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SIXTH YUGOSLAV CONFERENCE ON TRIBOLOGY

YUTRIB '99

SA MEĐUNARODNIM UČEŠĆEM
WITH INTERNATIONAL PARTICIPATION

ZBORNIK - PROCEEDINGS

moto konferencije
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TRIBOLOGIJA I ODRŽAVANJE
TRIBOLOGY AND MAINTENANCE

Kragujevac, Jugoslavija, 29. - 30. septembar 1999.

MOGUĆNOST TRIBOLOŠKIH UTICAJA NA DUBOKO IZVLAČENJE PREKO PROMENLJIVE SILE DRŽANJA

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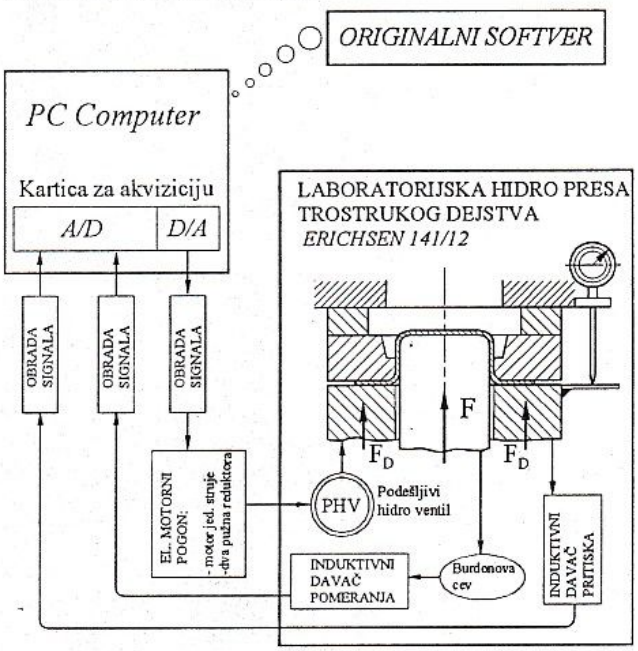
Okvir za uspešno odvijanje procesa dubokog izvlačenja tankih limova čine dva moguća defekta: razaranje i pojava nabora. Razaranje se dešava posle dostizanja graničnih iznosa napona u kritičnim zonama prenosa deformacione sile. To je najčešće okolina radijusa izvlakača. Nabori se javljaju na obodu komada usled delovanja tangencijalnih pritisnih napona. Talasi nabora uzrokuju generisanje aksijalne sile čiji je intenzitet, u tom slučaju , veći od sile držanja. Na taj način se oslobađa prostor između držača i matrice i nabori rastu sve dok ne budu uvučeni u otvor matrice pri čemu, najčešće, dolazi do zaglavljivanja izvlakača.

Jednaku važnost kao ostali faktori (materijal, geometrija radnog komada, mašina i alat) imaju triboloski uslovi u procesu dubokog izvlačenja. Naročito treba istaći triboloska zbivanja na obodu komada zbog delovanja sile držanja koja je veoma pogodan parametar za praćenje i upravljanje.

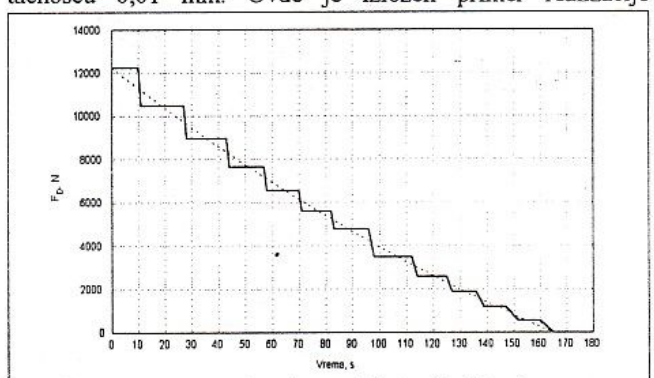
Poslednjih nekoliko godina vrše se brojna istraživanja uticaja sile držanja sa ciljem postizanja visoke efikasnosti procesa oblikovanja. Primenjuju se kompjuterski sistemi za akviziciju i upravljanje od laboratorijskih razmera pa do velikih industrijskih postrojenja /1 /. Ostvaruje se programski zadata promenljiva sila držanja i pokušava ovladavanje pojavom nabora i razaranja.

