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Parametric Optimization of Process Parameters of Cylindrical Cups using Deep Drawing for AISI-304 Stainless Steel

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ABSTRACT

One of the main procedures for producing sheet metal parts is deep drawing. For the mass manufacturing of various forms like cylindrical cups, conical cups, etc., in the aerospace, automotive, and packaging industries, parametric optimization of deep drawing is frequently required. To reduce the amount of expensive trial-and-error processes involved in tool design, finite element analysis can be used to simulate the process. This research is important for creating a component with a shorter manufacturing lead time. The significance of key process parameters, such as punch velocity, coefficient of friction, Thickness of sheet and Number of steps on the deep drawing characteristics were established in this project work. The Optimization of process parameters is done by using Taguchi Technique using L9 Orthogonal Array Method. The degree of difference or similarity between two or more groups of data is determined using a statistical technique called ANOVA. The D-FORM software uses the Finite Element Analysis (PEA) method. Using D-FORM software, analysis and simulations were conducted. The results obtained from D-FORM were validated experimentally. The optimal process parameters will be shown by the simulation results. For deep drawing, AISI-304 Stainless Steel is the material of choice.

The cup of Trail 7, with punch velocity 5rnm/s, coefficient of friction 0.1, number of steps 100 and sheet thickness l.0 mm was found to be best drawn in terms of damage and effective stress.

CONCLUSIONS

In the present work, AISI-304 Stainless Steel was used for analysis. The investigation was focused on the process parameters such as punch velocity, coefficient of friction, Number of steps and sheet thickness. The major parameters which influenced damage of the cup were Number of steps and coefficient of friction. The damage was found to be least when punch velocity, sheet thickness and number of steps are 3.5mm/s, 0.8mm and 50 respectively. Effective stress was found to be increasing with increase in coefficient of friction and is most influenced by sheet thickness. Effective stress was found to be increasing from the Number of steps 75 to 100. The major parameter which influenced surface expansion ratio is the sheet thickness and found to be decreased with sheet thickness values from 1mm-1.2mm. Surface expansion ratio was found to be decreasing, with the increase in Number of steps from 50 to 75. Cup Height was found to be decreasing with increase in coefficient of friction and the cup Height increased from increasing the Number of steps from 75 to 100.

The cup of Trail 7, with punch velocity 5mm/s, coefficient of friction 0.1, number of steps 100 and sheet thickness l.0 mm was found to be best drawn in terms of damage and effective stress.

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