CONTRIBUTIONS TO THE STRUCTURAL MODIFICATIONS THAT OCCUR WHEN RECONDITIONINGBY SPRAYING ON ULTRASONIC FIELD

Gheorghe Amza[1], Relu Fenechiu[2] , Dan Florin Nițoi[3,] , Zoia Apostolescu[4]
[1]Polytechnic University of Bucharest, amza@camis.pub.ro
[2]S.C.ENGEKO S.A. Iași, mariana.fenechiu@gmail.com
[3]Polytechnic University of Bucharest, nitoidan@yahoo.com.
[4]Polytechnic University of Bucharest, zoia@camis.pub.ro

ABSTRACT: The paper presents major structural changes occurring in the filler material, heat affected zone and base material whereas if by spraying reconditioning on ultrasonic field compared to structures obtained if reconditioning without activation ultrasonic by spraying. Remarkable change substantially crystalline grain size in order to reduce it under the action of ultrasonic waves, the uniform distribution of precipitates that can appear tough in the heat affected zone and getting a homogeneous structure with equiaxed grains. As a result of these structural changes is functional and technological change and properties substantial improvement in their sense under the action of ultrasonic waves
Keywords: reconditioning, ultrasound, structures, spraying, composition, chemical

1. INTRODUCTION

Pursuant to the thermal cycle to which the application material is exposed (heating - melting - cooling - solidification) during application onto the base material onto which it solidifies, slight modifications in chemical composition may develop thanks to the phenomenon of infusion and modification of structure. The scheme of measuring the chemical composition around the demarcation line is shown in figure 1.

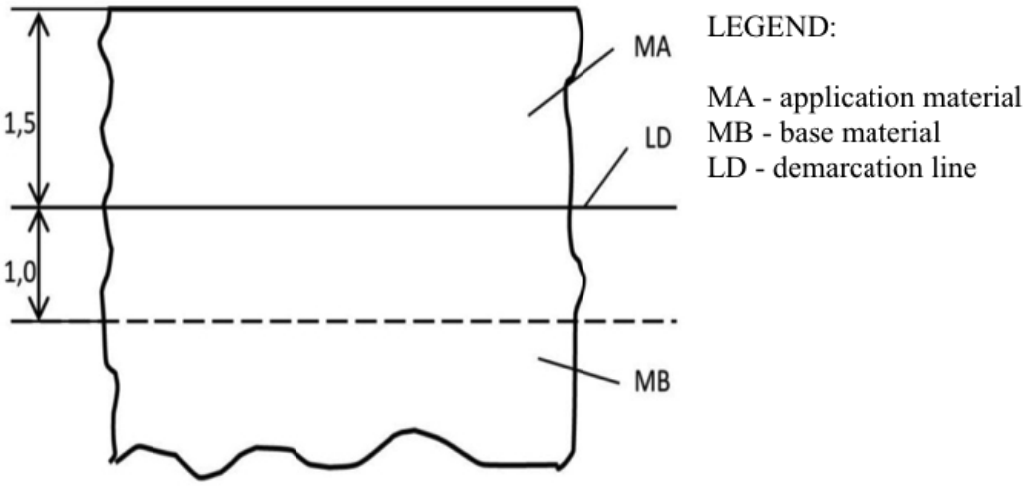

Figure 1. Scheme of measuring the chemical composition around the demarcation line

The analysis of the results obtained using the spectrochemical analysis by X-ray fluorescence (ISO 9556/2002), the measurement being performed from the outer surface of the application material towards the inside, yielded the following results:

- the W, Fe, Cr, Co components vary very little in depth in the case of metallization without ultrasound activation, as the bind between the applied layer and base material is done mechanically, the process of diffusion being barely noticeable;[4.10].
- the variation of the concentration of W, in the case of ultrasound activation entails a decrease by 7-9% in the applied material and an increase in the base material by 5-8% as the

process of diffusion is accelerated by the ultrasound waves, around the demarcation line developing a series of W carbides which will lead to an increase in the hardness of the base material (fig. 2), unlike the case of ultrasound activation (fig. 3) where these carbides are fragmented and uniformly spread;

- the variation of the Fe concentration, in the case of ultrasound activation entails an increase by 5-10% in the applied material thanks to the occurrence and acceleration of the process of diffusion under the effect of ultrasound waves, leading to a decrease of the hardness around the demarcation line;
- similar to the variation of the W content is the variation of the Cr and Co content which diffuse from the applied material towards the base material;
- in the case of metallization without ultrasound activation one can see multiple areas where adhesion is not good (fig. 4), as well as the development of pores spread unevenly, unlike the metallization with ultrasound activation where adhesion is much better and pores are not to be found (fig.5).

