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應用有限元素法於橢圓柱模具之鈦合金超塑性氣吹成形之分析

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摘要

本研究利用有限元素 DEFORM 3D 軟體,於改變氣吹壓力的成形條件下，以鈦合金(Ti-6Al-4V)薄板為材料，進行橢圓柱模具之超塑性氣吹成形之模擬。本解析模擬模式中，假設材料為均質等方向性、且變形時材料行為視為剛塑性變形。當模擬橢圓柱之超塑性氣吹成形時，以三維實體元素進行模擬，並以不同的壓力控制模式、定剪摩擦因子、入模角半徑、胚料溫度、短軸長度及模具深度等變化情形下探討成品厚度分佈、有效應力、有效應變與破壞準則之影響。模擬結果希望能確認有限元素軟體對鈦合金薄板於氣吹成形參數選擇之適用性。

關鍵字: 有限元素;超塑性氣吹成形;鈦合金;破壞準則

Analysis of Titanium Alloy Superplastic Blow-Forming in Ellip-Cylindrical Die Using Finite Element Method

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Abstract

This study employs the commercial DEFORM 3D finite element analysis software to simulate the 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 the control pressure, the shear friction, entry radius, the temperature of billets, the length of the die's short axis and the die height on the thickness, effective stress, effective strain and critical damage characteristics of the formed sheet. The simulation results confirm the effectiveness of the finite element method in identifying the blow-forming parameters selection for the current Ti-6Al-4V titanium alloy sheet.

Key words: Finite element;Superplastic blow-forming;Titanium alloy; Critical damage