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HIGH STRENGTH COATING TESTING LAYERS ON MACHINE PARTS ON THE ABRASIVE WEAR

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***Abstract**: This study was conducted plasma technology application of coatings on machine parts. During the application the formed spray hits the surface of the material and the particles are deposited on the surface. In this way, the layers can be applied with a high thickness, and thus revitalized worn machine parts. Studied was the resistance to abrasive wear two types of layers: A12O3 and the A12O3 with phosphates, applied on the base material using plasma technology. Resistance to abrasive wear of coating was investigated by the method ASTM G 65-85. Shown are the result of material volume loss due to abrasive wear of the two aforementioned types of coatings on three samples. It was also presented the results of the material volume loss at different wheal revolution per minute. The layer impregnated with phosphates showed significantly greater resistance to abrasive wear.*

***Key words:** plasma spraying, ceramics layers, abrasionwear*

1. INTRODUCTION

The research of metal materials is directed in two directions in the world: on the creation of new materials and on the improvement of the existing ones. Aluminum is the metal most commonly found in the Earth's crust (7.5%), and belongs to the group of light metals whose specific weight is 2.7 mg / m, which is 1/3 of the specific gravity of steel. It is corrosion resistant and has high electrical conductivity. Therefore, it is necessary to direct research into the application and satisfactory exploitation of these materials.

One of the basic conditions for long-term protection of metals from corrosion is the qualitative surface preparation. The coatings coated with the plasma-coated aluminum plasma method showed high quality, providing improved adhesion and corrosion protection [1].

The application of Tor1o is a very widespread coating method. The basis of the hot application is the melting of the additional material and the direction of the molten material towards the surface of the base material, where rapid hardening and precipitation occurs. Different hot application methods differ according to the characteristics of the additional material (wire or powder) and the energy source needed for melting [2].

One of the hot application methods used is the application of a plasma that can be applied to different materials (ceramics, metals or alloys). In this procedure, the gas mixture is ionised by an electric arc. The energy obtained in this way is used to apply additional material, supplied in the form of a powder, at a high speed over the base material. The achieved high temperatures (1600 ° C) enable the melting of ceramic materials [3]. Application of ceramic coatings has been applied in many cases where high temperature resistance as well as resistance to wear and corrosion is required [4].

How these coatings can be coated with large thickness (up to several mm) can be used to improve the exploitation characteristics of new or reparation of damaged machine parts. About 50% of all cases of waste are wasted on the abrasion process. The characteristic of this type of wear is the presence of hard abrasion particles of mainly mineral origin and is often referred to as mineral wear. Typical examples of abrasive wear are working parts of agricultural, construction and mining machinery, submersible sludge pumps, particle processing tools, etc. The highest resistance in these tribo systems is caused by excessive abrasion wear, low surface fatigue resistance, and the least dangerous, ie tribocorous wear is acceptable.

These coatings can be successfully used to restore fragile parts of agricultural technology. A quality regenerated part can be reliable to perform its function in a technical system.

2. MATERIAL AND METHOD OF WORK

2.1 Method of operation

The plasma application procedure was carried out in the Institute for Materials of the Faculty of Technology in Tampere, Finland.The A12O3 layers were applied using the plasma A 3000 S, using the Amperite 740.1 powder layer, between 350 and 400 μm layers.The basic material was biosteel (S235JO).

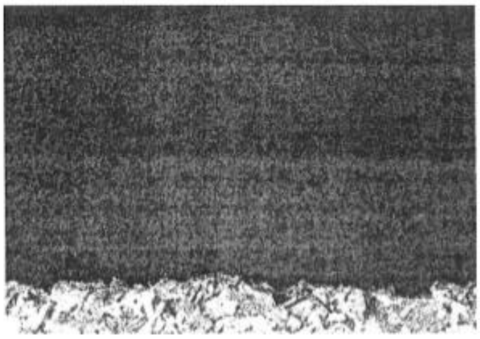
In samples with aluminum phosphates, the porosity of the A12O3 layers was reduced by the addition of phosphate, using a solution of A1 (ON) 3 - N3RO4 by weight ratio l: 4.2; with the addition of 20% distilled water. The solution was impregnated at room temperature and atmospheric pressure.

The duration of the impregnation was 12 hours after which the samples were thermally treated. Thermal treatment was carried out in three steps: 2 hours at a temperature of 100 ° C, 2 hours at a temperature of 200 ° C and 2 hours at a temperature of 400 ° S [5].

