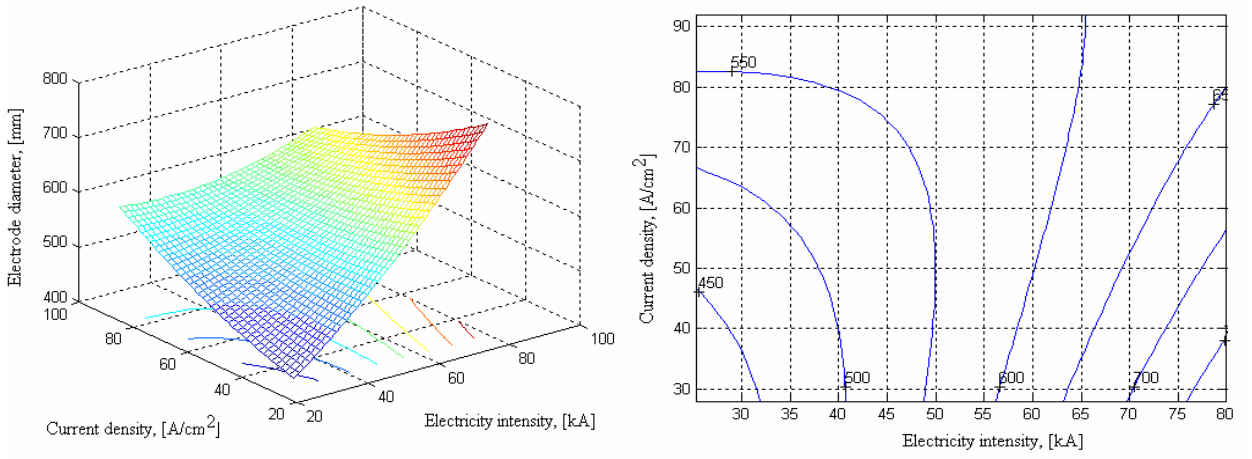

Figure 6. Electrode diameter vs. Current intensity vs. Current density

To establish the most representative experimental data dependencies have been processed in Matlab computer program resulting regression surfaces and areas of variation for the parameters analyzed (fig.4-6). It also presents correlation equations, regression coefficients and deviations from the regression surfaces.

❖ CONCLUSIONS

The analysis of the research the following conclusions:

- ☐ the correlation graphs and equations obtained by the Excel program, we allow the correct choice of electrode diameter, can use one of two other relations for sizing relations for verification;
- ☐ Matlab program correlations obtained allow us first choice of electrode diameter on the basis of two parameters, the values between two limits can be checked by two other correlations and multiple;
- ☐ by using two sets of single and multiple relationships, may result in the optimum value of the diameter of the electrodes, which will eventually lead to lower specific energy consumption, electrode and increase furnace productivity.

Research will continue in order to establish correlations to obtain equations of degree 2 with three varying parameters and surface regression of grade 3 and 4.

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