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Energy and Material Conservation Through Friction & Wear Reduction

ZBORNIK - PROCEEDINGS

UTICAJ PROMENLJIVIH TRIBO-USLOVA NA POLOŽAJ KRIVE GRANIČNE DEFORMABILNOSTI TANKIH LIMOVA PRI NEMONOTONOM DEFORMISANJU

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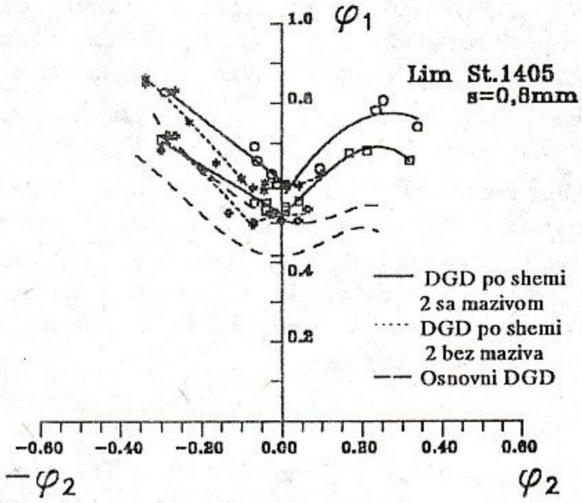
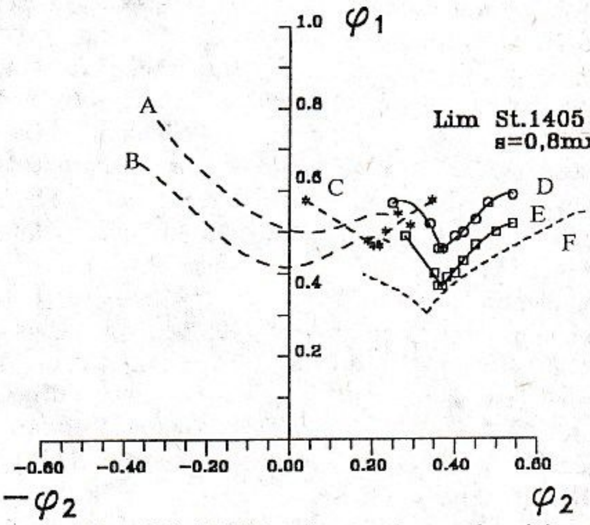
U radu se prikazuju eksperimentalni rezultati ispitivanja uticaja tribo-uslova na položaj krive granične deformabilnosti (DGD) pri nemonotonom deformisanju i predlog jednostavnog analitičkog načina definisanja položaja DGD s obzirom na kontaktne uslove.

U eksperimentu su realizovana dva dvofazna nemonotona postupka. Prvi (označen kao shema 2) u prvoj fazi sadrži jednoosno zatezanje trake lima širine 200 mm brzinom deformisanja 20 mm/min, a u drugoj postupak određivanja DGD izvlačenjem serije epruveta promenljive širine polusfernim izvlakačem /1,2/. Drugi (označen kao shema 4) u prvoj fazi ima dvoosno zatezanje ostvareno na dnu cilindričnog komada prečnika 100 mm dobijenog čistim dubokim izvlačenjem /1/, a u drugoj određivanje DGD kao kod prethodnog postupka. Eksperiment je rađen na mašini ERICHSEN 142/12 (max. sila 120 kN) i hidrauličnoj kidalici WPM ZD 40 Pu (max. sila 400 kN). Uticaj tribo-uslova je ispitivan korišćenjem ekstremnih kontaktnih uslova (suve površine odmašćene acetonom i podmazivane uljem i polietilenskom folijom). Kod sheme 2 u prvoj fazi ostvarena je prirodna deformacija 0,172 odnosno 0,182 za krive sa mazivom. Materijal je lim inostrane proizvodnje St. 1405 po DIN-u (približno Č0148P5 po JUS-u). Karakteristike su date u /1/.



