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The Possibility of Producing a Tractor's Hood in a Single Stage Hydroforming Process

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ABSTRACT: In this study, possibility of producing a complex part of tractors (tractor's hood) in a single stage hydroforming process, which was not possible to produce in traditional deep-drawing method, has been investigated. To reduce production costs and to increase quality of manufactured pieces, original dimensions of the blank has been optimized by sensitivity method. In addition, influence of fluid pressure was examined on quality of the produced work pieces. It was concluded that it is feasible to produce the part in a single stage hydroforming process, when the initial blank shape was optimized and also when the fluid pressure was appropriate.

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1- Introduction

Sheet hydroforming is a new technology, capable of shaping sheet metals, especially for the deep drawing industries. During the past two decades, the hydroforming technology has had the attention of researchers and industries due its several advantages [1-16].

In this paper, the possibility of forming a complex part of the body of tractors in a single stage (Figure 1(a)) that is currently produced by multistage processes (Figure 1(b)), has been examined by hydrodynamic deep drawing process.

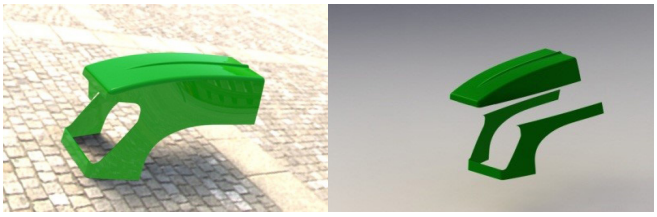

Figure 1. (a) Tractor's hood, (b) the upper part and the wall of the hood

2- Experimental procedure

2- 1- Description of the Model

In this work, a rigid punch similar to the final shape of the part and a hydrodynamic deep drawing die with radial pressure have been used for finite element simulation and laboratory tests. Figure 2 shows the final part before the cutting process.

2- 2- Sheet metal properties

A low carbon steel sheet, ST14, with 0.6 mm thickness was used for simulation and experimental tests.

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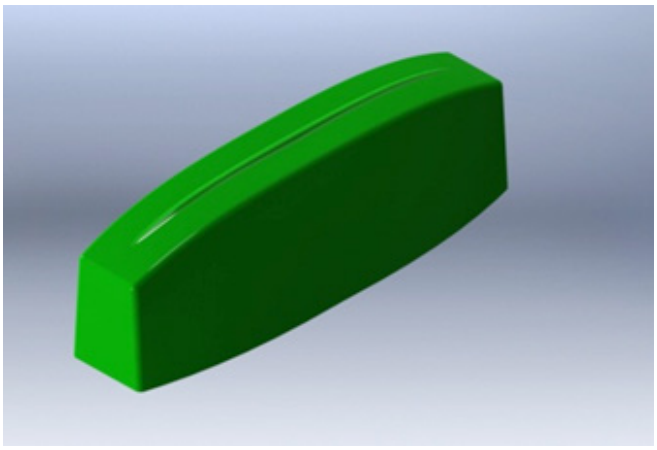

Figure 2. The required part (before cutting and trimming)

2- 3- Initial blank shape optimization

In this investigation, the sensitivity method was used to optimize the dimensions of the blank.

3- Results and Discussion

Initially, a comparison between the traditional deep drawing and hydroforming processes has been performed. Figure 3(a,b) show the formed parts obtained from FE simulation, and Figure 3(c) illustrates the corresponding thickness distribution curves. As it is seen from the curves, the hydroforming process can produce the work piece with much more uniform thickness distribution.

To achieve the desired flange area after forming the part, the initial blank shape optimization was performed. Figure 4 showing the formed parts by simulation and experimental test.

