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REASERCHES REGARDING THE ADHESION STRENGTH EVOLUTION OF THE LAYERS DEPOSITED BY METALLIZATION

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Abstract: *The study focuses on the influence of the powder cladding with electric charges upon the adhesion strength of the layers that were deposited through the process of recondition by thermal spraying. The flame and metallizing system CastDyn DS 8000 and Proxon 21021 powder had been used. By this procedure, we have in view, the improvement of the exploitation period of the pieces but also a diminution of their prices,and, thus, it is necessary to increase the physical, chemical and technological characteristics of the deposited layers.*
Keywords: *powder, electric charge, recondition, thermal spraying*

1. INTRODUCTION

In this paper are presented the experimental researches in order to emphasize the evolution of the adhesion strength of the deposited layers in the case of metallization with flame and powders cladded with electric charges.

For the experiments that were performed, it was used the standard metallization module ***SSM 10*** of the ***Castodyn DS 8000*** system of spraying with flame and powder.

In order to obtain a deposit by spraying in optimal conditions, the powder must capture a big load when passing through the electric field. (Gavrila, 2006)

The loaded particle can lose partially or even totally the electrical charge that was accumulated, in the distance between the pistol and the piece.

In this sense, the shape of the particles is important; the spherical particle can keep the charge easier than the particles with irregular shape. (Andreescu, 2004); (Andreescu & Andreescu, 2009)

If the pistol is placed at a distance d from the basic material and between them a U voltage is applied, an uniform electric field is developing.(Roata et al., 2009)

This principle is reflected in figure 1.

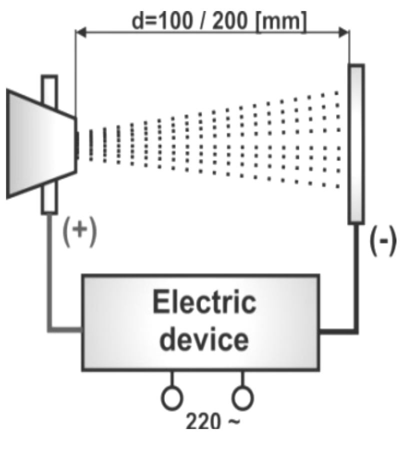

Fig. 1. Diagram of the electric field generation unit

A device was made for this procedure, in order to generate the electric field and having the following characteristics:

- supply voltage of the device Ud = 230 [V] CA
- electric field voltage U = 0 – 12 [V] CC
- electric field strength I = 0 – 800 [mA]

2. EXPERIMENTAL RESEARCHES AND RESULTS

For these experiments, powders from Proxon series 2100 had been used, namely, ProXon 21021.The ProXon 21000 series allows the use of spraying process „in a single step", because it does not need a binding layer deposit.

The main technological recommendations for the standard metallization module SSM 10 are the following:

- Before the metallization process, the surface preparation operation is performed.
- The spraying distance during the process (the distance from the pistol to the metallization surface) is to be found between 100-200 [mm]. If the spraying distance is too short, an overheating of the surface is produced and, consequently, this fact may lead to exfoliation and burning of the deposit material. If the spraying distance is too long, it may lead to the increase of porosity and decreasing the liability, embedding a large amount of cold particles in the deposit material.
- The best quality of the deposit will be obtained when the sprayed metal jet is projected perpendicularly on the metallization surface. When de 45^0 angle of the surface is overrunned, an inadequate deposit is obtained, with low adhesion and accentuated porosity by the so called shadow effect.
- It is generally used in the case of cylindrical surfaces that will be cold sprayed. (Iovanas & Iovanas, 2006)

The parameters used in turning and threading operations are presented in table 1. These operations were performed on an universal lathe.

Exterior threading			Step thread [mm]
Number of turns [rot/min]	Feed [mm/rot]	Cutting depth [mm]	
150	0,5	0,35	0,7

Tab. 1. Parameters used for tests exterior threading and turning

Test Labelling	Spraying distance [mm]	U [V]	I [mA]	Tp [^{0}C]
P1	100	12	800	60
P2	200	12	800	60
P3	200	-	-	60

Tab. 2. Parameters of the deposition by spraying with flame and powder method

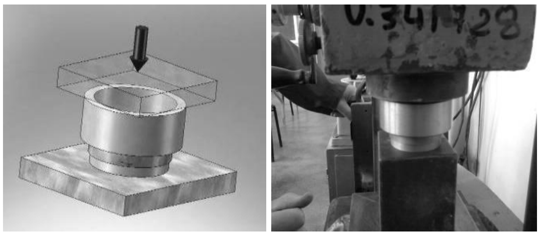

Fig. 2. Diagram of the adhesion force determination

The determination of the adhesion strength of the deposit layer consists in the application of a compression charge on the test piece, and the deposit layer is liable to shear stress, without shocks and in an uniform mode, until its detachment.

