# Corrosion stability of components surface treated galvanizing

Vladimír Kročko, Štefan Álló, Maroš Korenko, Ján Žitňanský

***Abstract***

*This research deals with the corrosion stability of components surface treated with galvanizing. The aim is, to check, if the roughness of the surface influences the resistance against corrosion. On 10 pieces of components was performed the galvanizing method Zn in the bath-line. After measuring the thickness of the surfaces, the components was inserted in the salt spray corrosion chamber for a test period lasted 456 hours in the test solution in the test solution of NaCl. After the corrosion test was controlled the original part on the components and the treated parts. The test showed that on the treated parts after 456 test hours wasn't signs after red corrosion. After this research we can conclude, the roughness obtained by the turning process ha no influence on the resistance against corrosion.*

***Keywords:*** *corrosion test, salt-spray, resistance against corrosion.*

## 1. Introduction

In the modern times are increasing demands on the quality and reliability of the components in the automotive industry. These components during the functionality and life-time are exposed to various stresses. Devaluation, damage and the loss of the function of the components causes the damage of the surface, corrosion and wear.

The aim of the surface treatment to obtain the desired properties and to protect the surfaces of the components from the long-term side effects. With the surface treatment dealt several authors [3, 4, 5].

## 2. Methodology

### Corrosion tests in artificial atmospheres – Salt spray test

Salt spray tests are generally particularly recommended for corrosion resistance tests for rapid detection of cracks, porosity and damage of organic coatings and inorganic coatings. Moreover, quality control may make a comparison between samples with the same coating.

However Salt mist tests are suitable only for comparative testing of coatings which have sufficiently similar chemical composition.

Salt spray tests are mainly used to determine the integrity of the breach, such as porosity and other defects metallic coatings, organic coatings, coatings formed anodic oxidation and conversion coatings [1].

**Tab 1. Test conditions**

| Test method | Neutral salt spray (NSS) | Acidified acetic salt spray (AASS) |
|---|---|---|
| Temperature | 35 ºC ± 2 ºC | 35 ºC ± 2 ºC |
| Average rate of accumulation of horizontal collecting area 80 $cm^2$ | 1.5 ml/h ± 0.5 ml/h | |
| Concentration of sodium chloride (accumulated solution) | 50 g/l ± 5 g/l | |
| pH (accumulated solution) | from 6.5 to 7.2 | from 3.1 to 3.3 |

## 3. Surface treatment Zn on suspension galvanizing bath line

Suspension galvanizing process is divided into several operations. Important processes are degreasing and rinsing, which is performed before the application of coatings. At the beginning of galvanizing process is the chemical degreasing performed by 65 degrees -75 ºC and checked visually. Followed by pickling and cathodic - anodic degreasing in degrees 45 to 65 ºC and at a current of 1000 A. The galvanizing process

takes place twice in a weak acid bath and followed by repeated rinsing and thick filmed passivation. The last processes are the conservation and drying at 60 to 90 ºC.

By the research we used 10 pieces from the same elements, which are used as stabilizers in the axletree of cars. Each one of these elements had a different value on roughness, which we achieved with parameter changes by the turning work. After the suspension galvanizing on the bath line we measured the coating thicknesses of these elements on the original and the treated surfaces. Before galvanizing process, we also measured the roughness of the treated surfaces. Thickness measurement was performed manually with the device Mikrotest G6, which is used for the thickness coating control in production. With the device Mikrotest G6 we can measure in a range up to 100 μm.

**Tab 2. Measured data of thickness coating on the original and treated surface**

| Nr. of the element | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Avg. value of the coating thickness on the original surface (μm)** | 13.25 | 21 | 13.42 | 16.08 | 10.75 | 16.25 | 14.75 | 12.17 | 13.83 | 13.92 |
| **Roughness of the surfaces Ra (μm)** | 4.740 | 4.425 | 2.930 | 3.093 | 2.238 | 1.819 | 2.241 | 2.262 | 0.420 | 0.245 |
| **Avg. value of the coating thickness on the treated surface (μm)** | 19.08 | 24.67 | 14.33 | 18.00 | 14.33 | 17 | 16.83 | 14.08 | 12.67 | 15.00 |

Tab.2 includes the measured data of coating thickness on the original surfaces and surfaces on the treated parts. The table also includes the values of roughness on each component.

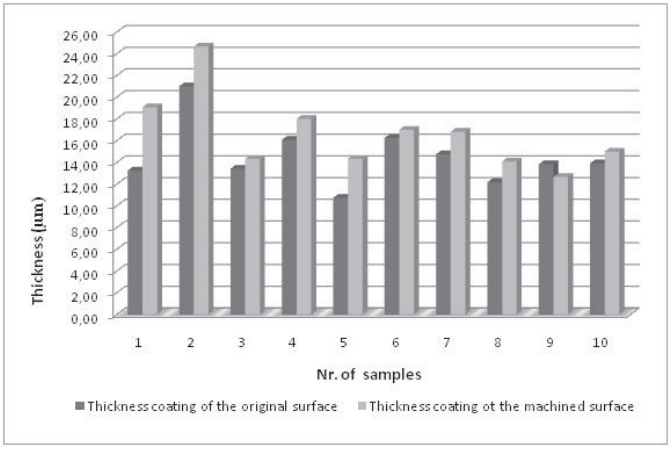


Fig.1. Thickness coatings of the original and treated surfaces

The figure 1 contains the measured thickness coatings on the original and treated surfaces. In one case, we measured the thickness of the coating in the original area of the elements, where the lowest average value was 10.75 microns and the highest average 21.0 microns. In the second case, we measured the thickness of the coating on the treated surfaces, where the lowest average value was 12.67 and the highest 21.67 microns.

