Thermomechanical Analysis of the Friction Stir Welding Process

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Abstract. Since its development, FSW has been pointed as an excellent alternative to fusion welding. Although this technology was initially settled for welding aluminium alloys, recent developments allowed extending its application to a more diversified range of base materials. Due to the complexity of the process, the use of numerical simulation become a common practice for optimizing process parameters and/or for understanding the physical phenomena governing it, which are impossible to analyze using common experimental practices. In present work, COMET software was used to model different conceptual materials, designed in order to enable a deep analysis of the influence of base materials plastic properties, at different temperatures and strain rates, on heat generation and material flow during FSW. Perfectly plastic materials, as well as strain rate and non-strain rate sensitive materials, were tested using Norton-Hoff constitutive model. Torque, axial load, temperature and material flow were evaluated and related to base materials plastic properties and contact conditions at the tool-workpiece interface. Numerical and experimental results are compared and discussed.