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# CONTRIBUTIONS TO THE OPTIMIZATION OF TARGET FUNCTIONS IN THE PRELUCRATION BY TURNING OF WAGON WHEELS

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The experimental determinations regarding the roughness of the prelucration surfaces, the durability of the knives used, the cutting forces, the plastic deformation coefficient of the resulted splinters etc. were realized by direct measurement and by establishing some mathematic models specific to those functions through some experimental programs, followed by the corresponding prelucration of the results obtained.

The experimental research necessary to the establishment of mathematical relations between physical process sizes (the studied functions) and the independent variables (optimization parameters) were realized having in mind the fundamental objectives of the research:

- having a high precision regarding the determined mathematic model;
- consuming as little time/energy/materials as possible.

By using statistic programming of experiments, although the working process parameters were simultaneous varied, in the end the effect of each of them on the responses was determined in isolation, quantitative like the interactions between the different parameters.

The strategy of the research englobed two distinct working stages:

-programming and realizing experiments;

-prelucration and analysis of experimental data.

The responses of working process and optimization parameters, being variables and being error prone, were prelucrated with standard calculation programs that use multiple regression and dispersional analysis.

The statistic analysis of the results obtained was possible by making a large number of experiments and proved efficient only through statistic programming.

Statistic programming of exdperiments, multiple regression and dispersional analysis, form together an evoluated and modern research method named the response surfaces method, used on a large scale latelly to the research of cutting prelucration processes.

Through the method used, a large part of the parameters were varied simultaneously and their main effects of superior rank, as well as the interactions between them could be evaluated separately.

There were also verified, the precision of the mathematic model ( adequancy) and the degree of influence of each variable (the significance level).

**1.Prelucration of experimental data**

The mathematic model chosen for the processes is representated by functional relations of dependence between the responses of the working processes and the independent variables that can be measured and controlled.

$$R_a, T, F_z, C_{dl}, P_u, p = f\left(v, s, t, \chi, \lambda, \gamma, HB\right) \qquad (1.1)$$

The form of these relations are determined by some experiments, the function *f* being developed in Taylor series around the experimental center, after which it is replaced with an approximation polynom under the following form:

$$\hat{Y} = b_0 + \sum_{i=1}^{4} b_i x_i + \sum_{i=1}^{3}\sum_{j=2}^{4} b_{ij} x_i x_j + \sum_{i=1}^{4} b_{ii} x_i^2 \qquad (1.2)$$

Due to the coefficients that are determined by the small square method, the regression analysis has the following stages:

- calculation of the regression coefficients;
- statistic analysis of mathematic model;
- verification of the adequacy of the model;
- verification of reliable intervals and statistic errors.

The chosen experimental program has two main conditions:

- a small number of experiments;
- allows a simple and precise estimation of the coefficients of the used model.

## 2. Calculation of regression coeficients

After establishing the form of the linear model and of the independent variables, we establish the center of the experiment on the basis of precedent information near the level considered the best, we establish the variation interval for each variable, in natural units and taking into account the technological limits of the experimental region.

We codify the values of the levels of each variable on three codified levels –1, 0 and +1,
and we neglect the effects of the second degree interactions (the are physically insignificant), using thus, fractionate factorial programs that allow the estimation of the coefficients of independent variables and their main interactions.

The programation for the determination expressed in polytrophic relations, which by logarithms become polinoms, codifying the natural levels of the independent variables $X_j$ in levels –1, 0, +1 of the variables $x_j$ was made by the changing of variables according to the relations:

$$x_j = \frac{2\left(\ln X_j - \ln X_{j\max}\right)}{\ln X_{j\max} - \ln X_{j\min}} + 1 \qquad (1.3)$$

We took into account the minimum levels, central and maximum, to be in geometrical progression, by using some tool-machines with regulation in steps of the turation and working advances.

Regression coefficients were determined by the method of the smallest squares with the relations:

$$b_0 = \frac{1}{n}\sum_{i=1}^{n} y_i \qquad b_j = \frac{1}{m}\sum_{i=1}^{m} x_{ji} \cdot y_i \qquad (1.4)$$

where n- is the total number of experiments, including those that were replicated;
m- the number of experiments of the established program.

In centralized tables the data obtained after the experiments, with codifying levels and the responses of the corresponding process functions, for the types of prelucrated steel.

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