Finite element Analysis of Cold Deep Drawing process for Pyramidal Cups of Aluminium Alloy 6061

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ABSTRACT

Deep drawing is an essential process used for producing cups from sheet metal in large quantities. So, understanding the mechanics of the cup drawing process helps in determining the general parameters that affect the deep drawing process. In the present work, Taguchi techniques and finite element analysis were implemented to assess the formability of Pyramidal cups using cold deep drawing process. The process parameters are punch velocity, coefficient of friction, strain rate and displacement per step. The deep drawing dies are designed by Siemens NX and the simulations are done using a finite element software namely, DEFORM - 3D. The control parameters are assigned according to the trials given in the orthogonal array(L9) .The material used for the drawing the Pyramidal cups is "Aluminum Alloy 6061" and the blank thickness is varied between 0.8mm, 1.0 mm,1.2mm. It is evident from the results that considered parameters can alter the physical characteristics of the cup obtained at the end of the drawing operation. Punch velocity, coefficient of friction, displacement per step were the major process parameters which influenced the quality of pyramidal cup.

CONCLUSIONS

In the present work Aluminum alloy 6061 was used. The analysis was focused with punch velocity, coefficient of friction, displacement per step, strain rate as control parameters. The optimization in the deep drawing process is a challenging task as the process output is related to the control parameters and important task as it can reduce the manufacturing cost. So, it is necessary to find the influence of the control parameters on deformation of sheet metal. From ANOVA graphs, Damage factor was found to increase with strain rate and the maximum value of damage factor was 8 at strain rate 100/ s, Damage factor was found to decrease with displacement per step and reached minimum value of 3.1 at displacement per step 1 step/ mm. From ANOVA graphs, surface expansion ratio increased for both increase in punch velocity and coefficient of friction and the maximum value was found to be 6 at punch velocity 5mm/sec and coefficient of friction 0.2. Punch velocity, coefficient of friction, displacement per step were the major process parameters which influenced the quality of pyramidal cup.

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