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THE DEPENDENCE OF CHANGE IN THE PART THICKNESS ON THE DEPTH OF SHEET METAL DRAWING

Abstract: *An analysis of change in the thickness of a hollow part obtained by plastic deformation was carried out in this article. It is noted that when deep drawing sheet metal, the thinning of the part walls can reach up to 12% of the initial thickness. At the same time, the increase in the thickness of the part walls during compression deformation reaches up to 22% of the initial thickness of the sheet metal.*

Key words: *deep drawing, blank, thickness, thinning.*

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Introduction

Sheet metal drawing is the most common method for producing hollow metal parts of various configurations [1-3]. Since this technological process is accompanied by plastic deformation, the material is subjected to compression and tension, temperature deformation, etc. [4]. The intensity of sheet metal deformation during the drawing process can be analyzed through computer simulation [5]. When the blank material is deformed, the wall size of the part being formed changes from the initial thickness, i.e. thinning occurs [6-10]. The wall thickness of the part may increase or decrease depending on the type of deformation. Analysis of the degree of thinning of the part walls during deep drawing will allow us to draw a conclusion about the general stress and strain state of the material.

Materials and methods

A model of a blank 1 mm thick, made with the properties of a deformable aluminum alloy, was subjected to plastic deformation. The formation of the part cavity was carried out with a cylindrical punch. The deep drawing process continued until the height of the hollow part was 60 mm. The values for change in the wall thickness of the semi-finished product were obtained over the entire range of movement of the punch along the centerline of the sheet metal. The maximum values of the wall thickness of the semi-finished product under conditions of tension and compression were accepted.

Results and discussion

The dependence of change in the initial thickness of the blank on the drawing depth is shown in the Fig. 1. In the graph, zero corresponds to the initial thickness of the sheet metal before plastic deformation. Positive thinning values are characterized by a decrease in the wall thickness of the formed semi-finished product, and negative thinning values are characterized by an increase in the wall thickness of the formed semi-finished product. Pulling sheet metal into the die to a depth of up to 12 mm does not change the initial thickness. When the drawing depth reaches 12 mm, the wall thickness of the semi-finished product begins to change, that is, at the same time there is a decrease and increase in the wall thickness of the semi-finished product in various contact zones of the die and the punch. At the same time, a constant reduction in the wall thickness of the part to the maximum value occurs up to a drawing depth of 40 mm. A constant increase in the wall thickness occurs up to a drawing depth of 60 mm.

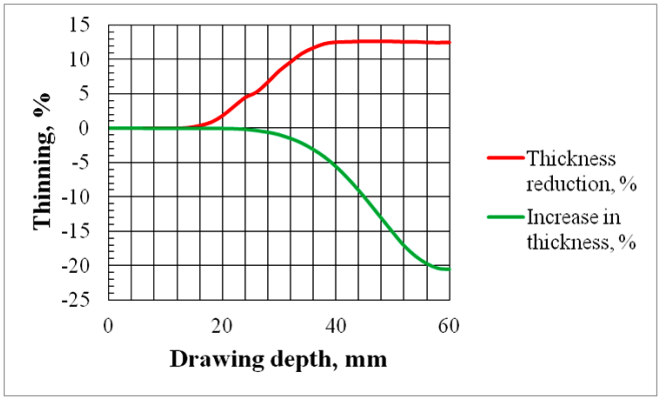

Figure 1 – The dependence of change in the initial thickness of the blank on the drawing depth.

Thus, the degree of compression of the material during drawing is approximately twice as great as the degree of stretching.

Conclusion

Sheet metal undergoes greater compression deformation during deep drawing. The maximum increase in wall thickness (approximately 22%) is observed when the part is drawn to its full height. The maximum reduction in wall thickness (approximately 13%) is observed when the part is drawn to 2/3 of the height.

References:

1. Semiatin, S. L. (2006). Metal Working: Sheet Forming. *9th ed., Vol. 14, Ohio: ASM International*, 319-336.
2. Musafija, B. (1987). Metal forming by plastic deformation. *V Edition, Svjetlost, Sarajevo*, 326-500.
3. Nepershin, R. I. (2014). Deep drawing of a thin-walled hemisphere. *J. Mach. Manuf. Reliab., 43*, 60-68.
4. Woo, D. M. (1968). On the complete solution of the deep-drawing problem. *Int. J. Mech. Sci., vol. 10, no. 2*, 83-94.
5. Nepershin, R. I., & Prusakov, M. A. (2016). Modeling of thin-walled half sphere deep drawing. *Industrial engineering and machine science, №1 (36)*.
6. Pradipkumar, P., & Inamdar, K. H. (2016). Study of effect of various parameters on Thinning tendency in Deep Drawing using Simulation. *International Journal of Emerging Technologies and Innovative Research, Vol. 3, Issue 6*, 88-93.
7. Atul, T. S., & Lenin Babu, M. C. (2019). A review on effect of thinning, wrinkling and spring-back on deep drawing process. *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture, 233(4)*, 1011-1036.
8. Karabegović, I., & Hadžalić, E. (2012). Mathematic modelling and the deep drawing force simulation with the wall thickness thinning experiment application. *Mechanika, Volume 18(2)*, 220-226.
9. Zein, H., et al. (2013). Effect of die design parameters on thinning of sheet metal in the deep drawing process. *American Journal of Mechanical Engineering*.
10. Chemezov, D. (2021). Features of the deformed state of thin-walled parts obtained by deep drawing. *ISJ Theoretical & Applied Science, 08 (100)*, 79-82.