



ABSTRACTS OF PAPERS

from

2nd WORLD TRIBOLOGY CONGRESS

Vienna, Austria, 3 - 7 September 2001

organized by



The Austrian Tribology Society
(Österreichische Tribologische Gesellschaft – ÖTG)

Editors: Friedrich FRANEK, Wilfried J. BARTZ, Andreas PAUSCHITZ

INFLUENCE OF VARIABLE CONTACT CONDITIONS IN DEEP DRAWING

M. STEFANOVIC, S. ALEKSANDROVIC,
Faculty of Mechanical Engineering, S. Janjic 6, 34000 Kragujevac, YUGOSLAVIA; e-mail: stefan@knez.uis.kg.ac.yu

Keywords: deep drawing, holding force, formability

ABSTRACT

The process of deep drawing is influenced by many factors. The significance of tribological conditions in the forming process is equal to the influence of the other factors: materials, tools and machines [1]. The only two factors that could be modified in course of the process, by using special devices, are holding force and position of draw beads. Variable blank-holding force (VBF) is especially important for forming of low formability materials (Al-alloys, high strength steel sheets, tailored sheets etc.) [2]. Researching device has been made and its main purpose is to realize arbitrary dependence of holding force on time (i.e. drawing travel) on the feed back principle. Holding force functions are realized by steplike approximation (figure 1) at which accuracy can be adjusted. Also, on the closed loop principle, by changing the holding force, it is possible to maintain the intensity of drawing force in the previously given range.

In this paper the results of investigations of two materials will be given; those materials are: low carbon steel sheet for deep drawing (marked C0148P5) and electrogalvanized sheet metal zinc coated at one side (marked TyZn). Both materials are 0.8 mm thick. Work piece is of a cylindrical geometry with diameter 50 mm. Blank diameter is 110 mm. For that geometry, holding force dependence (fig. 1) was obtained by relatively simple empirically-analytical procedure [3]. Function was obtained at given condition of constant specific holder pressure.

The effects of the VBF are monitored through principle plain strains distributions, thinning strain distributions, depth and drawing force. The device makes possible the defining of the moment of the wrinkles appearance (according to the chosen criterion) and direct recording of the force dependence (fig. 1).

In the case of sheet metal C0148P5 (fig. 2), VBF decreasing dependence was applied, marked with DN1 in fig. 1, with change of contact conditions (dry, oil, and oil plus polyethylene foil) without history change (one phase procedure). In case of dry surfaces and application of oil (boundary and mixed lubrication) loops that correspond to VBF are much more favorable. Furthermore, drawing depths were increased for 13.5 % (oil) and 30.5 % (dry) in comparison to constant blank holder force (CBF). In extremely favorable case of lubrication by oil and foil, tendency to the appearance of wrinkles increases so CBF intensity should only be sufficiently increased.

The application of VBF leads to better technological results and more complete comprehension of the deep drawing process. The results given in this paper (in

reduced form) point to the positive influence of the decreasing holding force, especially in conditions of mixed lubrication (application of oil for deep drawing).

Much more favorable strain distribution is achieved, which postpones (or complete avoids) fracture with rather successful compensation of wrinkles.

This researches (only small part of which is given here) has also included other VBF types: increasing, combined decreasing-increasing and pulsating VBFs. By theoretical and empirical investigations it is possible to define the VBF which would improve results in each particular forming case.

REFERENCES

- [1] Stefanovic M., Aleksandrovic S.: Importance of strain analysis in Tribo-Modelling in Deep Drawing. 1st World Tribology Congress, 1997, London, Abstract of papers, pp. 626.
- [2] Siegert K., Ziegler M., Wagner S.: Closed loop control of the friction force. Deep drawing process. Journal of Mat. Proc. Techn. 71 (1997): 126-133.
- [3] Stefanovich M., Aleksandrovich S.: The significance the change of contact pressure in blank holder zone in deep drawing, Balkantrib 99, Sinaia, Proc. 249-256.

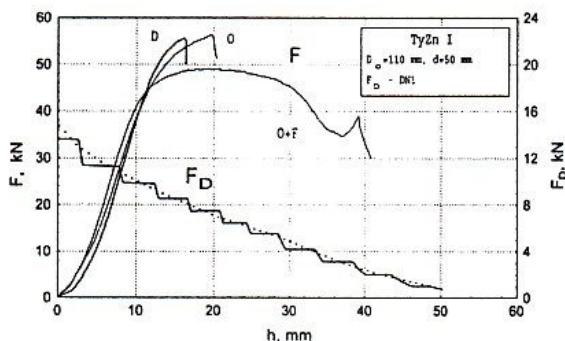


Fig. 1: Drawing and holding force

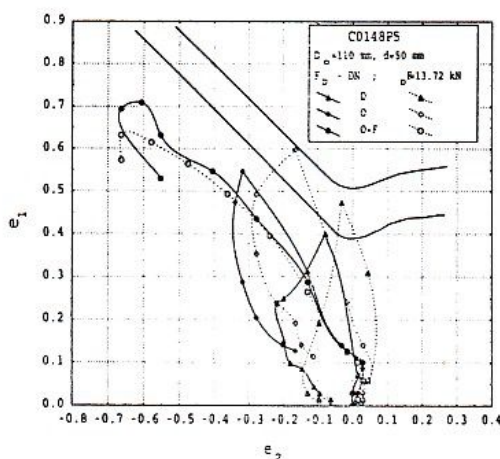


Fig. 2: Strain distributions