Na Mašinskom fakultetu u Kragujevcu formiran je laboratorijski uređaj za programsko upravljanje silom držanja pri dubokom izvlačenju (sl. 1).



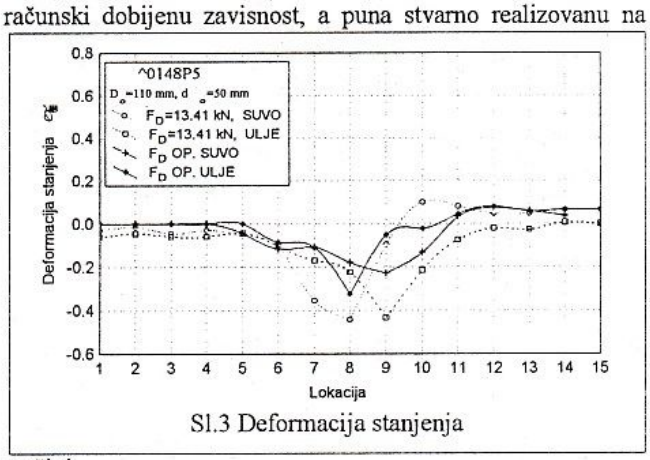
Sl.1 Shema uređaja za ispitivanje

Uređaj predstavlja kompletan sistem za akviziciju i upravljanje baziran na A/D i D/A konverziji. Meri se sila izvlačenja i sila držanja, a upravlja silom držanja. Postoji mogućnost identifikacije nabora mehaničkim putem sa tačnošću 0,01 mm. Ovde je izložen primer realizacije



Sl. 2 Ostvarivanje opadajuće sile držanja

opadajuće sile držanja po principu ostvarenja konstantnog specifičnog pritiska držača (sl. 2). Sila opada u skladu sa smanjivanjem površine oboda tokom procesa (zavisno od hoda, odnosno vremena) /2/. Isprekidana linija označava računski dobijenu zavisnost, a puna stvarno realizovanu na



Sl.3 Deformacija stanjenja

mašini.

Sl. 3 prikazuje jedan od mogućih načina ocene efekata opadajuće sile držanja – praćenjem deformacije stanjenja lima. Dato je upoređenje distribucija za promenljivu (pune linije) i konstantnu (isprekidane linije) silu držanja. Takođe, varirani su kontaktni uslovi na držaču (suve površine i primena ulja za duboko izvlačenje domaće proizvodnje). Primetan je manji intenzitet stanjenja pri opadajućoj sili držanja uz ravnomerniju distribuciju deformacije φ_3.

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THE POSSIBILITY OF THE TRIBOLOGICAL INFLUENCES ON DEEP DRAWING BY VARIABLE BLANK HOLDING FORCE

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The framework for successul realization of process of thin sheet metals deep drawing is made of two possible defects: fracture and appearance of wrinkles. Fracture takes place after reaching the limit stress values in critical zones of forming force transfer. In most cases it is the surroundings of punch radius. Wrinkles appear on the work piece flange in consequnce of the activity of tangential compressive stresses. Waves of wrinkles cause generation of axial force, the intensity of which is, in that case, larger then holding force. In that way space is released between holder and die, and wrinkles increase until they are drawn into the die opening and in most cases the punch gets stuck in course of that.

Tribological condition in deep drawing process are as important as other factors (material, work piece geometry, machine and tool). Tribological activities on work piece flange suould be especially emphasized because of activity of holding force which is a very convenient parameter for monitoring and control.

During the last few years many researches of blank holding force influence have been carried on in order to attain hihg efficiency of the forming process. Computer systems for acquisition and control including everything from laboratories to big industrial equipments have been applied /1/. Programme given variable holding force have been realized and mastering of the appearance of wrinkles and fractures has been given a try.