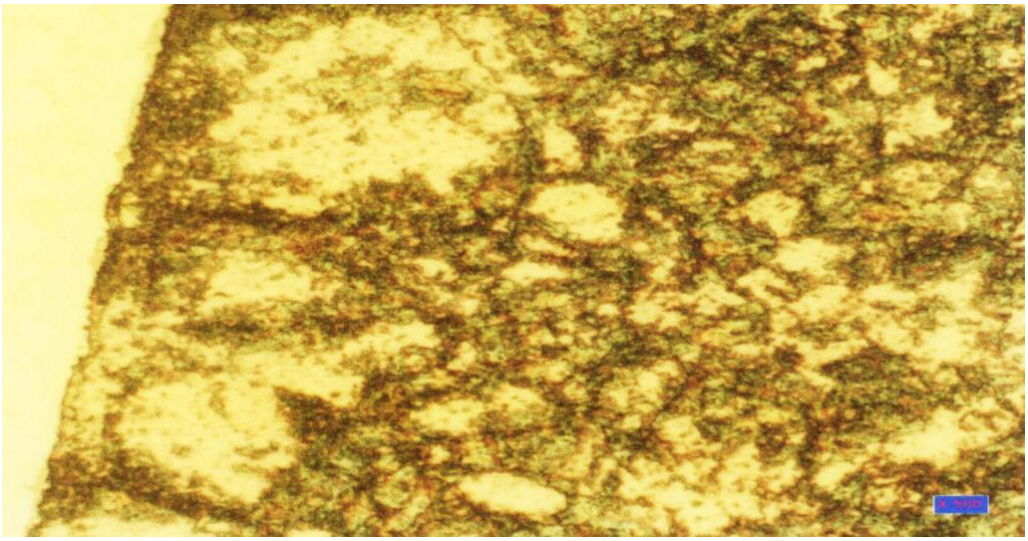

Figure 2. Structure of the base material, adjacent to the demarcation line in the metallized sample without ultrasound activation: treatment: Nital solution 2%; magnification 500X

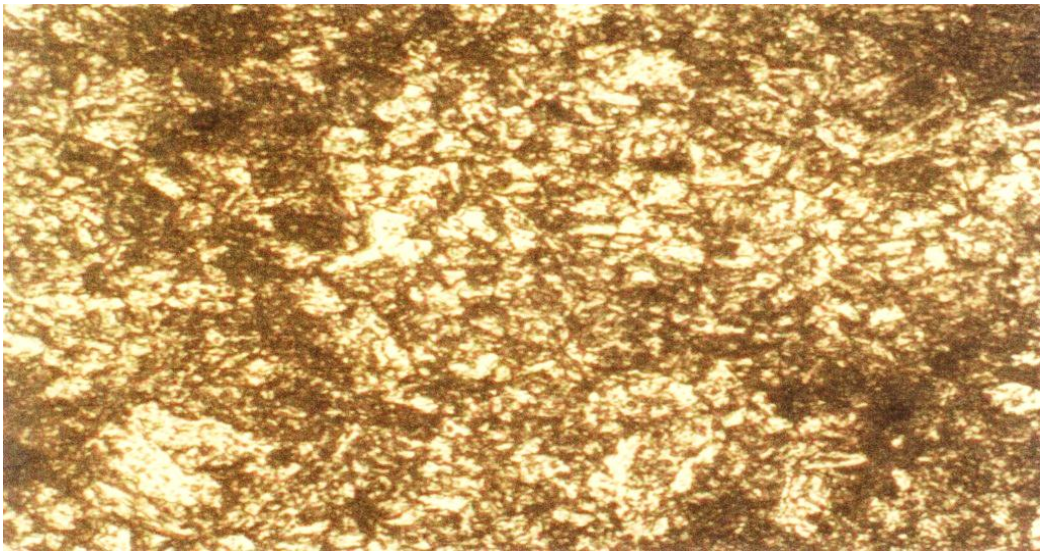

Figure 3. Structure of the base material adjacent to the demarcation line for the sample obtained by ultrasound field metallization: treatment: Nital solution 2%; magnification 500X

