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MATERIJALI I METALURGIJA

BOOK OF ABSTRACTS
ZBORNIK SAŽETAKA

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ACCEPTED ABSTRACTS	**424**
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Organizer

Šibenik, CROATIA, June 19 – 23, 2016
ŠIBENIK, HRVATSKA, 19. – 23. lipnja 2016.
HOTELSKO NASELJE *SOLARIS HOLIDAY RESORT*

ORGANIZER: CROATIAN METALLURGICAL SOCIETY (CMS)

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- The South African Institute of Mining and Metallurgy
- Iron and Steel Institute of Thailand
- Vietnam Steel Corporation

1. J. Raab, J. Mannheim, Czech Republic
Another milestone year for the steel industry? After relatively long period of sustaining growth we can observe some stagnation or even decline since 2014. Unlike the 2009 crisis, which impacted mainly the developed countries, but it was just slight from the global point of view, recent stagnation has wider extent regarding the global issue. In this context, we have to state the factors, which are related to this situation. We would like to stress overcapacities – the capacity utilisation ratio has dropped from the coveted level of 84%, as it was recommended by OECD in the end of 1990s, to recent level of nearly 65%. The other factors, such as environmental burden, energy intensity, lack of interest of young generation, as well as the international trade, contribute to the recent developments and following predictions. The main objective of the presentation is the description of further trends of the steel industry taking into consideration above mentioned factors, mainly form the European point of view. The case study of recent trends within the Czech steel producing company is completing the assumption.

2. G. Bălan, M. D. Ungureanu, G. Dobrotă, Romania
Characteristics and tendencies in the steel industry, globally and regionally. Metalurgija 55 (2016) 3, 511-514 (whole the Article)

3. M. Holtzer, R. Dańko, A. Kmita, Poland
The state of art and foresight of world's casting production. The casting production is considered of the main factors influencing the development of World economy. Actual capacity of the world's casting production, which is about 110 mln metric ton per year (2014), is strongly diversified. The last decade brought significant changes in the World map of the greatest casting producers. Globalization and transformation of economic systems is reflected by variations of foundry production in different countries, moreover the globalization of the economy is regarded not only as a chance but also as a menace for European foundries. The most important research directions leading to further development of the foundry industry: - development of new technologies of molding sands – implementation inorganic binders; - development of new casting alloys and casting composites, - save energy and materials; - reduction of the emission of dangerous gases and dust; - reclamation of the used sands.

4. P. Fajfar, M. Fazarinc, G. Kugler, M. Terčelj, Slovenia
Laboratory assessment of thermal fatigue resistance. Thermal fatigue resistance is one of the most important characteristics of the materials subjected to rapid temperature changes, i.e., high-pressure die casting, hot forging or hot rolling. For a better understanding of materials behavior subjected to thermal fatigue, two test rigs were developed. With the first test rig, the suitability of using the functionally graded materials in applications subjected to thermal fatigue was determined. Comparative testing of different welded, newly developed functionally graded, nitrided and PVD coated surface layers were carried out. The second test rig enabled better understanding of materials behaviour subjected to thermal fatigue of work rolls used in hot rolling mill. This test was applied for the testing of thermal fatigue resistance of work rolls used in common rolling conditions. Furthermore, it also enabled the simulation of the thermal loading of the work rolls during a mill stall. All tests were performed using Gleeble1500D thermo-mechanical simulator.

5. M. Schmidtchen1, R. Kawalla, Germany
Fast numerical simulation of heavy plate hot rolling processes using a multiscale layer model. The simulation tool LaySiMS provides new insight for inhomogeneous material flow and microstructure evolution e.g. for heavy plate rolling or rolling conditions of low roll gap ratios L_d/H_m <1. A deepened understanding of the influence of inhomogeneities in initial material state, temperature profile and material flow and their impact on the finished product can be reached e.g. by allowing for variable layer thickness distributions in the roll gap. Coupling temperature, deformation work and work hardening/recrystallization phenomena accounts for covering important effects in the roll gap. The underlying concept of the LaySiMS approach will be outlined with special emphasis on shear stress gradients and their effect on microstructural evolution, stress and strain state. Due to the used computational approach, the origin of local residual stresses can be investigated as well. For selected cases of heavy plate rolling a comparison between computation and experimental data will be given. Special emphasis is put on the derivation of dedicated rolling schedules for thicker gauge pipe grades with special focus on through-thickness homogeneity of the final product.

6. J. Kliber, Czech Republic
Advanced forming technology. Forming is usually the final stage of metallurgical production of steel (about 90% of the 1,7 billion tons of total steel production in the world) and traditionally also largely in the products of non-ferrous metals. Procedures and methods are many and we will remark only some of them. Hot and cold deformation, flat rolling, plate mill, superplastic deformation, rolling of sheet pile, slitting rolling, cold roll bonding of alloy / steel bimetal strips, drawing process of the wires of copper and aluminum, drawing of sheets, seamless tube and tube bending, sheet metal forming, stamping, forging, extrusion, deformation in semi-solid state with rapid solidification, high-rate plastic deformation, equal channel angular pressing (ECAP), the severe plastic deformation (SPD), continuous extrusion of metals using Conform ™, and other. The aim is usually to achieve ultra-fine grained structure, the proper microstructure and (mechanical / electrical) properties on innovative materials. The presented article mentions only examples.

7. I. Samardžić, M. Dunđer, B. Despotović, T. Marsenić, Croatia
Modern materials used in construction of thermal power plants. Energy production with waste incineration in thermal power plants is also becoming increasingly popular, especially in big cities as it serves as a great solution for garbage accumulation. Efforts to increase the operating parameters of thermal power plant (temperature, pressure) are leading to development of materials appropriate for high temperature service in conditions of different aggressive corrosion media. This paper presents the characteristics of modern low-alloyed and high-alloyed steels and Ni-base alloys that are used in construction of modern thermal power plants for the purpose of increasing their service parameters and their overall efficiency. Welding technology is unavoidable for joining of these materials, and it is also crucial from the viewpoint of thermal power plant reliability. Therefore, this paper presents existing experience related to welding technology of modern materials used in construction of thermal power plants.

8. I. Alfirević, Croatia
Advances in mechanics and its influence on science, technology and society. The development and progress of mechanics strongly influenced many human activities from philosophy and science to technology and engineering. Its progress particularly enhanced technology and engineering such as metallurgy and metalworking. Mechanics is unavoidable and indispensible in analysis of metal forming and metal cutting processes. Generally the development of mechanics can be divided in the three periods. The first one form Aristotle and Archimedes to da Vinci. In this period mechanics is dominated by Aristotelian or peripatetic mechanics which considers the universe as a sphere with its center at the Earth. The second period from Galileo and Newton to Einstein and Planck is the period of classical mechanics which is strongly deterministic. The classical mechanics rests on the three laws of motion, the law of gravity and the parallelogram of forces. All other laws can be deduced from them. At the beginning of the 20th century Einstein propounded relativistic mechanics. According to Minkowski space by itself and time by itself are doomed to fade away into mere shadows and only a kind of union of the two will preserve an independent reality.

1. A. Milinović, V. Marušić, I. Samardžić

Research into boride layers growth kinetics on C45 carbon steel. This study focuses on evaluation of borides formed on C45 steel. Pack boronizing is carried out at a temperature range of 870 – 970 °C in durations of 4 to 8 h. Values of frequency factor ($4{,}51 \cdot 10^{-4}$ $m^2 \cdot s^{-1}$) and activation energy (199,63 $kJ \cdot mol^{-1}$) are determined by means of Arrhenius equation. Analysis is also performed to assess the change in volume share of boride phase and the surface microhardness in the layer cross section. Results indicated that cross sectional changes of volume share of boride phase depends on boronizing temperature and duration. In addition, empirical expression showing functional relationship between them has been obtained.

2. M. Zuk, J. Gorka, A. Czuprynski, M. Adamiak

Properties and structure of the weld joints of quench and tempered 4330V steel. This work outlines the research on welding of heat treated 4330V steel using the flux core arc welding process. The research describes the effect of preheat temperature, interpass temperature, heat input, and post weld heat treatment on strength, hardness, toughness, and changes of microstructure in the weld joint. Welding with the lower heat input and without post weld heat treatment results in optimal mechanical properties in the weld metal. Austempering at 400 °C results in optimal mechanical properties in the heat affected zone (HAZ). Increasing preheats and interpass temperature from 340 to 420 °C did not improve Charpy V-notch values or ultimate tensile strength in the weld metal or heat affected zones.

