World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:13, No:06, 2019

Feasibility Study of Friction Stir Welding Application for Kevlar Material

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Abstract : Friction stir welding (FSW) is a joining process in the solid state, which eliminates problems associated with the material melting and solidification, such as cracks, residual stresses and distortions generated during conventional welding. Among the most important advantages of FSW are; easy automation, less distortion, lower residual stress and good mechanical properties in the joining region. FSW is a recent approach to metal joining and although originally intended for aluminum alloys, it is investigated in a variety of metallic materials. The basic concept of FSW is a rotating tool, made of non-consumable material, specially designed with a geometry consisting of a pin and a recess (shoulder). This tool is inserted as spinning on its axis at the adjoining edges of two sheets or plates to be joined and then it travels along the joining path line. The tool rotation axis defines an angle of inclination with which the components to be welded. This angle is used for receiving the material to be processed at the tool base and to promote the gradual forge effect imposed by the shoulder during the passage of the tool. This prevents the material plastic flow at the tool lateral, ensuring weld closure on the back of the pin. In this study, two 4 mm Kevlar® plates which were produced with the Kevlar® fabrics, are analyzed with COMSOL Multiphysics in order to investigate the weldability via FSW. Thereafter, some experimental investigation is done with an appropriate workbench in order to compare them with the analysis results.

Keywords : analytical modeling, composite materials welding, friction stir welding, heat generation
Conference Title : ICMME 2019 : International Conference on Metal Materials and Engineering
Conference Location : Copenhagen, Denmark
Conference Dates : June 11-12, 2019