Rzeszow University of Technology
The Faculty of Mechanical Engineering and Aeronautics

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Abstract of doctorate thesis

Title: Selection of constitutive equations of elastomer used for drawing tools.

Author: mgr inż. Grzegorz PASOWICZ
Supervisor: dr hab. inż. Stanisław KUT, prof. PRz

Abstract:

The experimental part of the doctoral dissertation contains the results of tests of plastic properties and springback of aluminum sheets made of AlCu4Mg1 alloy (AW-2024) in the annealed condition and after solution heat treatment during natural ageing. Based on uniaxial tensile tests, technological characteristics of plasticity of aluminum sheets made of AlCu4Mg1 alloy (AW-2024) in the annealed condition and after solution heat treatment during natural ageing were prepared in the form of strain hardening curves. Based on these curves, material coefficients in the constitutive equations of the Hollomon, Swift, Voce and El-Magd yield stress were determined. In the case of the tested sheets subjected to heat treatment, the material coefficients in the constitutive equations were determined as a function of the natural ageing time of the tested sheet material in the range of 0-120 minutes after solution heat treatment. Based on the analysis of the fitting errors of the strengthening curves, the effectiveness of the above-mentioned constitutive equations in describing the yield stress of the tested sheet material was assessed.

Springback surveys were conducted on the basis of bending tests of the tested sheets. Based on the results of these tests, so-called springback characteristics were prepared. On their basis, the relationship of the springback coefficient as a function of the relative sample deflection and the band thickness for annealed sheets was determined, as well as the relationship of the springback coefficient as a function of the relative sample deflection and the natural ageing time in the range of 0-120 minutes.

The further part of the dissertation is devoted to verifying the effectiveness of computer simulations of the plastic forming processes of tested sheets using previously determined material coefficients in the constitutive equations of the yield stress. Five numerical models of the bending process of tested annealed sheets were developed and verified in terms of their effectiveness in predicting the bending force and springback after bending. The most effective of the developed numerical models was used to prove the thesis formulated in the doctoral dissertation. The experimentally verified results of the numerical simulations of the bending process and the process of forming the production drawpiece confirmed the validity of the thesis formulated in the dissertation.