Sl.1 Položaj DGD pri postupku po shemi 2

Sa sl.1 vidljiva je tendencija značajnog porasta tangencijalne deformacije φ_2 pri približno istoj deformaciji φ_1 ako se trenje između izvlakača i lima svede na najmanju meru (ulje i folija). Slična tendencija nije zapažena kod DGD dobijenog pri monotonom deformisanju (osnovni DGD) po istraživanjima datim u /1,2/. Takođe, po istim istraživanjima nije prihvatljiv stav (čest kod nekih autora) da manje trenje znači generalno dizanje krive DGD, što bi značilo da je moguće zaustavljanje priraštaja deformacije φ_2 uz porast prve glavne deformacije φ_1 . Prethodno uočena pojava smanjenog priraštaja φ_1 uz značajno povećanje priraštaja φ_2 ima objašnjenje u složenim procesima na mikro-nivou koji se dešavaju u metalnoj rešetki pri višefaznim nemonotonim procesima deformisanja.



Sl.2 Položaj DGD pri postupku po shemi 4

Na sl.2 dat je komparativan prikaz dijagrama za deformisanje po shemi 4. Sa A i B su označene osnovne krive. C označava krivu razaranja za slučaj suvih površina u drugoj fazi. D i E predstavljaju krive razaranja i lokalizacije za primenu maziva u drugoj fazi. Kriva F je teorijska kriva. Maksimalna deformacija φ_1 u prvoj fazi za krivu C iznosi 0,172, a za krive D i E 0,182. Tendencija porasta φ_2 prisutna je ovde još izraženije. Kriva F je dobijena postupkom datim u /3/ i /1/ ali uz korekciju za priraštaj deformacije φ_2 uočen u uslovima smanjenog trenja. Predlaže se da on bude dat kao kvadratna funkcija koeficijenta trenja: $\Delta\varphi_2=0{,}228-2{,}51\mu+6{,}29\mu^2$.

LITERATURA

1. S. Aleksandrović : Granična deformabilnost tankih limova u uslovima nemonotonog procesa plastičnog deformisanja, mag. rad, Mašinski fakultet Krag. 1993.g.
2. M. Stefanović: Tribologija dubokog izvlačenja, Jugosl. komitet za tribologiju, Kragujevac, 1994.g.
3. B. Devedžić: Granična deformabilnost limova pri različitim istorijama deformisanja, 24. Savetovanje proizv. mašinstva Jugoslavije, Novi Sad, 1992.g.,s. 1-11 do 1-19.

INFLUENCE OF VARIABLE TRIBO-CONDITIONS ON POSITION OF FORMING LIMIT CURVE OF THIN SHEET METALS IN NON MONOTONOUS FORMING

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Here we present experimental results of influence of tribo-conditions on position of forming limit curve (FLC) in non monotonous forming, and proposal of simple theoretical way to define position of FLC depending on contact conditions.

Two two-phase non monotonous procedures has been realized by experiment. In the first procedure (assigned as scheme 2), in the first phase we perform uniaxial tension of sheet metal stripe 200 mm wide, while in the second phase we determine FLC by drawing of the specimens with different wideness by semispherical punch /1,2/. In the second procedure (assigned as scheme 4) , in the first phase we perform biaxial tension of the bottom of the cylindrical part, 100 mm in diameter, obtained by pure deep drawing /1/, while in the second phase we determine FLC, as in former procedure. Experiment has been performed on the press ERICHSEN 142/12 (max. force 120 kN) and hydraulic laboratory press WPM ZD 40 Pu (max. force 400 kN). Influence of tribo-conditions has been investigated by use of extreme contact conditions (dry surfaces clined with acetone and lubricated with deep drawing oil and polyethylene foil). In the first phase of the scheme 2 we obtained natural strain 0.172 and 0.182 for curves where lubricants are used. Material used here is sheet metal St.1405 after DIN. Properties of the material are given in /1/.

