

Riyadh Ahmed Sarhan Al-Taie. Influence of Residual Stress on Fatigue Behavior for Aluminum alloy (2024). University of Technology Mechanical Engineering Department. M.Sc. Supervisors: Dr. Ahmed Naef Al-khazraji, Dr. Farag Mahal Mohammed.2010. 83p.

ABSTRACT

A general investigation was done in the present work to study the effect of the residual stresses on the fatigue behavior for 2024 aluminum alloy. The residual stresses were introduced from different sources (heat treatment, pre-strain, and welding) and measured by X-Ray diffraction. All the test specimens were treated by annealing before any test.

For heat treatment, groups were heated to (420, 450, 480, and 510) °C up 30 min, then quenched in water (at room temperature), and followed by natural aging (stayed at room temperature for seven days). After heat treatment at 510 °C, an 85.6 MPa compressive residual stress has been introduced, leading to improve the mechanical properties (yield stress, ultimate stress, and hardness) by (45.83%, 42.53%, and 72.88%), respectively, while the elongation was decreased by (40%). The fatigue strength at 10^6 for this alloy was improved by (61.03%) as compared with the same alloy as received.

For pre strain, groups were loaded to (265, 290, 315 and 340) MPa by a tensile testing machine. All these loads were between the yield and ultimate strengths. When loaded to 340 MPa, a compressive residual stress of 62.448 MPa was generated, which leads to improve the fatigue strength by (46.453%), while for welding series, the fatigue strength decreased by (23.452%) due to the 76.9345 MPa of residual stress with using arc welding in width direction.

A finite element model was used to compare and satisfy the results of (fatigue life, deflection, and stress) at any load. The comparison exhibits that the error is not more than 13% between the experimental results and numerical analysis, These errors due to the condition of experimental work were not exact and can not be controlled at this condition, such as the environment, equipments, and surface finishing.

Keywords: Residual stress. Fatigue. Numerical Analysis