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ENERGETICAL CONSIDERATIONS TO HYDROSTATICAL EXTRUSISION

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ABSTRACT

In this paper there are presented a few aspects connected with the parameters of the process of hydrostatic extrusion, but also by their applications on the energetically problems of this process. There are also presented the results of some experimental attempts made up in the "department – labs" T. C. M. from the University of Galati and after that there could be made up remarks on the analytical methods to calculate the process parameters.

1. Theoretical aspects

On of particularities of the hydrostatic extrusion method, with direct implication on the consumed energy for the development of the process, is connected by the absence of the abrasion between the billet and the interior surface of the stencil, figure 1 (a-classical extrusion and b-hydrostatic extrusion).

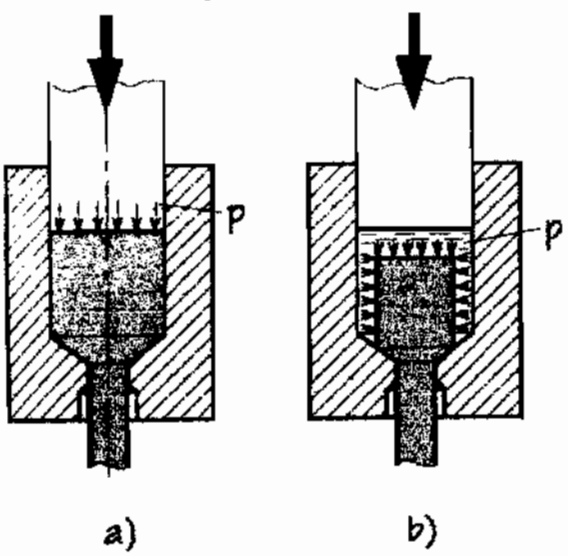

Figure 1

In the processes of conventional extrusion, the half-ended is pushed trough the office of the stenoil, its lateral surface being in direct contact with its walls, in order to avoid the buckling or the lateral deformation. In this way the size of the report length is limited because the normal tension that length/diameter is limited because the normal tensions that appear at the contact surface between the billet and stencil make up great abrasion forces.

In the case of the hydrostatic extrusion the hydraulic agent being put the surfaces of the billet and of the stencil, the abrasion with its cylindrical wall is completely removed. In the absence of this abrasion the studies [1] emphasised important changes that regard the influence of the deformation degree on the "p" extrusion pression, figure 2.

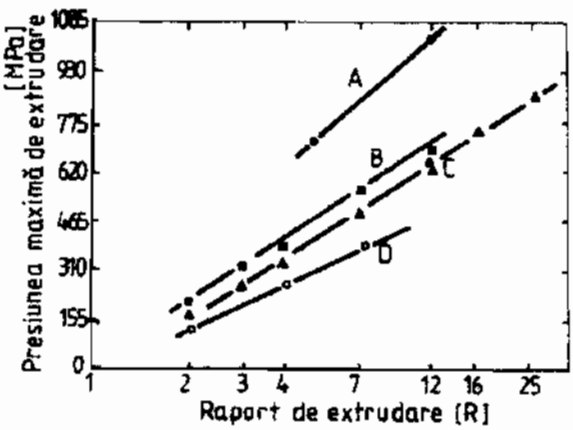

Figure 2. A-conventional extrusion $2\alpha=120°$;
B-hydrostatic extrusion $2\alpha=120°$;
C-hydrostatic extrusion $2\alpha=90°$;
D-hydrostatic extrusion $2\alpha=60°$.

Since the pressure is a constitutive of the hydrostatic energy is a evident that an analyse of the way of variation this parameter in according to the factors that influence the extrusion process is, in fact, an energetic analyse. In this case it way extrapolated the method of calculation by V. I. Perlin [3] in case of a direct classical extrusion of a cylindrical half-finished, for the hydrostatic extrusion of the some type of billet.

If the billet has the diameter D and it gets by extrusion the diameter d, figure 3, taking into account by the typical parameters of the deformation zone, the leaking of the material trough the cone of the stencil takes place under the action of two values of pressure p_1 and p_2, pressure that action on the spherical surfaces defined by the projections a_o, b_o, c_o and a_1, b_1, c_1.

