FEA of High Strain Rate Superplastic Deep Drawing Process for Circular and Cylindrical Cups of AA1070: Experimental Validation

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ABSTRACT

Many investigations have been carried out to obtain an optimal blank shape that can be deformed into the near-net shape. The strength of 1070 aluminum can be improved by small addition of different amount of borax. 1070 aluminium alloy is highly resistant to chemical corrosion and has good crack resistance. 1070 is being widely used in less demanding on the strength of the product, such as chemical equipment, sheet metal processing parts, deep drawing or spinning hollow-ware, welding parts, heat exchangers, bell surface and disk, plate, kitchenware, decorations, utensils and other reflective.

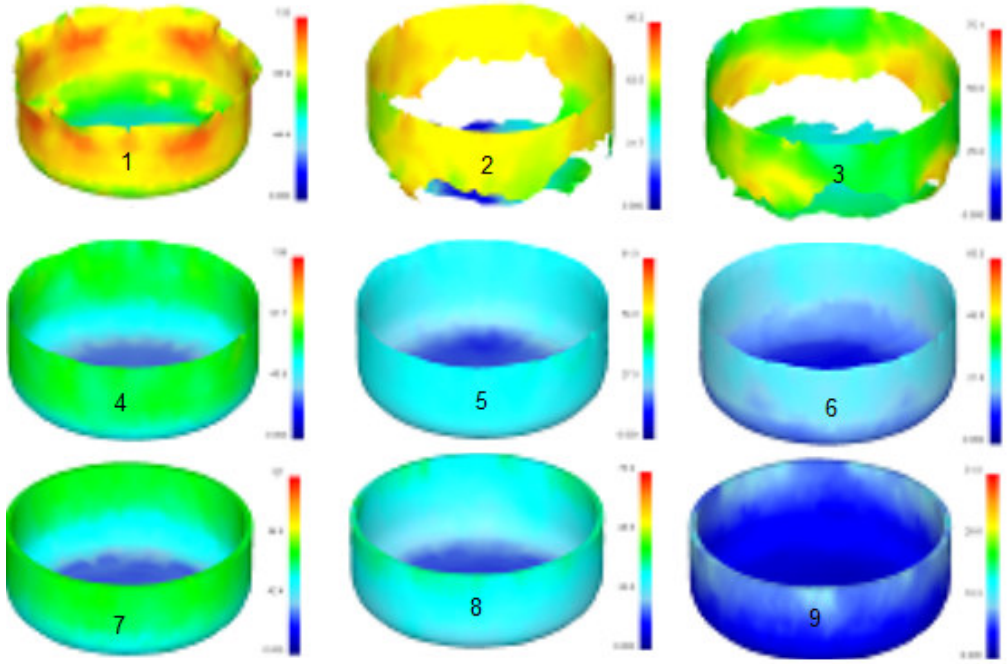

Figure 1: Influence of process parameters on the effective stress.

The objective of the present work is to optimize the warm deep drawing process of 1070A aluminium alloy using Taguchi technique. In this present work, a statistical approach based on Taguchi and ANOVA techniques was adopted to determine the degree of importance of each of the process parameter on the formability of deep drawn cylindrical and pyramidal cups. All the experimental results have been verified using D-FORM software.

The thickness of sheet, temperature, and coefficient of friction influence the effective stress. The major parameter which can influence effective strain, volume of the cup is the thickness of sheet. The damage in the cups was less with thick sheets and it was more at high coefficient of friction, strain rate and temperature. The formation of wrinkles was less with medium coefficient of friction and with thick sheets.

The successful pyramidal cups with zero damage of 1.5mm blank thickness were obtained with operating conditions of 300^{o}C, temperature; 0.05, coefficient of friction; and 500, strain rate. The successful pyramidal cups of 1.0mm blank thickness were obtained with operating conditions of 500^{o}C, temperature; 0.1, coefficient of friction; and 500, strain rate. The factors which cause the damage of cups have been found to be room temperature operation of deep drawing, high coefficient of friction, and low strain rate.

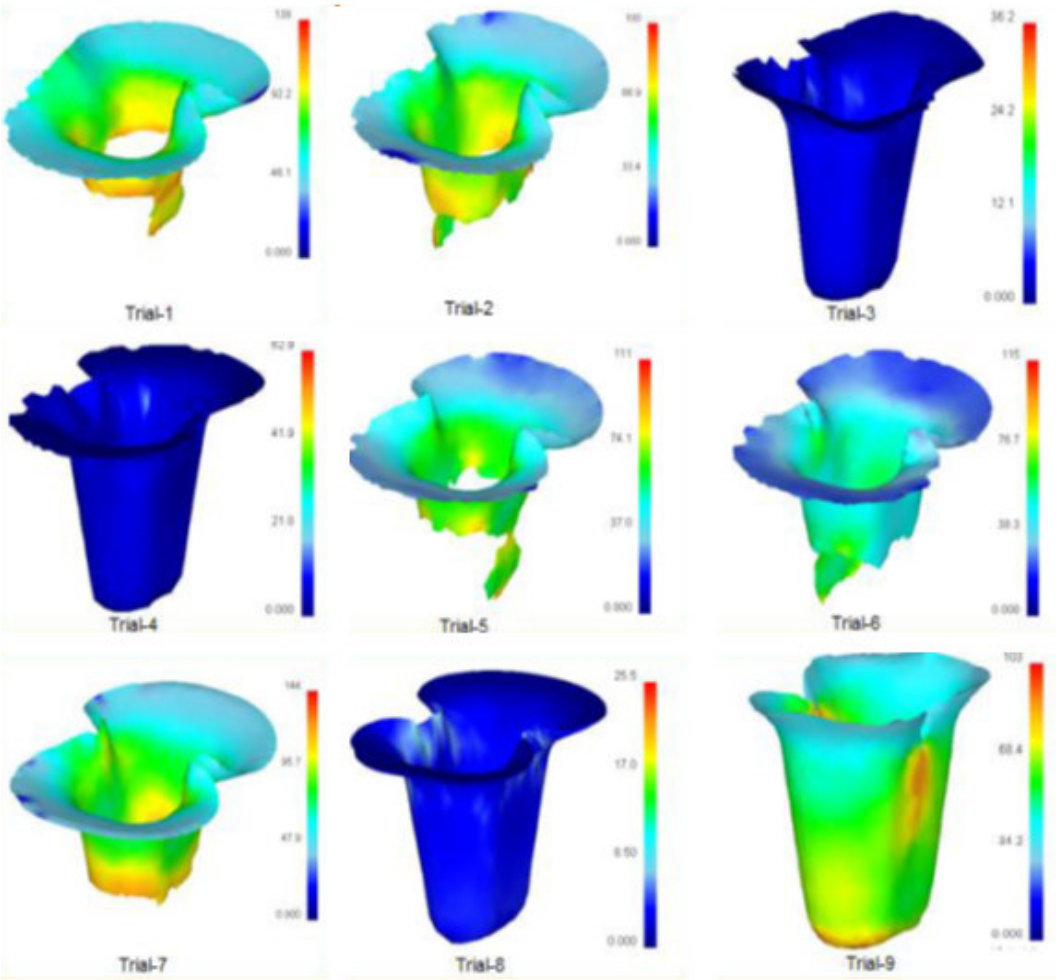

Figure 2: Effective stress in pyramidal cups under different operating conditions.

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