2.2. Metallographic analysis of samples

Experimental investigations in this paper include the examination of structural characteristics by metallographic testing using optical microscopy. Samples were prepared for metallographic analysis by rope cut, then crushed into the nital. When cutting the sample (mechanical and thermal method), it is necessary to pay particular attention to the absence of structural changes. The magnification of the light microscope was optimally 200 times [6].

Figure 1 shows the microstructure of the sample to which the layer A12O3 is applied, and in Figure 2, the microstructure of the sample onto which the A12O3 layer is impregnated with aluminum phosphates.



Picture l. Microstructure of the sample onto which the A12O3 layer was applied, 200: 1 magnification

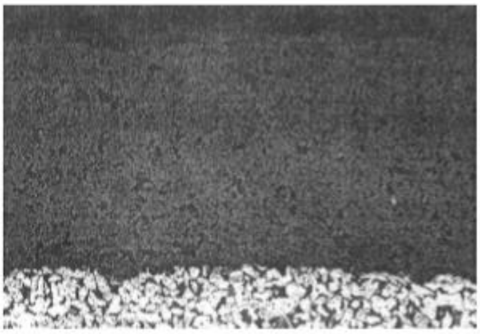


Figure 2. Microstructure of the sample onto which the A12O3 layer is impregnated with aluminum phosphates, magnification 200: 1

2.3. Hardness testing

The hardness test was carried out using the Vickers HV O 3 method, and the results are given in Table 1. The test is performed using a presser that is imprinted on the test material and the size of the imprinted trace is measured. The dishwasher is made of diamond in the form of a regular four-sided pyramid with an angle at the top of 136 ° ± 0.5 °. According to the standard procedure, the optimum impulse was 10 N. The loading time of the injection force into the sample surface of the material was 10-15 s, with a uniform increase in force.

Table 1. Results of hardness testing

Vrsta sloja	Tvrdoća HV 0,3
Al_2O_3	920
Al_2O_3 impregniran Al fosfatima	1120

2.4. Resistance testing for abrasive wear

The Abrasive Abrasion Resistance Test was carried out using the "dry sand / rubber wheel" method according to ASTM G 68-85, and to the variants of procedures B and C, Table 2 [7].

Standard device ASTM G 65-85 test device using the dry sand method and rubber wheel, and consists of abrasion tubes12x12x75 mm, with standard rounding with quartz sand Ottawa AFS 50 70. The tube rests on a hard-padded tire with a hardness tire about 64 Shorra, and is loaded with weights over the crankshaft. The force F is 130 N or 45 N depending on the variant of the procedure, and the speed of the wheel is regulated by the speedometer. The diagram of the abrasion resistance tester is shown in Figure 3. The diameter of the rubber point on the testing device is 228.6 mm, the width and thickness of the rubber ring is 12.7 mm, the sanding nozzle is made of chic (DIN EN S235JRG2) and achieves a flow of 250-350 g / min, the speed of the drive electric motor is 196 rpm.

The results of the monitoring of the behavior of regenerated machine elites in exploitation show that the age of thieving is not the same. Already often higher. The cost of regeneration makes up 10 to 20% of the new machine part.

Table 2. Process variants

Varijante postupka	Veličina sile na epruveti	Broj obrtaja točka [o/min]	Relativan pređeni put [m]
A	130	6000	4309
B	130	2000	1436
C	130	100	71.8
D	45	6000	4309

For version B, the test sample was 130 N and the speed of the revolver was 2000 rpm. For the C variant, the force of the test sample was 130 N, but the speed was 100. For both types of layers, three samples were tested. Samples after wear are shown in Figure 4. The results of the volume loss ΔVASTM in mm3 are shown in Table 3 and in Figures 5 and 6. The density of the layers when calculating ΔVASTM was 3.98 g / cm3.

