An analytical model for the heat generation in friction stir welding

The objective of this work is to establish an analytical model for heat generation by friction stir welding (FSW), based on different assumptions of the contact condition between the rotating tool surface and the weld piece. The material flow and heat generation are characterized by the contact conditions at the interface, and are described as sliding, sticking or partial sliding/sticking. Different mechanisms of heat generation are behind each contact condition, making this study important for further understanding of the real FSW process. The analytical expression for the heat generation is a modification of previous analytical models known from the literature and accounts for both conical surfaces and different contact conditions. Experimental results on plunge force and torque are used to determine the contact condition. The sliding condition yields a proportional relationship between the plunge force and heat generation. This is not demonstrated in the experiment, which suggests that the sticking contact condition is present at the tool/matrix interface.

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