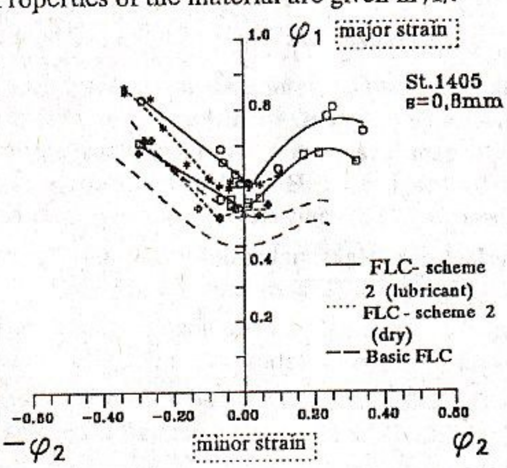

Fig.1 Position of FLC by scheme 2

On the fig.1 is obvious significant increase of tangent strain φ_2, when strain φ_1 has aproximately constant value, with minimized friction between punch and sheet (oil and foil). Such behaviour has not been observed on FLC obtained with monotonous forming and described in references /1,2/. They pointed out, also, that it is not correct to conclude (often claimed by some authors) that decrease of friction means lifting up of FLC leading to a conclusion that it is possible to stop increasing of strain φ_2 during increase of first proper strain φ_1. Here observed phenomenon of small increase of φ_1 with sharp increase of φ_2 has explanation in complex process on the micro level that appear in metal lattice during multyphase non monotonous processes of forming.

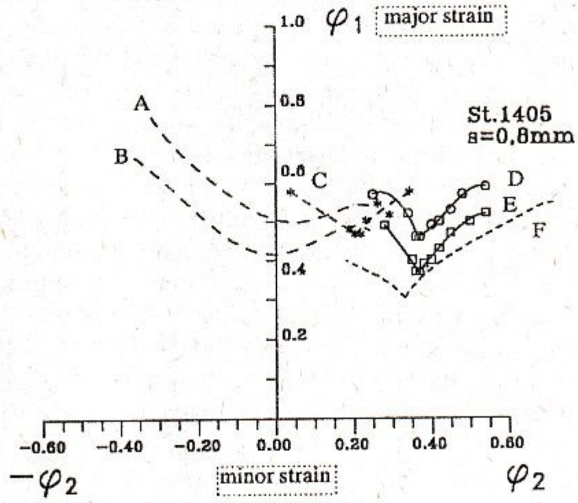

Fig.2 Position of FLC by scheme 4

On the fig.2 we illustrate the forming curves according to scheme 4. Basic curves are marked as A and B on the graph. Failure curve for dry surfaces in second phase has been labelled as C. Curves D and E represent failure and localization curves, respectively, for lubrication in second phase. Curve F is theoretical one. Maximal strain φ_1 , in the first phase, for curve C has value 0.172, and for curves D and E has value 0.182. The increase of φ_2 here is more remarkable. Curve F has been obtained by procedure given in /3/ and /1/ with correction of increase of strain φ_2 observed in conditions of decreased friction. We propose it to be quadratic function of friction coefficient in the form $\Delta\varphi_2$=0.228–2.51μ+6,29μ^2.

REFERENCES

1. S. Aleksandrovich: Forming Limit of Thin Sheets in Conditions of Non monotonous Plastic Forming (In Serbian), M. Sc. Thesis, Faculty of Mechanical Engineering, Kragujevac, 1993.

2. M. Stefanovich: Tribology of Deep Drawing, Yugoslav Committee of Tribology, Kragujevac, 1994. (In Serbian).

3. B. Devedzich: Forming Limit of Sheet Metals in different Forming histories, XXIV SPMJ, Novi Sad, 1992. Proceedings pp. 1-11 to 1-19 (In Serbian).