UDC 621.313, 624.014

Tetyana F. Arkhipova

A THEORY OF THE MAXIMUM STATES IS IN TASKS OF STRENGHS OF MATERIALS

Vinnitsa National Technical University

Анотація

Розроблено розрахунковий апарат для оцінки ресурсу пластичності попередньо деформованих листових заготовок. Модель руйнування дозволила при відомих механічних характеристиках заготовок оцінити характеристики пластичності при будь-якому напруженому стані. Показано задовільну збіжність розрахункових та експериментальних даних.

Ключові слова: обробка тиском, пластичність, технологічна спадковість, тензор руйнувань, використаний ресурс пластичності.

Abstract

A calculation method is worked out for the prediction of resource of plasticity of the preliminary deformed sheet metal. The model of destruction allowed at the known mechanical descriptions of purveyances to estimate descriptions of plasticity at any tense state. It is shown satisfactory convergence of calculation and experimental data.

Keywords: treatment, plasticity, technological inheritance, tensor of failure, used resource of plasticity, pressure strength, deformation.

After the different operations of treatment of metals pressure a technological inheritance is formed are remaining tensions, work-hardening, gradient of deformations, remaining plasticity and others. The indicated factors influence in future on the operating internals of wares, what predetermines the task of creation of methodologies of quantitative estimation of the indicated factors. Majority from the enumerated factors to date studied enough [1], however some of them, for example, an estimation of plasticity of the preliminary deformed purveyance still is a thorny and studied not enough problem. The aim of the real work is development of method of estimation of plasticity preliminary deformed. By the measure of plasticity in the moment of destruction of material of purveyance in area of eventual deformations we will accept the intensity of deformations (parameter of Udquist) accumulated on all stages of deformation [1]**:**

$$e_p = \int_0^{\tau_p} \dot{\varepsilon}_u d\tau, \tag{1}$$

where $\dot{\varepsilon}_u$ – intensity of speed of deformation.

Plasticity of metals depends on many factors among that, except nature of material, basic are термомеханические parameters of process: temperature, speed of deformation, type of the tense state, history of deformation, gradient of deformation and many others Dependence of plasticity on the type of the tense state at simple deformation and fixed temperature-speed terms is his mechanical description. The tense state it is accepted to characterize the indexes of the tense state. Index of the tense state according [2] is:

$$\eta = \frac{I_1(T_\sigma)}{\sqrt{3I_2(D_\sigma)}} = \frac{\sigma_1 + \sigma_2 + \sigma_3}{\sigma_1}, \tag{2}$$

where $I_1(T_\sigma)$ – first invariant of tensor of tensions, σ_1, σ_2, σ_3 – main strains, $I_2(D_\sigma)$ – second invariant of stress deviator or intensity of tensions.

The elementary particle of metallic body goes across from resilient in the plastic state, when intensity of tensions arrives at a value equal to tension of fluidity at the linear plastic tense state. At the plastic state intensity of tensions is constantly equal to tension of fluidity:

$$\sigma_u = \frac{1}{\sqrt{3}} \sqrt{(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2} = \sigma_m. \tag{3}$$

If in the condition of plasticity (3), to examine σ_1, σ_2, σ_3 as current positions, that equalization will assume:

$$\frac{1}{\sqrt{3}} \sqrt{(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2} = 2\sigma_m^2. \tag{4}$$

If main normal tensions in some element of solid are such, that they determine a point lying on the surface of cylinder, this element will be in the plastic state. Thus, surface, according to equalization (1) is the "maximum surface of flowage" according to the power condition of plasticity. Graphically this cylinder is presented on Fig.

