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THE SOFTER COSMOS USING IN DRAWING PROCESS SIMULATION

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Abstract: *This work presents the conditions by simulation of drawing small cylindrical pieces as well as the markers result in trace of deforming sheet.*

Keywords: *drawing, Lankford coefficient, strain hardening exponent, band sheet A3k - Sidex*

I. INTRODUCTION

This paper presents simulation results obtained using the drawing process by finite element software COSMOS / M.

The possibility of amending the conditions of simulation and simulation repetition whenever needed without considerable Increase expenditure is the major advantage of this theoretical research tool, represented by simulation. These possibilities leads to optimal solution - still in the design phase - and the shape of the active elements or materials. They have certain effects on productivity growth, as long as softwareurile used to simulate cold plastic deformation processes allow a detailed analysis of the different variants of the process of plastic deformation, it remains only to make a check of the results obtained by numerical simulation using experimental data.

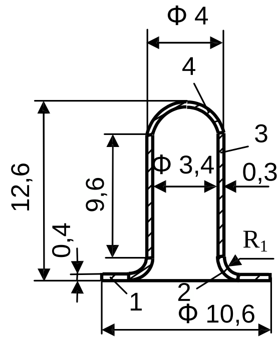

Fig. 1. The sketch of piece analyzed

1.1. The shape and dimensions of the work-piece

Due to this experimental program variants (Table 1) [1, 2] to simulate the process of drawing with thinning wall thickness in order to obtain cylindrical parts hemispherical bottom flange. In this model (Figure 1), the pieces have the lowest values of diameters and higher values of height and minimum limits of the coefficients considered drawing and thinning were the lowest [3]. Following the simulation first experience of this experimental program using software COSMOS M resulted in the breakage of parts of the wall connection flange.

These results led to the design of other variations of the experimental program, which differ by the radius die. In relation to the initial version of the clearance was achieved growth of active elements and a better approximation of the admissible limit drawing coefficient These changes have led to changes in the size of finished pieces Simulation drawing process corresponding to these variants of the experimental program was performed using finite element software to another.

1.2. The blank used

We considered the following dimensions of blank tape: g = 0.4 mm thickness, width B = 22 mm. Due to this variation of the experimental program, the process simulation was performed with the software COSMOS / M, was considered continuous strip (intact).

1.3. The material used

We used a aluminum-killed steel tape, A3K made to Sidex. Characteristic curve σ - ε introduced by points, using data provided by the characteristic curve registered at the traction (Figure 2) in the laboratory of "Strength of Materials" UPB.

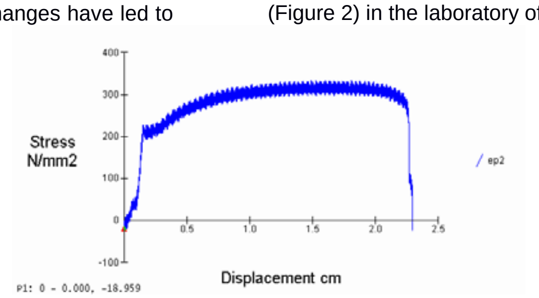

Fig. 2. The characteristic curve tensile strip material A3K-Sidex

The specimen used was standardized (Figure 3) [4]. In Table 1 are shows the values of the measured parameters, respectively the calculated after performing experimental tests.

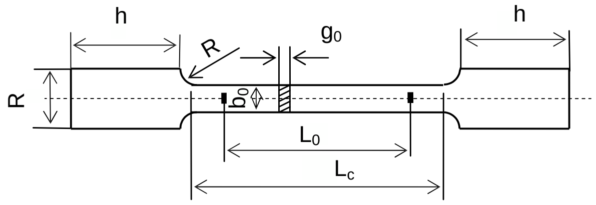

Fig. 3 The sketch of tensile specimen used

Tabel 1. The values of the measured parameters, respectively the calculated after performing experimental tests

