SIMULATION POSSIBILITIES OF THE EAF MANAGEMENT PROCESSES

Adrian Ioana
University "POLITEHNICA" of Bucharest, Romania
adyioana@gmail.com

Keywords: Management, Simulation, EAF.

Abstract: The paper begins with a theoretical substantiation of the electric arc furnace's management processes. The classification's most important criteria is the proceeding's technical-economical efficiency. The original optimization mathematical model of the electric arc furnace's charge preheating process mainly takes into considers 2 thermo-technological aspects: the heat transfer between fluids and particles and the heat transfer between the fizz layer and an exchange surface. The mathematical model's results are presented as the analysis and quantification of the thermo gradients.

1. TEORETICAL FUNDAMENTATION

Mathematical modelling of the electric arc furnace's processes for the optimisation of the functional and technological performances of this complex unit is based on the next principles [1,2,3]:

A. The principle of analogy – consists in observing and analysing competently the modelated reality, using both analogy with other fields of research and logical homology. According to this principle, for mathematical models making were used the following steps:

- ***the modelated subject definition*** – represents the first phase of the modelation analysis. This step must satisfy both the purpose and the simultaneous system's aims, assuring their compatibility;
- ***the effiency criteria's definition*** – is a step imposed on the correct definition of the system's aims and allows the optimisation of the modelling solutions;
- ***making the options*** – basing on accessing some realistically, ***original and efficient solutions***;
- ***choices evaluating*** – related to the established efficiency criterials;
- ***choosing the final solution*** – based on the analysis between the different solutions of the modelling.

B. ***The principle of concepts*** – is based on the sistems'theory, including ***feed-back*** concept.

C. The principle of hierarchisation – consists of making a hierarchical models systems, for ***structuring the decision and coordinating the interactive subsystems***.

2. THE CONCEPT OF THE BLOCK DIAGRAM FOR THE MODELLING SYSTEM

The modelling system's central element of the EAF processes conceived consists of the system's ***criteria function***. Knowing that the technological processes study for EAF is subordinated to high quality steel obtaining, the modelling system's criteria function (CF) is the ratio between ***quality and price***:

$$CF = \left(\frac{QUALITY}{PRICE} \right)_{\max} \qquad (1)$$

The maximum of the criteria function [4,5] is assured by the mathematical model of prescribing the criteria function (M.P.C.F.)

The mathematical model of prescribing the criteria function concept consists of transforming the criteria function (CF) in a ***quality-economical matrice*** M_{QE}, as in the scheme presented in figure 1.

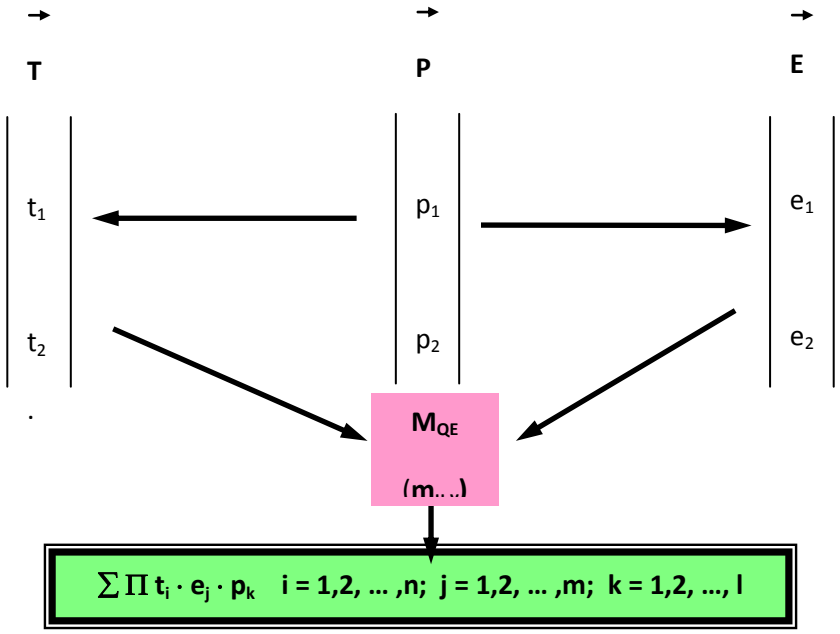

Figure 1. The modelling system's criteria function's evaluation

The levels of prescribing the criteria function can be obtained by using a composition algorithm for three vectors [6,7]:

- $\overline{T}$ vector – technical parameters' vector (t_i);
- $\overline{E}$ vector – economical parameters' vector (e_j);
- $\overline{P}$ vector – weight vector (p_1).