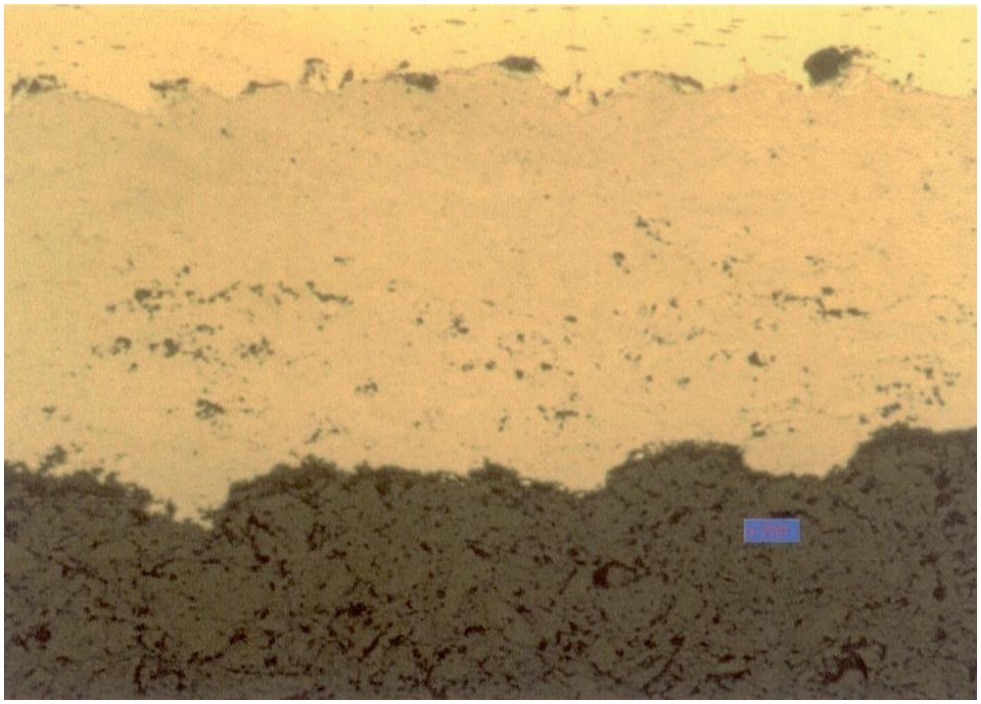

Figure 4. Adhesion of the first layer of application material and of the second layer, in the case of spray coating metallization without ultrasound activation: Nital; magnification 200X; base material: X30NiMoVCr11; application material: TP 4000[6].