**Corrosion test – Salt spray tests**

The corrosion test and the Salt spray test provides the standard of ISO 9227: 2006, and the Methods of corrosion testing of metallic and other inorganic coatings on metallic substrates provides the standard ISO 10289:1999.

During the test we put the tested components in the salt spray corrosion chamber, which was made from the manufacturer Liebnisch Labortechnik tip SKB TR-1000 A. The test period lasted 456 hours in the test solution of NaCl. The proportion of the water and the solution NaCl must be 5.5 kg on 100 Liter water.

**Tab 3. Test conditions and controlled parameters during the test**

| Test method | Neutral salt spray (NSS) | Controlled parameters during the test |
|---|---|---|
| **Temperature** | 35 ºC ± 2 ºC | 35 ºC |
| **Average rate of accumulation of horizontal collecting area 80 cm$^2$** | 1.5 ml/h ± 0.5 ml/h | 1.5 ml/h |
| **Concentration of sodium chloride (accumulated solution)** | 50 g/l ± 5 g/l | 50 g/l |
| **pH (accumulated solution)** | from 6.5 to 7.2 | 6.5 |

The table 3 describes the conditions and the controlled parameters during the test. The first column describes the parameters, which are controlled, the second column includes the values according to the standard ISO 9227: 2006, and the third column includes the values, which was controlled during the salt spray test.

**The evaluation of the salt spray test**

After the test we left the elements to dry 1 hour, to reduce the risk of removing corrosion products. According to the requirements of several customers, these components must withstand in the corrosion chamber at least 240 hours without a hint of red corrosion. In our case we controlled the treated surface and also the original surface, but not the all surfaces on the components. The evaluation we made according to the standard of ISO 10289: 1999.

**Tab.4. The salt spray test evaluations**

| Time: | 240 h | 360 h | 456 h |
|---|---|---|---|
| **White corrosion** | W.C. | W.C. | W.C. |
| **Red corrosion** | None | None | None |
| **Evaluation of the changes by appearance $R_A$** | Vw | Vw | W |
| **Evaluation of the level of protection $R_p$** | 9/- | 8/- | 7/- |

Table 4 contains the evaluation of corrosion tests according to ISO 10289: 1999. The first line describes the controlled time, the second and the third the controlled corrosion, the fourth includes the evaluation of the changes by appearance, which can be very weak, weak, slightly and hard. The last line describes the evaluation of the level of protection. The highest level is 10 – which means, the elements are without defect- and the lowest level is 0, which means, the controlled surface has more than 50 % of defects.

The controls of the components are made in time within 240, 360 and 456 hours. During the controls, we not found on the controlled areas the incidence of white corrosion, or the occurrence of red corrosion. The change according to the appearance was very weak, and at 456 hour was weak. The degree of protection reflects the ability of the

coating to protect the underlying metal against corrosion. Since level 10 is the highest, controlling the degree of protection at 456 hours is nr. 7.

**4. Ending**

In this research we controlled the surface treatment Zn on suspension galvanizing bath line and also controlled the resistance these parts against corrosion. Corrosion is one of the defects, why we must to change elements on cars. In this case is important to identify, which parameters are influencing the corrosion. after this research we can conclude, that the roughness obtained by the turning process has no influence neither on the surface treatment, nor on the resistance against corrosion.

**5. Literature**

[1] ISO 9227:2006, Corrosion tests in artificial atmospheres - Salt spray tests. ICS: 77.060, p. 23

[2] ISO 10289:1999, Methods for corrosion testing of metallic and other inorganic coatings on metallic substrates. Rating of test specimens and manufactured articles subjected to corrosion tests, ICS: 25.220.20, 25.220.40, p. 22

[3] Krastev G., Kangalov Pl., Research on the rate of coating iron with Hull cell, Ruse: PB at Ruse University “A. Kanchev”, 2006, Vol. 45 p. 45-48

[4] Staneva G., Kangalov Pl., Stanev L. Wear resistance of recovered parts with phosphate conversion coating of sliding friction, Ruse: PB at Ruse University “A. Kanchev”, 2007, Vol. 46 p. 62-66

[5] VETTER. J., et al. 2005, Surface treatment selections for automotive applications, In Surface and Coatings Technology vol. 200, 2005, p. 1962-1968.

**Contact**:

Kročko Vladimír: Department of Quality and Engineering Technologies, Faculty of Engineering, Slovan University of agriculture in Nitra, e-mail: vladimir.krocko@uniag.sk

Álló Štefan: Department of Quality and Engineering Technologies, Faculty of Engineering, Slovan University of agriculture in Nitra, e-mail: stefan.allo13@gmail.com

Korenko Maroš: Department of Quality and Engineering Technologies, Faculty of Engineering, Slovan University of agriculture in Nitra, e-mail: maros.korenko@uniag.sk

Žitňanský Ján: Department of Quality and Engineering Technologies, Faculty of Engineering, Slovan University of agriculture in Nitra, e-mail: jan.zitnansky@uniag.sk