3. RESULTS AND CONCLUSIONS

The components of two vectors $\overline{T}$ and $\overline{E}$ which are considered to have important weight in the criteria function's evaluation are:

- t_1 – the steels chemical composition;
- t_2 – the steels purity (in gases);
- t_3 – the steels purity (inclusions);
- e_1 – the specific consumption of basic material and materials;
- e_2 – the specific consumption of energy;
- e_3 – the elaboration process's productivity in EAF.

The best level (NO) for each component of the 2 vectors is:

- for t_1 – the prescribed variation limits of the elaborated steel quality composition arithmetical mean.
- for t_2 - the minimum prescription of the gas content.

- for t_3 - the minimum prescription of the inclusion content.
- for e_1 - the minimum content specific consumption prescribed of basic materials
- for e_2 - the minimum prescribed specific energy consumption.
- for e_3 - the maximum prescribed productivity of the elaboration process.

The correlation between the criteria function's (C.F.) prescribed levels and $\overline{T}$ vector's components' variation (figure no. 2) and respective the $\overline{E}$ vector's components' variation (figure no. 3) are presented in figure no. 2 and 3.

The cumulated correlation between the criteria function's (C.F.) prescribed levels and $\overline{T}$ and $\overline{E}$ vectors' variation

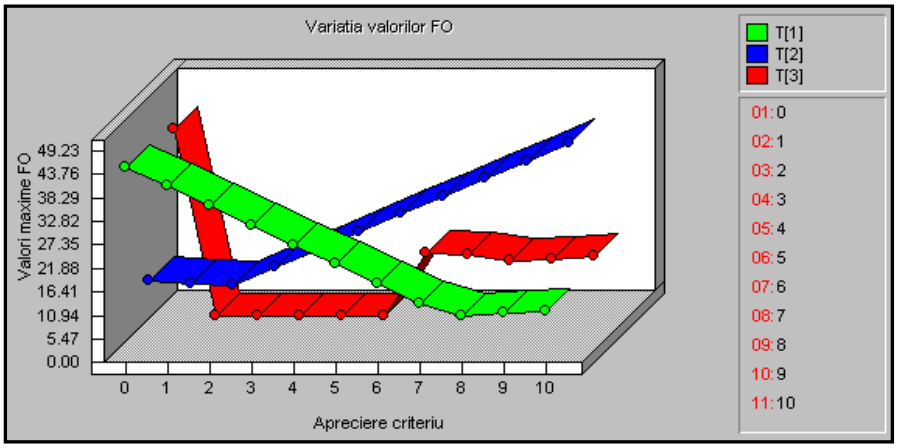

Figure 2. The correlation between the criteria function 's (CF) prescribed levels and the $\overline{T}$ vector's components' variation ($\overline{T}_1$, $\overline{T}_2$, $\overline{T}_3$)

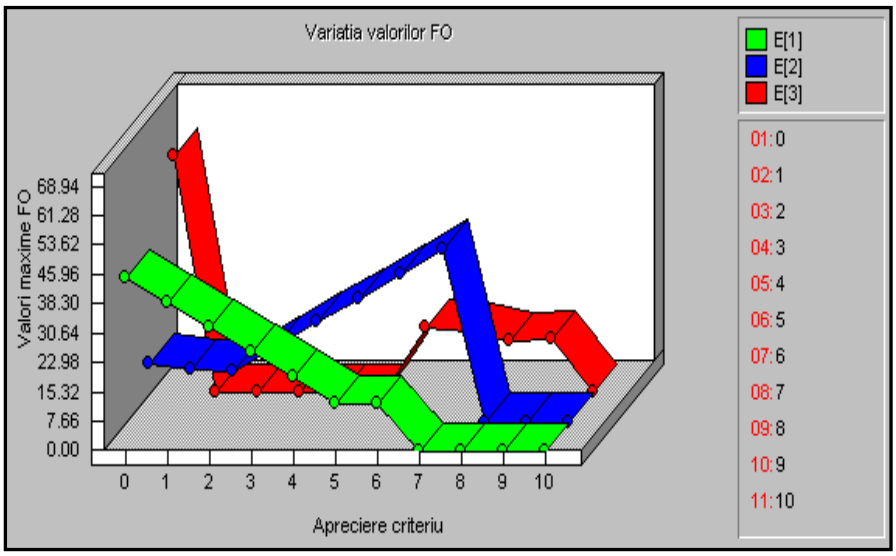

Figure 3. The correlation between the criteria function 's (CF) prescribed levels and the $\overline{E}$ vector's components' variation ($\overline{E}_1$, $\overline{E}_2$, $\overline{E}_3$)

