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The Quality Analysis of the Thermal Sprayed Deposited Layers by Electronically Microscopy

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The analysis performed by electronically microscopy lead to obtain the experimental data under tabular form. A linear chemical quantitative analysis over a 228.87 µm length was made of on a microscopically image at 250x magnification. The number of points where analyze was made of is 512. Due to the higher number of points which were used for marking of these curves, the interpretation is difficult. Therefore, is necessary an additional assessment processing of these curves which can permit the interpretation of the quantitative chemical analysis. Among the processing versions of the curves, the average for a number of values, choose dependent on the follow purpose, lead to some curves which permit the interpretation of the results.

***Keywords**: Thermal Spraying, Electronic Microscopy, Chemical Quantitative Analysis*

1. Introduction.

The technical and informatics developments permit a new approaching for the chemical quantitative analysis. Thus, in the case of thermally sprayed layers is required a linear chemical quantitative analysis, on the course of sub layer – adherence layer – deposited layers.

2. Manufacturing the experimental samples.

In these experiments were used bushings with 140 mm internal diameter and 100 mm length from steel. For good adhesion of the sprayed layers, the bushings were internal turning, nuts threaded and after that were sandblasted and an adherence layer was deposited on the sub layer. This layer was deposited by electric arc spraying procedure and the filler metal was a Ni alloy (table 1). The final thickness of this layer it was 0.05 – 0.1 mm. [1]

The procedure for depositing the layers on the bushings was electric arc spraying. The final thickness of these layers (1.0 mm) was obtained after three passes. The filler materials were two wires: one from brass and the other from aluminum bronze (table 2). The parameters used for depositing the layer are inserted in table 3. [1]

Table 1. The chemical composition of the filler material

Material	Thermanit NiCro 82
The chemical composition, [%]	
C	0.016
Fe	0.8
Mn	3.14
Cr	20.6
Ni	72.4
Si	0.05
Ti	0.332
Cu	0.002
Nb	2.53
S	0.002
P	0.005

Table 2. The chemical composition of the filler materials used for the layers

Filler metal type	Chemical composition, [%]	Wire diameter, [mm]
Sprabronze AA	Cu – 90; Al – 9; Fe – 1	1.6
Laromet	Cu – 63; Zn – 37	1.6

Table 3. The parameters used in electric arc spraying process

Rotation, [rot/min]	200
Arc amperage, [A]	200
Arc voltage, [V]	28 – 32
Compressed – air pressure, [bar]	2.4
Spraying distance, [mm]	130 – 150
Angle of spraying, [°]	Max. 45
Layer temperature, [°C]	80 – 100

The macroscopically analysis point out a good compatibility of the layers, absence of irregularities and surface defects.

Metallographic preparations of the samples and microscopic investigations were made by means of scanning microscope at POLITEHNICA University from Bucharest. Microscopic images were taking over by two techniques:

- BSE – backscattered electron;
- SEI – secondary electron image.

2. Experimental results.

Some of the images tacked over were chemical quantitative analyzed in certain points or areas, dependent on the pursued purpose. Thus, were observed the presence of the main chemical elements from the wire which was used to deposit the adherence layer, respective Cr and Ni, the presence of the brass and the aluminum bronze, the presence of the oxides. [2,3]

The linear chemical quantitative analysis can complete and offer more information's. In this purpose, was selected a microscopically image, at 250x magnification (fig. 1).

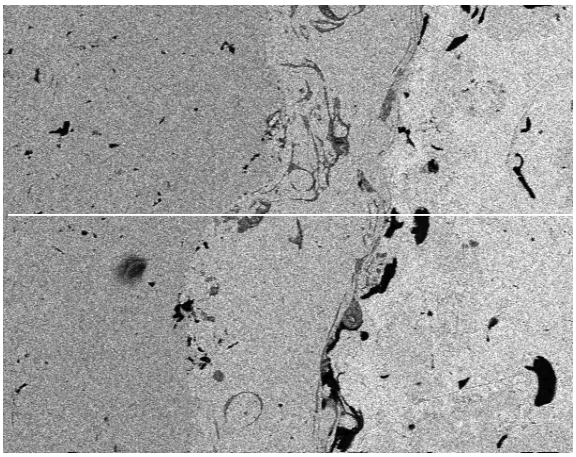

Figure 1. The microscopically image used for the linear chemical quantitative analysis, x250

On this image was made the linear chemical quantitative analyze along the white line, which have a course of sub layer–adherence layer–deposited layers. The length of this line is 228.87 μm and the number of points where the analysis was realized is 512. Due to the higher number of points the results of this analysis are under tabular form and difficult to interpret. For a good interpretation of these results they must be processed. For each element of this table it could be obtained a chart using the Microsoft Excel software. But, thanks to the higher number of points these charts are still difficult to interpret. Therefore is needed a supplementary processing of these results. [1]

