

Parametric Optimization of Warm Deep Drawing Process for Cylindrical Cups of Al1050

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ABSTRACT

Deep drawing is a sheet metal forming process in which a sheet metal blank is radially drawn into a forming die by the mechanical action of a punch. So, understanding the mechanics of the cup drawing process helps in determining the general parameters that affect the deep drawing process. Here, a statistical approach based on Taguchi and ANOVA techniques and finite element analysis was adopted to determine the degree of importance of each of the process parameters on the formability of the cylindrical cups made from aluminium alloy (Al-1050) using a warm deep drawing process. The process parameters were the thickness of blank, temperature, coefficient of friction and strain rate. The finite element analysis results obtained using finite element software namely DEFORM 3D were validated through the experimental results. From the analysis performed it is observed that higher temperature and an intermediate value of the coefficient of friction result in better cup quality.

CONCLUSIONS

All the process parameters i.e thickness of the sheet, temperature, coefficient of friction and strain rate influence the height of the cup produced. The thickness of the blank sheet has the most influence on the damage to the cup (the higher the thickness lowers the damage to the deep-drawn cup). The temperature and the thickness of the blank sheet influence the effective stress of the cup. The major parameter to influence effective strain was the thickness of the cup. The formation of wrinkles was less with cups formed with sheets of more thickness and a high coefficient of friction. From the analysis performed, combining the results of all the discussions for the concerned output parameters we find that the cup formed for the 9th trial which had a thickness of 1.5mm at a temperature of 300°C, coefficient of friction of 0.05 and a strain rate of 100 s⁻¹ forms a cup of the desired cup quality. But we observe that from the experiment performed, thick sheets result in cups with less damage but as the coefficient of friction increases the damage on cups increases due to the formation of cracks and breakage on cups. This phenomenon is observed from the experimental results that were obtained. So, for the formation of optimal quality the temperature of the blank is to be high.

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