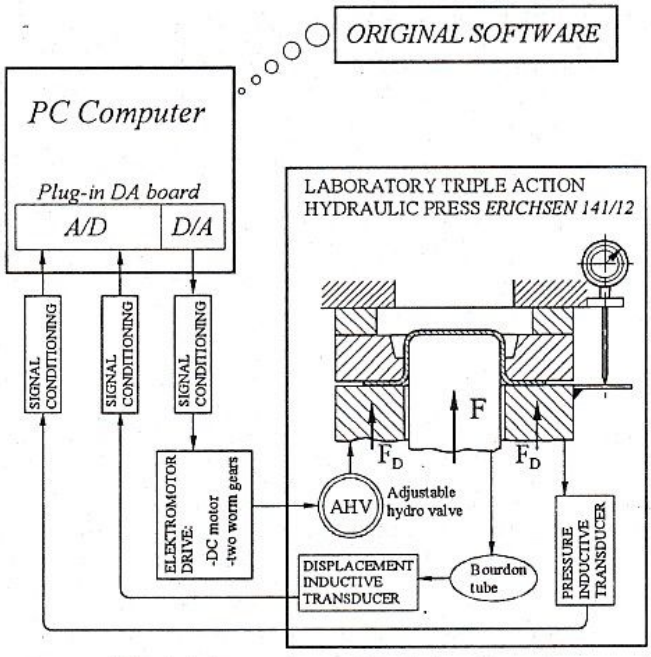

Fig. 1 Scheme of experimental equipment

At the Faculty of Mechanical Engineering in Kragujevac laboratory device for programme control of holding force in deep drawing has been made (fig. 1).

The device represents complete system for acquisition based on A/D and D/A conversion. Drawing force and holding force are measured, and holding force is put under control. There is possibility of identifying wrinkles mechanically with accuracy of 0.01 mm. The example of realization of the decrease

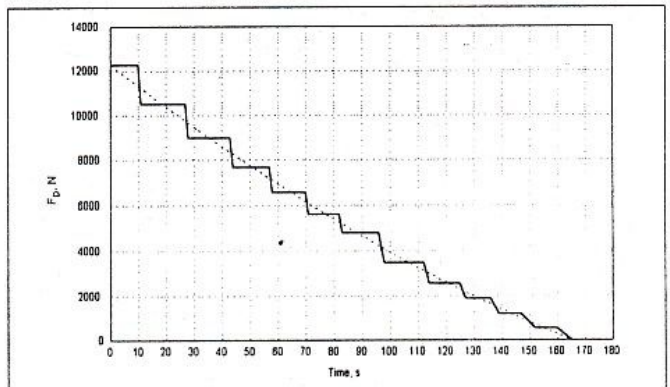

Fig. 2 Realization of decrease holding force

holding force on the principle of realization of constant specific holder pressure (fig. 2) is given here. The force decrease linearly with increase of flange surface in course of

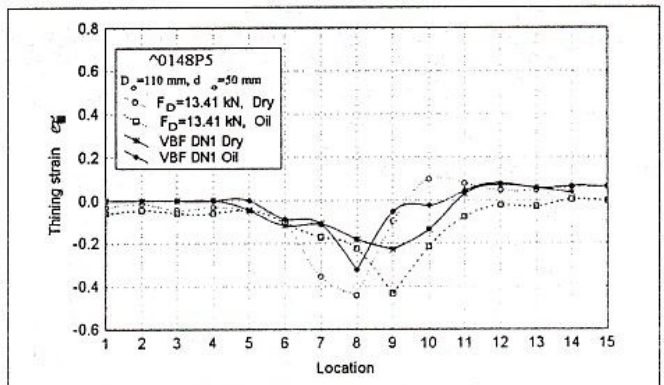

Fig. 3 Thinning strain distributions

process (in dependence on punch travel, i.e. time) /2/. Dashed line represents the dependence obtained by calculations, and full line the dependence actually realized on machine.

One possible method of evaluation of decrease holding force effects – by monitoring of sheet thinning strain is given in fig. 3. The comparison of distributions for variable (full line) and constant holding force (dashed line) is given. Also, contact conditions on holder (dry surfaces and application of oil for deep drawing) were varied. Smaller intensity of thinning at decrease holding force with more uniform strain distributions φ_3 is noticeable.

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