Numerical Simulation of Truncated Conical and Pyramidal Cups of AA1050-H18 Alloy Fabricated by Single Point Incremental Sheet Forming and Validation through Experimentation

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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 (figure 1). In a series of re-search on deep drawing process to fabricate variety of cup shapes (figure 2), rich investigation have been carried out to improve the superplastic properties of materials such as AA1050 alloy, AA1070 alloy, AA1080 alloy, AA1100 alloy, AA2014 alloy, AA2017 alloy, AA2024 alloy, AA2219 alloy, AA2618 alloy, AA3003 alloy, AA5052 alloy, AA5039 alloy, Ti-Al-4V alloy, EDD steel, gas cylinder steel. The different cup shapes such as pyramidal, rectangular and cone were fabricated.

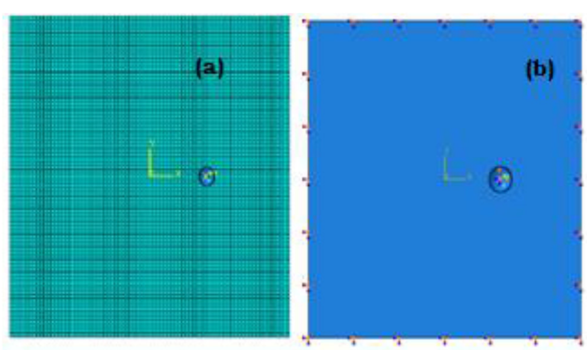

Figure 1: Finite element modeling: (a) mesh generation and (b) boundary conditions.

The current study was to evaluate the formability of frustum of cone cups of AA1050 alloy using SPIF by finite element method. For this purpose the design of experiments was executed as per Taguchi technique. The process parameters of SPIF were sheet thickness, step depth, tool radius and coefficient of friction.

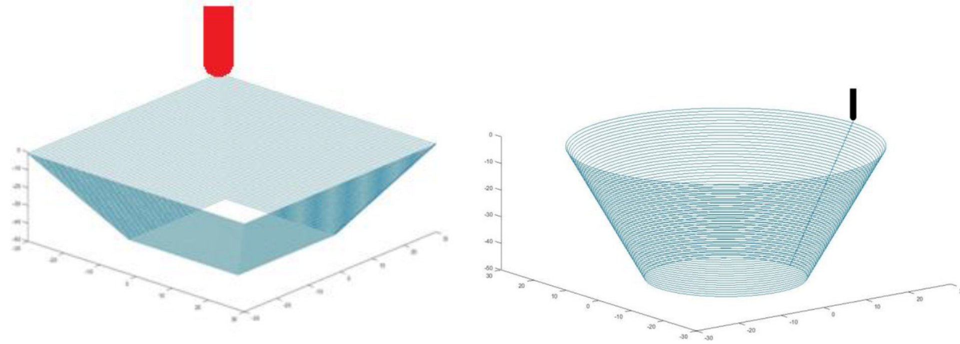

Figure 2: Tool path generation.

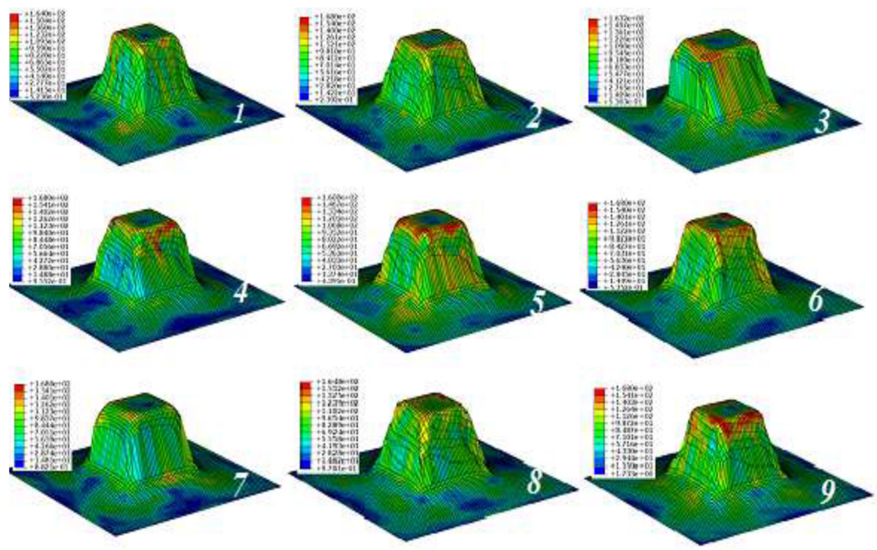

Figure 3: Raster images of von Mises stress in the pyramidal cups.

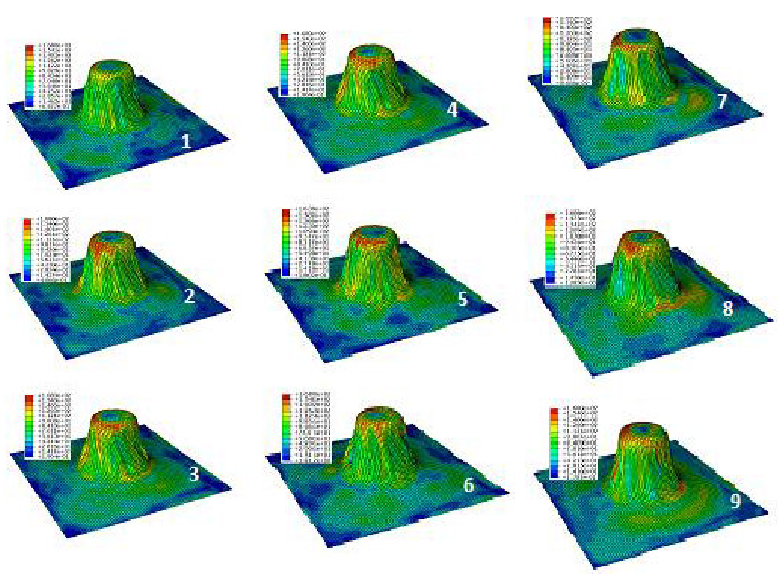

Figure 4: Raster images of von Mises stress in the conical cups.

The major SPIF process parameters which influence the formability of frustum of cone and pyramidal cups of AA1050-H18 alloy were sheet thickness and tool radius. The optimal process parameters could be sheet thickness of 1.5 mm, step depth of 0.5 mm, tool radius of 4.0 mm and coefficient of friction of 0.05.

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