3. V. Pepel, A. Žerovnik, R. Kunc, I. Prebil

Crack growth through low-cycle fatigue loading of material Armox 500T. This paper presents microstructure analysis of the creation and growth of cracks in uniaxial load. Analyse were done for steel Armox 500T (armour sheet). Results show that cracks are present quit early in steel lifetime. First micro cracks occur before the 200th cycles, whereby crack growth is progressive during further loading. Also it can be seen that after a certain number of cycles there are more longer cracks then shorter ones.

4. I. Matin, M. Hadžistević, Đ. Vukelić, B. Trifković, M. Potran, T. Brajlih, I. Drstvenšek

Advanced procedure for fabrication of substructure in dentistry. The paper presents some aspects of the novel integrated system, procedure for fabrication of metal substructure of metal-ceramic crowns. The results been shown that the CAD/CAE/RP technology integration presented in this paper can be fully applied to casting metal substructures. The substructure fabricated in this way, confirm the reduction of the total manufacturing time, with an increase in the percentage of high quality castings that use integrated system.

5. A. Vaško, J. Belan, L. Kuchariková, E. Tillová

Low and High Frequency Fatigue Tests of Nodular Cast Irons. The paper deals with the influence of charge composition on microstructure of nodular cast iron and its fatigue properties at low and high frequency loading. The basic charge of experimental melts was formed by a different ratio of pig iron and steel scrap. Chemical composition of individual melts was regulated alternatively by metallurgical silicon carbide or ferrosilicon and carburizer. Fatigue tests were realised at low and high frequency sinusoidal cyclic push-pull loading (stress ratio R = –1) at ambient temperature (T = 20 ± 5 °C). Low frequency fatigue tests were carried out with frequency f » 100 Hz, high frequency fatigue tests with frequency f » 20 kHz.

6. E. Tillová, M. Chalupová, L. Kuchariková, J. Belan, A. Vaško

Influence of laser surface hardening on corrosion properties in Al-Zn-Si cast alloy. Advanced automotive applications require materials with special surface properties such as high corrosion and wear resistance. This work is focused on the effect of the laser surface treatment (laser power 50 and 80 W) on microstructure and corrosion properties of self-hardened AlZn10Si8Mg cast alloy used for engine and vehicle constructions. Electrochemical impedance spectroscopy (EIS) technique and Tafel's plots in a 1M NaCl test solution at 20°C were carried out. A detailed corrosion study showed that corrosion resistance samples with laser layer were marginally less; probably presence of chloride ions significantly damaged the Al_2O_3 film and caused the formation of $NaAlO_2$.

7. L. Kuchariková, E. Tillová, J. Belan, M. Chalupová, A. Vaško

Quantitative assessment of structural parameters in aluminium cast alloy with NIS elements software to optimize the properties of aluminium materials. The present work deals with evaluation of eutectic Si (its shape, size, and distribution), dendrite cell size and dendrite arm spacing in aluminium cast alloys which were casted into different mould. The morphology, size and distributions of eutectic Si and dendrite cell size, dendrite arm spacingeffect on all of aluminium cast alloys properties. Structural parameters were evaluated with using NIS-Elements software. This software is imaging analysis software for the evaluation, capture, archiving and automated measurement of structure parameters. The control of structural parameters by NIS Elements shows that optimum mechanical properties of aluminium cast alloys are strongly dependent upon the distribution, morphology, size of eutectic Si and matrix parameters.

8. J. Belan, L. Kuchariková, E. Tillová, A. Vaško

The Inconel's alloy 718 is iron-nickel base superalloy with working temperature up to 650°C. Presented phases such g¢¢ (Ni_3Nb), g¢ (Ni_3Al), and δ (delta – Ni_3Nb) are responsible for alloy's unique properties. The δ – delta phase is profitable when situated at grain boundaries in small quantities due to increasing fatigue life. However, at temperatures close to 650°C is g¢¢ transforming to δ – delta and causes decreasing of fatigue life. Heat-treatment (800°C/ for 72 hours) and its influence on fatigue life are discussed in paper. The fatigue tests were provided at room temperature. After the test the S-N curves for both stages were plotted. The SEM fractography was carried out as well.

9. J. Tušek, D. Klobčar

Tungsten inert gas welding of aluminum alloy 7075–T6. A study of tungsten inert gas (TIG) welding of aluminium alloy 7075-T6 in the butt joint was done. The welding was done with 2.4 mm diameter filler wire made of AlMg5 at five different preheating temperatures. During the welding a temperature was measured at six locations with thermocouples. The tensile tests were done and microstructure of base metal, heat affected zone (HAZ) and weld was analysed. The welds brake at HAZ between base metal and the weld. The optimal preheating temperature was at 180 °C.

10. M. Mihalikova, A. Liškova

Dynamic characteristics of automotive steel sheets. This work deals with the influence of the strain rate on the properties of automotive steel sheets. Two different types of steel : IF steel, and micro – alloyed steel were used. According differents measured values as well as according the analysis of literary knowledge it can show the hardness of all tested materials had a higher level in dynamic loading conditions by slow rate of deformation. The higher strain hardening of materials was recorded too that was confirmed by distribution of dislocation.

11. S. Sawicki, H. Dyja, A. Kawałek, M. Knapiński, M. Kwapisz, K. Laber

High-temperature characteristics of 20MnB4 AND 30MnB4 micro-addition cold upsetting steels and C45 and C70 high-carbon-steels. The paper analyzes the high-temperature plasticity characteristics of 20MnB4 and 30MnB4 with micro-additives, intended for cold upsetting and high-carbon steels C45 and C70 in the "solid phase-liquid" during heating and cooling. The investigation was conducted to determine the plastic formability of the examined alloy under hot plastic working conditions. Experiments were carried out on the simulator Gleeble 3800 with the aim of determining the susceptibility of 20MnB4, 30MnB4, C45 and C70 steels to cracking at high temperature. The nil strength (NST), nil ductility (NDT) and ductility recovery temperatures (DRT), and the fracture toughness factor and the BRT (brittleness temperature range) have been determined.

12. T. Dembiczak, M. Knapiński, B. Garbarz

Mathematical model of dynamic and metadynamic recrystalisation in highcarbon bainitic steel during hot plastic deformation. The article presents the results of physical simulation aimed at determination of the coefficients of constitutive equations for describing the kinetics of dynamic and

metadynamic recrystallization for a new class of steel. Based on the tests results the coefficients were calculated in the constitutive equations describing the kinetics of dynamic and metadynamic recrystallization of high-carbon bainitic steel during hot plastic deformation. The mathematical model shows the relationship between the kinetics of structural changes and the size of initial austenite grains, the plastic strain, the strain rate, temperature and time.

13. J. Kulhánek, P.Tomčík, R. Trojan, M. Juránek, P. Klaus
Experimental Modeling of Weld Thermal Cycle of the Heat Affected Zone. Contribution deals with experimental modeling of quick thermal cycles of metal specimens. In the introduction of contribution will be presented measured graphs of thermal cycle of heat affected zone of weld. Next will be presented experimental simulation of measured thermal cycle on the standard specimens, useable for material testing. This approach makes possible to create material structures of heat affected zone of weld, big enough for standard material testing.

14. J. Drápala, S. Brožová, I. Szurman, K. Konečná, G. Kostiuková, J. Vontorová, P. Jonšta, K. Sobotková
Influence of selected non-ferrous metals on structural characteristics of 42CrMo4 steel. The influence of rare-earth (RE) metals addition on solidification structure of the low-carbon 42CrMo4 steel was investigated. Alloys were prepared by means of a centrifugal casting. The addition of cerium, praseodymium or mischmetal in the steel produced greatly improved solidification structure with a suppressed columnar grain zone, finer grain size in the equiaxed grain zone, and zero area fraction of casting shrinkage cavity. The added RE metals occurred in the steel bath in the form of RE oxide and/or oxide-sulphide inclusions and as dissolved atomic RE segregated along with other elements at prior grain boundaries and inter-dendritic spaces. Microstructure (light optical microscope, SEM), X-ray EDX chemical microanalysis, and TOF-SIMS analysis – mapping of elements in the structure of alloys were obtained.

15. M. Losertová, M. Štamborská, J. Lapin, V. Mareš
Comparison of deformation behavior of 316L stainless steel and Ti6Al4V alloy applied in traumatology. The comparative analysis of mechanical properties was performed for AISI 316L stainless steel and Ti6Al4V alloy using digital image correlation (DIC) method. Both types of materials are commonly used for implants in traumatology. The room temperature tensile tests of the cylinder tensile specimens were performed at initial strain rate of 2.5 x10-3 s-1. The strain analysis during tensile tests was carried out by means of Vic 2D image correlation software. Ti6Al4V alloy showed higher yield strength and ultimate tensile stress. The differences in the strain localization zones were observed.

