

Summary

The doctoral dissertation discusses the issue of the impact of the shot peening process on the load capacity of adhesive joints made of aluminum alloy EN AW-2024-T3. The topic of the dissertation was adopted in response to the need to develop an efficient, easy, and effective method of strengthening adhesive lap joints.

As part of the work, the influence of selected parameters of the shot peening process on the load capacity of single-lap adhesive joints made of aluminum alloy EN AW-2024-T3 was experimentally examined. Furthermore, the possibility of using selected methods to control the shot peening process to predict the load capacity of the adhesive joints after the shot peening and to assess the correctness of the strengthening treatment was checked. The experiments were carried out according to the Hartley PS/DS-P:Ha₃ plan methodology. Using statistical methods (one-way analysis of variance, regression, and correlation analysis), the relationships between the load capacity of adhesive joints subjected to shot peening and the Almen strip deflection, surface roughness parameters and the state of residual stress of samples made of aluminum alloy EN AW-2024-T3 were analysed. In order to explain the mechanism of increasing the load capacity of adhesive joints as a result of shot peening, the state of residual stresses in the bond-line of treated and untreated joints was compared. Comparison of the stress state was performed using the finite element method using Ansys 16.2 software.

The test results allowed to prove the correctness of the hypothesis presented in the work, according to which the treatment of strengthening the overlap zones of adhesive joints made of aluminum alloy EN AW-2024-T3, carried out by shot peening with appropriately selected technological parameters, allows to increase their load capacity. For the range of variability of the input factors assumed in the research, the load capacity of the shot peened connections was up to 33.4% higher than the load capacity of the non-peened connections. The load capacity of the treated joints was shown to decrease with increasing value of the Almen strip deflection. The surface roughness parameters most closely related to the load capacity of adhesive joints subjected to shot peening were the *Rku* and *Sdr* parameters. The load capacity of adhesive joints increased with increasing values of the *Rku* and *Sdr* parameters. The results of numerical analyses proved that shot peening of the outer surface of the overlap led to a reduction in stresses in the bond-line, with the greatest decrease in stress values being noticeable in the case of normal stresses perpendicular to the surface of the bond-line.