

REVIEW OF THE LECTURES OF PLASTIC PROCESSING - SECTION "C"

69 contributions have been received for Section C on Plastic processing of materials. According to their scope they were subdivided into 9 groups:

- plastic deformation (contributions no. **1-34**);
- plate and shape rolling (contributions no. **35-44**);
- extrusion (contributions no. **45-46**);
- wire drawing (contributions no. **47-51**);
- tubes production (contributions no. **52-56**);
- sheet metal forming (contributions no. **57-60**);
- reheating process (contributions no. **61-63**);
- modernization (contributions no. **64-67**);
- miscellaneous (contributions no. **68-69**).

The most numerous are the contributions of the scientists from Croatia (24), Poland (22), Slovenia (20), Russia (6), Slovakia (4), Bosnia and Herzegovina and Czech Republic (3) and Germany, Turkey and Romania (1). Survey of the authors shows that nearly one fifth of the contributions are the result of co-operation between research institutes from different countries. The most evident is co-operation of Croatian scientists with colleagues from Ukraine, Slovenia, Slovakia and Bosnia and Herzegovina. Most contributions have been sent by research institutions (59), 12 of them are result of co-operation between research institutions and industry and only 4 of them have been written by authors who work only in industry.

Plastic deformation. The influence of technological parameters of a process on distribution of stresses and strains in zone of the form changing is shown in paper no. **1**. Using the solution of a closed problem of the theory of plasticity some analytic expressions were obtained for determination of the strain parameters of zone of deformation in view of the temperature factor (no. **2**). Hot plasticity of two tool steels: CRV3 (no. **3**) and AISI A2 (no. **4**) were investigated by using thermo-mechanical simulator Gleeble 1500D. Hot deformation behaviour of as-cast and of deformed ZnCuTi alloy was investigated to check the possibilities of rolling of block with increased dimensions on determined rolling mill (no. **5**). Investigation of shear-relaxation oscillations dynamics during plastic flow of metals is topic of paper no. **6**. To study autoswaging mechanism of process of plastic deformation of metal at rolling a polarization-optical model was developed (no. **7**). Effect of chemical composition on hot deformability of AISI D2 tool steel (no. **8**) are presented. The influence of antimony, arsenic and lead content of the copper cathodes on the elongation of the rolled copper wire is discussed in paper no. **9**. Paper no. **10** deals with flow stress and deformability of high and low alloyed structural steels by high temperatures. Flow stress of hot compressed tool steel was predicted by CAE neural networks and hyperbolic-sine equation (no. **11**). In presentation (no. **12**) the simplified model of metal behavior accounting the effect of plastic strain non-uniformity on micro level (but neglecting strain hardening and viscosity effects) is described. Estimation of stability of performing compression tests, the comparison of flow stress curves for the first and the second stage of deformation and estimation of softening are presented. Influence of interruption time on multi-stage flow lines for two steel grades was examined (no. **13**). Influence of severe plastic deformations on structural, mechanical and plastic properties of ARMCO-Fe in equal-channel angular pressing procedure was investigated (no. **14**). Thermal stability of nanomaterials formed by severe plastic deformation is topic of paper no. **15**. Structure and properties of oxygen-free copper after different types of severe plastic deformation are presented in paper no. **16**. Structure and phase transformations in 0,1%C-Mn-V-Ti steel during high-pressure torsion were investigated (no. **17**). Equal channel angular pressing method was used for study the structure and properties of Al-Mg-Sc-Zr alloys (no. **18**) and 0,14 % C and 0,1% C - B low-carbon steels (no. **19**). TRIP steel is topic of two papers where comparison of various methods for structure analysis and strength properties (no. **20**) and influence of reheating and cooling conditions on structural changing (no. **21**) were studied. Pig iron deforming and strength at complex conditions under stress is presented in paper no. **22**. Effect of low-temperature discontinuous yielding of metals realized at temperatures below 30 K was studied (no. **23**). System of phenomenological criteria defining the conditions of realization of the low-temperature discontinuous yielding effect was formulated and the relationships between them were established (no.

24). Superplastic deformation of the Al-Al₄C₃ composites with different volume fraction of Al₄C₃ phase was investigated at different temperatures and different strain rates (no. 25). Stable and unstable deformation of the defect-containing components is presented in paper no. 26. Similarity of contour of an inhomogeneous necking for hot tensile test was studied (no. 27). Plane-strain spike forming test rig for determination of friction coefficient in metal forming was designed (no. 28). Paper no. 29 presented research of technological parameters influence on the process of Nitinol fabrication and plastic deformation. Problems of quantification of residual stresses in hot rolled sheets produced under various regimes are topics of paper no. 30. Cladding of commercial steels DIN X155CrVMo12-1 and construction steel DIN 20MnCr5 was studied by laboratory hot rolling experiments (no. 31). Peculiarities of rheologically complex metal flow while rolling with superreductions were studied (no. 32). Metallographic, X-ray diffraction and electron microscopy were used to study the effect of a crystal structure on a kinetic and a mechanism of deformation dissolution of metastable and stable aluminides in Al alloys with transition metals (no. 33). Character and mechanisms of damage in Ni-based superalloys of various crystalline structures, both uncoated and with protective coatings including multilayer ones, under high-temperature thermal cyclic loading in a gas flow are presented in paper no. 34.