Take off specimen	b_O [mm]	L_O [mm]	A_O [mm ^{2}]	F_r [daN]	F_C [daN]	L [mm]	B [mm]	σ_r [N/mm^2]	σ_c [N/mm^2]	ψg	r	n	$\sigma real$
At 90 ° to the direction of rolling	12,5	50	12,5.0,4	160	90	72,5	9,2	320	180	0,264	4,713	0,359	$701{,}036.\psi^{0{,}359}$

We used the following relationship for calculating [5]:

- hardening curve

$$\sigma_{real} = C * \psi^n = \frac{\sigma_r}{1-\psi_g} * \left(\frac{\psi}{\psi_g}\right)^{\frac{\psi_g}{1-\psi_g}} \tag{1}$$

- rupture constriction

$$\psi_g = \frac{A_0 - A_f}{A_0} = \frac{b_0 - b_f}{b_f} \tag{2}$$

- strain hardening exponent

$$n = \frac{\psi_g}{1-\psi_g} \tag{3}$$

- Lankford coefficient

$$r = \frac{\ln\frac{b_0}{b}}{\ln\frac{b * L}{b_0 * L_0}} \tag{4}$$

2. MODELING USING SOFTWARE COSMOS / M

2.1. The geometric model of deformation

The drawing process simulation was performed for a model of deformation, the information in Table 2.

Table 2. The experimental program 3^2 for D' = 13.55 mm (r_m = 1mm)

Nr. Crt.	Coefficients drawing			The force retaining Q[N]	The force drawing F_a[N]	d_p [mm]	g = j /2 [mm]	d_m [mm]	h [mm]
	m	m_y	m_{glt}						
1.	0,40	0,35	0,14	864,27	759,96	4,62	0,14	4,90	12,58

The notation used in the table have the following meanings: m - coefficient of drawing without thinning admissible; m_y - admissible thinning coefficient; m_{glt} - global total admissible coefficient; d_p - punch diameter; g - wall thickness; j - the clearance of active elements; d_m - diameter of the die; h - height calculated piece; Fa - force calculated drawing; D '- diameter blank that is made piece without flange; die radius r_m = 1 mm; Q - calculated retaining force.

The active elements were considered rigid linear elastic, with $E = 2{,}1 \cdot 10^5$ N/mm^2, ν = 0.3. To contact between the die band was considered μ = 0.01.

The finite element type was considered 2D PLANE, which is 4-8 nodes and is
used for determining the state of plane stress and deformation in axisymmetric workpieces; so and the blank as active elements were discretized unevenly, being more frequent finite elements corresponding rays connecting the center of the blank.

In Fig. 4 is shown how to take active elements made blank mesh and in Fig. 5 are given boundary conditions imposed.

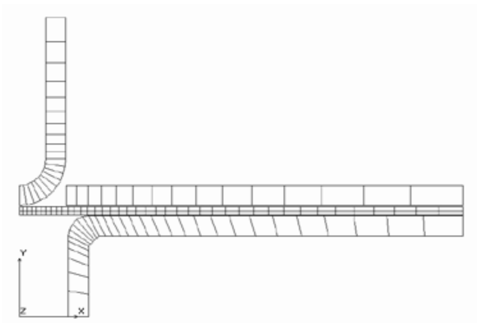

Fig. 4. Mesh blank and the active elements: 20 EF considered the punch; 31 E.F. considered active plate; 15 E.F. considered the retaining plate; 40 E.F. considered the blank

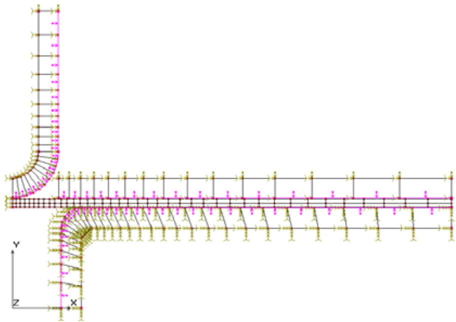

Fig. 5. Boundary conditions: - Punch moves in a vertical direction; - Active plate is fixed; - Retaining plate is moved vertically to a depth of 5 mm, after contact with the blank, after which remains fixed