16. A. Macháčková, P. Kuchta, Z. Klečková, R. Kocich, J. Szwed
Numerical simulation of the heat treatment for steam generator. Heat treatment of the weld of the steam generator is investigated in this paper. Annealing is realized by system of heating elements that are placed on casing of the generator. An experiment using real parameters and a computational fluid dynamics analysis using COMSOL Multiphysics software were performed. Experimental data were compared with results of the analysis. Boundary conditions for numerical prediction had been derived on basis of results obtained from a supplementary calibration experiment. There was good correlation between predicted and measured data. Based on results it can be stated that 67 heating elements with heating output of 60-70 % of maximum range is sufficient number for required heat treatment.

17. S. Rusz, I. Schindler, P. Kawulok, R. Kawulok, P. Opěla, J. Kliber, Z. Solowski
Phase transformation and cooling curves of the mild steel influenced by previous hot rolling. Rods from mild steel S235JR were intensively rolled in the laboratory continuous mill. Specifically defined temperature of phase transformation Ar was determined from the free cooling curves measured by the temperature scanner. The Ar value increased from 763 to 786 °C with rolling temperature descending from 1 200 to 800 °C. Value Ar = 730 °C was obtained at free cooling of the non-deformed rod of the same diameter 9,8 mm from heating temperature 1 000 °C. The obtained results were compared with CCT and DCCT diagrams based on the dilatometric tests.

18. L. Řeháčková, R. Dudek, S. Rosypalová, D. Matýsek, J. Dobrovská
Comprehensive study of rheological and surface properties of the selected slag system in the context of its internal structure. Rheological (dynamic viscosity, flow curves) and surface properties (surface tension) of real slag system were experimentally investigated. Measurements of dynamic viscosity were performed with use of the high-temperature viscometer Anton Paar FRS 1 600. The method of sessile drop was used for measurement of surface tension. Surface tension and dynamic viscosity were measured in the temperature interval from 1 200 to 1 600 °C. The structural characteristics of the selected samples were determined by X-ray diffraction (XRD). The samples for given analysis were prepared by quench cooling. Experimentally determined values of dynamic viscosity and surface tension were compared with the results of X-ray diffraction phase analysis.

19. K. Skotnicová, G. S. Burkhanov, Y. Koshkidko, T. Čegan, D. Růžička, J.Cwik, N.B. Kolchugina, A. A. Lukin, O. Životský, K. Hrabovská
Influence of heat treatment on the structural and magnetic characteristics of $(Nd_xPr_1\text{-}x)_2Fe_{14}B$-based magnetic material for low-temperature application. Sintered Pr-Nd-Fe-B-based permanent magnets with 10 and 13 wt.% Pr were prepared by traditional technology and then subjected to various heat treatments. Their microstructure, phase composition and magnetic properties were studied. The stoichiometric composition of the matrix grains corresponds to $(Pr_{0.3}Nd_{0.7})_2Fe_{14}B$ and $(Pr_{0.4}Nd_{0.6})_2Fe_{14}B$ compound, respectively. According to the literature, these compositions have a spin reorientation temperature in the boiling temperature of liquid nitrogen. This makes these magnets are potentially applicable to low temperatures.

20. L. Ambriško, M. Cehlar, D. Marasova
The rate of stable crack growth in automotive steels. The main aim of this paper is determining the stable crack growth (SCG) rate for automotive steel sheets. The SCG was monitored using the non – contact videoextensometry technique. CT (Compact Tension) specimens of three steel grades were loaded by eccentric tension under two loading conditions. The SCG characteristics including rate depend on steel grade, on the rolling direction as well as on the loading rate. Linear relation between the SCG rate and 0R-curve slope was determined.

21. W. Matysiak, D. Bartkowski, A. Myszkowski
Microstructure and selected properties of sintered tool materials after the thermal drilling process. The paper presents the study results on the selected properties of sintered tool materials used for thermal drilling process. The studies were carried out on a series of the commercial tools. Microstructure, chemical composition, microhardness and surface roughness were investigated before and after thermal drilling process. The content and kind of phases and porosity in sintered material were determined on the base of microstructure and the chemical composition study. Additionally, in the case of tools which have been damaged during the process, the type of fracture was determined. On the fracture surfaces the beach marks were observed, thus confirming that it was fatigue crack. The possibility of applying the thermal drilling method were also described in this paper.

22. D. Bartkowski,W. Matysiak, A. Bartkowska, J. Koper
Co-based alloy coatings reinforced with tungsten carbide particles produced on low carbon steel using laser cladding. This paper focuses on the selected properties of coatings produced on low carbon steel using laser cladding with powder. The power of laser beam 550 W and feed rate 340 mm/min were applied. The aim of this study was to obtain the microstructure similar to sintered carbide. Microhardness, microstructure studies using optical microscopy as well as phase analysis and corrosion resistance tests were carried out. It was found that the presence of WC particles in metal matrix had a negative impact on corrosion resistance of coating compared to the unreinforced coating. Phase analysis confirmed the presence of the hard interstitial phases (WC, W2C, M7C3 and M23C6) in the matrix.

23. J. Burja
Precipitation of metallic chromium during rapid cooling of Cr_2O_3 slags. The slag systems of $CaO\text{-}SiO_2\text{-}Cr_2O_3$ and $Al_2O_3\text{-}CaO\text{-}MgO\text{-}SiO_2\text{-}Cr_2O_3$ were analyzed. These slag systems occur in the production of stainless steel and are important from the process metallurgy view. Synthetic slag samples with different chromium oxide content were prepared and melted using electric arc electrodes. The melted slag samples where then rapidly cooled on large steel plates, so that the high temperature microstructure was preserved. The samples were analyzed by scanning electron microscopy. The precipitation of different chromium oxide phases was studied, but most importantly the precipitation of metallic chromium was observed. These findings help us interpret industrial slag samples.

24. B. Kalandyk, R. Zapała, J. Kasińska, B. Radoń
Impact strength of GX8CrNi12, GX5CrNi18-9 and GX5CrNiMo19-11-2 cast steel at - 30 °C. The results of impact tests carried out at - 30 °C on cast alloyed GX8CrNi12, GX5CrNi18-9 and GX5CrNiMo19-11-2 steel grades are reported. It has been shown that at - 30 °C, the addition of 1 % Ni to cast GX8CrNi12 steel does not provide the required impact strength of 35 J/cm^2. In contrast, other tested materials containing 8 ÷ 9 % Ni can easily reach exceeding 50 J/cm^2. Numerous non-metallic inclusions present in the microstructure of cast GX5CrNiMo19-11-2 steel resulting from, among others, the miscalculated refining process were found to be one of the main causes of reduced impact strength as compared to the cast GX5CrNi18-9 steel.

25. F. Kafexhiu, F. Vodopivec, B. Žužek, B. Podgornik
Primary creep analysis of simulated HAZ in 9-12% Cr steels. The primary creep of the parent metal (α), and the simulated inter-critical (α+γ) and coarse-grained (γ) microstructures of HAZ for the X20 and P91 steels, additionally tempered for 6 months at 750°C and 2 years at 650°C was analyzed. The time and creep strain at the transition point from primary to secondary creep were found to vary drastically between parent metal and the two HAZ microstructures, especially after tempering at 750°.

26. S. V. Konovalov, I. A. Komissarova, D. A. Kosinov, V. E. Gromov, Yu. .F. Ivanov
Effect of electron beam processing on the change in structure-phase states of Ti alloy leading to the increase in fatigue life. The formation and evolution of structure-phase states and defect substructure of titanium of grade VT1-0 subjected to electron beam (EB) processing and multicyclic fatigue loading to failure were investigated. EB processing in optimal modes results in the increase in fatigue life of Ti by the factor of 2.0. It is shown that irradiation of titanium with EB results in the refinement of grain structure and formation of intragranular substructure, formation of additional structural levels in a surface layer. It has been proposed that the layered character of surface layer structure is one of the main causes of increase in fatigue life.