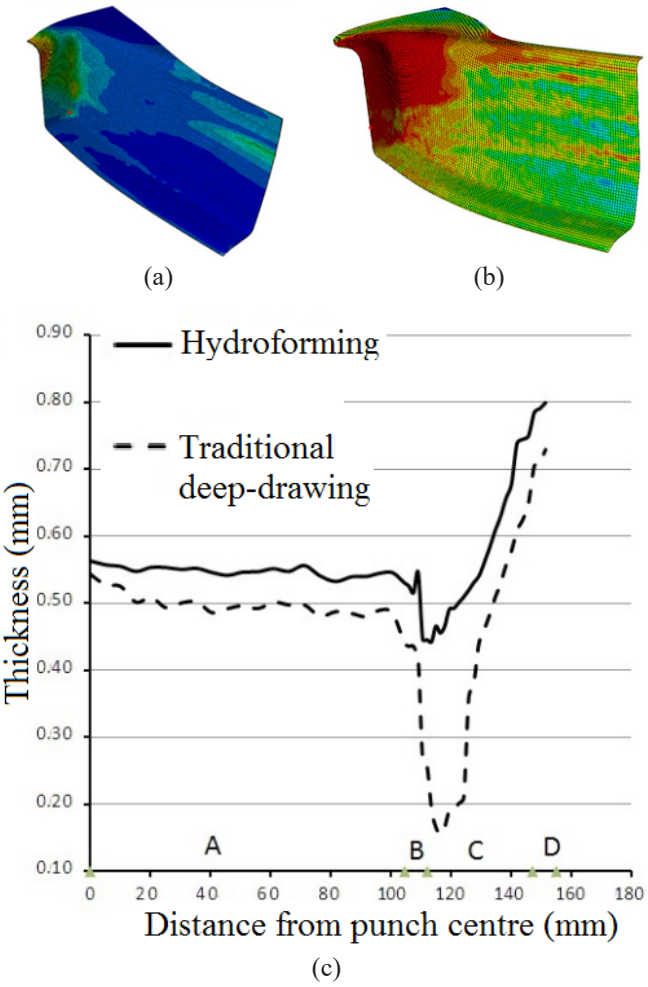

Figure 3. (a) Formed part by traditional deep-drawing method, (b) Formed part by hydroforming method, (c) Thickness distribution curves in the longitudinal direction, (A: bottom area of punch, B: Radius of the punch, C: Wall of the punch, D: Radius of the die)

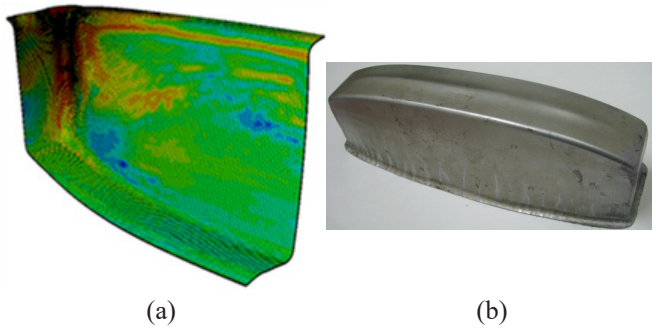

Figure 4. (a) Formed part by simulation method, (b) Formed part by experimental method

To study the perfect formation of the bulge on the bottom of the punch, three final pressures, 500, 650 and 800 bars were applied. Figure 5 shows the formed part at three final pressures. As can be seen from the figure, at 800 bar pressure, the profile is fully formed.

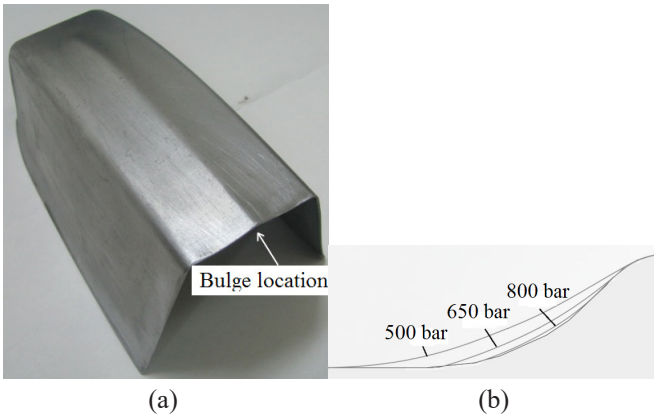

Figure 5. (a) Experimental result with 800 bar pressure, (b) The curves of formed blanks in the bulge area with three pressures

4- Conclusions

It has been concluded from this research that a complex body part of tractors can be formed in a single stage sheet hydroforming process with the optimized initial blank and a suitable forming pressure. By increasing the fluid pressure up to a certain value, the bottom profile of the work piece can be improved.

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