The software offers some versions to process these curves. From all of these versions, the moving average trend line is much appropriate for processing the curves. Also, this version can be set to make the average between 2 and 255 points. For example, it was choose an average between 15 points. The final results are shown in the figures 2 to 6. [2,3]

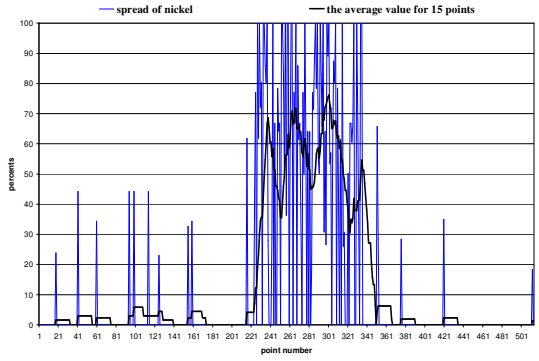

Figure 2. The spread of nickel along the course of sub – adherence – deposited layer

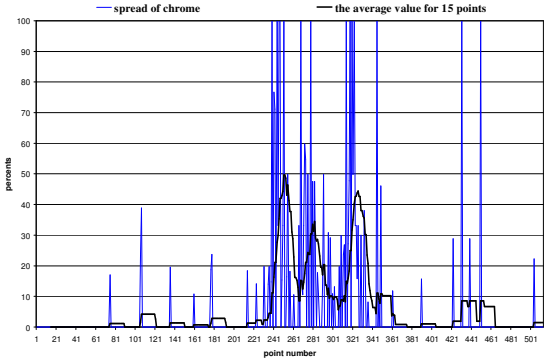

Figure 3. The spread of chrome along the course of sub – adherence – deposited layer

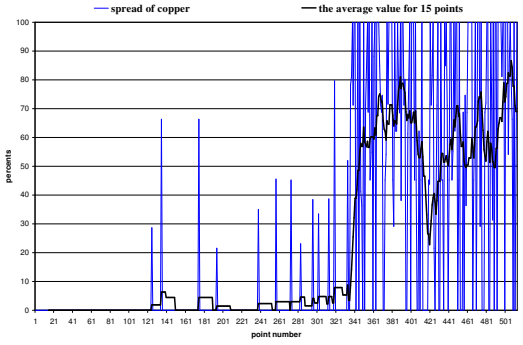

Figure 4. The spread of copper along the course of sub – adherence – deposited layer

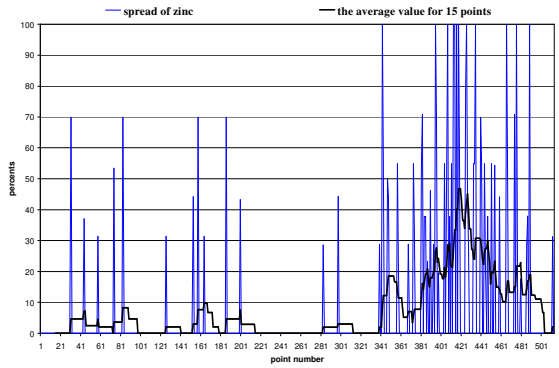

Figure 5. The spread of zinc along the course of sub – adherence – deposited layer

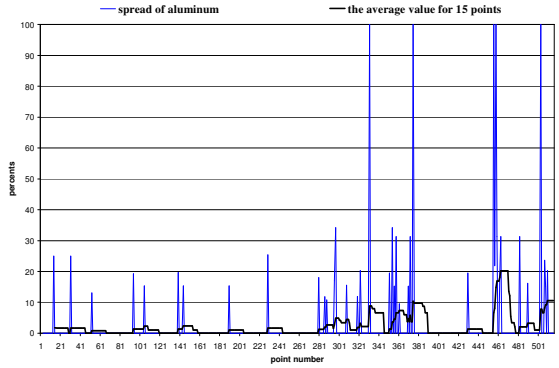

Figure 6. The spread of aluminum along the course of sub – adherence – deposited layer

These new curves are easier to interpret and they complete the information's about the chemical quantitative analysis. They show the distribution of the chemical elements along the course of sub layer – adherence layer – deposited layers, even accidentally appearance of the elements in some areas.

4. Conclusion.

The conclusions which appear after the processing of the experimental data can be summarized as it follows:

- The chemical quantitative analysis made with electronic microscopy represents one of the obvious choices in researching the quality of the deposits.

- The linear chemical quantitative analysis offer more information's about the microstructures of the deposited layers.
- The number of the samples necessary for this type of examination is lower, even one sample is enough.
- For a better interpretation of the experimental data obtained after the analysis the results must be adequate processed.

References

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[3] Petrica A.V., *Quantitative microscopically analysis of the thermal sprayed layers on cylindrical internal surfaces.* Sudura review, An XV, nr. 3/2005, pag. 5 – 10.

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