27. M. Sedlaček, B. Podgornik, D. Česnik
Influence of heat treatment and K_{Ic}/HRc ratio on the dynamic wear properties of coated high speed steel. The aim of this work was to determine the impact of various heat treatments on the KIc/HRc ratio and subsequently on the wear properties of coated high-speed steel under dynamic impact loading. High-speed steel was vacuum heat treated under six different conditions with the aim to modify hardness and fracture toughness of the steel. After heat treatment all specimens were coated with very common TiAlN coating. In order to determine the influence of substrate properties on the coating adhesion and wear properties, Ball-on-plate impact wear test was used. The results showed that hardness and improvement in the fracture toughness have significant influence on the adhesion and impact wear properties of the coated high-speed steel.

28. S. Malej, M. Godec, J. Medved, F. Tehovnik, B. Šetina Babič
Microstructural evolution of inconel 625 during thermal aging. Inconel 625 was primary designed as a solid solution strengthening alloy by addition of chromium and molybdenum. However, due to elements like carbon and niobium Inconel 625 is prone to precipitation of different intermetallic phases and carbides during thermal aging. The base of investigation is nickel alloy 625 in as rolled state. Aging was conducted at temperature 650 °C with different duration of treatment for each sample. Microstructural analysis was performed by light microscope and electron microscope. The results showed the precipitation of intermetallic phase () in the γ matrix and precipitation of carbides at the grain boundaries.

29. P. Hvizdoš, M. Fides, R. Džunda
Development of electrically condutive SiC based ceramics. SiC based materials are used for their exceptional hardness, excellent wear resistance and high temperature properties. They are highly brittle and difficult to machine. Making them electrically condutive opens a possibility of machining by electric discharge methods. In the present work a range of complex composites based on SiC matrix with various amount of electrically conductive additives were prepared. The microstructure and chemical composition were studied by SEM equipped with EDX analyzer. Hardness and fracture toughness of the prepared materials were evaluated by means of indentation. Propagation of indentation cracks was analyzed using light microscopy and SEM. The electric conductivity as function of fraction of additives was determined.

30. V. Brozek, M. Vokac, J. Kolisko, P. Pokorny, T. F. Kubatik,
Incorporation of tungsten metal fibers in metal and ceramic matrix. Tungsten fibers have high tensile strength but a poor oxidation resistance at elevated temperatures. Using this first characteristics and prevent oxidation of tungsten armored composite materials in which the primary requirement reinforcement against destruction or deformation was studied on tungsten fibers and tungsten wires which were coated by applying the metal and ceramic powders by plasma spraying device in plasma generator WSP®. Deposition took place in an atmosphere of Ar + 7 % H_2, sufficient to reduce the oxidized trace amounts of tungsten. Short tungsten filaments were consolidated into the same matrix by Spark plasma sintering method at temperatures of 1400 – 1900°C and pressures up to 80 MPa.

31. B. Žužek, F. Kafexhiu, B. Podgornik
Effect of carbide size and distribution on the creep rate. In creep resistant steels one of the most influencing constituents are the carbide particles distributed in the matrix of the steel. Carbide particles are obstacles to dislocations movement, with the creep rate strongly depending on their size and distribution. At elevated temperatures to which creep resistant steels are exposed, carbides are growing and dissolving thus changing the creep resistance of the steel. Therefore the aim of our work was to study the role of size and distribution of carbide particles on creep rate. With different heat treatments different distribution and size of carbides was obtained, followed by creep test to study the effect of different distribution on the steel creep resistance.

32. B. Arh, F. Tehovnik, J. Burja, F. Vode
Changes in physical properties of the casting powder during the continuous casting of steel with increased Al content. To meet the requirements of the casting powder by forming a liquid slag lubricating steel strand in its slip in the mold and steady heat transfer, we need to achieve high infiltration of slag in the casting gap of the mold. The melting and viscous properties of the casting powder are relevant. The aim of this study was to determine changes in chemical and physical properties of the casting powder due to the reactions of Al from the melt with the slag casting ability to identify and change the lubrication of the casting slag to time in the continuous casting of ferritic stainless steels with an increased content of Al.

33. F. Tehovnik, J. Burja, B. Arh, F. Vode
Precipitation of sigma phase in superaustenitic stainless steel UHB 904L. Superaustenitic stainless steel UHB 904L with high Mo concentration widely used in applications that require good toughness and corrosion resistance. Given certain thermal histories, UHB 904L may be susceptible to the formation of potentially detrimental intermetallic phases, such as the sigma phase. The formation of sigma phase is promoted by high concentrations of Cr and Mo, while elements such as carbon, nickel and nitrogen retard its formation. Samples of UHB 904L were exposed to isothermal annealing within the temperature range between 800-1050 °C, with ageing times varied between 0,5 h in 8 h, followed by water quenching. Microstructural analysis showed that sigma phase forms up to 1000 °C. Optical and electron microscopy and Auger electron spectroscopy were used.

34. J. Török, M. Kočiško, J. Dobránsky, M. Telišková, L. Běhálek
Evaluation of Strength Properties of Composite Materials Using Additive Technologies. This paper deals with the strength properties of composite components created by FDM technology. Examined samples are sequentially formed directly from a multicomponent operating medium with an admixture of different additives and composite material created during the 3D printing process. Test samples will be printed according to the relevant technical standards. The samples will be then determined to mechanical, static, strength properties, and Brinell hardness tests. The impact of various additives on the strength properties of printed composite materials will be assessed. Based on the results can be prepared conclusions and recommendations for future reference additives. Reciprocal Linking of various materials enables to extend the range of applications of 3D printing and helps to the development in given field.

35. M. Janák, J. Dobránsky, M. Kočiško, L. Běhálek
Verification of Mechanical Properties of Carbon Base Composite Materials. There is wide variety of composite structures achieved by hand-layup technology. These materials are diverse in their attributes. The paper will verify the influence of chemical constitution, physical construction and also of specific technological procedures realized in production process of composite materials. Presented experimental testing focuses to the properties of dif-

ferent composite materials made of carbon based structures. The samples from different composite materials will be created using the milling technology according to the dimensions determined in international standard. Samples will then be tested accordingly to verify their mechanical properties, such as tensile testing, toughness, hardness etc. In the end, the results and relevant reasons will be published while describing the mechanical properties of selected composites.

36. Y. Bozkurt

Dissimilar friction stir welding between Al based SiC particle reinforced metal matrix composite and AlMn1Cu alloy. In the present study, aluminium based SiC particulate reinforced MMC and AlMn1Cu aluminum alloy sheets were successfully friction stir welded by offsetting the high tensile strength sheet to retreating side of the tool. Scanning electron microscopy with energy dispersive spectroscopy were used to characterize the effects of the welding parameters on the microstructural properties. The joint exhibited a typical ductile mode of failure characterized by the presence of dimples known as microvoid coalescence. The highest tensile strength value was obtained to be approximately the same that of the aluminum alloy base metal. This study represents that FSW is a good candidate for joining of dissimilar alloys.

37. I. Stojanović, V. Alar, V. Šimunović

Study of corrosion performance of polyester and epoxy-polyester powder coatings. If the construction material isn't corrosion resistant enough in the foreseen conditions, either the conditions should be changed, or a protective coating should be applied. Many currently used anticorrosive coatings are not environmentally acceptable because of their high solvent emissions in the air. One of the environmentally friendly anticorrosion solutions are powder coatings. In this study, the corrosion performance of polyester and epoxy-polyester powder coatings was evaluated, using Electrochemical impedance spectroscopy (EIS), salt spray and humidity chamber, and Scanning electron microscope (SEM) with Energy-dispersive X-ray spectroscopy (EDX) analysis. Study revealed that the epoxy-polyester powder coating demonstrated a better performance than polyester powder coating. The influence of surface texture on thickness and barrier properties of the coating was also determined.

38. I. Juraga, V. Šimunović, I. Stojanović

Influence of surface and structural changes in stainless steels weld joints area on their properties. High alloyed Cr-Ni steels are important group of structural materials and their use in various industrial fields are almost irreplaceable for example in food industry, pharmaceutical and petrochemical industry. Structures made of this steels are almost always made as welded, and because of heat input during welding processes surface and structural changes occurs which may have negative influence on weld joint properties particularly corrosion resistance and mechanical properties. In this paper real cases of damages, which were caused by surface and structural changes in weld joint areas, on various welded structures made of stainless steel are analyzed and recommendations for their avoiding are presented.

