

Optimization Of Process Parameters in Deep Drawing Process Based on Simulation Software

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ABSTRACT

This paper “Optimization Of Process Parameters In Deep Drawing Process Based On Simulation Software” is one of the most used metals forming process within the industrial field. This paper focuses on the optimization of multistep deep drawing process by using simulation software. Here, a case studied of cylindrical shaped aluminum container. The main challenge of optimization process is to reduce number of drawing step, therefore the production cost and time will decrease and product life will increase. Many process parameters and other factors that affected production quality produced by the deep drawing process. Recent development and research work in the process of deep drawing is shown in the paper. A three stage deep drawing process has considered as a case study to optimize the sizes such as punch and die corner radius, friction, clearance. The objective of this paper is to use ABAQUS simulation software for multistep deep drawing process. Also the paper shows that the conventional multistep deep drawing process.

Keywords: Multistep Deep Drawing, Simulation, Optimization, ABAQUS.

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I. INTRODUCTION

The most widely used industrial manufacturing process is sheet metal forming that changes the geometry of sheet without loss of material. Deep drawing is a manufacturing process which is mostly used in industrial area due to its versatility and good mechanical properties. More number of drawing steps increases manufacturing cost and time. Many researchers had studied optimization of one step deep drawing process to reduce final cup residual stress, wrinkling, thinning, etc. The software package of ABAQUS for finite element analysis will be used to conduct experiments. Many researches on the multi-stage deep drawing process have been carried out with trial and error experimental work in the factory without fundamental understanding of the complicated deformation mechanism and plasticity theory.

In (1994), Danckert, proposed a finite element simulation of two stage deep drawing process followed by ironing of the cup wall to analyze the residual stresses in the cup wall after the drawing stages and after ironing of steel blank. The results show that the ironing process causes a

drastic change in the residual stress and causes a favorable distribution with regard to fatigue strength, stress corrosion resistance and stress cracking.

Lee & Cao (2001), developed an axisymmetric shell element for the multi-step inverse analysis for more accurate prediction of design variables such as the initial blank shape, strain distribution, and intermediate shapes. This approach is more accurate and the punch increment per step is much larger than that in the conventional incremental analysis.

The deep drawing process requires careful selection of process parameters and many factors should be considered. The variables involved in this process are:-

1. Die radius
2. Friction
3. Punch radius
4. Blank diameter

In deep drawing process, there are two types of process as single step deep drawing process and multistep deep drawing process.

II. DEEP DRAWING PROCESS

“The metal forming process in which a sheet metal blank is radially drawn into forming die by the mechanical action of a punch is known as deep drawing process.”

It is thus a shape transformation process with material retention. The process is considered as “deep” drawing when depth of the drawn part exceeds its diameter. This is achieved by redrawing the part through a series of dies. The flange region (sheet metal in the die shoulder area) experiences a radial drawing stress and a tangential compressive stress due to the material retention property.

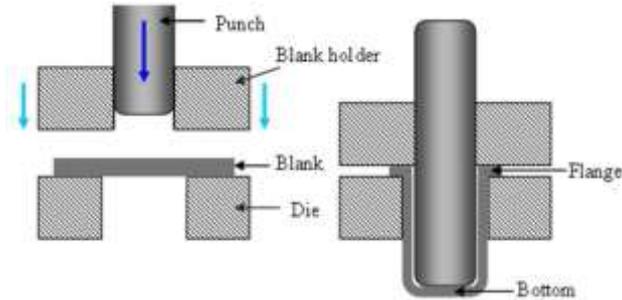


Figure-1. Deep Drawing Process

Multistep deep drawing process

In multistep deep drawing process, there are more than one draws. Two or more redrawing operations should be done in multistep deep drawing process.

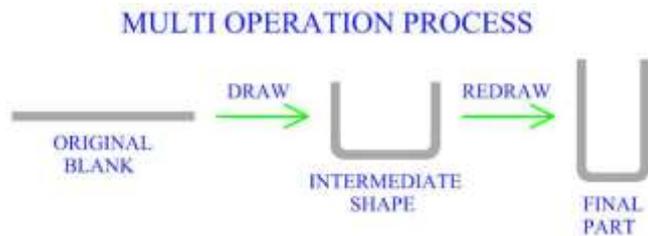


Figure-2. Multistep Deep Drawing Process

III.METHODOLOGY

The complexions of this processes and the number of factors involved in them makes very difficult to select the parameter values properly. Then, there are different analytical, numerical, and experimental methods are being developed to analyze the best combination of them.

Now a days analytical methods are continue studied and developed in spite of numerical methods allow obtaining the solutions with high precision and detail levels in the analysis of this type.

Finite element method has been used in several studies in metal forming processes such as single step deep drawing process recently.

IV. CONVENTIONAL METHOD

The product by using multistep deep drawing process is as shown in figure 3. This product has been manufactured by

using pneumatic and hydraulic deep drawing press. On press the product has been manufactured by 3 step redrawing process by using various punch and die sizes.



Figure-3. Cylindrical Shaped Aluminium Container

Material used for conventional method

Material of used sheet is aluminium alloy. The Aluminium alloy used in this conventional process in industry contains.

TABLE I
ALUMINIUM ALLOY CONTENTS

Contents	Percentage
Aluminium	98.5% to 99% pure
Fe	0.3%
Si	0.1%
Mn	0.15%
Other elements	0.45%

Dimensions of the product

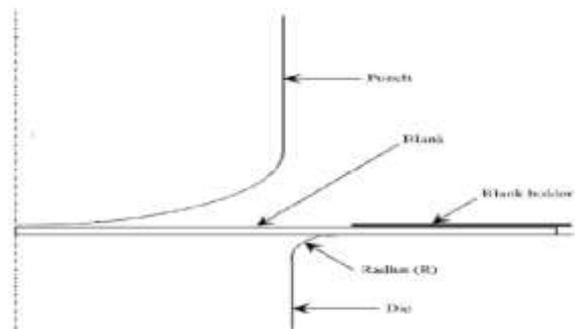


Figure-4. Geometry of the die profile

TABLE II
DIMENSIONS OF CONVENTIONAL METHOD

Parameter	Dimensions in mm
Blank Diameter	483 mm
Punch Diameter	208 mm
Die Diameter	209.5 mm
Blank Holder Diameter	210 mm
Blank Thickness	1 mm
Punch Edge Radius	3mm

V. OPTIMIZATION OF MULTISTEP DEEP DRAWING PROCESS

Above method is the conventional method for multistep deep drawing process by using hydraulic and pneumatic press. But the research work is that to optimize the multistep deep drawing process by using the simulation software package.

The research work is that to optimize the process and to reduce the step of multistep deep drawing process by using simulation software package such as ABAQUS. Researchers had studied the single step deep drawing process to optimize the stress, wrinkling, thinning, etc. But this research work is to optimize the process and to reduce the step for reducing manufacturing cost and time.

VI. CONCLUSION

This paper presents the method for optimizing the deep drawing process of cylindrical shaped aluminium container. A three steps deep drawing process has been considered as a case study to optimize the process for manufacturing cost and time. The paper shows the method of optimization of three steps deep drawing process to reduce the step for reducing the manufacturing cost and time by using simulation software package ABAQUS.

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