ABSTRACT

In Reducing the tensile residual stresses induced from spot welding Using Shot Peening Process are presented in this reserch, so, the stainless steel material type 316 in form of sheet with a thickness of 1.5 mm was selected. The as-received sheets were first cut to prepare specimens with a dimension of (55 x 55) mm for welding purpose. In order to check the conformity of this material in the as-received condition with the standard type, the chemical composition and the mechanical properties of this material were obtained, and the results were presented for comparison purposes.

The as-received specimens were then stress relieved in furnaces according to ASTM A 313 specification in order to obtain the effect of using this heat treatment on the induced residual stresses and strains. Therefore, both specimens of the as-received condition and those stress relieved were tested using the X-Ray Diffraction method (XRD) to measure the residual stresses. The results showed that this heat treatment is effective due to the reduction of the tensile residual stresses created by the mechanical working utilized during the production of as-received stainless steel sheets from (49.97 to 6.52) MPa.

Then, the stress relieved specimens were prepared and spot welded for three different cases for different welding times (0.1, 0.20 and 0.26 sec) to find out their influence on the induced residual stresses, and the results of the XRD tests exhibited that the induced residual stresses after spot welding after these periods of time are tensile residual stresses (320, 300.4, 326.5) MPa respectively.

Accordingly, for the purpose of reducing the detrimental effect of these tensile residual stresses on the performance and life of these stress relieved specimens, the shot peening process was selected and carried out for various periods of time, and the XRD measurements indicated very good results in relieving theses tensile residual stresses due to their total transformation to compressive type (first spot with time 0.1 sec -300 MPa, second spot with time 0.2 sec -333 MPa, third spot with time 0.26 sec -267.52 MPa) .

Finally, in order to verify the experimental results of the residual stresses induced in spot welded specimens, a finite element method (FEM) was used to perform both the nonlinear transient thermal and nonlinear residual stresses analyses at different welding times (0.1, 0.20 and 0.26 sec) and to determine the effect of both temperature dependency of material and heat generation value. The numerical results are found in a very good agreement with the experimental data by agreement percents (98.77 % for first spot, 96.28 % for second spot, 92.6 % for third spot) .