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An investigation into the effect of friction welding parameters on tensile strength of titanium tubes by utilizing an empirical relationship

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Abstract

Friction welding is a useful technique to join tubes, including titanium tubes, without the presence of certain common defects encountered with conventional fusion welding. Grade 2 titanium tubes with an outer diameter of 60 mm and wall thickness of 3.9 mm were effectively joined by friction welding. An empirical relationship was developed to investigate the effect of process parameters on the ultimate tensile strength (UTS) of the joints. A central composite rotatable design consisting of three process parameters and five levels was used to minimize the number of experiments, i.e., welded joints. The process parameters considered were rotational speed, friction time and burn off. The influence of these factors on the UTS is evaluated based on the empirical relationship developed. The trends obtained are explained by reference to a macrostructural and microstructural characterization of the joints. The variation in joint strength is correlated to the presence of pores, poor consolidation and ejection of excessive plasticized material from the joint interface.

Key words: Titanium; Tube; Friction welding; Tensile strength; Microstructure.