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PROPERTIES OF COMPOSITE WEAR RESISTANT LAYERS CREATED BY LASER BEAM

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Abstract: *Creating of laser layers is using laser heat source, which allows a thin layer of deposited metal required for the processed material (substrate). This paper presents the creation of surface layers of laser cladding with the use of additional materials in the form of powder with a direct addition to the welding process. It describes the results of the primary site of mechanical, metallurgical and qualities that suggest commercial opportunities created layers.*
Key words: *laser beam, surface layers, cladding, powder, abrasive wear*

1. INTRODUCTION

Most parts are worn with the influence of operating conditions, such as mechanical and thermal effects, abrasion, fatigue, erosion and so on. These effects determine the life of machine components. Another use might lead to excessive growth of wear and later it even could crash the device. The current development of science and technology requires the development of new types of materials with high technical parameters. There is a positive use of the properties of individual types of materials, which are mutually connected by their fragility, as well as a positive use of the high-strength plastic materials. One technology of surfacing is surfacing by laser beam (Blaškovitš et al., 2006; Kotus et al., 2011).

Surfacing technology protects the exposed parts of the wear with the objective to obtain a higher wear resistance or specific characteristics of surface layers of components (***, 2011; ***, 2008; Hu et al., 2010).

2. EXPERIMENT

On the experimental program we used laser cladding technology with additional material in powder form. Additional material was given to the place during the cladding process itself. We used four types of powders. By laser cladding with direct addition of powder laser beam penetrates through the powder and forms melting bath on the surface of base material. In the melt bath is powder added by inert gas, subsequently remelted and consequently forming a bond with the melted base material.

Research on properties of composite layers formed by laser cladding used these materials and equipment:

- industrial gas CO_2 laser from the company Ferranti Photonics Ltd., P.Z. a. s Bratislava
- as a background - the basic material was used low carbon steel S255 GT (12050) with a thickness of 10 mm in the form of plates 100 x 100 mm
- as an additional materials were used composite powders NP 16 + 30% WC, NP 22 + 30% WC, NP 42 + 30% WC and NP 62 + 30% WC (WC – wolfram carbides).

3. RESULTS

3.1 Macroscopic analysis

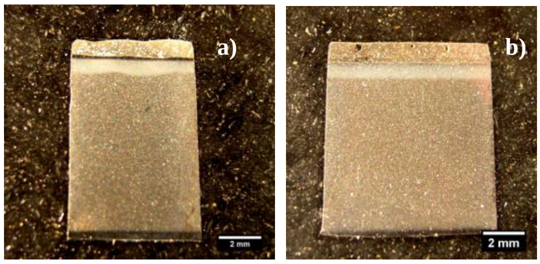

Fig. 1. Macrostructure of the samples a) NP 16 + 30% WC, b) NP 42 + 30% WC

Macroscopic analysis of laser clads showed that all clads are of high quality. Clads are perfectly associated with the base material and thicknesses of the clad layers are smooth and relatively homogeneous (Fig. 1 a), b)). Heat-affected zone extends to a depth of approximately 0.5 mm. When placing individual caterpillars was a perfect connection to the material.

3.2 Microscopic analysis

Samples were observed by light microscopy after etching in 3% Nital fig. 2 a) and fig. 3 a) and by REM after electrolytic etching fig. 2 b) and fig. 3 b).

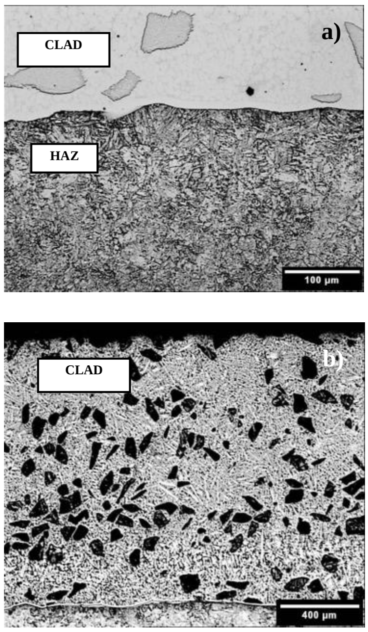

Fig. 2. Microstructure of the samples a) NP 16 + 30% WC, b) NP 16 + 30% WC transition between the melting layer and BM

