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INFLUENCE OF FRICTION IN THE DRAWING A CYLINDRICAL PART BRASS

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Abstract: *In this paper are analyzed the variation of deformation, the stresses of flow, the wall thickness in case of drawing process simulation conducted under two conditions: without the use of a lubricant used in liquid form. The analysis aims to establish the influence of friction on the quality of the piece drawing brass.*
Key-words: *punch, die, brass*

1. INTRODUCTION

Deep drawing process simulation was performed without thin wall thickness with the aid of finite element software named Marc Mentat [1]. The piece is cylindrical flange, flat base, connected with the vertical wall. The blank is a disc made of brass able to delivery a soft CuZn-37-O [2] with a diameter of 17 mm and a thickness of 0.4 mm ([3], [4]).

2. CONDITIONS OF THE SIMULATION

To achieve the the simulation had to be introduced through the points of the characteristic curve σ-ε (fig. 1) [1], which has been used characteristic curve recorded data from the tensile (fig. 2) ([5], [6]).

The form of the active elements is shown in fig. 3. They were considered rigid linear elastic with $E = 2.1 \cdot 10^5$ N/mm^2 and Poisson's ratio v = 0.3 [1].

Their dimensions are: the punch diameter d_p =7.7 mm, the die diameter d_m = 8.5 mm, the punch radius r_p = 2 mm, the die radius r_m = 2.5 mm, the height of piece h = 5 mm, the clearance of active elements j = 0,4 mm, coefficient of deep drawing without thinning admissible m = 0.56 ([3], [5]).

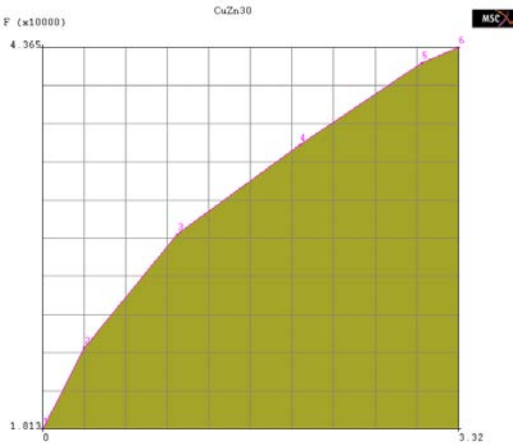


Fig. 1. Characteristic curve σ-ε introduced by points for the brass CuZn 37-O

Fig. 2. Characteristic curve recorded for traction specimen taken in a direction which is 0 ° to the rolling direction

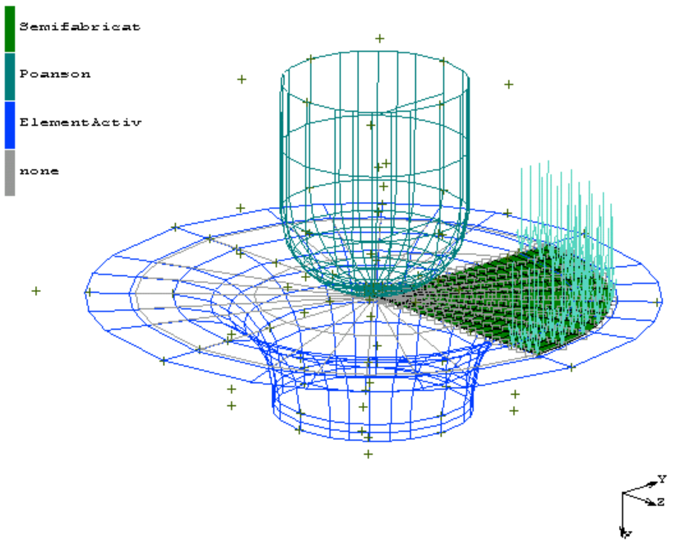


Fig. 3. Meshing of the active elements, of the blankholder and of the blank in finite elements

Should be mentioned that in the graphic representations the total deformation equivalent values are given in percentage, of flow stress von Mises criterion - in psi (= 6894.8 N/m2), of variation force (depending on the increment) - in lbf (= 4.44 N) and of the variation cross-sectional thickness (for all representations noted by b)- in inch (= 25,4 mm) (in the abscissa is considered half of the value of the diameter of the piece, which is flared with the die radius).