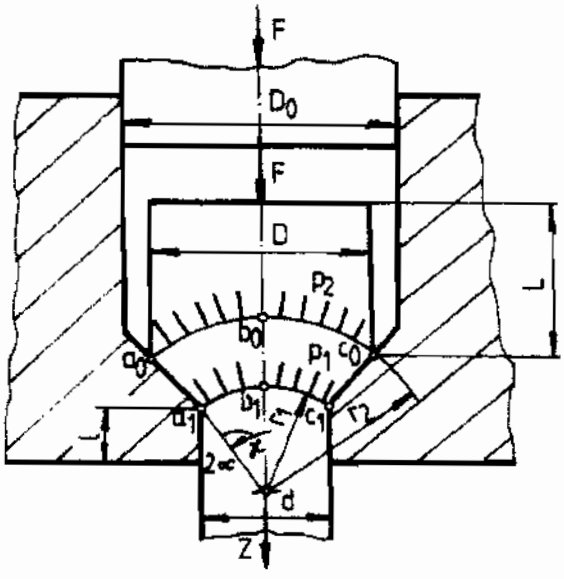

Figure 3

Generally, the whole mechanical action necessary for the passing of the material trough the orifice of the stencil and its movement "u_z"on the direction of the axle of the billet is:

$$L = Ld + Lf + Lp = F \cdot u_z \qquad (1)$$

where:

L_d - mechanical action necessary for the changing of the shape;

L_f - mechanical action necessary for the defeating of the abrasion forces;

L_p - mechanical action necessary for the defeating of the resistance at the deformation in focus zone;

F - the force necessary for deformation.

The mechanical action necessary for the deformation itself given by the expression:

$$Ld = \iiint \sigma_i \varepsilon_i d\,V \qquad (2)$$

where:

σ_I - the force of the unitary tension;

ε_I - the force of the deformations.

By the expression of the force of deformations in accordance with a system of cylindrical co-ordinates and of the force of the unitary tensions in concordance with the criteria Huber - Misses - Hencky, we obtain:

$$Ld = 4\pi\sigma_c \cdot u_z \cdot r^2 (1 - \cos\alpha) \int_{r_2}^{r_1} dr \qquad (3)$$

Taking into account the particularities of the process of hydrostatic extrusion just mentioned $L_f = 0$.

The mechanical action necessary to defeat the resistance at deformation in the focus zone is:

$$Lp = p_1 \frac{\pi d^2}{4} u_z \left(\frac{r_1}{r_2}\right)^2 \qquad (4)$$

where:

p_1 - the pressure given to the resistance at the deformation where the abrasion forces interfere from the cylindrical zone of the dies, which has an "l" length.

$$p_1 = 4\sigma_c \cdot f \cdot \frac{l}{d} \qquad (5)$$

Finally, replacing in (1) and dividing the resulted expression to $\left(u_z \cdot \frac{\pi d^2}{4}\right)$ it is obtained the expression of the extrusion pressure:

$$p = \sigma_c \left(4f\frac{l}{d} + \frac{2}{1+\cos\alpha} \cdot \lambda\right) \qquad (6)$$

where:

$$\lambda = \left(\frac{D}{d}\right)^2 .$$

2. The Results of Experimental Research and Conclusion

In the "desk labs" of the Technology of Making up Machines From the University "Dunărea de Jos" Galaţi there were made up experiments of direct hydrostatic extrusion using a proper stencil of extrusion, figure 4, assembled on a hydraulic press, fitted out with a system that measures the moving away. The trying conditions had as components: billet from Al 99,9; the angle of the die of the stencil $2\alpha = 90°$; hydraulic agent, oil + 10 % graphite.

After the attempts there were done diagrams force-run as the figure 5, the values of the resulted parameters being centralised in the next table.

In base of these results it was determined the useful mechanical action and it was made

up its diagram of variation, figure 6, in relation with values of the deformation degree.

Taking into account the some values of the degree of deformation, there were determined, analytically, using the relation (6), the values of the extrusion pressure, realising that these are with almost 5 % less those resulted experimentally.

