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Design of titanium alloy superplastic blow-forming in ellip-cylindrical die using Taguchi method

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Abstract

This study employs the commercial DEFORM™ 3D finite element analysis software to simulate superplastic blow-forming of titanium alloy (Ti-6Al-4V) sheet in an ellip-cylindrical die. The titanium sheet is assumed to be a rigid-plastic material with homogeneous and isotropic properties. The model of the ellip-cylindrical die and titanium sheet is constructed using three-dimensional solid elements. Simulations are performed to investigate the effects of shear friction, sheet temperature, die height and length of the die's short axis on the thickness, effective stress, effective strain and critical damage characteristics of the formed sheet. The Taguchi method is then applied to optimize the processing parameters for the superplastic blow-forming process such that the thickness of the formed titanium sheet is optimal average distribution. The simulation results confirm the effectiveness of the Taguchi method in identifying the optimal blow-forming processing parameters for the current Ti-6Al-4V titanium alloy sheet.

Key words: Superplastic blow-forming; Ellip-cylindrical die ;
Ti-6Al-4V titanium alloy sheet ; Taguchi method