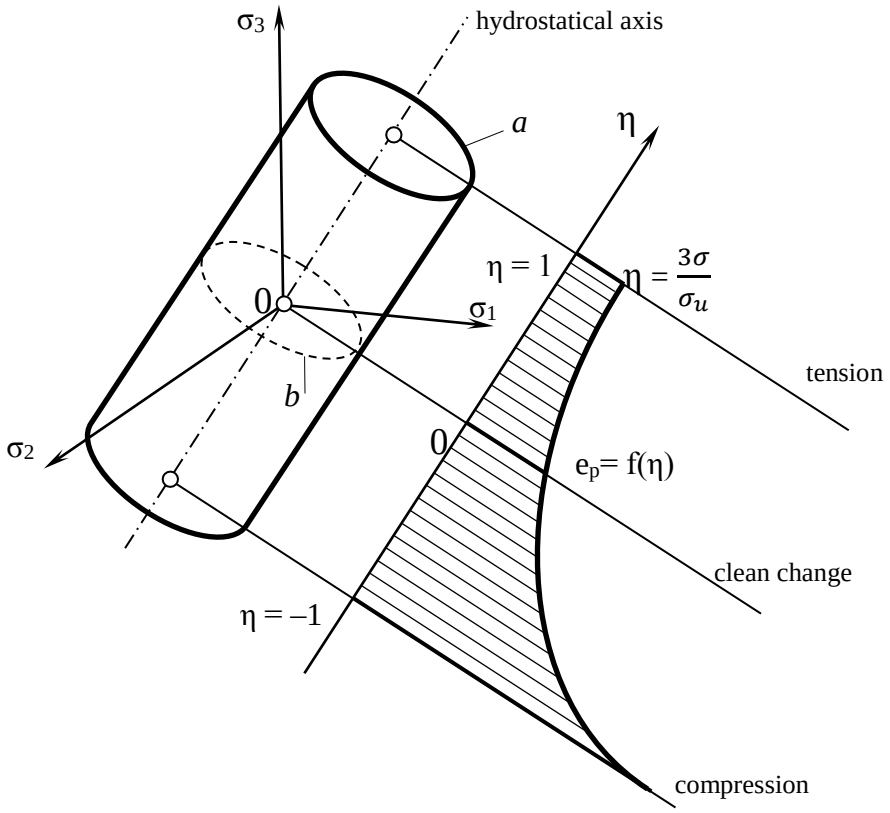

Fig. – Maximum surface of tensions according to the power condition of plasticity

If main normal tensions in the element of body are such, that they determine a point lying into a cylinder, then an element will be in the resilient tense state. Combination of tensions and qualificatory points out of surface of cylinder do not have physical sense. What more tension of fluidity σof т, the anymore and radius of cylinder of r. If deformation is accompanied by work-hardening, σт increases and, consequently, the maximum surface of flowage broadens. Circumferences on the surfaces of cylinder (for example, and, b), got crossing by his planes perpendicular to his axis, are a geometrical place of points qualificatory the maximum tense states, i.e., tense states with an identical ball tensor (by hydrostatical pressure), for that a sum of main normal tensions is a permanent size It follows from that equalization of planes normal to the axis of cylinder is equalization:

$$\sigma_1+\sigma_2+\sigma_3 = P\sqrt{3},$$

where P – length of the normal conducted from beginning of coordinates to this plane.

REFERENCES

1. Огородников В. А. Оценка деформируемости металлов при обработке давлением. – Киев: Вища школа, 1983. – 175 с.
2. Dell H. A Comprehensive Approach for the Prediction of Sheet Metal Failure / H. Dell, H. Geese, G. Obezhover // Materials Processing and Design, Modeling< Simulation and Applications/ Part 1. Numiform 07. American Institute of Physics. – 2007. – P. 165-170.

Архіпова Тетяна Федорвна – канд. техн. наук., доцент кафедри опору матеріалів та прикладної механіки, Вінницький національний технічний університет, Вінниця, e-mail: tfarhipova@gmail.com

Tatiana F. Arhipova − Cand. Sc. (Eng), Assistant Professor of Strength of Materials and Applied Mechanics, Vinnytsia National Technical University, Vinnytsia, e-mail: tfarhipova@gmail.com