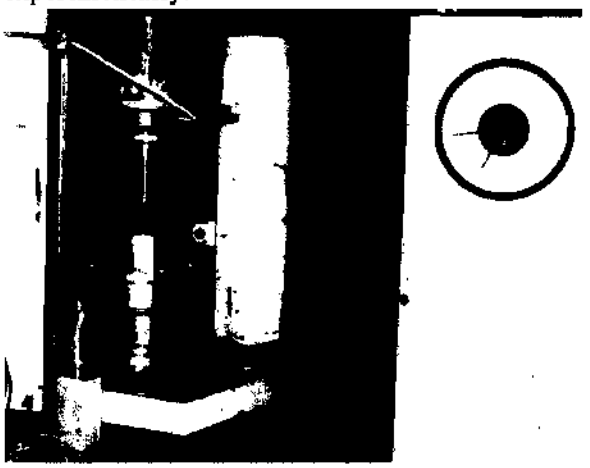

Figure 4

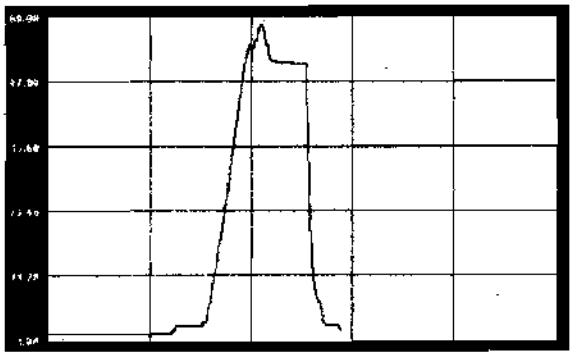

Figure 5

No. attempts	*The degree of deformation* %	*Run* [mm]	*Force* [KN]
1	43	32	45
2	55	35	53
3	64	38	58
4	70	42	67
5	74	47	72

In conclusion, it way by appreciated that the analytical determination of the energy in the processes of hydrostatic extrusion, by the calculation of the effort parameters necessary to the unfolding of the process is made up with deviation; the resulted values being less than those obtained experimentally. This happens taking into account the complexity of the process of hydrostatic extrusion and to a great number of factors which interfere in its unfolding.

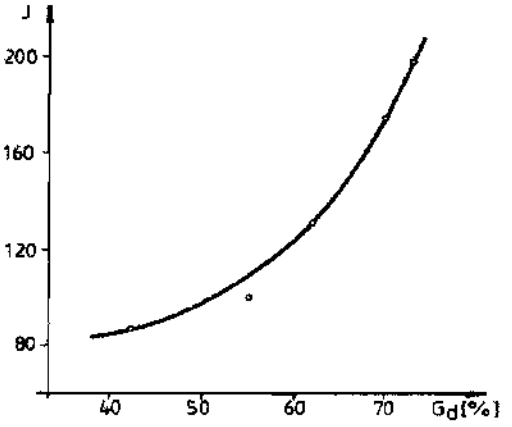

Figure 6

So, we consider that at the application of processes of hydrostatic extrusion, for a correct estimate of the values of the parameters of effort that interfere (force, pressure) is imposed a verification of the analytical relations for calculating them, by experimental methods because after a comparison of the results to be able to be corrected wherever necessary.

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CONSIDERATII ENERGETICE LA EXTRUDAREA HIDROSATICA

Rezumat

În lucrare sunt prezentate câteva aspecte legate de atât de parametri procesului de extrudare hidrostatica cât şi de implicaţiile lor asupra problemelor energetice ale acestui proces. De asemenea sunt prezentate rezultatele unor cercetări experimentale efectuate in laboratoarele catedrei T.C.M. de la Universitatea "Dunărea de Jos" din Galaţi in urma cărora s-au putut face aprecieri asupra metodelor analitice de calcul a parametrilor de proces

CONSIDÉRATIONS ÉNERGIQUES À EXTRUSISION HYDROSTATIQUE

Résume

En cet article on présente quelques aspects liés aux paramètres du processus de l'extrusion hydrostatique, mais également par leurs applications sur énergiquement les problèmes de ce processus On présente également les résultats de quelques tentatives expérimentales composées dans "service de T. C. M. de laboratoires" de l'université de Galati et ensuite ce là pourrait être des remarques composées sur les méthodes analytiques pour calculer les paramètres de processus.