World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Finite Element Modeling of Friction Stir Welding of Dissimilar Alloys

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Abstract : In the current work, a Coupled Eulerian Lagrangian (CEL) model is developed to simulate the friction stir welding (FSW) process of dissimilar Aluminum alloys (Al 6061-T6 with Al 5083-O). The model predicts volumetric defects, material flow, developed temperatures, and stresses in addition to tool reaction loads. Simulation of welding phase is performed by employing a control volume approach, whereas the welding speed is defined as inflow and outflow over Eulerian domain boundaries. Only material softening due to inelastic heat generation is considered and material behavior is assumed to obey Johnson-Cook's Model. The model was validated using published experimentally measured temperatures, at similar welding conditions, and by qualitative comparison of dissimilar weld microstructure. The FE results showed that most of developed temperatures were below melting and that the bulk of the deformed material in solid state. The temperature gradient on AL6061-T6 side was found to be less than that of Al 5083-O. Changing the position Al 6061-T6 from retreating (Ret.) side to advancing (Adv.) side led to a decrease in maximum process temperature and strain rate. This could be due to the higher resistance of Al 6061-T6 to flow as compared to Al 5083-O.

Keywords : friction stir welding, dissimilar metals, finite element modeling, coupled Eulerian Lagrangian Analysis
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020