39. I. Paulin, A. Kocijan, Č. Donik, M. Hočevar, K. Zelič, M. Godec

Influence of different treatments on corrosion behavior of Fe-based biodegradable alloy. Traditionally, the most commonly used biodegradable materials for biomedical applications are Mg and Zn-based alloys. The limitations of those alloys are too fast degradation of metal parts and too high amount in relatively short time of the elements and compounds released during the degradation in the body. Nowadays, the research is extended also on Fe-based alloys. The benefits of those alloys are longer lifetime in the body, when this is urgent for some treatments and healing. When served the material also decompose in the body and no additional operation is needed to remove the implants. The limitation of such a material is the time could be too long. In the present study we focused on synthesis of Al-Mn alloys by commonly used producing steps. The aim was to produce the material with faster degradation. The study was focused on corrosion testing. Characterization of the material was performed by SEM/EDS, LM and mechanical testing.

40. P. Mikolajczak, L. Ratke

ThermoCalc prediction of solidification front in aluminum alloys with Mn-rich intermetallics. Solidification of AlSiMn alloys was studied using directional solidification facility and the ThermoCalc software was applied to calculate phase diagrams and to predict occurring phases. The ternary phase diagrams presented different solidification paths caused by segregation in each selected specimen. The property diagrams showed modification in the sequence and precipitation temperature of the phases. It is proposed in the study application of thermodynamic calculations to visualize the mushy zone in directional solidification. 2D maps based on property diagrams show a mushy zone with a channel in the AlSi7Mn1.0 specimen center, where Mn-rich phases may precipitate separately to α-Al dendrites.

41. P. Mikolajczak, J. Janiszewski

Morphology in slowly solidified AlSi9Fe0.3Mn0.3Mg0.3 alloy by various stirring speeds. The paper present the effect of the intensive stirring on the microstructure of aluminum alloys AlSi9Fe0.3Mn0.3Mg0.3 slowly cooled in uniform volume solidification. The stirring generated by rotating magnetic field caused changes in precipitation of α-Al dendrites and occurring phases. The measured chemical composition measured across specimens showed good mixing of the components. The modification of the microstructure was studied as effects of the different rotation speeds and strength of the electromagnetic field.

42. P. Mikolajczak, L. Ratke

Effect of solidification velocity by forced convection on microstructure and Fe-rich intermetallics in AlSi alloys. The current study aims to identify the role of forced convection on the alloys microstructure and formed intermetallics in Al-5 wt.% Si-0.2/0.4/1.0 wt.% Fe alloys directionally solidified under definer thermal and flow conditions in Artemis-3 facility. The experiments were carried out by various solidification velocities from 0.02 to 0.12 mm/s. The results showed the effect of solidification velocity by forced flow different on the length and number density of Fe-rich needles together with modification in microstructure characterised by changes in primary and secondary dendrite arm spacing and specific surface of the dendrites.

43. P. Schlafka, A. W. Bydałek, M. Holtzer, W. Wołczyński

The influence of the ionic reactions on the refining secondary raw materials. The article presents the concept of refining with the use of slag activated with carbide coating. It pointed out the important role of stimulators of ionic reactions. The results of research from the melting of the CuAl-10Fe4Ni4 alloy obtained from recycled materials in metallurgical conditions were shown. The changes in the structure of the alloy depending on the nature of the used simulators were indicated. Chemical reagents used and the stimulants in the form of haloids helped to improve the molding sand exchange process. The use of chemical regent in the form of calcium carbide and stimulants has also contributed to the formation of a protective atmosphere in the furnace bottom.

44. A. Z. Issagulov, A. B. Akhmetov, Ye. P. Naboko, G. D. Kusainova, A. A. Kuszhanova

The research of modification process of steel hadfield integrated alloy ferroalumisilicocalcium (Fe-Al-Si-Ca/FASC). There is article discusses the process of modification of high-manganese steel, Hadfield, which will significantly increase the yield of the casting at the stage of melting and casting the steel. The steel modification performed integrated alloy FASC (*ferroalumisilicocalcium*) in an amount of 03 - 0,5% by weight of the metal. The integrated alloy unlike traditional methods of modification leads to globalizatsii and purification of steel from nonmetallic inclusions and for grinding grains of austenite, thereby greatly increases its mechanical properties.

45. J. Barglik, K. Ducki A. Smalcerz, D. Kuc

The analysis of the influence of continuous induction hardening on the structure and properties of steel 38MN6 grade. The paper presents tests which were aimed at the assessment of the influence of surface heat treatment on the mechanical properties and microstructure of the chosen element of the steering gear which was the toothed bar. The material for tests was special unalloyed steel type 38Mn6 for toughening and surface hardening. This steel type is used to produce steering gears and other components of wheels and suspension system. The influence of induction hardening on the thickness of hardened layer with the use of various parameters of the process was analysed. Tests were conducted on the multi-functional station for induction hardening on the Faculty of Materials Engineering and Metallurgy at Silesian University of Technology.

46. S. Spadło, P. Młynarczyk, W. Depczyński
Selected properties of nanocrystalline WC-Co Infralloy S7412 coating HVOLF sprayed. The paper presents a brief study of selected properties of nanocrystalline WC-Co Infralloy S7412 sprayed coating. The anti-wear coating was applied on carbon steel using HVOLF (*High VelocityOxy Liquid Fuel*) TAFA –JP-5000. These coatings may be applied to increase the abrasive wear resistance of tools and machine parts. Properties of the powders and coatings was investigated with metallographic methods and EDS analyses. SEM examination was performed using a JEOL JSM 7100F microscope with field emission (Schottky). The measurements of microhardness and nanohardness were performed on obtained layers. There was determined Young's modulus of elasticity. The methods of image analysis were used to determine the porosity of the received coating.

47. Z. Ignaszak, P. Popielarski, J. Hajkowski, B. Dudziak, M. Goscianski
Cellular automaton method applied for microstructure prediction of Al-Si casting treated by laser beam. The paper presents the results of tests related to modification of the surface structure of aluminium alloy casting treated by laser beam and the rapid remelting and solidification of the superficial casting zone. The microstructure of the casting (remelting zone) was characterized by decrease of the DAS (*Dendrite Arm Spacing*) value to a few microns (one order of magnitude lower with respect to the origin casting structure). The simulation tests of this laser process allowed to predicting the modified microstructure formation in the remelted zone. The Calcosoft CAFE (Cellular Automaton Finite Element) simulation code was applied. The CAFE database and predicted microstructure were validated experimentally.

48. M. Basiaga, W. Walke, A. Hyla
Physiochemical properties of TiO_2 nanoparticle thin films deposited on stainless steel. The purpose of this study was to evaluate the usefulness of tio_2 layer to improve hemocompatibility of 316LVM stainless steel. The TiO_2 layers studied in this work were deposited from $TiCl_4$ and H_2O in a low-pressure ALD reactor taking into account number of cycles and process temperature. As a part of the research, electrochemical and mechanical studies of the layer after 28 days exposure to artificial plasma were carried out. In particular, potentiostatic, potentiodynamic and impedance studies were conducted. Furthermore, the TiO_2 layer adhesion to the steel substrate was also evaluated. The obtained results were the basis for selection of surface treatment method dedicated to blood-contacting stainless steel implants.

49. K. Milewski, J. Kudliński, M. Madej, D. Ozimina
The interaction between diamond like carbon coatings and ionic liquids under boundary lubrication conditions. The aim of the study was to analyze the anti-wear diamond-like carbon coatings produced by Physical Vapor Deposition. The a-C:H diamond-like coatings were deposited on steel elements operating under friction conditions. The coating structure was studied by observing the surface topography using a scanning electron microscope – SEM and a profilometer. The friction and wear properties of the DLC coatings were examined using a ball-on-disk tribo-tester. The lubricants tested were two types of ionic liquids (1-butyl-3-methylimidazolium tetrafluoroborate and trihexyltetradecylphosphonium bis (trifluoromethylsulfonyl) amide). The experimental data was used to select the ionic liquids with the best tribological properties to operate under lubricated friction conditions with a DLC coatings.

50. L. L. Rokhlin, E. A. Lukyanova, T. V. Dobatkina, I. G. Korolkova, I. E. Tarytina
Phase equilibria in magnesium-rich Mg-Dy-Sm(-La, Ce, Nd) alloys at 500°C. The phase equilibria at 500°C in the Mg-Dy alloys additionally containing rare earth metals (REM) of cerium subgroups such as Sm, La, Ce, Nd were studied using optical microscopy, scanning electron microscopy, microprobe analysis, X-ray diffraction and electrical resistivity measurement. The phases, which are in equilibrium, and the joint solubility of Dy and Sm(La, Ce, Nd) in solid magnesium and in the compounds of magnesium with REM were determined. The boundaries of magnesium solid solution area and the phase areas adjoining to it were established. The partial isothermal sections of the ternary Mg-Dy-Sm(-La, Ce, Nd) systems at 500°C were constructed.