3. RESULTS OF NUMERICAL SIMULATION

Initial deep drawing process simulation was performed under the following conditions of friction: μ = 0.08 for contact between the blank and the die and μ = 0.25 for contact between the blank and punch. To see the influence of friction on the development process resumed deep drawing simulation for μ = 0.22 value at the contact between the blank and the die. The coefficient of friction between the blank and punch is kept the same.

3.1 The coefficient of friction at the contact between the blank and the die μ_{m-s} = 0.08 at the contact between the blank and punch μ_{p-s} = 0.25

3.1.1 Variation of total strain

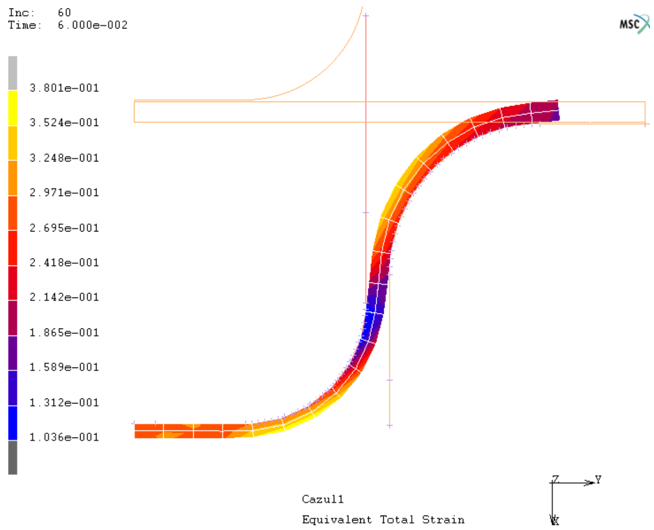


Fig. 4. Variation of total strain equivalent for piece brass CuZn37-O

The maximum values of the deformations are formed in the area corresponding radius the punch (fig. 4). This is justified the deformation history of this portion of material: to get here this portion of the material passed from a flat blank shape by the tensile + compressive dominant compression in the connection area between the flange and the wall piece, then by the tensile-compression dominant stretch in the wall piece and finally has reached this strong area harden. The high level of deformation is explained by obtaining cylindrical walls. Although brass piece is high, it is characterized by low values of maximum deformation due to high plasticity. The maximum values of the deformation is recorded corresponding the die radius.

3.1.2 Variation of tension flow after von Mises criterion

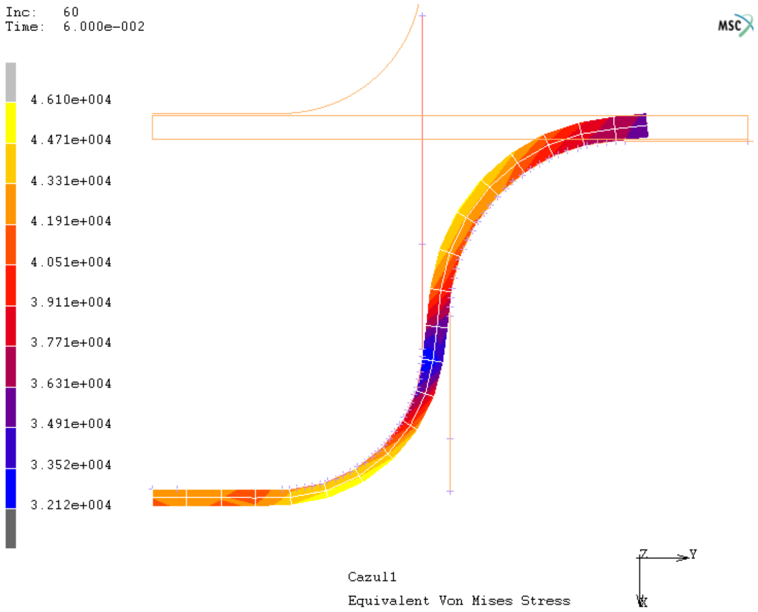


Fig. 5. Variation of tension flow after von Mises criterion, for piece brass CuZn37-O

