RESEARCH ON ACHIEVEMENT LAYERS OF ADHESION AND LOADING AT THERMAL SPRAYING ARC

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Abstract*. The work presents research results on achieving adhesion layers and submitting to various parts reconditioning from the composition of parts and determine optimal working parameters giving special operating characteristics of parts.*
Keywords*: layer of adhesion, layer deposition, working parameters*

1. FILING ADHESION LAYER AND OPTIMUM WORKING PARAMETERS

As is well known, adhesion layer is the first layer deposited on the surface aiming to achieve maximum adhesion. The thickness of this first layer is 0.1-0.15 mm, and working parameters will so be elected that lead to achieving maximum adhesion even at the expense of other characteristics of deposited layer (porosity, hardness, particle fineness, appearance). Working parameters to deposit adhesion layer are: voltage current work, the current intensity of work, spray compressed air pressure, sprays distance and speed of the gun of metal.
From analysis, studies and experiments conducted it have been revealed the following optimal values of parameters, as follows:
- *Working voltage current* must be higher than 2-2.5 V minimum voltage that arc is stable, for the material that is loaded. Increasing pressure leads to higher particle heat, which translates into a greater plasticity of the particle on impact and intense burning chemical elements of the input material. As is known, certain materials have better adhesion than others. Therefore, for submission layer adhesion on flat surfaces is recommended to use those materials that have the greatest strength, such as: low carbon steel, aluminum and molybdenum bronze.
- *Current intensity of work* has less influence on adhesion, and in conjunction with other parameters decisive influence on adhesion, it was established that the optimum value for submission layer adhesion strength is 250-280 A.
- *Compressed air pressure spraying* has greater influence on the adhesion of the way in which the compressed air spray molten metal bath, determining the shape, size and particle temperature in contact with metallic surface.Using for spraying compressed air with pressure and low flow results in spraying molten metal bath in larger particles which preserve a greater amount of heat and are more plastic on impact, forming the conditions required particle adhesion layer.To deposit layer adhesion determined optimal pressure for compressed air spray is 2-2.5 bar.
- *Spraying distance* has a large influence on adhesion, influencing temperature and plasticity of the material particle spray on impact. It is clear that once with the spray distance temperature of powder particles drops; therefore adhesion layer is deposited from a shorter distance.It was established that the optimal distance from accumulating adhesion layer is about 60 mm.
- *Speed of the gun of metal* is an important parameter which determines adhesion but causes the local temperature of the part and possible overheating that could lead to peeling metallic layer.Taking into account that the deposit of layer adhesion is made with a larger internal energy of sprayed particles which translates into a higher temperature during the impact, speed of the gun must be higher to avoid overheating. It's indicates that the speed of the gun to deposit adhesion layer (or relative speed of the gun and piece of metallic) is 80 m / min.

2. FILING LOADING LAYER AND WORKING OPTIMAL PARAMETERS

Loading layer is the final layer that brings the piece to the dimensions from which after processing, to obtain the required dimensions for the proper functioning of the unit part. Unlike the deposit layer adhesion, which seeks layer properties described above, load layer aims to obtain other properties and indicators such as:

- Toughness
- Porosity
- Particle fineness
- Productivity.

Working parameters for submission layer charging are:
- *Current blood work* that this time is important for determining losses through burning arc (especially burning of alloying elements). As stated above, layer charge will be filed with the least possible tension that arc is stable for material deposited (about 26V). This is the voltage where in the electric arc are produced the smallest flares.
- *Working current intensity* determines productivity and density of particles deposit per unit area, is determined to turn the local temperature of the piece. In conjunction with the pressure and flow of compressed air spray powder particles determines the intensity and finesse. Optimal intensity of current work to deposit layer on flat surfaces and interior aims to introduce small internal tensions about 100A.

- *Compressed air pressure spray* determines the smoothness of powder particles and porosity of deposited layer is closely working with the current intensity (quantity of molten metal arc). Optimum pressure of compressed air, indicated charging for submission layer is min. 4.5 bar min flow $2m^3$ /min.
- *Spraying distance* determines particle temperature from the moment of impact, so the layer and work piece temperature is metalizing. For metallization flat and inner surfaces will look for the larger metallization distance (with the condition that the particles reach the surface of metallic plastic state) about 50 mm larger than the deposit layers on the outer cylindrical surfaces. Optimum spray distance, as indicated, for lodging charge layer is 170-180 mm.
- *The speed gun metallization* quantity of metal deposited per unit time per unit area which, in case of flat surface metallization, should be smaller. Therefore, the speed of the gun of metal should be as large. Optimal speed of movement of the gun metallization, indicated, the submission loading flat layer is about 60 m / min. *When submitting the metallization layer loading on flat surfaces should be considered first sputtered particle density per unit area to avoid local overheating and flaking metallic layer.*