51. G. S. Dyakonov, I. P. Semenova, L. Dluhos, G. V. Klevtsov, R. Z. Valiev
Nanostructured Titanium for Dental and Maxillofacial Mini-implants. This work demonstrates the results of successful studies on the creation of miniature dental implants and implants for osteosynthesis in the cranio-facial areas from Ti Grade 4 rods nanostructured by ECAP via the Conform scheme and subsequent drawing. It is shown that the use of nano-Ti, with UTS=1330 MPa and endurance limit based on 10^7 cycles of 620 MPa, allows for creation of dental implants and miniature plates with an improved design. Such modern miniature dental implants with a diameter of 2.4 and 2 mm were manufactured by the "Timplant" company and the results of successful clinical trials are presented.

52. V. N. Serebryany, M. A. Kharkova, E. A. Lukyanova, F. R. Karelin, V. I. Kopylov
Effect of initial texture on deformation behavior of AZ41hp alloy sheets. The texture and microstructure evolution during the warm rolling and uniaxial tension in the magnesium AZ41hp alloy sheets with two different initial (the sharp and inclined dissipated basal) textures were studied by the X-ray quantitative texture analysis, mathematical simulation and optical microscopy. Application of the initial inclined dissipated basal texture provides combination of high strength and plasticity in the alloy sheets.

53. M. V. Koteneva, S. A. Nikulin, A. B. Rozhnov, A. V. Kudryashova
Structure and mechanical properties of oxide films of zirconium alloys. The structure and mechanical properties of oxide films (thickness 7-10 μm) of Zr-1Nb and Zr-1Nb-0,8Sn-0,3Fe zirconium alloys formed in autoclave corrosion tests in water under conditions of T=360 ºC, P=18,6 MPa, τ=600 days have been studied. The structure of the film in Zr-1Nb samples consists of layers of elongated and equiaxed grains. Structure of the film in Zr-1Nb-0,8Sn–0,3Fe samples mainly consists of elongated grains. The film structure defines the resistance and mechanism of fracture of films during mechanical loading. Fracture of the oxide films in Zr-1Nb samples occured through the formation of longitudinal cracks and delamination. In the films of Zr-1Nb-0,8Sn-0,3Fe sample transverse cracks were formed perpendicular to the film surface.

54. A. A. Krugljakow, S. A. Nikulin, N. V. Lebedeva, V. M. Khatkevich, S. O. Rogachev
Effect of chemical composition on the hot hardening of die steel with regulated austenitic transformation. A new class of die steels for hot deformation, namely, steels with regulated austenitic transformation realized during exploitation (RATE) have been developed in Russia. These steels are characterized by the technological advantages of traditional α-solid solution-based steels and, when working in the austenite state, assure the enhanced tool life. RATE steels have a tendency to hot hardening during operation. The nanophase hardening occurs in RATE steels being in the austenitic state, during multiple plastic deformation at temperatures of 450-750 °C. Effect of chemical composition (replacement of nickel by manganese) on the structure, phase composition and hardening of RATE steel is analyzed.

55. O. B. Kulyasova, R. K. Islamgaliev, R. K. Valiev
The effect of Ca in biodegradable Mg-Zn-Ca magnesium alloys on grain refinement by HPT. Mg-Zn-Ca magnesium alloys have been selected for the investigations because they have a great potential for biomedical applications due to their biocompatibility, low density, elastic modulus comparable to bone, and biodegradability. However the magnesium alloys of this system are characterized by rather weak mechanical properties. It is known that high pressure torsion (HPT) provides an unique opportunity for nanostructuring of various alloys. This work is focused on the investigations of the microstucture and mechanical properties of ultrafine-grained Mg-1%wtZn-xCa alloys processed by HPT. This study was supported by the Russian Ministry of Education and Science within the basic part of the program for universities.

56. S. A. Nikulin, A. B. Rozhnov, V. A. Belov, S. O. Rogachev, E. V. Li
Acoustic emission application for the mechanical properties evaluating of the embrittled zirconium alloys. Nowadays the residual ductility criterion determined at the first load drop during ring sample compression test is used to evaluate the embrittlement degree of oxidized zirconium alloys. This criterion does not always adequately reflect the real state of the material, as through-wall crack may occur later than the first load drop. A special technique of ring sample compression test with measurement of acoustic emission and crack metallographic analysis has been developed to study the kinetics and mechanisms of tube specimen destruction. This test revealed that through-wall crack in a sample under loading is not formed at the first load dropping, but later.

57. E. A. Lukyanova, N. S. Martynenko, V. N. Serebryany, V. S. Yusupov, S. V. Dobatkin, Y. Estrin
Microstructure, texture and mechanical properties of Mg-Al-Zn-Mn alloy processed by rotary swaging. The Mg-4.4%Al-0.9%Zn-0.4%Mn(wt.%) alloy was processed by rotary swaging with decreasing deformation temperature from 400°C to 200°C up to a logarithmic deformation strain of ε=2.77. Microstructures, texture and tensile properties of the alloy was investigated using optical microscopy, TEM, EBSD, X-ray analyzes and tensile tests. It is shown, that the microstructure evolution in the alloy is strongly influenced by twinning. Twinning leads to fragmentation of the initial grains from 16.8 μm to 2.6 μm. Inside the primary twins grain refinement takes place by dynamic recrystallization and twinning. The alloy swaged at 200°C (ε=2.77) is characterized by UTS=360 MPa and YS=320 MPa at elongation of 7.5%.

58. S. A. Nikulin, T. A. Nechaykina, A. B. Rozhnov, S. O. Rogachev
Structure and mechanical properties of high-temperature three-layer material "stainless steel /vanadium alloy /stainless steel". Vanadium alloys are promising materials for the fuel cladding of fast nuclear reactors due to their high thermal conductivity, high-temperature tensile strength, high temperature creep resistance (at temperatures up to 800°C) and radiation stability. However, oxygen and nitrogen are highly soluble in vanadium at temperatures up to 400ºC. We propose a three-layer material based on high-temperature V-4Ti-4Cr alloy that is protected by corrosion-resistant ferritic steel from the surface. It is shown that "transition" layer with monotonically changing chemical composition is formed in the three-layer material due to the joint hot deformation and annealing. Tensile tests demonstrate that three-layer sample behaves as a monolithic material.

59. A. V. Nikitin, V. G. Khanzhin, V. Yu. Turilina
Acoustic emission analysis of hydrogen embrittlement steels by bending. The delayed fracture resistance to hydrogen embrittlement in 35KhGM (Russian standart - 35ХГМ) and 33 KhM1F (Russian standart - 33ХМ1Ф) steels was investigated. Based on the results of a comparative analysis of the mechanical behavior of materials under four-point bending and uniaxial tension by measuring the acoustic emission and fractography, the differences in the mechanism and kinetics of fracture of steels were shown.

60. S. A. Nikulin, A. B. Rozhnov, T. A. Nechaykina, S. O. Rogachev
Structure and mechanical properties of vital parts of rail transport after the volume-surface hardening. Using the volume-surface hardening for hardening of vital parts of rail transport from low-carbon cast steel improves the mechanical properties: tensile strength at 1.6-2.0 times; the yield strength at 1.3-1.6 times; the bearing capacity at 1.4-2.6 times; the fatigue strength to 10%. The volume-surface hardening by fast-moving flowing water provides the surface hardened layer (with thickness of 5-8 mm) in the wall of the fragment with the tempered troostite structure. In this case the gradient of strength and hardness over the cross section of the wall of the solebar fragment (from 21 HRC in the core to 36 HRC on the surface) is achieved.

61. D. A. Romanov, V. E. Gromov, L. R. Bahrieva
Composite coatings based on electroerosion resistant and wear resistant systems. Composite coatings based on electroerosion resistant (W-Ni-Cu, Mo-Ni-Cu, Cr-Cu) and wear resistant (TiC-Ni, TiC-Ni-Mo) systems and their modification was implemented in two stages. At the first stage the electroexplosive coating deposition with a layered filled structure was conducted. At the second stage irradiation of the coatings formed by high-intensity pulse electron beams was performed in order to reduce the degree of surface roughness, homogenization and nanostructuring, improve electroerosion resistance, hardness and wear resistance.

