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STRUCTURAL EXAMINATIONS AND MECHANICAL TESTS TO CHARACTERIZE THE METALLURGICAL INTERFACE BASE MATERIAL AND FILLER THERMAL SPRAYED SAMPLES

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Abstract :*Assessment characteristics and properties Thermal spray coating layers is achieved by performing measurements of the characteristics and properties depend on the nature and properties of base materials and coating layers but also how to prepare base material, the selection regime parameters metal coating and the type of metallization process.*
Keywords Metal spraying, arc spraying, coatings

1. INTRODUCTION

The machines and the parts due to the operating conditions, in particular due to the environment are subject to corrosion. The methods of reconditioning machines and parts are made in dimensions of technological documentation execution[1].
A wide range of applications it has thermal metal spraying. Examples of areas where heat is used for metal spraying are:

- ✓ civil, industrial and agricultural buildings;
- ✓ Special industrial construction (in the chemical and petrochemical industries, conventional energy, wind and nuclear, food industry, water supply and sewerage;
- ✓ aviation industry;
- ✓ medicine (prosthetics orthopedics, optics, instrumentation);
- ✓ telecommunications, electronics;
- ✓ road and rail transport and marine transport and construction; (Fig. 1 Road bridge in Bucharest);
- ✓ Household Household (packaging, containers, furniture).
- ✓

Fig. 1: Road bridge in Bucharest

Technological reconditioning process has a number of benefits: thermal metal spraying costs are low due to low cost of metallization equipment. It can save the material do not need a new piece, the one with imperfections can be reconditioned[2].
Imperfections of metal spraying are non thermaladhesive, coating layers is porous structure, voids, inclusions, oxide interface presence of material - filler. in the substrate, the outside coating layers[3].
The mandrel bending mechanical tests can determine the ability of plastic deformation by bending workpieces which was deposited by metal spraying arc with two wires non-ferrous materials, alumiu,copper and zinc. Following the inspection adherence deposited layers is observed.
A sample was analyzed by electron microscopy work that was submitted copper and zinc, which had a good grip. Selection of technological parameters depending on the material base and filler and how to prepare surfaces greatly affect the adhesion of the deposited layer and the appearance of imperfections[8].

2. TECHNICAL REQUIREMENTS

2.1. Selection by thermal metal spraying process.

For the layers deposited by thermal spraying the following bending test is used :
Workpieces with metallization layers deposited by thermal spray as shown in the following selected research; thermal metal sprayingof electric arc (EA) was performedon sets ofsamples (I, II, III) using fillersdiameter1.62mmfrom the first and second group(aluminum and copper) and the three group(aluminumandzinc). BasemetalaresteelS235JR(OL 37- Romanian standard) The samples areflat dimension 100 x60 mm,thickness3 mm, see fig. 2.

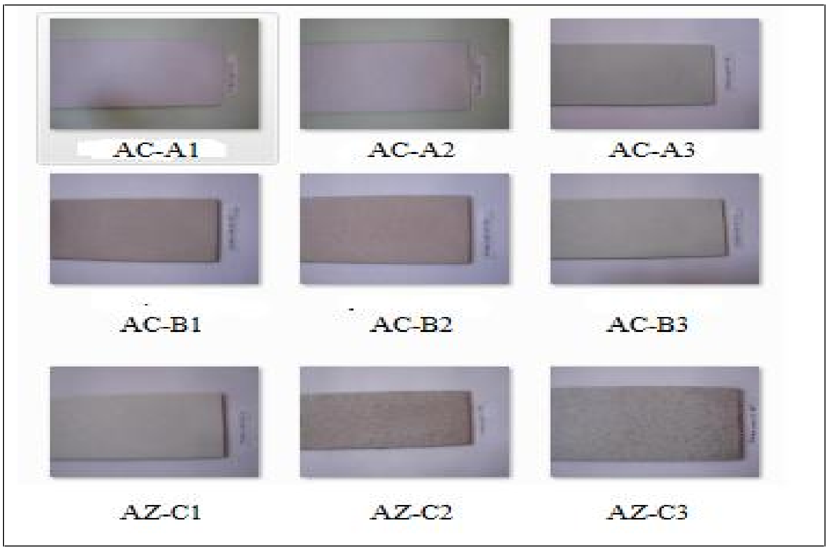

Fig. 2: Thermal metal sprayed samples

2.2. Working parametres

2.2.1 The parameters from the thermal metal spray electric arc see table1, table2,table3.

Table 1:working parametres process

Parametres	Values recommended	Values used
Arc voltage, U_a [V]	30 V	30V
Electricity I [A]	30 A 50 A 60 A	30 A 50 A 60 A
Filler material	Al (99.5% Al) Cu (99.8% Cu	Al (99.5% Al) Cu (99.8% Cu
Diameter filler [mm]	1.6 1.6	1.62 1.62