3. ANALYSIS OF EXPERIMENTAL DATA

Data and experiments have demonstrated that:
- Set failure values for voltage leads to higher combustion chemical elements (the higher values) or arc instability (lower amount);
- Failure of prescribed values for current intensity leads to local overheating (at higher values) or lower productivity (lower amount);
- Failure to set values for compressed air leads to less fine particles and spray deposited layer with higher porosity (lower amount);
- Failure of spray distance leads to local overheating (the values too small) or inadequate adhesion (at levels too high);
- Value of feed speed failure leads to overheating (speed too low) or an uneven coverage (at levels too high).

Experiments have determined the optimum technological parameters of deposition technology which must strictly adhere to rebuild and have a quality guarantee. In addition to determining the optimum parameters for deposition of composite materials, of studies and analysis emerged and *practical rules of metal sliding bearings*, described below. *Metallization deposition of anti friction coating is based on geometric shape and size to be loaded bearings*.

In case of bearing piece is important to note that can be metallic if the length / diameter max. 0.75 , and charging by metallization is made up to mid-bearing from one side, then back track and load the other half, as shown in Figure 1.

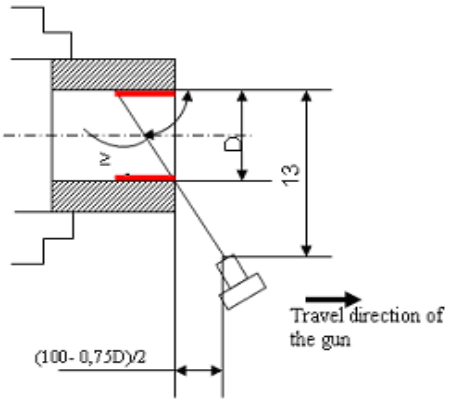

Figure 1.Metalizing procedure of piece bearings

If metalizing gun positioned as in Figure 1, minimum angle of 70^0 is achieved, when loading the middle of the inner surface. From this angle will no longer get a good grip of the material submitted.
Position impose that can be charged only from mid-camp to exterior. Turning camp, it proceeds to load the other half. Figure 2 presents the variation of adhesion material applied by spraying according to the angle of material design.

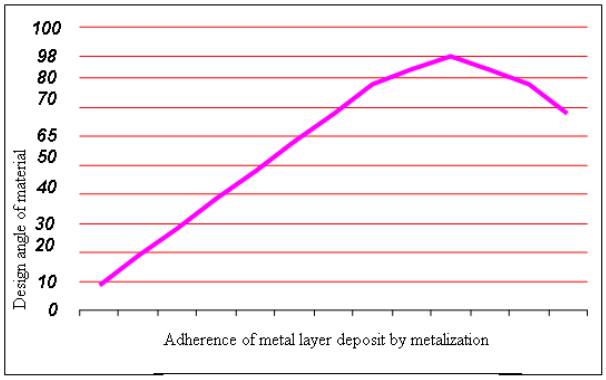

Figure 2. Changes in adhesion depending on the angle of spray of composite material

Another special case is the metallization bearings (bushings) formed by two pieces (bushes).
As shown, if the two bushes are metalizing together (technical solution most wanted), appears the impossibility of detaching bushes due to the metallization deposited metal layer, as seen in Figure 3.

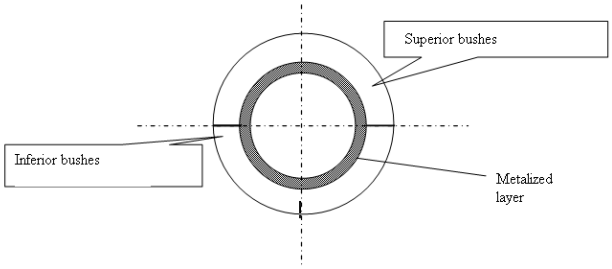

Figure 3. Presentation bushes assembled metallization

To avoid this difficulty it has been devised various methods practical. One of these additions is the introduction of partitions between the bushes, called "spies", positioned to the bushes with their positioning very important. Meet the following two cases:
1) - *If these "spies"* are smaller than the thickness of the camp pulverized material will penetrate the gap between two bushes and appears the danger of its separation after cut used spies, as shown in Figure 4.

