Finite Elements Method Modelling Of Void Closure During Multi Directional Hot Forming of Steel

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Abstract. Voids such as shrinkage porosity are generally generated during the casting process of steels and are responsible for the deterioration of mechanical properties of the material. In order to reduce the size and the impact of these cavities, multidirectional forming process like multi-stage rolling and cogging are used. Understanding the closure mechanism involved during hot forming is thus crucial to evaluate the degree of soundness reached in the material. For this purpose, the FEM-modelling of void closure is useful to obtain shape information concerning porosity and thermomechanical fields values all along the deformation path. This paper presents an explicit method of FEM-modelling of void closure using the commercial FEM code Forge NxT 2.1®. The study is based on a multi-stage free hot forging process performed at a laboratory scale using shaped anvil and alternated forming direction. Process parameters involved in FEM-modelling are first identified by comparing calculations and experimentations. A numerical method of void volume evaluation on the FEM-model is then proposed and modelling settings are fixed to obtain a convergence on the volume of the voids obtained after deformation. It results in the definition of a FEM-modelling of void closure that can be compared to experimental void closure of porosity initially contained in samples used for forging on a laboratory-scale test.