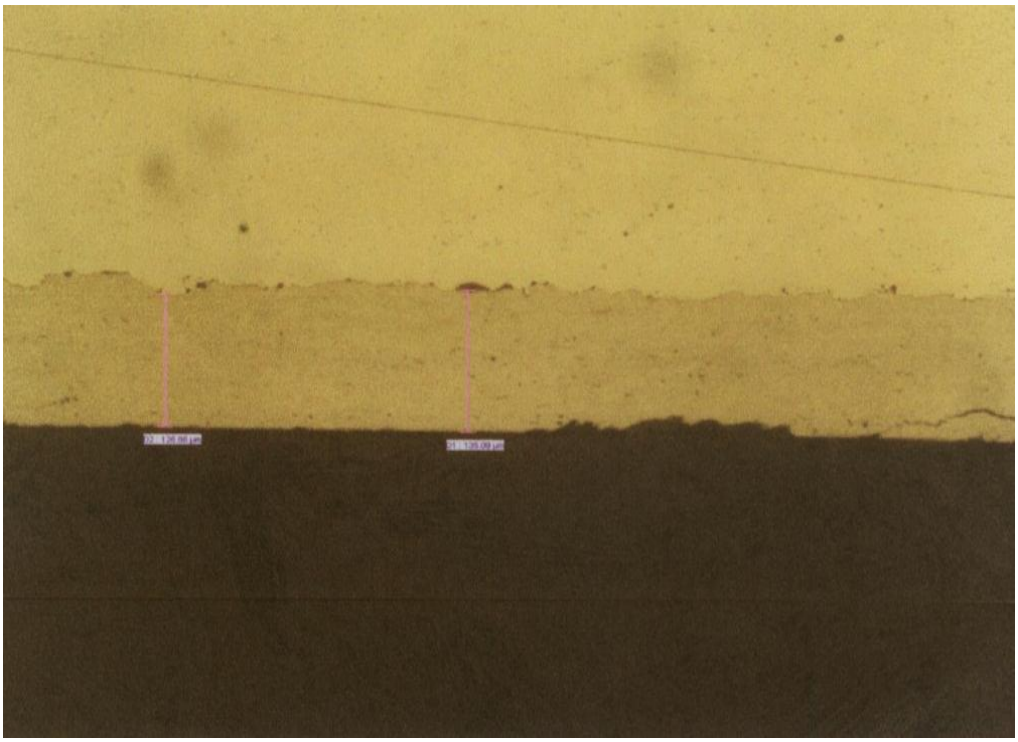

Figure 5. Adhesion of the first layer of application material and of the second layer, in the case of spray coating metallization with ultrasound activation: Nital 2%; magnification 200X; base material: X30NiMoVCr11; application material: TP 4000

2. EXPERIMENTAL RESULTS

The determination of the shear resistance was performed on samples taken from the areas presented in figure 6 and the shock bend test was performed on samples from areas presented in figure 7.[5,6].

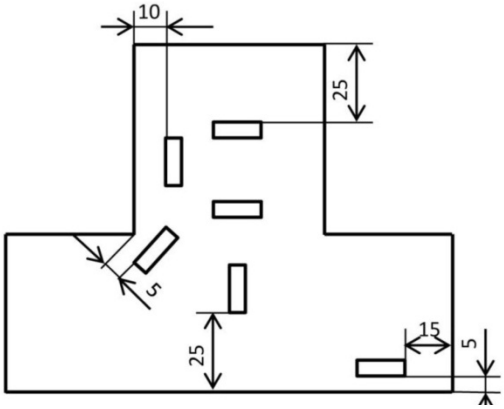

Figure 6. Place of sampling for traction testing

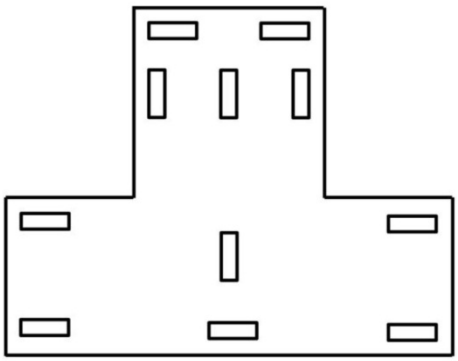

Figure 7. Place of sampling for shock bending testing

The tests were conducted as per norms ASME WS – 001716 and ISO 15612 – 4, using test equipment existing in the test and analyses lab of INCERAN S.A.

For determining the hardness were used the schemes from figures 8 and 9, as per ISO 15614 – 7 and ASME WS – 001711.

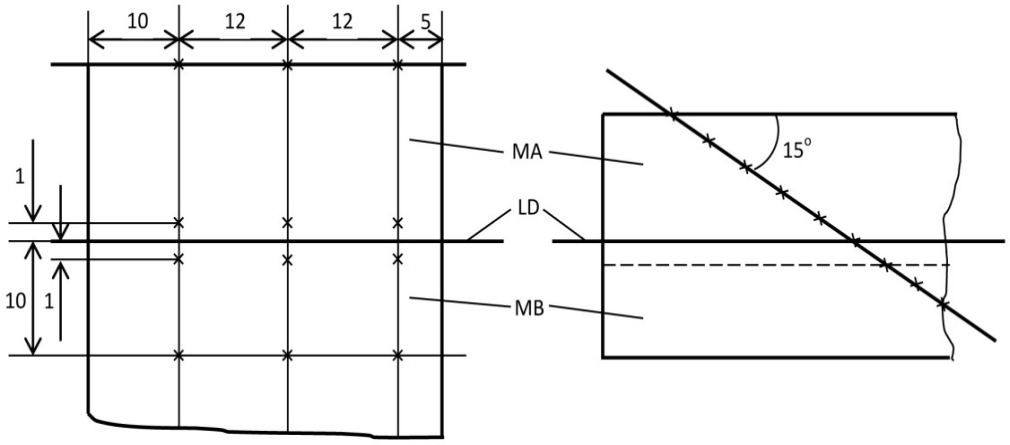

Figure 8. Scheme for determining the HRA hardness, as per ASME WS - oo1711, on a sample taken from the reconditioned part

Figure 9. Scheme for determining the HV10 hardness, as per ISO 15614 - 7, on a sample taken from the reconditioned part

The main functional characteristics of the reconditioned part by spray coating metallization with or without ultrasound activation are shown in table 1.

