Effect of tool tilt angle on Friction Stir Welds

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ABSTRACT

This work studies the effect of the tool tilt angle on the Friction Stir Welding (FSW) in terms of thermomechanical results such as the heat generation and the material flow [1]. The FSW model presented in this work is based on the apropos kinematic framework [2] and the two-stage speed-up strategy [3].

The effect of the tool tilt angle on the FSWelds is taken into account through an enhanced friction model [4, 5]. The friction shear stress field is rotated by an angle dependent on the tool tilt angle and the process parameters. This angle is calibrated via experimental data.

The differences on generated heat and material flow by using different tilt angles are discussed. The computed thermomechanical results are compared with the experimental evidence and a good agreement is observed. Differences between the temperatures at the retreating and advancing sides are also compared with the experimental measurements. It is concluded that higher values of the tilt angle induce greater frictional forces as well as higher temperature in the trailing side of the tool. This enhances the material flow in the rear side and prevents the generation of defect.

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