Experimental validation of Friction Stir Welding (FSW) numerical model

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ABSTRACT

This work presents the results of the numerical simulation and experimental validation of a fast and accurate FEM model for FSW simulation [1,2].

In this model, the fully coupled thermomechanical problem is solved using an apropos kinematic framework, a mixed pressure-velocity formulation and an accurate stabilization procedure with optimal numerical dissipation.

The model considers the friction between the tool and the workpiece and the plastic dissipation as the main sources of heat generation. The friction model proposed is a modified viscoplastic Norton's law that not only relates the frictional shear stress to the sliding velocity but also accounts for the pressure distribution.

The constitutive model proposed is calibrated by the experimental material characterization provided in terms of stress/strain rate.

The study shows that the proposed modelling approach can be used to predict and interpret the FSW behaviour for a given pin geometry. The results obtained in terms of forces, torque and temperature evolution are validated against the measurement provided by the industrial partner (SAPA).

REFERENCES

[1] Dialami, N., Chiumenti, M., Cervera, M. and Agelet de Saracibar, C. (2017) A fast and accurate two-stage strategy to evaluate the effect of the pin tool profile on metal flow, torque and forces during friction stir welding, International Journal of Mechanical Sciences 122:215-227.

[2] Dialami, N., Chiumenti, M., Cervera, M. and Agelet de Saracibar, C. (2017) Challenges in thermo-mechanical analysis of Friction Stir Welding processes, Archives of Computational Methods in Engineering, 24:189-225