62. V. V. Roschupkin, M. M. Lyahovitsky, M. A. Pokrasin, N. A. Minina, A. G. Kol'tsov
Experimental Investigation of 30HGSA Steel Acoustic Properties. The results of experimental studies of speed and ultrasonic attenuation, as well as the relative thermal expansion of 30HGSA steel relating to the class of structural alloyed steels in the temperature range 20–1100 °C are lead. It is noted the peculiarities in the behavior of the investigated properties when heated in the temperature range 735–850°C and 760–830 °C and when cooled –1020–990 °C and 710–670 °C. Approximating equations for the temperature dependence of the investigated (speed, ultrasonic attenuation and relative thermal expansion) and calculated on their basis (density and Young's modulus) properties are given. Constructed a table of values of these properties in the entire temperature range of study.

63. S. A. Nikulin, A. B. Rozhnov, T. A. Nechaykina, S. O. Rogachev
Application of X-ray method for determining the surface stress of vital parts of railway transport. The applicability of X-ray method to determine the surface stress for the most typical steel for rolling stock vital parts has been confirmed. The effect of surface roughness and microstructure on the shape and half-width of the diffraction peaks in the determination of surface stress was shown. The microstructure of the steels with different contents of carbon was a mix of ferrite and pearlite in various ratios with a sufficiently fine grains. Advance preparation of the part faces consisting of polishing and electrolytic etching is required for the formation of doublet form diffraction peak with a smaller width in comparison with the un-prepared surface.

64. S. A. Nikulin, V. G. Khanzhin, A. V. Nikitin, A. B. Rozhnov, V. Yu. Turilina, S. O. Rogachev
Acoustic emission analysis of static failure of solebar fragments of freight-car trucks. The kinetics and evolution of the failure of solebar fragments of freight-car trucks from low-carbon cast steel during a static three-point bending was investigated by acoustic emission. The fragments in initial normalized state and after the volume-surface hardening were analyzed. Volume-surface hardening of solebar fragments included heating to 950-970 °C, holding for 60 minutes and cooling at 800 deg/s by fast-moving flowing water. It is shown that the volume-surface hardening of solebar fragments change the kinetics of their failure. Maximum load of the main crack formation during bending increases from 400-500 kN (for normalized fragments) to 600-700 kN (for fragments after a volume-surface hardening).

65. J. Borowiecka-Jamrozek, J. Lachowski
Effect of properties of metal matrix on the retention of diamond particle. The paper presents modelling mechanical properties of materials used as matrices in diamond impregnated tools. Powder metallurgy materials were manufactured by the hot press process from various combinations. After consolidation the specimens were tested for density, hardness and tensile properties. The stress/strain fields around a diamond particle in a matrix were been obtained by computer simulations. The effective use of diamond impregnated tools strongly depends on mechanical properties of the matrix, which has to hold the diamond grits firmly. The diamond retention capability of the matrix is affected by interactions between the diamond crystal and the matrix during the segment manufacture. The stress and strain fields generated in the matrix were calculated using the Abaqus software.

66. R. Beckowski
Effect of cladding parameters on the hardness of bimetal plates. Hardness is one of components responsible for the resistance to wear. The development of new materials with hardness surface more than 65 HRC is possible with use welding technologies. High chromium cored wires belong to welding materials that are often used to cladding to protect surface. This article show the problem of determining the important parameters of cladding FCAW to obtain the most hard surface. The use of high chromium cast iron to cladding on to structural steel S235JR showed us how important is knowledge about influence the technological parameters by made this plate and how have a significant impact on the final characteristics surface. For experiment Plackett-Burman design is used.

67. M. Madej, D. Ozimina, R. Gałuszka, G. Gałuszka
Corrosion, friction and wear performance of diamond like carbon coatings. Very good properties of DLC coatings make them widely applicable to a range of sectors including the tool manufacturing, automobile, food, and medical industries. Remarkable mechanical properties, high surface smoothness and chemical inertness of the DLC coatings, enable excellent performance of tribological systems in special environments. The a-C:H:W, TiN/a-C:H:W and the CrN/a-C:H:W coatings were deposited on steel surface by physical vapour deposition methods and studied for corrosion and tribological properties, after elemental and structural analysis. In friction pairs the elements coated with diamond-like carbon showed better tribological properties than the elements without coatings. The presence of interlayers in coatings contributed to an improvement in the tribological properties and corrosion resistance.

68. J. Kasińska
Modification influence of mischmetal on fractography fracture of G17CrMo5-5 cast steel samples after the three-point bending test. The article presents an analysis of fracture of the samples after the three-point bending test at temperature range from +20 °C to - 80 °C. The author shows a beneficial effect of mischmetal on the cracking mechanism and on the character of samples fracture. It has been shown that the width of the ductile fracture zone under the bottom of the notch and the nature of the cracking mechanism changes with decreasing test temperature.

69. K. Semrád, K. Draganová
Methodology for repeated load analysis of composite structures with embedded magnetic microwires. The article processes issue of strength of cyclically loaded composite structures with the possibility of contactless stress measuring inside a material. Implementation of the magnetic microwires into the composite structure gives the possibility to create a build-in sensor inside the material without its structure violation and to measure induced stresses. The practical application of the solution is designed for the repeated load of the wing hinge connection, including FEM fatigue strength analysis. It covers history and physics of fatigue, the E-N approach - strain cycles, which involves effect of mean residual stresses, hysteresis loop capture and rainflow cycle counting. Factors affecting fatigue life include component size, loading type, surface finish, surface treatment and effect of surface treatments on the endurance limit.

70. L. B. Zuev, S. A. Barannikova, Yu. V. Li
Research of the plastic deformation localization of electrolytically saturated with hydrogen alluminum alloy by the digital image correlation method. The paper presents investigations of the effect of hydrogen embrittlement on the plastic flow. It is found that the mechanical properties and plastic flow curves of aluminum alloy are affected adversely by hydrogen embrittlement. These are found to show all the plastic flow stages: the linear, parabolic and pre-failure stages would occur for the respective values of the exponent n from the Ludwik-Holomon equation. Microhardness tests were performed for as-treated aluminum alloy. Using scanning electron microscopy method, the changes in the fracture surface were investigated.

71. R. Lukauskaitė, O. Černašėjus, J. Škamat, S. Asadauskas, A. Ručinskienė, R. Kalpokaitė – Dičkuvienė, N. Višniakov
Improving sliding wear resistance of Al-Mg parts by plasma spraying. Durable coatings, which would combine good technological properties, high hardness with excellent tribological characteristics, are of great interest for engineering fields where working parts are produced from aluminium and its alloys. In present work, plasma spray technology was used as a means to increase durability of Al-Mg alloy parts. NiCrSiBFe coatings deposited on aluminium alloy substrate at different thickness were studied. Before spraying, the surfaces of aluminium alloy were modified using different surface pretreatment methods. The phase composition, microstructure, microhardness, porosity and adhesion of deposited coatings were characterized. Ball-on-plate wear tests with NiCrSiBFe coatings were carried out in dry and lubricated conditions, using SEM to characterise the worn track and the wear mechanism.

72. J. Čerňan, M. Cúttová, K. Ratkovská, F. Adamčík
Effect of the thermal barier coating on heat transfer into nickel based refractory alloy. The aim of experiment is evaluate an effect of industrially used plasma sprayed coatings of TBC on transfer of heat into refractory material designed for aeronautical aplications. This study uses basic structural material of combustion chambers - components of turbine engines during operation highly termally stressed by flow of hot gasses. Using the hot gasses from gas burner, the operational conditions inside the combustion chambers are simulated. The use of TBC coating shows positive effect on alloy overheating reduction. The results demonstrated decrease of temperature with values in extent of hundreds of °C for materials covered with TBC. This phenomenon can contribute to development of a new types of aircraft engines with higher operational temperature and better fuel economics.

73. M. Grygorowicz, P. Wasilewicz, W. Matysiak
Microstructure and mechanical properties of commercially pure titanium foam with varied cell size fabricated by replica impregnation method. The paper deals to structural and mechanical properties of aluminum alloy foams. That kind of structures are commonly used in civil and mechanical engineering i.e. as medical implants or parts of the vehicle frames. The aim of presented investigations was to compare mechanical properties of three-layer sandwich structures with the aluminum foam core. The structures were treated forging. After forging the microstructure, microhardness and surface roughness were observed. The structures were also cut into the pieces using laser and the heat affected zone was investigated. Decrease of the microhardness values was observed in locations set further from the rim edge – inside the material, which may additionally improve the thread properties – it will keep a durable surface and a malleable core.