Arc temperature [K]	5900	5900
Pressurecompresed air[MPa]	0,5-0,7	0,6
Spray distance [mm]	160	160
Working atmosphere	Air	Air

Table 2:working parametres process

Parametres	Values recommended	Values used
Arc voltage, U_a [V]	30 V	30V
Electricity I [A]	50A	50A
Filler material	Al (99.5% Al) Cu (99.8% Cu)	Al (99.5% Al) Cu (99.8% Cu)
Diameter filler [mm]	1.6	1.62
Arc temperature [K]	5900	5900
Pressure compresed air [MPa]	0,5 0.6 0.7	0,5 0.6 0.7
Spray distance [mm]	160	160
Working atmosphere	air	Air

Table 3:working parametres process

Parametres	Values recommended	Values used
Arc voltage, U_a [V]	30 V	30V
Electricity I [A]	50A	50A
Filler material	Al (99.5% Al) Zn (99.8% Zn)	Al (99.5% Al) Zn (99.8% Zn)
Diameter filler [mm]	1.6	1.62
Arc temperature [K]	5900	5900
Pressure compresed air [MPa]	0,5	0,5
Spray distance [mm]	100 160 200	100 160 200
Working atmosphere	air	Air

2.2.2 Mark samples:

-samples set I : AC-A1, AC -A2, AC-A3,
-samples Set II :AC- B1, AC-B2, AC-B3,
-samples set III AZ-C1, AZ-C2, AZ-C3.

Arc metal spraying consists of melting the wire-electrode filler material with electrical arc which is formed between the two electrode wires Al , Cu and Zn. This melted material is then sprayed using the compressed air on the reconditioned piece surface

Is filed three layers with ARC Metal Equipment 140 S350-CL.

From plates with metallic materials deposited by thermal spraying were processed mechanical test : bending mandrel.

Mechanical test: bending: SR EN ISO 5173: 2010[6].

Test conditions: The tests were conducted at ambient temperature.

• Equipment: 400KN universal machine, traction machine type EFDZ 400,testatmosphere.

2.2.3Bending

The results of thebendingtestareshown in Table 4: bendingtest resultsaccording to SR EN ISO5173: 2010using a12 mmdiametermandrelaredetailed inTable 4.

Table 4: The results of thebendingtest

Marking samples	Thicknes ssamples a[mm]	Width samples b[mm]	Distance of therollsl [mm]	The diameterm andrel d[mm]	The angle bending α[°]	The result test	Aspectben ding
0	1	2	3	4	5	6	7
AC-A1-1	3,3	20,0	21	12	52	cracked	Fig. 3
AC-A1-2	3,3	19,7			46	cracked	Fig. 4
AC-A2-1	3,7	19,8			15	cracked	Fig. 5
AC-A2-2	3,6	19,1			21	cracked	Fig. 6
AC-A3-1	3,3	19,0	21	12	40	cracked	Fig. 7
AC-A3-2	3,3	19,7			22	cracked	Fig. 8
AC-B1-1	3,4	18,2			34	cracked	Fig. 9
AC-B1-2	3,4	20,6			26	cracked	Fig. 10
AC-B2-1	3,4	19,4			39	cracked	Fig. 11
AC-B2-2	3,2	18,8			70	cracked	Fig. 12
AC-B3-1	3,1	20,7			64	cracked	Fig. 13
AC-B3-2	3,2	19,0			79	cracked	Fig. 14
AZ-C1-1	3,4	20,0			34	cracked	Fig. 15
AZ-C1-2	3,3	20,1			28	cracked	Fig. 16
AZ-C2-1	3,3	19,6			46	cracked	Fig. 17
AZ-C2-2	3,3	20,5			41	cracked	Fig. 18
AZ-C3-1	3,3	20,0			43	cracked	Fig. 19
AZ-C3-2	3,3	19,7			63	cracked	Fig. 20