The maximum values of flow stress (Fig. 5) correspond to areas of maximum strain, but on a larger distribution.

3.1.3 The diagram force - stroke

The diagram force - stroke punch is shown in fig. 6. This is in accordance with increased plasticity of brass.

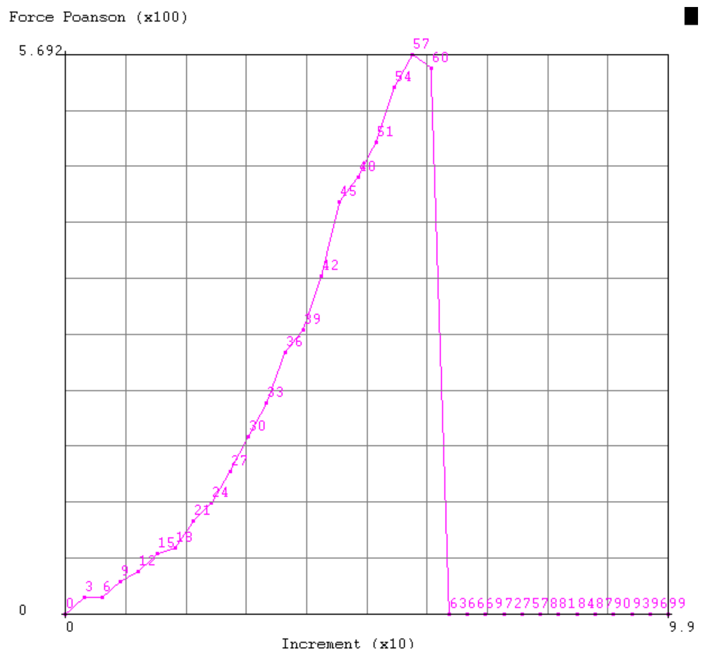


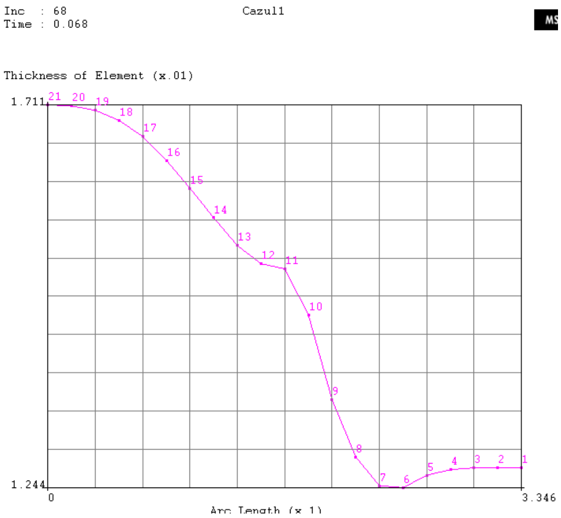
Fig. 6. The diagram force – stroke for piece brass CuZn37-O

