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Experimental and simulation study on the warm deep drawing of AZ31 alloy

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ABSTRACT

The presented work aimed at studying the deep drawing process of a magnesium alloy sheet at elevated temperatures. This is because magnesium is being considered as a promising alternative for high strength steel and aluminium within many applications because of its low density and high specific strength. It is a well-known and recognised fact that fracturing and wrinkling during the deep drawing process can be minimised or eliminated by selecting an appropriate warm-forming temperature of the magnesium, as the formability of magnesium increases considerably as the temperature increases. Hence a warm formability study of AZ31 was performed and tested by experimental and simulation methods and resulted in superior formability at elevated temperatures in both cases. A 3D Finite element model was developed for the simulation of circular cup deep drawing and tested for different temperatures ranging from room temperature to 300 °C and it was found that the limiting drawing ratio (LDR) increased significantly with any increase in temperature. The experimental and simulation results were found to be in good agreement.

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Eksperimentalna in numerična raziskava vroče globoko vlečene zlitine AZ31

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POVZETEK

Pričujoče delo je bilo namenjeno študiju globokega vleka pločevine iz magnezijeve zlitine pri povišanih temperaturah. Namreč, magnezijeve zlitine so pri mnogih aplikacijah obetavna alternativa jeklom z visoko trdnostjo in aluminijevim zlitinam, saj imajo nizko gostoto in visoko specifično trdnost. Znano je, da lahko razpoke in gubanje pri globokem vleku zmanjšamo ali odpravimo z izbiro ustrezne temperature magnezijeve zlitine, saj se sposobnost preoblikovanja s povišano temperaturo bistveno izboljša. Zaradi tega smo proučili vroče globoko vlečenje zlitine AZ31, in sicer eksperimentalno in tudi s pomočjo numerične simulacije. Oba pristopa sta pokazala odlično preoblikovalno sposobnost pri povišanih temperaturah. Za potrebe numerične simulacije globokega vleka smo uporabili krožno skodelico, ki smo jo opisali s 3D končnimi elementi in izvedli simulacije pri različnih temperaturah, od sobne temperature pa do 300 °C. Ugotovljeno je bilo, da se mejno vlečno razmerje (LDR) z višanjem temperature bistveno povečuje. Ujemanje eksperimentalnih rezultatov in izidov, dobljenih s simulacijo, je bilo dobro.

PODATKI O ČLANKU

Ključne besede:
Vlečenje
Mejno vlečno razmerje (LDR)
Vroče preoblikovanje
Anizotropija
Diagram mejnih deformacij

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