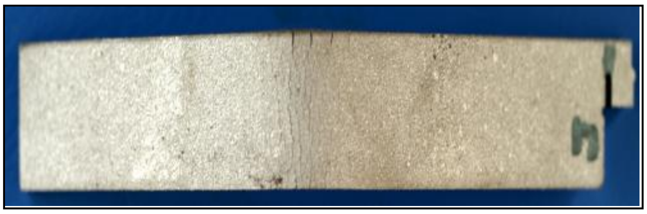
Fig. 3Samples AC-A1-1

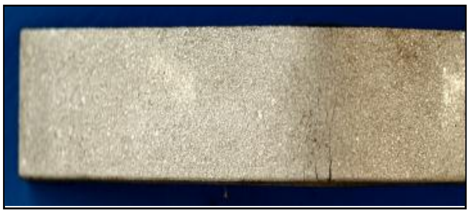
Fig. 4 Samples AC-A1-2

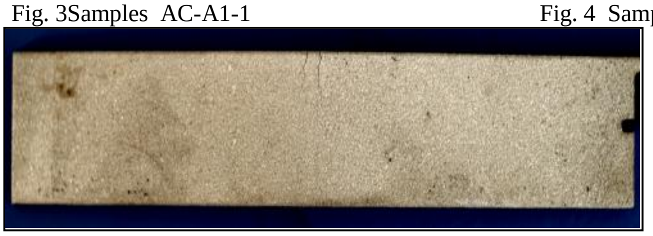
Fig. 5 Samples AC-A2-1


Fig.6 Samples AC-A2-2


Fig. 7 Samples AC-A3-1

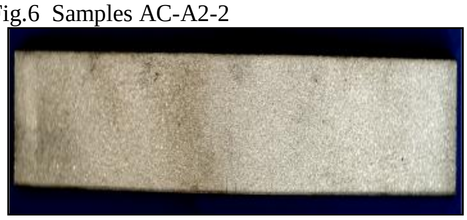
Fig. 8 Samples AC-A3-2

Fig. 9 Samples AC-B1-1

Fig. 10Samples AC-B1-2

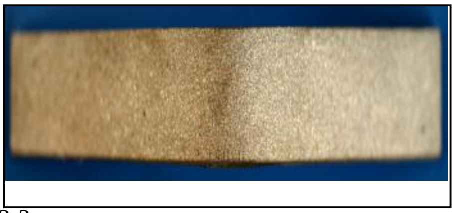

Fig. 11 Samples AC-B2-1

Fig. 12 Samples AC-B2-2

B3

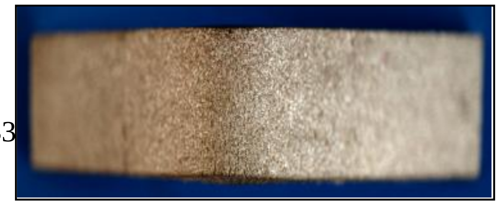

Fig. 13 Samples AC-B3-1

Fig. 14 Samples AC-B3-2

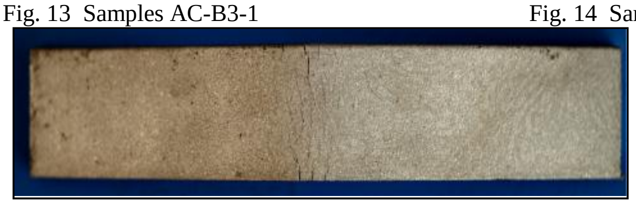

Fig. 15 Samples AZ-C1-1

Fig. 16 Samples AZ-C1-2

Fig. 17 Samples AZ-C2-1

Fig. 18 Samples AZ-C2-2

Fig. 19 Samples AZ-C3-1

Fig. 20 Samples AZ-C3-2

Results of the tests bending.

The variationofthe bendingangleαspecimenssubmitted from theACgroupsandthegroup A-Z, according to thesamplesof test specimensareshown in Fig.21and22.

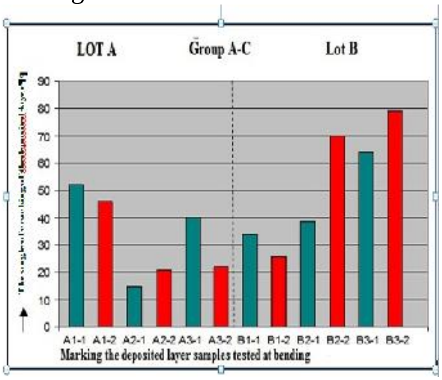

Fig. 21: Variationangleα=f(GroupAC)