2.2. The results of numerical simulation with finite element

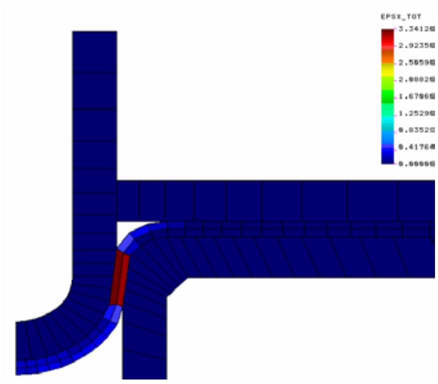

Fig. 6. For a drawing depth of punch hp = 4.68 mm , there is a maximum deformation direction Ox, ε_x max = 334.12%

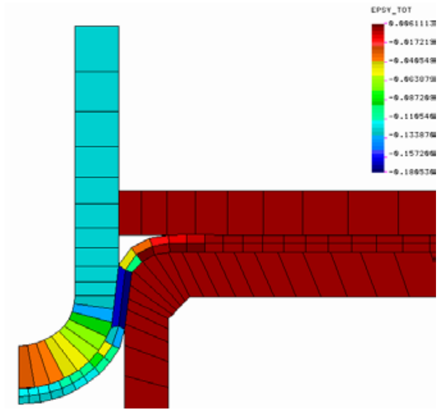

Fig. 7. For the drawing depth of the punch hp = 4.68 mm, there is a maximum deformation direction Oy, $\varepsilon_{y\,min}$ = - 18.05%

The computer processing data provided to a depth of penetration of the punch hp = 4.68 mm. Due to this size, in figures 6, 7, 8 are shown the values of maximum deformation direction Ox or Oy and the total deformation and in figures 9, 10, 11 are given maximum tension values directions Ox and the Oy, respectively equivalent stress von Mises criterion. The configuration shown in Fig. 12 was considered the deformed finite element thickness. It is noted that the corresponding finite element of said clearance is strongly distorted, so that your computer has not provided further data processing. In addition, more characteristic voltage values exceed σ_c material.

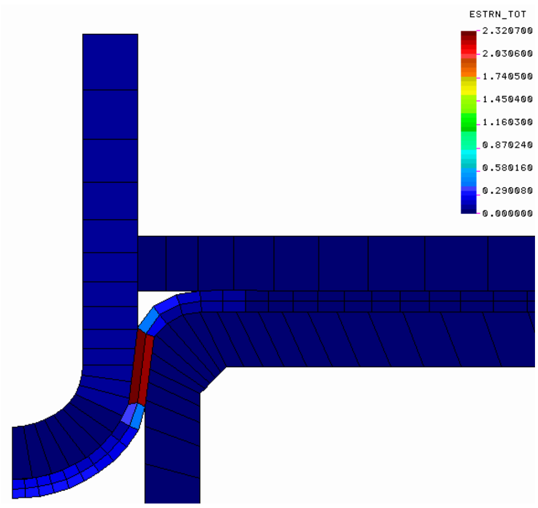

Fig. 8. For the drawing depth of the punch hp = 4.68 mm, there is a total deformation $\varepsilon_{tot\,max}$ = 232.07%

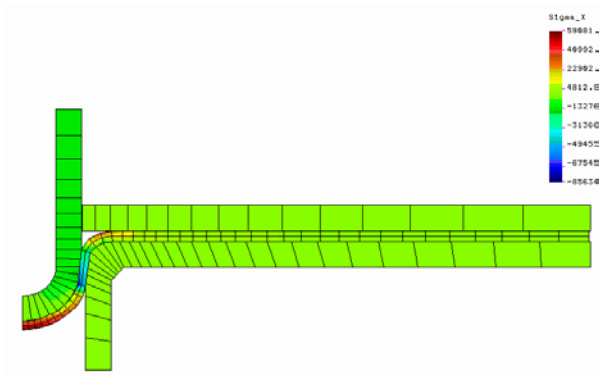

Fig. 9. For a drawing depth of punch hp = 4.68 mm, there is a tension $\sigma_{x\,max}$ = 59 081 N / mm^2, respectively $\sigma_{x\,min}$ = - 85 634 N / mm^2