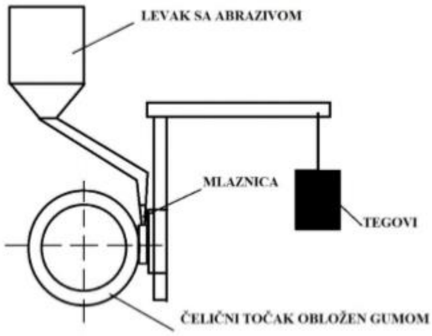


Figure 3. Schematic of the abrasion resistance tester

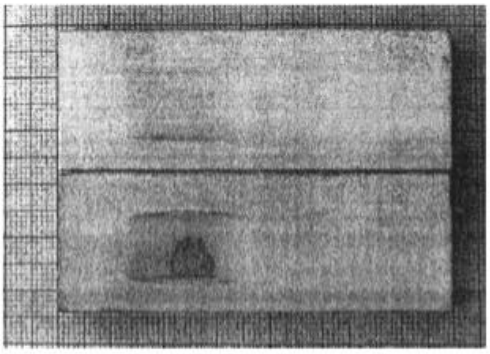
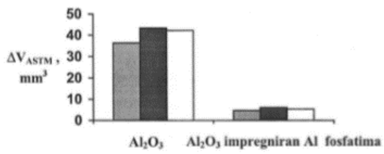
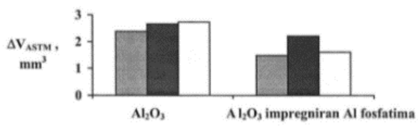


Figure 4. Samples after wear



Slika 5. Gubitak zapremine nakon abrazivnog habanja po metodi ASTM G 65-85, varijanta postupka B



Slika 6. Gubitak zapremine nakon abrazivnog habanja po metodi ASTM G 65-85, varijanta postupka C

Table 3. Results of abrasive abrasion resistance test using the ASTM G 65-85 method

* - There was a breakdown of the surface layer

In addition to testing the ASTM G 65-85 ro-routine, the sampling rate of the samples was also reversed, with a force of 130 N after the force, after 100, 200, 300, 400 and 500 rotation points. The results of the volume loss ΔVASTM in mm3 are shown in Table 4 and Figure 7.

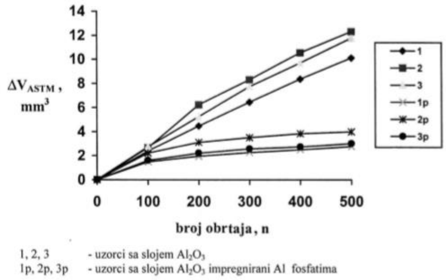


Figure 7. Abrasive abrasive flow Table 4. Results of abrasive wear monitoring

Broj obrtaja ns	ΔV, mm³					
	$A1_2O_3$			$A1_2O_3$ impregniran Al fosfatima		
	1	2	3	1	2	3
100	2,387	2,663	2,733	1,482	2,211	1,608
200	4,472	6,231	5,251	1,960	3,116	2,211
300	6,457	8,317	7,739	2,261	3,518	2,563
400	8,367	10,553	9,698	2,487	3,844	2,739
500	10,126	12,337	11,784	2,764	3,995	3,015

3. CONCLUSION

The results of the test show that the A112 A3O3 impregnated with Al phosphates is more resistant to abrasive wear compared to the A12O3 layer according to ASTM G 65-85. For the variant of Method C, this increased resistance is less pronounced, while in the process variant B, the layer A12O3 is impregnated with Al phosphates, more resistant to abrasion than the layer A12O3, six to nine times. In this case, the removal of the A12O3 layer in the process variant B was complete

Abrasive abrasive flow monitoring indicates that the abrasion resistance of the A12O3 layer of impregnated Al phosphates and the A12O3 layer begins to differ significantly after 200 rpm. With a further increase in the speed, this difference in resistance is increasingly increasing in favor of the layers A1203 of impregnated Al phosphates.

In addition to the constant control of the tribometer device, it is especially necessary to control the quality of sand AFS (50/70), the granulation composition is round and square. The moisture must not exceed 0.5%. Sand that is exposed to moisture can adversely affect the results of the test. Multiple use of sand is not recommended.

The selected coatings are particularly resistant to abrasion wear and can be applied to the demanding parts of modern agricultural technology.

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PUBLIC TRANSPORTATION AS A REDUCTION FACTOR OF TRAFFIC CONGESTION IN URBAN AREAS

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Abstract:*As a residents of urban areas, everyday we witness increase in the number of registered vehicles that daily move through urban zone of small, medium and large cities. Such an increase in vehicles number results in various forms of congestion like gas emissions and air pollution, usage of traffic areas and daily traffic jams, excessive noise as much as reduced traffic safety. The future development of public transportation in urban areas should give solution to traffic congestion in all respects. This research will present analysis of the existing traffic conditions in urban areas through the analysis of exhaust gas emissions, usage of traffic areas, traffic congestion as well as traffic noise, increase the level of traffic safety. As a result of this research: proposal of potential measures for reducing the harmful impact of public transport on the environment, its role as a generator and a key factor in reduction of traffic congestion in urban and highly urban areas.*

Keywords: *Public transportation, emissions, pollution, air, noise, congestion, safety.*