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Material characterization of a ferritic stainless steel sheet with different yield criteria at elevated temperature

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To date, extensive researches on warm forming were performed experimentally and computationally mainly for magnesium alloys [1-3], aluminium alloys [4.5] and austenitic stainless steels [6,7]. Although various process parameters and their influence on the material properties have been investigated for different sheet metals, research has not been done thoroughly for ferritic stainless steels. In addition, studies on the anisotropy of the sheet metals and associated material modelling, which are closely related to the formability of the material, are very limited. In this study, material characterization mainly by different yield functions, i.e., isotropic von Mises, quadratic anisotropic Hill 1948 and the non-quadratic anisotropic Yld2000-2d, for a ferritic stainless steel sheet at elevated temperature was done. For that, simple uniaxial tensile test and bulge test with a newly developed apparatus at elevated temperature were carried out. The experimental results were used to determine the parameters for the three different yield functions. To utilize the Yld2000-2d, a user subroutine, UMATHT, was implemented into the FE code, ABAQUS. For the sake of evaluation and validation of the material characterization, cup drawing tests at elevated temperature were carried out experimentally. Finite element (FE) analyses with the yield functions were also carried out to simulate the cup drawing tests. FE simulation and experimental results were compared in terms of limiting drawing ratio, earing profile and thickness distribution in the cup drawing tests. Among three different yield functions, Yld2000-2d gave better results than others.

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