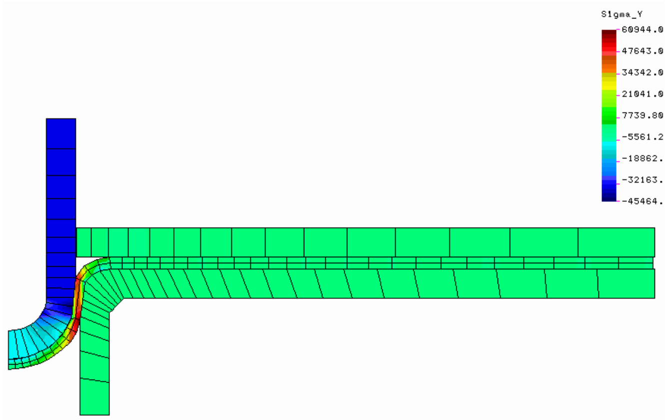

Fig. 10. For the drawing depth of the punch hp = 4.68 mm, there is a tension $\sigma_{y\,max}$ = 60 944 N / mm^2, respectively $\sigma_{y\,min}$ = - 45 464 N / mm^2

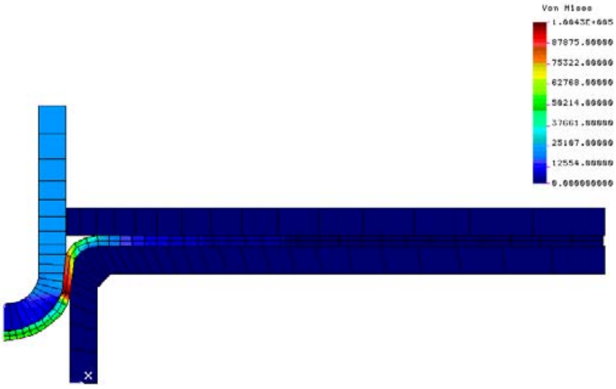

Fig. 11. For a drawing depth of the punch hp = 4.68 mm, there is an equivalent tension von Mises criterion σ = 105 N / mm^2

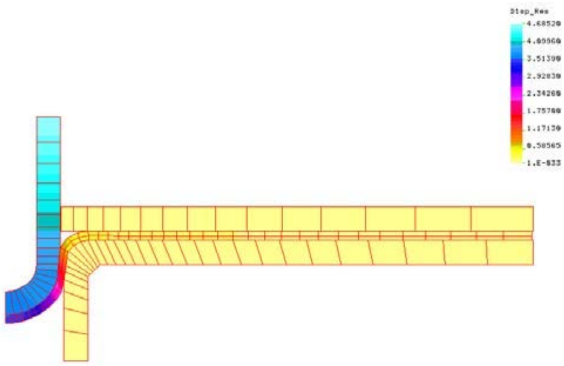

Fig. 12 It is represented the configuration of E.F. considered the deformed sheet thickness corresponding to the drawing depth of the punch hp = 4.68 mm. It is noted that E.F. corresponding the clearance of active elements is strongly deformed, so that your computer has not provided further data processing

3. Conclusions

By analyzing the simulation results we can draw the following conclusions: 1) the coefficient of friction μ not greatly influence the state of tensions and the deformations as dragging band is not observed between active elements, so that the corresponding finite element clearance is deformed by stretching a lot; 2) to a drawing depth the punch hp = 4.86 mm was a reduction in thickness from 0.4 mm to 0.15 mm, considering that the wall thickness in the program is 0.14 mm; 3) high values of ε_x strain that determines breaking; any of the recorded values exceed by far the elongation determined experimentally; 4) The tension values far exceed the material yield strength (σc = 240 N / mm2) right from the drawing depth of punch hp = 3,84mm; hp = 3,84mm;

These results, which were added to the experimental ones (Figure 13) (obtained in the laboratory of "cold pressing technology" UPB) causing breakage of parts, led to the conclusion redesign experimental program.

Fig. 13. Workpieces obtained from continuous strip

4. Bibliography

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