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Neutrons as tool for Residual Stress characterization from the surface to the bulk –RS state improvement of a 316L ITER welded plate by machining

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Welding generally introduces unwanted local residual stress states on engineering components hindering a high quality performance in service. Most common procedures to reduce the undesired tensile residual stresses are post heat treatments or mechanical surface treatments as e.g. hammering or shot peening. However, all of these post treatment processes are elaborate and rather cost-intensive. The question arises if successive surface machining can be applied to effectively mitigate detrimental near surface tensile residual stresses. Within the framework of the Task Group (TG4) of the NeT project (The European Network on Neutron Techniques Standardization for Structural Integrity) a three pass slot weld made from austenitic stainless steel 316L has been manufactured with the aim to undertake 3-dimensional analyses of these residual stresses by both experimental and numerical means [1-2]. In this presentation we report on the effects of successive surface machining on the residual stress in a welded TG4 austenitic steel plate. The residual stress profile was determined experimentally using neutron diffraction measurements from the surface (100 ⊠m) into the bulk and the results are compared and discussed with other experimental methods and finite element simulations – FEM. The numerical simulations use a dedicated "hybrid method", specifically set up to simulate finish milling, which has been subsequently applied to the welding simulation so as to predict the final state in the component and its interaction with previous operations. The near surface neutron diffraction data were corrected for spurious strain effects due to the instrument setup and data smearing inside the gauge volume using an analytical approach developed for STRESS SPEC instrument [3-5].

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