ALUMINISATION THERMOCHEMICAL TREATMENT APPLIED TO WEAR RESISTANT COATINGS

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Abstract: *Aluminisation process is particularly widespread the process to increase wear resistance, oxidation resistance, heat-resistant alloysto replace expensive heat resistant to 800°C-1000°C, with cheaper materials.*

Keywords: powder, aluminium, laser-sintering

1.Introduction

In a previous paper „*Platyng of wear resistant surface layers by the method - laser sintering”* I presented some pieces of a base material from OLC 45, that were made by process *laser-sintering* layer of Al_2O_3 powder. In this paper we apply these parts heat treatment aluminisation in order to observe changes in structure and physico-mechanical properties obtained.

By aluminisation (alitare or hardening aluminum) surface enrichment is achieved by diffusion of aluminum products made of ferrous alloys, to increase resistance to oxidation at high temperatures (800°-900°C) in solid medium, liquid or gaseous, diffusion layer thickness reaching value 0,02 – 1,2mm.

Speed of diffusion of aluminum in the alloys of iron with carbon is influenced by their content of carbon and alloying elements is the lower, the higer their proportion is higher. For this reason, aluminisation applies in particular products made of carbon and low alloy steels, with low carbon content and less of the average content of carbon steels or cast iron.

Aluminisation process is particularly the process of increasing the wear resistance, oxidation resistance to hot, to replace refractory alloys expensive, heat resistance 800°-1000°C, with cheaper materials.

2.Experimental study

2.1. The material investigated. Experimental study

Based on unfavorable influence on the deformability of aluminum and steel hardening, will try aluminisation heat treatment of samples of OLC 45 that were previously filed by laser-sintering technology, additional layers consisting of Al_2O_3.

For the experimental, were used specimens obtained in the work „*Wear resistant coatings obtained by the method - laser sintering”*.

Aluminum surface enrichment of samples was done by keeping the different times al temperatures 820°C şi 860°C in a bath of molten aluminum, containing 90% aluminum (Al 99,7) and 10% submitted filings to protect evidence them against corrosion.

To avoid oxidation of aluminum melt, on its surface to put a layer of flux with explicit composition in table 1.

Table 1- *Flux coating composition.*

Composition	NaCl	KCl	Na_3AlF_6	AlF_3
[%]	40	40	10	10

For making the experiment using a ceramic melting pot, which was filled with 900g aluminum and 100g iron powder, so that after melting the fullness load of the melting pot was 75%. Melting pot was introduced into the furnace and was heates to 800^oC, so that aluminum is melted, covering iron powder. Immediately after the melting of aluminum metal bath was covered a thick layer of flux around 10mm.

Then, molten metal in the form described above, heated furter to temperatures 820^oC respectively 860^oC. At this point, samples were placed on all melt bath and maintained for a period of time according to a schedule previously (table 2).

Table 2- *Regime aluminisation*

Sample	Regime aluminisation		
	T[^oC]	**Hold time [min]**	**Cooling medium**
1	820	15	oil
2	820	15	oil
3	860	20	oil
4	860	20	oil

2.2. Structure and properties of aluminized layer

Aluminized layer structure, nature, sequence and structural constituents of different morphology, are determined directly from concentration and distribution of aluminum in the diffusion layer. Aluminized layer constituents monophasic domains corresponding equilibrum diagram of iron-aluminum. The concentration and distribution of aluminum in the surface layer is due to both process and technological parameters used aluminisation selected (temperature and duration of maintenance), and steel type submitted aluminization.

Sample 1- Plate of OLC 45 with dimension h=4mm, L=80mm, l=50mm that have submitted a layer of Al_2O_3 with thick 0,2mm. After application of termochemical treatment aluminisation in the conditions described above, resulting microstructure shown in figure 1.

In the sample microstructure distinguished four succesive zone:

1- outer layer on the sample surface machanically joined during extraction in the bathroom, with a thickness of about 0,15mm and an irregular interface as a result of interdifusion processes between the two layers ;

2- between the top layer consist of aluminum + phase θ and layer deposited there is a thin border around 0,02mm, strongly attacked by reactive.

3- layer made of Al_2O_3, weak attack, is in alloy of aluminum with alumina, thick 0,2mm;

4- basic mass of the sample, spoon showing fine structure, being attacked intensely reactive;

Sample 2 - Palte of OLC 45 with dimension h=4mm, L=80mm, l=50mm that have submitted a layer of Al_2O_3 with thick 0,6mm. After application of termochemical treatment aluminisation in the conditions described above, resulting microstructure shown in figure 2.