3.1.4 Variation of wall thickness in longitudinal section

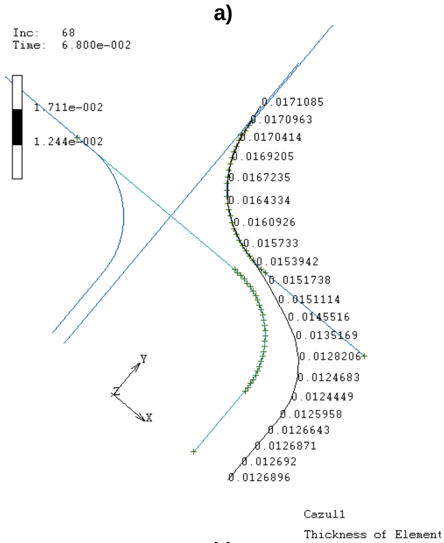
Of fig. 7a deduce the conclusion that there is a bulging piece of the bottom. It is due to a residual bending moment caused by bending and straightening of the material which passes over the die radius and the stretch corresponding formation of part wall. This moment determines the final curving, which represents a form of the elastic comeback, because the material of the basis punch is in contact with only the punch radius.

Of fig. 7b is observed that the thinning increases from the point of connection to the radius of the bottom of the punch, on a part of the area connected, after which it begins to decrease slightly right of this area so that the thickness achieve the nominal value on the input portion in the radius of the die, the material is then thickened to flared end portion of the workpiece.

Brass has a relatively small thinning of the bottom flat due to better deformability and deformation values reflect this.



a)



b)

Fig. 7. Variation of thickness in longitudinal section for piece brass CuZn37-O

3.2 The coefficient of friction at the contact between the blank and the die $\mu_{m\text{-}s}$ = 0,22 at the contact between the blank and punch $\mu_{p\text{-}s}$ = 0.25

3.2.1 Variation of total strain

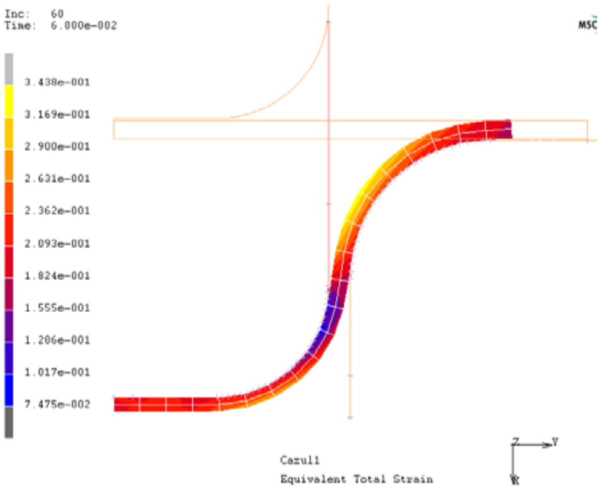


Fig. 8. Variation of total strain equivalent for piece brass CuZn37-O (without lubricant)

In fig. 8 are shown the values of equivalent total strains under conditions of changing the coefficient of friction. It is observed that the brass piece shows the maximum values of their deformation corresponding to die radius and they are close to those which used lubrication.

3.2.2 Variation of tension flow after von Mises criterion

In fig. 9 is present the values of flow stress after von Mises criterion under conditions of changing the coefficient of friction. This is in accordance with the variation of the deformations and the maximum values corresponds with the die radius area.