The deposit layers thickness is 1 [mm].

The adhesion strength by compression test can be calculated with the following relation:

$$R_H = \frac{F_{\max}}{S}\left[\frac{N}{mm^2}\right] \quad (1)$$

Where : F_{max}- Maxim compression force that is applied to the test piece, in [N]; S - Cross - sectional area of the test piece, in [mm^2].

After performing the analysis, an increase of the deposit layers adhesion can be noticed in the case of the tests where powders cladded with electric charges were used in the metallization process. (metallization distance = 100/200 [mm], U = 12 [V], I = 800 [mA]). This hypothesis is presentet in figure nr.3.

In figures 4-6 are presented the tests forms after the determination of the adhesion strength of the layer that was deposited by metallization.

Test	Compression force	Adhesion strength
	[N]	[N/mm²]
P 1	8.534,70	947,03
P 2	8.436,60	936.15
P 3	7.848,00	870,84

Tab. 3. The results that are obtained

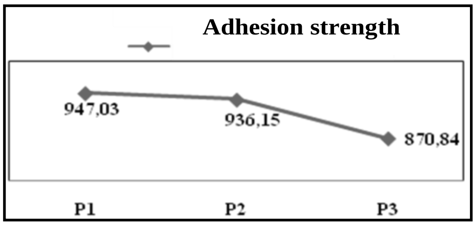

Fig. 3. Graphical reprezentation of the adhesion strength

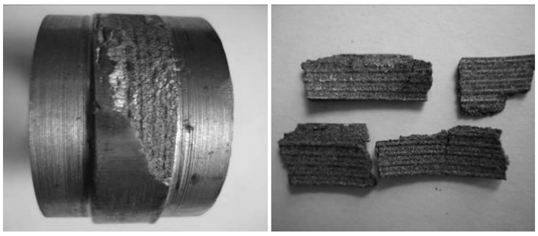

Fig. 4. Test P1 - d= 100 [mm], U = 12 [V], I = 800 [mA]

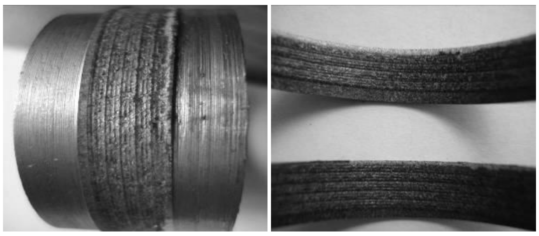

Fig. 5. Test P2 - d= 200 [mm], U = 12 [V], I = 800 [mA]

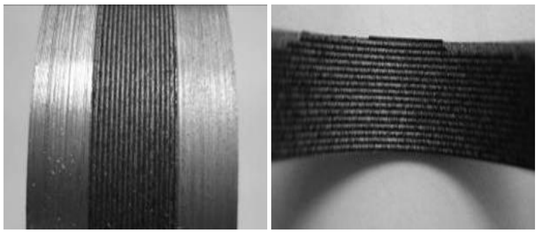

Fig. 6. Test P3 - d= 200 [mm]

A partial stratification can be noticed, in the case of the tests where powders cladded with electric charges were used in the metallization process, and a total stratification of the deposit layer in the case of classic test.

3. CONCLUSIONS

- By powder cladding with electric charge, the adhesion is improved by a high speed and by performing several microweldings between the basic material and the deposit material.
- The technological recommendations concerning the process of recondition by metallzation with flame and powder had been exposed.
- After performing the analysis, it can be concluded that the metalic powder cladding with electric charge improve the qualities of the deposit layers, using the following parameters: metallization distance = 100 [mm], U = 12 [V], I = 800 [mA].

4. FURTHER RESEARCHES

In the following researches , the achievement of a device for powder cladding with electric charges is desired, having a voltage of the electric field up to 70 [V] both in continous current and in alternative current.

I also wish to create a program in order to determine the optimal technological parameters for the process of reconditioning by metallization and to perform certain finite element analysis by correlating the voltage, temperature and speed of the particle.

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