In the sample microstructure distinguished four succesive zone:

1- outer layer adhered on the sample surface during mechanical extraction in the bathroom, with a thickness of about 0,05mm. Thickness smaller than for sample 1 is caused by speed extraction of the sample in the melting pot;

2- thin boundary layer around 0,01mm, consists of phase θ;

3- layer made of Al_2O_3, thicker than for a sample 1 about 0,6mm, presenting to play a sinuous contours;

4- basic mass of the sample, showing spoon fine structure, being attacked intensely by the reactive;

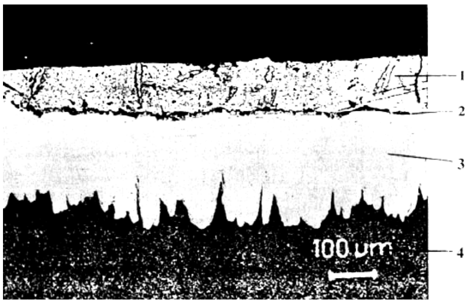

Fig.1. *Microstructure of sample 1 (thickness deposited h = 0,2 mm, optic 100x)*

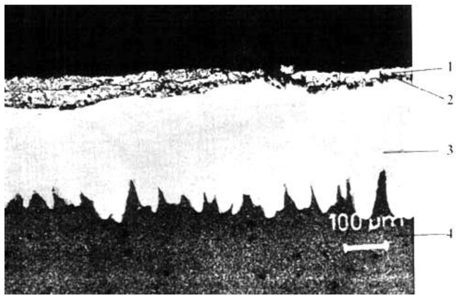

Fig.2. *Microstructure of sample 2 (thickness deposited h = 0,6 mm, optic 100x)*

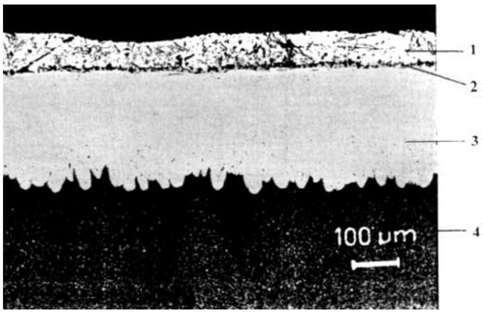

Fig.3. *Microstructure of sample 3 (thickness deposited h = 1 mm, optic 100x)*

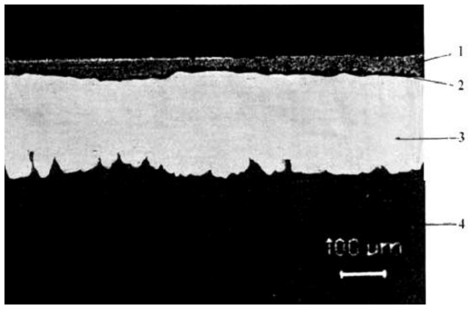

Fig.4. *Microstructure of sample 4 (thickness deposited h = 1,2 mm, optic 100x)*

Sample 3 – Plate of OLC 45 with dimension h=4mm, L=80mm, l=50mm that have submitted a layer of Al_2O_3 with thick 1mm. After application of termochemical treatment aluminisation in the conditions described above, resulting microstructure shown in figure 3.

In the sample microstructure distinguished four succesive zone:

1- outer layer adhered on the sample surface during mechanical extraction in the bathroom, with a thickness of about 0,1mm consists of aluminum and phase θ. Medium thickness 0,1mm indicates a low extraction rate of the sample in the melting pot;

2- the thin boundary layer about 0,01mm, consists of phase θ;

3- layer deposited of Al_2O_3 thick 1mm, shown into play also has a sinuous shape but more subdued than in sample entered the bathroom located at a temperature of 820^oC;

4- basic mass of the sample, showing spoon fine structure, being attacked intensely reactive;

Sample 4 - Plate of OLC 45 with dimension h=4mm, L=80mm, l=50mm that have submitted a layer of Al_2O_3 with thick 1,2mm. After application of termochemical treatment aluminisation in the conditions described above, resulting microstructure shown in figure 3.

In the sample microstructure distinguished four succesive zone:

1- outer layer adhered on the sample surface during mechanical extraction in the bathroom, with a thickness of about 0,12mm consists of aluminum and phase θ. Medium thickness 0,12mm indicates a low extraction rate of the sample in the melting pot;

2- the thin boundary layer about 0,02mm, consists of phase θ;

3- layer deposited of Al_2O_3 thick 1,2mm, shown into play also has a sinuous shape;

4- basic mass of the sample, showing spoon fine structure, being attacked intensely reactive;

3. Conclusions

From the examination microstructures shown in figures 1-4 allows the following conclusions:

-as expected, after aluminisation, in the section samples resulted four successive zones, characteristic on the process of thermochemical treatment used;

-on the surface has been obtained one layer mechanically joined during the extraction from bath of aluminum. Interface with the adjacent layer is in the all cases irregular, due to interdifusion processes that occur during aluminisation between molten metal and steel sample;

-the first layer thickness was variable from sample to sample, depending on the speed sample extraction of the melt bath;

-in the outer layer, optical microscope examination revealed the fact that not only is the aluminum phase θ ($FeAl_3$);

-between aluminum layer + phase θ formed and diffusion layer, observed presence of a thin 0,01-0,02mm border, strongly attacked by reactive;

-the third layer is the diffusion of aluminum in the alumina layer, rich in aluminum;

-the fourth layer (base layer) not substantially altered the structure;

References

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