Plate and shape rolling. Algorithms of management of the speed mode of multithreads groups by running in size inflexibilities of mechanical descriptions of drive engines of cages were developed (35). Investigation of schedules of the thermomechanical treatment for the complex form rolled products under conditions of the heavy shape mill is presented in paper no. 36. Papers no. 37, 38, 39 deal with influence of lubrication on strip rolling process. Influence of undercooled surface of CCSP on core distribution of longitudinal and transversal stresses during hot rolling was investigated (no. 40). Paper (no. 41) shows the review of plastic processing of aluminium and aluminium alloys and describes the parameters of processing by hot rolling. Paper (no. 42) focuses on an automatic calculation of the deformational energy consumed for slab-width rolling. In paper (no. 43) a new approach for calculation of electromotor revolutions during forming process will be presented and verified on measured data obtained on rolling mill and forging machine. Pinion damage due to asymmetrical distribution of rolling torque on upper and lower driving shaft is presented (no. 44).

Extrusion. Wear behaviour of nitrided microstructures of AlSi H13 dies for hot extrusion of aluminium was investigated (no. 45). Experimental Technique for Tracing of Cooling Efficiency on Die Bearing Surface Paper (no. 46) presents an improved method of temperature measurement on the bearing surface during hot extrusion of aluminum and at different distances from the bearing surface of an industrial die on 55 MN press machine.

Drawing. Mathematical modelling of metal drawing process (no. 47) and theoretical calculation of the lubrication layer thickness by metal drawing (no. 48) are presented. Thickness forming of technological lubricant film at wire drawing in rotating die was investigated (no. 49). Theoretical determination of wire twisting corner during of its removing up from drums of magazine type at wire-drawing mills, working without sliding, was executed in the process of the continuous wire-drawing (no. 50) and a scale-breaker influence on twisting and ovalization of steel low carbon rod in a flow with wire-drawing was experimentally investigated (no. 51).

Tube production. Software to predict the integrated pulling force and the distribution of the contact forces between the supporting rings of the smaller pipeline and casing of the process of pulling the pipeline of smaller diameter through the bigger one was developed (no. 52). Goal of the work (no. 53) is to determine critical deformation of tubes at pilger rolling stand to avoid formation of cracks on the surface. Tube surface preparation for cold deformation in reactive oil to attain possible fabricating of surface high requirements cylinder tubes is presented in paper no. 54. An approximate analytical solution of lubricant layer calculation was derived at continuous rolling of seamless tubes for micro and nanotechnology on long floating mandrel (no. 55). New method of producing small diameter pipes and bars of hard deformation steel in the skew roll was developed (56).

Sheet metal forming. Finite element approach to analysis axisymmetric reverse drawing process of deep drawing Cr-Ni stainless steel is presented (no. 57). Increasing the deep drawability of Al-1050 aluminum sheet using multi-point blank holder was investigated (no. 58). In paper (no. 59) an analyse of stressed and strained state and forming force of spinning modelling process is shown. Theoretical fundamentals and experimental analyse of flow forming process is presented in paper no. 60.

Reheating Process. Optimisation of charge heating conditions in rotary-hearth furnace will be done (no. 61). Paper no. 62 deals with the quality of a steel charge heating and the load of the annular bootom of a rotating hearth furnace. To

analyse heating rate and temperature stresses in a charge a mathematical model (FEM) for the heating process of a steel charge having an octagonal cross-section will be developed (no. 63).

Modernization. The old rolling mill in Steelworks Split, was reconstructed by installing a new continuous type furnace, two break down stands for reforming billets, new continuous rolling stands with 13 stands and new thermal treatment of bars or coils capacity in 170000 t/per year (no. 64). Contribution no. 65 deals with modernisation of pilger rolling mill in the Tube Rolling Mill Sisak. First the paper no. 66 presents the situation and development of research and technology of processing by reformatting (at heating process) all round the world, then the situation is parallel described in Croatia. Technological chain of bar production from 6262 alloys in Impol - Slovenian aluminium producer - is supported with up to date numerical models, adapted for users, in position for planning the process parameters and predicting their influence on products microstructure (67).

Miscellaneous. Contribution no. 68 presents low carbon steel processed by equal channel angular warm pressing and contribution no. 69 deals with a yield criterion of isotropic materials with different tensile and compressive yield point.