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ABSTRACTS

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The abstracts are in order of the presenting author.

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Computational Modelling of Thermoplastic Behaviour of Inconel 718 in Application to Laser-Assisted Bending of Thin-Walled Alloy Tubes

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ABSTRACT

At present, nickel based alloys are broadly used in the aerospace industry due to their excellent corrosion resistance and high mechanical properties. Laser-assisted tube bending process is a promising manufacturing process because of its ability to produce forms and shapes that cannot be achieved by mechanical bending. Laser bending is particularly suitable for the high hardness and brittle materials, such as nickel alloys, ceramics and cast iron. An experimental investigation of the Inconel 718 alloy is used in validation of the constitutive model. The multiaxial constitutive model accounts for the strength-differential behaviour under uniaxial tension/compression [1-3]. It encompasses softening phenomena as well as the coupling between temperature and strains, both of them observed in experiments. Bending of thin-walled tubes in a specially designed device is studied. Mechanical loading and simultaneous heating of the material by a moving laser beam are introduced in a controlled manner to obtain the required deformation. The current paper is focused on numerical simulations to provide more insight into the laser bending process of the Inconel 718 tubes. A 3D thermomechanical analysis model is developed in the FE code ABAQUS. The temperature, stress and deformation fields during thermo-mechanical loading of tubes are determined in a sequentially coupled thermo-mechanical analysis. Laser beam is modelled as a surface heat flux using the dedicated DFLUX procedure. The temperature field is then used as a thermal load in the static general step, together with an external mechanical load. The tube is discretized using the C3D8R. For the steel rollers with horizontal and vertical axes, the R3D4 element is used. The process of tube bending is controlled by the displacement of the piston rod, while the thrust force is the resulting value. References 1. Iyer S. K., Lissenden C. J., Multiaxial constitutive model accounting for the strength-differential in Inconel 718, Int. J. Plasticity, 19, 2055–2081, 2003. 2. Vadillo G., Fernandez-Saez J., Pecherski R. B., Some applications of Burzynski yield condition in metal plasticity, Materials and Design, 32, pp.628-635, 2011. 3. Pecherski R. B., Szeptynski P., Nowak M., An extension of Burzynski hypothesis of material effort accounting for the third invariant of stress tensor, Archives of Metallurgy and Materials, 56 (2), pp. 503-508, 2011.