Table 1. Values of functional characteristics of the part reconditioned by spray coating metallization with and without ultrasound activation[1,2,3].

Spray coating metallization procedure	Manner of application of application material	Test area	$Rp_{0,2}$ [Mpa]	Rm [Mpa]	A [%]	Z [%]	KV – 46 [J]	HB [HB]
With oxy-gas flame and wire	without ultrasound activation	MB	840	950	18	30	176,4	430
		MA	660	770	23	55	166,0	460
	with ultrasound activation	MB	860	995	22	35	189,3	458
		MA	690	702	25	58	175,4	420

The measurement of the Vickers hardness in the close proximity of the demarcation line is presented in figures 10 and 11.

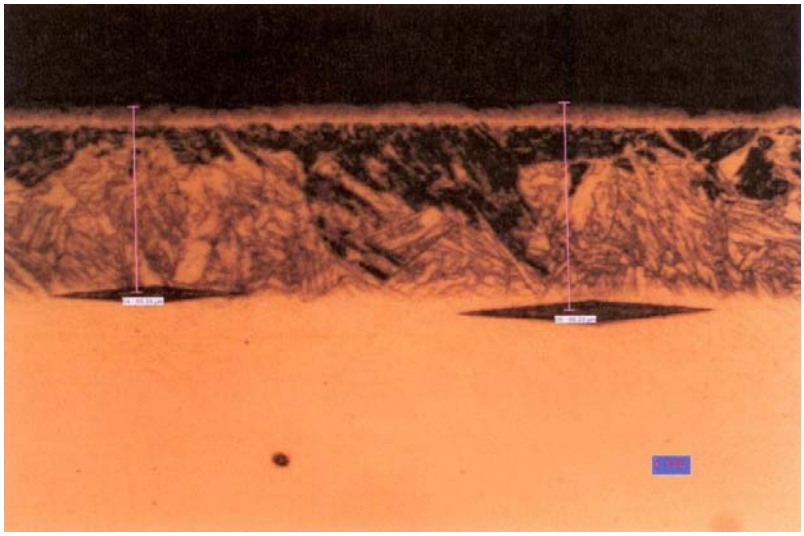

Figure 10. Measurement of the hardness in the close vicinity of the demarcation line in the base material

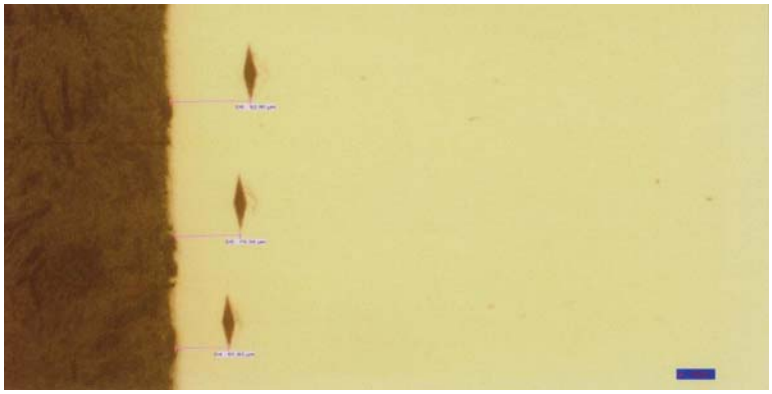

Figure 11. Measurement of the hardness in the close vicinity of the demarcation line in the application material

It was found that in the case of spray coating metallization without ultrasound activation, when there is a diffusion phenomenon, in the close vicinity of the demarcation line metal carbides and large grains develop, unevenly spread, which leads to a non-homogeneous micro-hardness and lack of homogeneity of functional characteristics (fig. 12), unlike spray coating metallization in ultrasound field, when the carbides are spread evenly and grains are smaller and equiaxed (fig. 13)

