

# Finite Element Analysis of Cold Deep Drawing Process for Circular Cups of Monel - 400 Alloy

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## **ABSTRACT**

Deep drawing is an essential process used for producing cups from sheet metal in large quantities. Understanding the mechanics of the cup drawing process helps in determining the general parameters that affect the deep drawing process.



Figure 1: Cylindrical cup

There are generally two methods of analysis: experimental and numerical. Experimental analysis can be useful in analyzing the process to determine the process variables that produce a defect free product. However, experimental work is usually very expensive and time consuming to perform. On the other hand, the numerical modelling can be used to model and analyze the process through all stages of deformation.

In the present work, Taguchi techniques and finite element analysis were implemented to assess the formability of cylindrical cups using cold deep drawing process. The process parameters are punch velocity, coefficient of friction, strain rate and displacement per step.

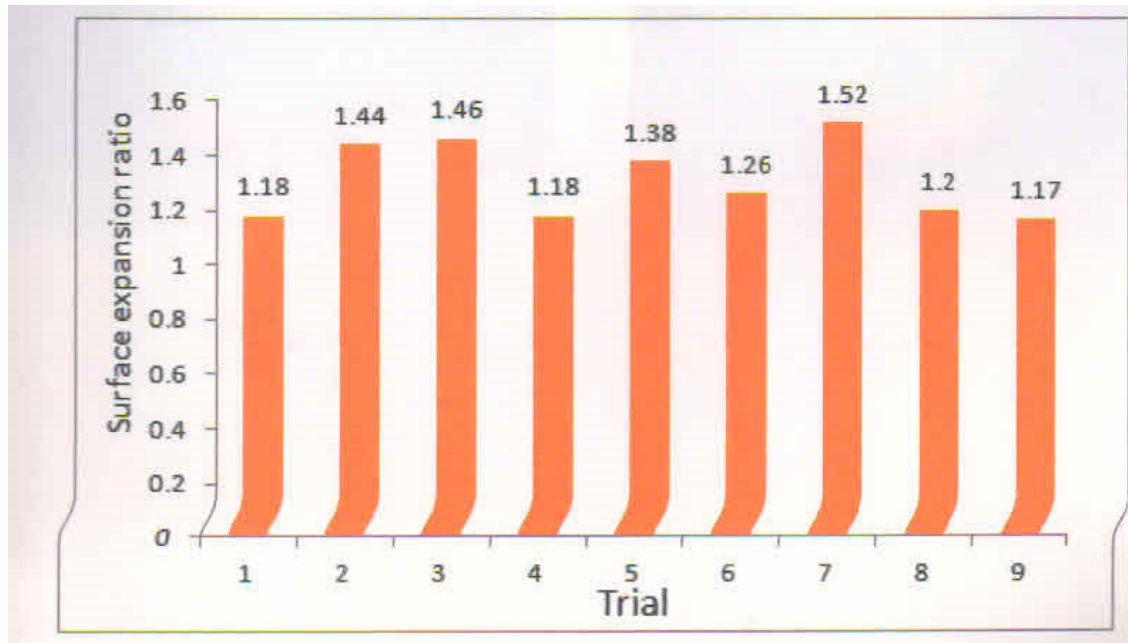


Figure 2: surface expansion ratios of cups with different trials of experimentation.

The deep drawing dies are designed and the simulations are done using a finite element software namely, DEFORM-3D. the material used for the drawing the cylindrical cups is Monel 400 and the blank thickness is 1.0 mm.

The major process parameters which could influence the quality of the cup was the strain rate and displacement per step. The effective stress, cup height would increase with an increase in displacement per step. The best value of strain rate was found to be  $100 \text{ s}^{-1}$ . The surface expansion ration was decreased with increase of coefficient of friction. The cup damage was increased with decrease in strain rate.

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