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Fatigue Behavior of Friction Stir Welded EN AW 5754 Aluminum Alloy Using Load Increase Procedure

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Abstract : Friction stir welding (FSW) is an advantageous method in the thermal joining processes, featuring the welding of various dissimilar and similar material combinations, joining temperatures below the melting point which prevents irregularities such as pores and hot cracks as well as high strengths mechanical joints near the base material. The FSW process consists of a rotating tool which is made of a shoulder and a probe. The welding process is based on a rotating tool which plunges in the workpiece under axial pressure. As a result, the material is plasticized by frictional heat which leads to a decrease in the flow stress. During the welding procedure, the material is continuously displaced by the tool, creating a firmly bonded weld seam behind the tool. However, the mechanical properties of the weld seam are affected by the design and geometry of the tool. These include in particular microstructural and surface properties which can favor crack initiation. Following investigation compares the dynamic properties of FSW weld seams with conventional and stationary shoulder geometry based on load increase test (LIT). Compared to classical Woehler tests, it is possible to determine the fatigue strength of the specimens after a short amount of time. The investigations were carried out on a robotized welding setup on 2 mm thick EN AW 5754 aluminum alloy sheets. It was shown that an increased tensile and fatigue strength can be achieved by using the stationary shoulder concept. Furthermore, it could be demonstrated that the LIT is a valid method to describe the fatigue behavior of FSW weld seams.

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