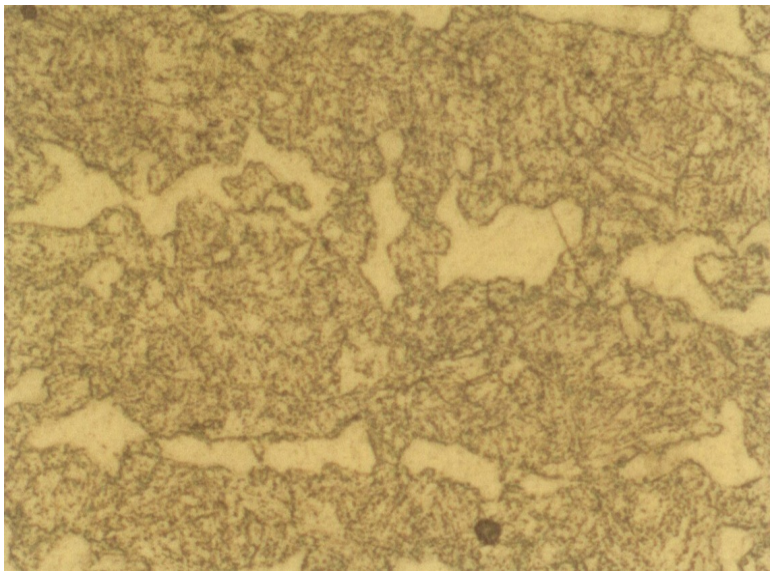

Figure 12. The development of metallic carbides in the case of spray coating metallization with oxy torch without ultrasound activation, in the close vicinity of the demarcation line, in the base material: base material: X30NiMoVCr11- Application material: STELLITE 12 AWS,W; Treatment: Nital 2%, Magnification 100X[6]

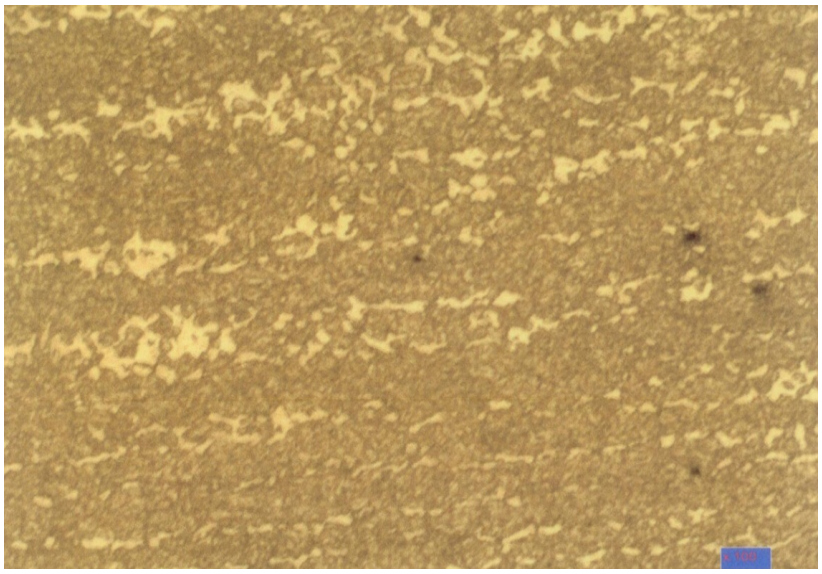

Figure 13. The development of metallic carbides in the case of spray coating metallization with oxy torch and powder with ultrasound activation of the part to be reconditioned, in the close vicinity of the demarcation line, in the base material: base material: X30NiMoVCr11- Application material: STELLITE 12 AWS,W; Treatment: Nital 2%, Magnification 100X[6]

3. CONCLUSIONS

The experiment results obtained and measurements performed in the case of reconditioning by spray coating metallization with and without ultrasound activation lead to some interesting conclusions:

- in the case of spray coating metallization in ultrasonic field was found a higher variation of the content of W and Fe around the demarcation line as compared to the metallization without ultrasound activation;[8,9].
- the adhesion of the layer of application material to the base material is much better in the case of ultrasound activation than in the case of metallization without ultrasound activation;
- in all cases of spray coating metallization in ultrasound field was found an increase of hardness by 12-18% in the close vicinity of the demarcation line and by 15-22% in the applied layer;
- the size of the grains of the resulted structure depends on the size of amplitude of ultrasound oscillations (the size of the grains decreases as frequency increases), with an optimal value for each couple of materials;
- upon spray coating metallization in ultrasound field we could not see any cracks or fissures in the base material or around the demarcation line or in the application material;
- upon the development of pores and inclusions, the method is very important of introducing ultrasound in the spray coating metallization process, as well as the amplitude and frequency of ultrasound oscillations;[12,14].
- in all spray coating metallization cases with ultrasound activation of the process, adhesion to traction forces increases by 15-29%, while adhesion to shear forces by 9-18%.

4. REFERENCES

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