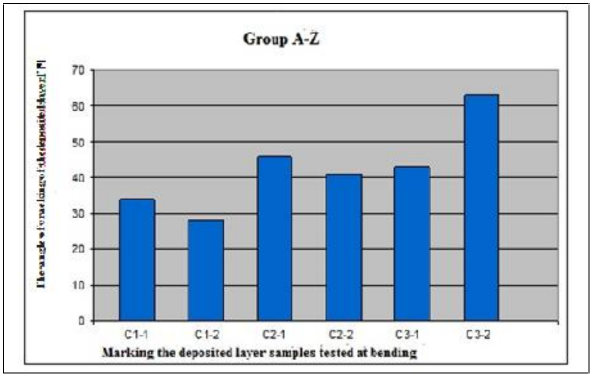

Fig. 22: Variation angleα=f(groupAZ)

TheACgroup(Figure 21) bendingangleαcrackingthedistinct values15ºand79ºbetweenbendingeffect thatmadeAl-Cu layershaveadifferent behaviorregardingadherence tonon-alloyediron-carbonalloys; standsofspecimenswithhigh adhesionlayers depositedduringthe crackingangles(greater than50º) incasespecimens AC B1-1,AC B2-2, AC B3-1and AC B3-2.

- ThegroupAZ(Figure 22), crackingbendinganglevaries between28º and63º, withhighervaluescorrespondingadherencebehaviorspecimensmeet AZC2-1, AZC3-1andAZC3-2.

2.2.4 Metallographic analysis of the layers deposited by thermal spraying

It was pointed phases and constituents, using a reagent - was used NITAL 2%[4,5].

The equipment used for optical microscopy analysis is FEI Inspect SEM in the laboratory LAMET faculty TMS Dept. IMST . The sample is analyzed using SEM microscopy sample AC A3 . The result is shown in Fig. 22 for the base metal ferrite-pearlite structure.

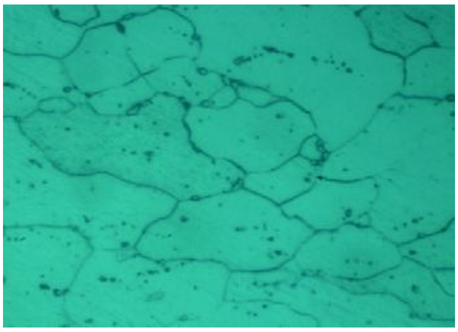

Fig.23: AC-A3, BM [atac Nital 2%, 500X]

For the deposited material result was shown in Fig. 24.

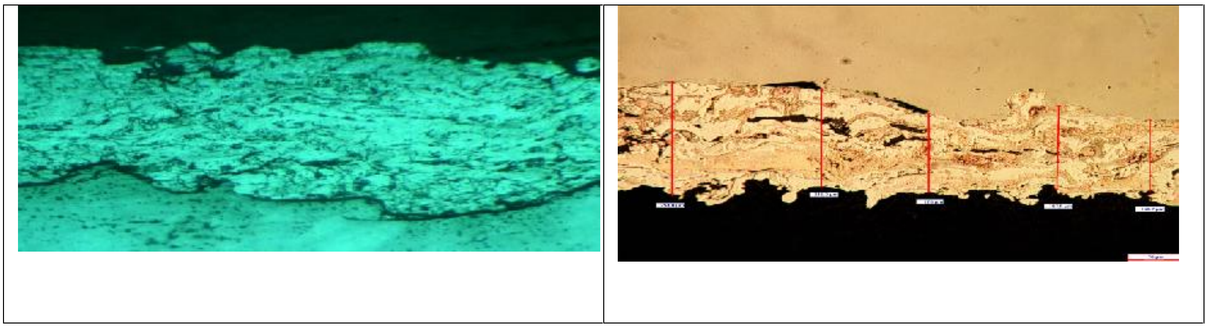

Fig.24: AC-A3, DM [atac F2, 100X]

Fig. 24 shows the joint appearance of the area between the two materials (X200). The structure is dendritic and can see perlite and ferrite grains. After microscopic analysis we can see the degree of adhesion that is good.

CONCLUSION

Changing electric current samples workpieces Group I, the pressure drop across the samples of workpieces group II and in the distance the spray gun metallization workpieces group III, caused differences on inspection adhesion layer deposited by electric-arc metallization. It was examined by electron microscopy SEM arc deposited layers and the base material and showed that a good adhesion is proven AC-A3. For the other workpieces is poor adhesion**.**

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