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Quench induced stresses considering precipitation in industrial aluminum pieces

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When processing heat treatable aluminium alloys, quenching is a key step. It consists in cooling the component to room temperature as quickly as possible to obtain a non-equilibrium solid solution. Quenching should be fast in order to avoid or limit precipitation. However, high thermal gradients through the thickness of the component cause non-homogeneous plastic strain resulting in residual stresses after quenching. In this paper, two approaches are presented to predict the as-quenched residual stress distribution in large 2xxx forgings and thick 7xxx aluminium alloy plates. The first approach consists in characterising the precipitation that occurs during quenching, e.g. using *in situ* small angle X-ray scattering, and modelling its impact on the yield strength and thus on the internal stress generation. The second approach is based on a thermo-mechanical model whose parameters are identified using a limited number of tensile tests achieved after representative interrupted cooling paths in a Gleeble machine. As quenched stresses measured *ex situ* using the neutron diffraction technique are compared with the modelling results and each approach is assessed.

Biography

J M Drezet has completed his PhD from Ecole Polytechnique Fédérale de Lausanne, Switzerland. In 1996, he started to conduct two European Research Projects (Empact and Vircast) dedicated to aluminum continuous casting and product quality. His fields of research are computations and measurements of internal stresses, solidification and precipitation in aluminum alloys and study of stress related casting defects such as hot tearing. From 2009, he started to use neutron diffraction to measure internal stresses in as-cast industrial aluminum billets and large ingots. In 2011, he used *in situ* neutron diffraction during casting to determine the rigidity temperature of solidifying aluminum alloys. He is MER Professor in Materials Science at EPFL where he teaches Continuum Mechanics, Metals and Alloys and Metals for Civil Engineering.

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