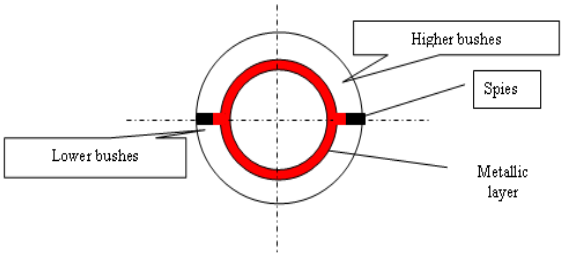

Figure 4. Location spies with smaller than the thickness camp

2) - *If "spies"* are longer than thick bushes, will create a firewall in the way of sprayed particles jet which will prevent uniform and compact metal deposit. Regardless the direction of shells' rotation during metallization, there will be a covered area of the extraordinary put out spies, in which will not submit material. This area tends to break and lead to lack of material sprayed on both bushes, as seen in Figure 5.

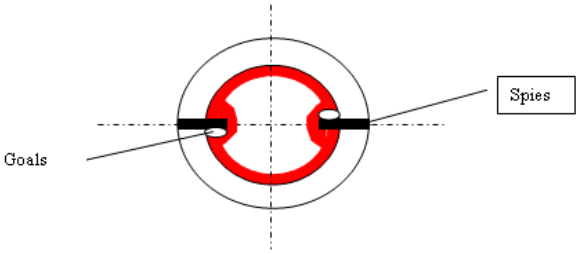

Figure 5. Location spies with thicknesses greater than the thickness of the camp and caused defects.

Best solution is to place spies out spin a length equal to deposited layer's thickness, which will remain after processing, as shown in Figure 6.

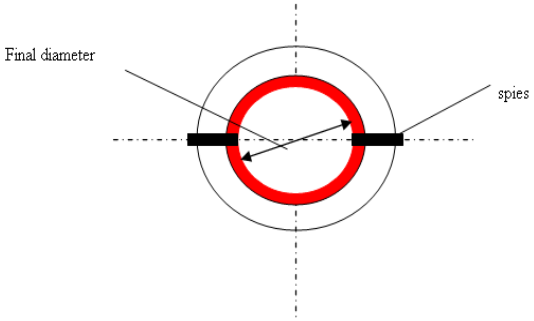

Figure 6. Optimal placement of spies

Another possibility to charge by metallization the two camps is loading their individual pieces. Individual loading of the two bushes requires execution of all operations above; differ only the way to protect metallization of adjacent surface area that metalize.

Side of the camp areas will be protected with paint as a release following, during the metallization deposition, to cleanse these areas of particles that have adhered to them and repaint

Paint with maximum properties that prevent adhesion of particles designed to metallization, particle removal in these areas is relatively easy. End plate surfaces are protected with textolite thin plate to be affixed there to positioning itself at the edge of fabric, as shown in Figure 7.

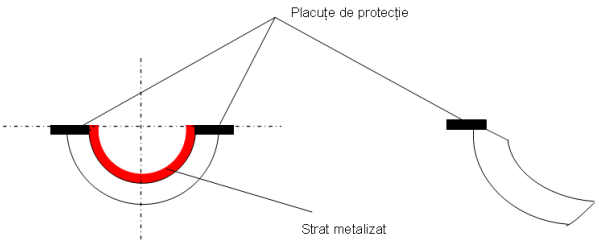

Figure 7. Positioning protection plates

The problem after finishing loading throw metallization is working flat sides of the camp after removal of protective pads.
Defining parameters for metal arc are: voltage and electric current intensity work (performing melting material), pressure and flow of compressed air spray (spraying carrying metal bath and the design of metallic melt on the surface).
In addition, there is distance covered and speed of metallization of metal gun (parameters that influence adhesion and uniformity of deposit).

4. CONCLUSIONS

To achieve an adhesion layer with special properties current voltage should be higher than 2-2.5 V minimum voltage that arc is stable, the intensity of 250-280 V, spray compressed air pressure of 2-2.5 bar, 60 mm spray distance, the speed of metal gun 80 m / min, and the implementation layer deposition current working voltage is about 26V, the intensity of about 100 A, spraying compressed air pressure of at least 4.5 bar at a rate of $2m^3$/min, 170-180 mm spray distance and speed displacement of metal pistol 60 m / min.

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