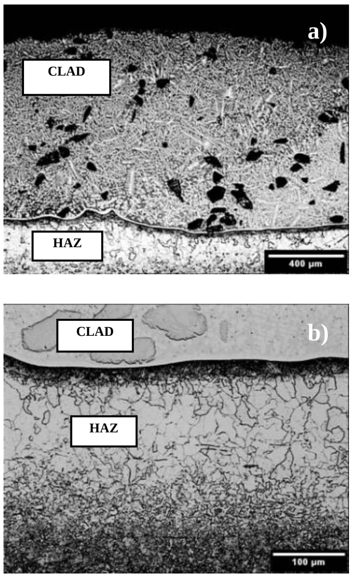

Fig. 3. Microstructure of the samples a) NP 42+30%WC, b) NP 42+30%WC transition between the melting layer and BM

Ferrite-pearlite structure is characteristic for the base material. In the clad structure occurs natural dendrides, is observed the presence of carbide particles. The largest concentration of WC was in the vicinity of the base material, respectively at the bottom of a clad layer fig. 2 a), fig. 3 a). The matrix was formed of nickel austenite. In the heat-affected zone (on the base material surface) was located layer of martensite (dark band) fig. 2 b), fig. 3 b) and was seen as ferrite decarburization layer (bright band).

3.3 Measurement of microhardness

Measurement of microhardness was carried out on the device Neophot 21 under load 100 Pond and 8x magnification. Microhardness was measured for each sample 5 times in ten areas, which were calculated from the average values (Fig. 4). The chart shows that the highest average value of microhardness HV0,1 achieved a sample that was formed with laser cladding with a composite powder NP 42 + 30% WC. Conversely the lowest value of microhardness reached a sample that was formed with laser cladding with a composite powder NP 16 + 30% WC.

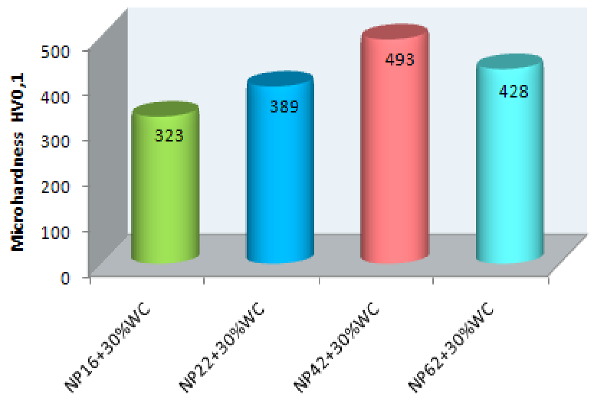

Fig. 4. Average measured values of clads microhardness

3.4 Test of abrasive wear resistance by STN 01 5084

The essence of the standardized tests is in the test of abrasive wear of test specimens by abrasive cloth. Results of resistance test for individual samples generated by laser cladding technology with the addition of powdered filler material into the process showed that the values ψ_{abr}. - relative abrasive wear resistance to measured on the samples ranged from 3.1 to 5.2, it is shown as a graphic representation (Fig. 5).

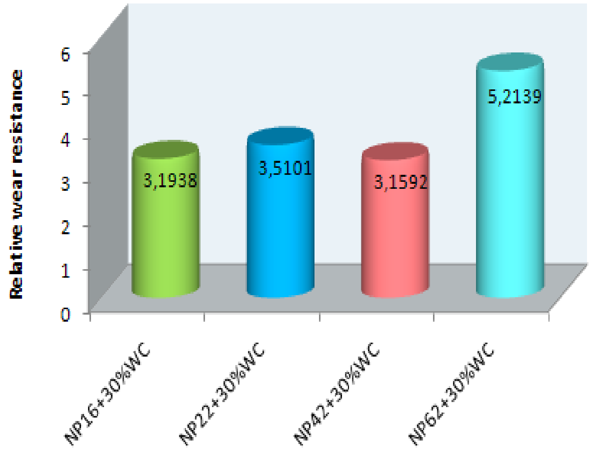

Fig. 5. Graphically illustrated the value of ψ_{abr}

The highest relative abrasive wear resistance $\psi_{abr} = 5.2139$ was measured for the sample using a composite powder NP 62 + 30% WC, although the average microhardness of the sample wasn't the highest among of all clad layers.

4. CONCLUSION

Based on the proposed and implemented experimental program and its evaluation, we can conclude that the most convenient sample is a sample that was laser cladding technology using filler material of the composite powder NP 62 + 30% WC. However, achieved the highest microhardness (the second in order), the highest abrasive wear resistance achieved the sample with powder NP 62 + 30% WC. Cause less hardness on the sample using a composite powder NP 62 + 30% WC was most likely to uneven distribution of WC particles in a clad layer, whereas the WC particles were densely distributed in the bottom of the clad layers. Microhardness could be less on the surface of clad layers, but abrasive wear resistance was higher.

Based on the results obtained is recommended further investigation of the additional materials in the form of powder and their properties in operating conditions.

5. ACKNOWLEDGEMENTS

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