Study of residual stresses and fracture toughness in welded and repaired joints using A516 Gr70 steel

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The properties of welded joints subjected to cyclic loading is an important subject in several áreas[1]. In this scenario, aiming to study this subject, welded joints made of ASTM A 516GR 70 steel plates, with a thickness of 30.5 mm, welded by the MAG - Metal Active Gas process (20% CO2) with the use of a K-bevel were analyzed. to allow full penetration due to the high thickness [2]. The joints were manufactured with seven welding passes on each side of the chamfer. After welding, one set was subjected to a repair pass, for remelting the surface of the bead using the TIG (Tungsten Inert Gas) process, while another set was subjected to two repair passes. This study aimed to analyze aspects of welded and repaired joints: dimensions (height and width) of the bead, behavior of the residual stress profile measured by X-ray diffraction, Vickers microhardness profile and fatigue crack nucleation with based on ASTM E466 and E606 standards. The results indicated that the greater number of repair passes decreased the compressive residual stress values in the transverse and longitudinal directions, from -350 MPa to 50 MPa. There was greater uniformity in hardness Vickers values (value between 200 and 210 HV) with the use of cord repairs. It was observed that the fracture toughness presented values of 1500 J/mm (without repair) and 900 J/mm (one pass and two repair passes), lower than that found in the material without welding (3500 J/mm). Therefore, as the repair passes were performed, the residual stresses in the weld bead tended to positive values, the hardness tended to stabilize with values of 200 HV due to the increase in the number of repair passes and the fracture toughness decreased in the welded material when compared to the values of the non-welded material. There was no significant difference in fracture toughness between repair passes.