SUMMARIES

Sińczak J., Pietrzyk M., Skubisz P., Łukaszek-Sołek A.:

Modelling of Microstructure Development in Forging of a Windmill Shaft

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The paper presents the results of investigation of microstructure evolution in hot-deformed steel in the process of forging of large forgings. Using a forging of a windmill main shaft as an example, description of the technological process is presented, focused on phenomena occurring in the microstructure during hot-forging. Investigation of the microstructure during and after forging of a shaft was made. The results of theoretical calculation of microstructure evolution during subsequent stages of production cycle are based on temperature changes plots derived from industrial practice. Simulation of microstructure evolution allowed plotting changes of grain size and recrystallized volume fractions versus time during forging and reheating operations.

Keywords: *open-die forging, upsetting, cogging, static recrystallization, grain growth*

Stefańska-Kądziela M., Majta J., Muszka K.:

Effects of Strain Rate on Work Hardening of HSLA and Ti-IF Steels

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This study presents some aspects of modeling of the mechanical behavior and strengthening mechanisms of HSLA and Ti-IF steels deformed under high strain rate conditions. Axisymmetrical compression tests at a wide range of strain rates have been performed to determine the mechanical and microstructural response of the material. The experimental data were compared with the results of computer modeling where proposed constitutive models are implemented in FEM code. The test data are used to find suitable values related to Zerilli–Armstrong model for microalloyed steels.

Keywords: *work hardening, strain rate, FEM, Zerilli–Armstrong model*

Pater Z., Kazanecki J.:

Thermo-mechanical Analysis of Piercing Plug Loads in the Skew Rolling Process of Thick-walled Tube Shell

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This paper deals with the issue of numerical modelling of the piercing process of thick-walled tube shell in two-rolls skew rolling mill, which is equipped with guiding devices of Diescher type. After a short characteristic of the process, the worked out numerical model of this process is described. The numerical model considers e.g. thermal phenomena taking place in the metal during forming. Mo-

reover, in this model tools were assumed as rigid bodies apart from the piercing plug which could be deformed in the elastic range. Applying the worked out FEM model, simulations of the piercing process in the skew rolling mill were made. The results of calculations were presented in the form of maps of: strains, stresses, temperatures and surface pressures.

Keywords: *tube piercing process, FEM analysis, piercing plug*

Grzesiak J., Sińczak J., Skubisz P.:

Numerical Modelling of Extrusion Process in Superplastic Flow Range

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The results of numerical modeling of direct and indirect extrusion process of a model alloy of high strain-rate sensitivity at room temperature, Sn38Pb, are presented. The studies were carried out for three values of die angle, three temperatures, four ram speed values, two values of extrusion coefficient and two values of friction factor. Effect of extrusion process parameters on distribution of effective strain, effective strain rate in extruded bar and extrusion load was estimated.

Keywords: *superplasticity, forward extrusion, backward extrusion, strain rate*

Karczewski K.:

High-efficiency Ceramic Recuperators to Glass Furnaces

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Mathematical model of high-efficiency ceramic recuperators using the new generation of shapes was elaborated. The parameters and characteristics magnesia, fusion cast alumina-mullite-zirconia, chamotte recuperator shapes were compared. Ceramic recuperator to glass tank was calculated by the model.

Keywords: *ceramic recuperator, shape, recuperator checkers, thermal efficiency, consumption of fuel*