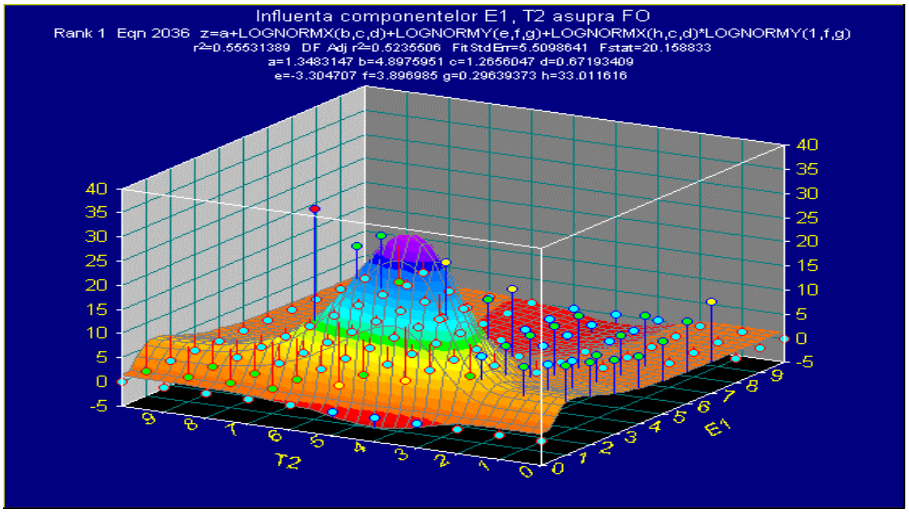

Figure 4. The cumulated correlation between the criteria function's (CF) prescribed levels and $\overline{T}$ ***and*** $\overline{E}$ ***vectors' variation.***

You can notice the obtaining of:

- the criteria function's maximum level $FO_{T,max}$ = 43,76 for the $\overline{T}$ vector's variation (t_1 component - the prescribed variation limits of the elaborated steel quality composition arithmetical mean).
- the criteria function's maximum level $FO_{E,max}$ = 55,31 for the $\overline{E}$ vectors' variation (e_3 component - the maximum prescribed productivity of the elaboration process).

And respective the criteria function's maximum level $FO_{CUM,max}$ = 19,85 for the $\overline{T}$ and $\overline{E}$ vectors' cumulated variation.

References

1. Ioana, A., Managementul producţiei în industria materialelor metalice. Teorie şi aplicaţii, Ed. PRINTECH, (ISBN 978-973-718-758-1), Bucuresti, 2007.
2. Ioana, A., Nicolae, A. ş.a., Optimal Managing of Electric Arc Furnaces, Ed. Fair Partners Publishing, (ISBN Code 973-8470-04-8), Bucharest, 2002.
3. Ioana, A., The Electric Arc Furnaces (EAF) Functional and Technological Performances with the Preheating of the Load and Powder Blowing Optimisation for the High Quality Steel Processing, Doctoral Degree Paper, University "Politehnica" of Bucharest, 1998.
4. Ioana A., Nicolae A., Predescu C., Dumitrescu D., Ivănescu S. –The Optimization of the Electric Arc Furnace's Charge Preheating Process by Mathematical Modelling, 7th European Electric Steelmaking Conference, Venice, Italy, 2002.
5. Ioana, A., Aspects regarding the EAF Functioning Effiency Improvement, International Conference & Expo DUPLEX 2007, Proceeding, Aquileia and Grado, Italy, 18-20 June, 2007.
6. Ioana, A., Bălescu, C., Semenescu, A., Dumitrescu, D. – Ways of Using the Artificial Neural Networks (ANN) to Identify and Model the Technological Process from the Industry of Materials, EUROMAT 2005 Conference, Praga, 2005.
7. Ioana, A., Management Elements for Optimization of Steel Elaboration in EAF, Fascicle of Management and Technological Engineering, Annals of the Oradea University, Vol. VI (XVI)/2007, ISSN 1583-0691, CNCSIS "Clasa B+", pg. 315, Oradea, 2007.