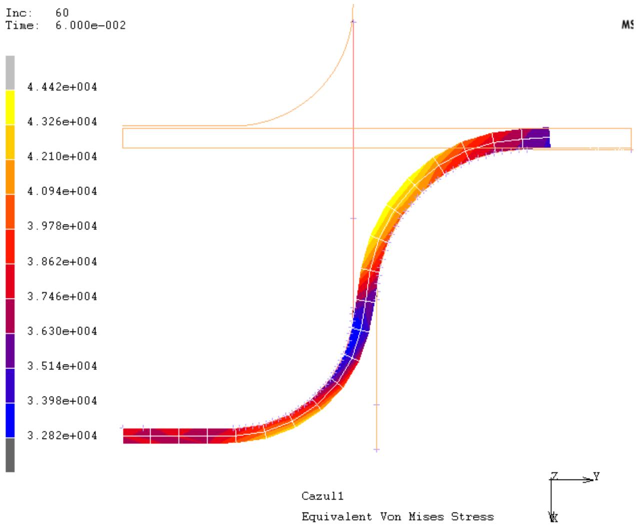
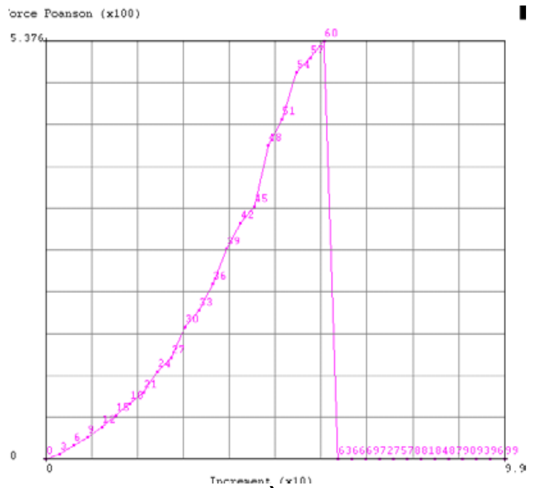
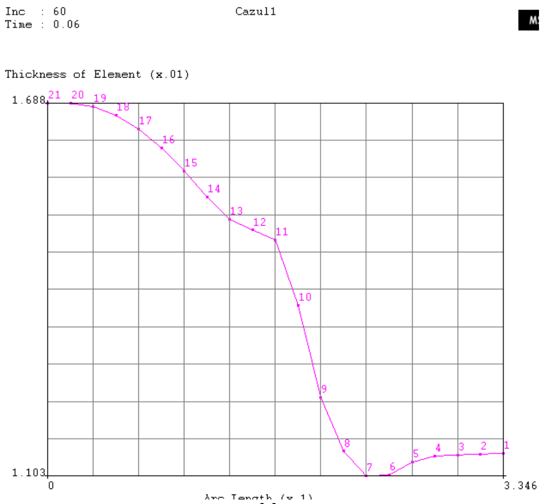


Fig. 9. Variation of tension flow after von Mises criterion, for piece brass CuZn37-O (without lubricant)

3.2.3 The diagram force - stroke



a)



b)

Fig. 10. The diagram force – stroke for piece brass CuZn37-O (without lubricant)

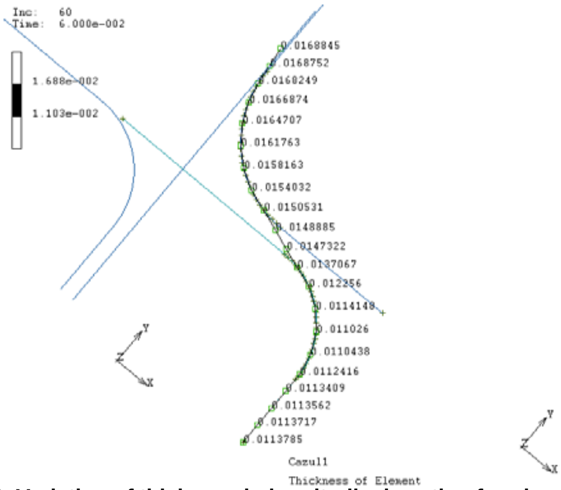


Fig. 11. Variation of thickness in longitudinal section for piece brass CuZn37-O (without lubricant)

The diagram force – stroke is shown in fig. 10 and is observed that the values are close to the case analyzed above.

3.2.4 Variation of wall thickness in longitudinal section

Variation of wall thickness in longitudinal section is shown in fig. 11. Thinning material is evidenced in the bottom flat. It is noted that the thickness of the cylindrical wall begin to grow. The nominal value of the thickness are attained at the entry of the die area, after which the material continues to thicken.

4. CONCLUSIONS

Increasing the coefficient of friction has a negligible influence on the brass, which compensates for the lack of lubricant with a high deformability.

5. REFERENCES

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