74. K. Gawdzińska, L. Chybowski, J. Grabian, A. Bejger, S. Krile
Determination of technological parameters of saturated composites based on SiC by means of a model liquid. The paper describes a method for determining technological parameters of the formation process of saturated composites based on SiC by applying the theory of dynamic similarity. The Reyn-olds number is used as a similarity index in the proposed method. Basic mathematical relations have been presented in terms of hydraulic analysis of the saturated liquid flow (liquid metal) and determination of the saturated composite density depending on the technological parameters of its formation process: saturation time and pressure. Adopting the method for determining the density of silumin composites reinforced with silicon carbide by means of Wood's metal as a model liquid has been described. Microscope images of the composite structure have been shown after filling it with the model liquid. Remarks have been made on the application of the method.

75. N. Radek, J. Pietraszek
The bootstrap-based analysis of uncertainty for the RSM model of the friction properties after laser texturizing of the silicon carbide surface layer. The surface coated by SiC through the electrospark deposition (ESD) has been treated by the laser beam machining (LBM) to lower roughness. The elements coated by ESD have been tested to determine tribological properties and they were compared before and after LBM. The relation between two controlled quantitative factors – a blackening and a diameter of a cavity – and a coefficient of friction was identified as a response surface model based on a design of experiment methodology. The obtained data violated normality test and it was a reason that a classic methods of uncertainty estimation were not appropriate. This paper presents a specific estimation of uncertainty based on a bootstrap approach. Details of the solution and the discussion of results are presented also.

76. G. Gałuszka, M. Madej, D. Ozimina, J. Kasińska, R. Gałuszka
The characterisation of titanium alloys for biomedical applications. The paper presents results of research on the use of pure titanium medical implants, dental and orthopedics - as pins hip replacements. The properties of metal biomaterials, including their hardness, determine the usefulness of the material and are one of the criteria for its use. They depend on their chemical composition and structure. Studies included the observation of the microstructure and mechanical properties of pure titanium. The observations surface were carried out using a scanning electron microscope SEM. The optical profiler was used to depict the geometric structure of the surface, and to carry out the nanoindentation tests a nano hardness tester was used.

77. F. Tehovnik, J. Burja, F. Vode
The recrystallization of austenitic stainless steels alloyed with molybdenum. The poor hot workability of austenitic stainless steels alloyed with molybdenum depends on the numbers of factors. The most probable explanation is connected with a retardation of the softening processes. The relationship between the softening and the hot-ductility phenomena was investigated using hot rolling experiments with wedged specimens. The fraction of the recrystallization was determined by metallographic investigation and the degree of mechanical softening.

78. J. Burja, F. Tehovnik, M. Godec, J. Medved
Formation of chromite spinel inclusions in stainless steel melt during decarburization in the eaf. Decarburization in the EAF is one of the most important phases in stainless steelmaking. During this phase oxygen is blown into the steel melt to reduce the carbon content, but unfortunately chromium is also oxidized in the process. The two completive reactions of carbon and chromium oxidation are crucial for control of the decarburization process. Laboratory experiments of oxygen blowing into Fe-Cr-C were carried out and the results were thermodynamically analyzed, with supporting microscopic analysis. The mechanism of stainless steel melt oxidation trough chromite spinel inclusions was proposed, explaining the thermodynamic calculation results.

79. M. Vaško, M. Blatnický, P. Kopas, M. Sága
Research of weld joint fatigue life of aluminium alloy AlMgSi07.F25 under bending-torsion cyclic loading. The contribution deals with a research of fatigue lifetime of weld joint of aluminium alloy AlMgSi07.F25. The paper will present unique biaxial testing equipment, process of preparation of specimen rods for fatigue test and results of fatigue life for aluminium alloy during cyclic bending-torsion loading. Fatigue tests under constant amplitude loading were performed in a special electromechanical machine with a suitable gripping system. Obtained fatigue curves were compared to most widely known fatigue criteria as LIU, F-S and B-M.

80. P. Kopas, M. Blatnický, M. Sága, M. Vaško
Identification of mechanical properties of weld joint of aluminium alloy AlMgSi07.F25. The aim of the contribution will be a presentation of an analysis of chosen mechanical properties of weld joint of aluminium alloy AlMgSi07.F25. The focus of attention will be on an influence of a shape of the weld surface of specimen rod neck over a tensile strength characteristic and over a distribution of hardness in a weld joint cross-section. An additional material in a TIG technology welding process was AlSi5 under the consideration. A part of the contribution will be a brief study of a numerical modelling of specimen rod welding.

81. P. Pastorek, P. Novák, P. Kopas, M. Močilan
Finite element analysis of bond behavior at steel-reinforced concrete structure strengthened by CFRP strips. The article deals with analysis of influence of carbon-fiber reinforced polymer (CFRP) on stress distribution in steel reinforced concrete beam loaded by the four point bending flexural test. Simulation of the delamination is modeled by cohesion zone material model. Distribution of cracks on models with and without CFRP strengthening is compared. Along the analysis was executed fatigue test of steel sample (W.Nr. 1.0429 - concrete steel), which was used in the concrete beam. From the fatigue test results was constructed the fatigue life curve.

82. M. Sapieta, V. Dekýš, A. Sapietová
Comparison of expression thermoelastic phenomenon of stainless steels during cyclic loading. The main aim of this paper is to compare the thermo-elastic stress on the specimens of stainless steel. Materials specimens were chosen stainless steel of type AISI 304, AISI 316Ti and AISI 316L. The specimens were cyclically loaded with three-point bending. The whole process was recorded using an infrared camera. Thermal difference that occurred during the test was evaluated based on the relationship of thermo-elastic stress. Subsequently stress distribution on specimens was compared for different types of stainless steel.

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83. B. Wang, Z. G. Yang, X. F. Zhang, Y. T. Wang, C. P. Nie, Q. Liu, H. B. Dong
Analysis of the effects of electromagnetic stirring on solidification structure of bearing steel, Metalurgija, 54 (2015) 2, 327

84. R. Bakić, M. O. Abukresh, A. Sedmak, I. Samardžić, R. Jovičić
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85. A. Bejger, K. Gawdzińska
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86. M. Szucki, D. Kalisz, J. Lelito, P. L. Żak, J. S. Suchy, K. W. Krajewski
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87. J. Burja, F. Tehovnik, F. Vode, B. Arh
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88. A. Dimitrescu, D. F. Niţoi, D. Dobrotă, Z. Apostolescu
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89. I. Sărăcin, G. Paraschiv, O. Pandia, I. Bozgă, D. Toma
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90. I. Samardžić, M. Dunđer, T. Vuherer
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91. P. Pokorny, L. Mastny, V. Sykora, Z. Pala, V. Brozek
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93. R. Kawulok, I. Schindler, P. Kawulok, S. Rusz, P. Opěla, Z. Solowski, K. M. Čmiel
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94. T. Puskar, A. Lapcevic, S. Arandjelovic, S. Radulovic, I. Budak, Dj. Vukelic, D. Jevremovic
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95. P. Pokorny, P. Szelag, M. Novak, L. Mastny, V. Brozek
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96. D. A. Skobir Balantič, B. Žužek, F. Vodopivec
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97. J. Piątkowski
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98. Gh. Amza, D. Dobrotă, V. Petrescu, Z. Apostolescu, R. G. Albulescu
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99. I. Samardžić, T. Vuherer, D. Marić, P. Konjatić
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100. Gh. Amza, V. Petrescu, D. Dobrotă, Z. Apostolescu, R. G. Albulescu
Influence of use of ultrasound on the mechanical properties of plated pieces by welding in ultrasonic field, Metalurgija, 54 (2015) 3, 531

101. R. Przeliorz, J. Piątkowski
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102. P. Armăşoiu, D. Dobrotă, V. Petrescu
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1. A. Kujawinska, M. Rogalewicz, M. Pilacińska, A. Kochański, A. Hamrol, M. Diering
Application of dominance-based rough set approach (DRSA) for quality prediction in a casting process. The main subject of the paper is a problem of capability assessment of a production process for manufacturing products fulfilling certain requirements. The paper presents theoretical assumptions of the DRSA method for classification of a process state based on so-called process state measures (e.g. process parameters, diagnostic signals, events). In the paper, results of application of the proposed methodology for assessment of capability of the nodular cast iron casting process are presented.

2. V. Marušić, I. Samardžić, I. Opačak, L. Marušić
Influence of induction hardening parameters on the GS30Mn5 weld properties. This study examines parameters of post-weld heat treatment on the test specimens made of cast steel GS30Mn5. The welding is performed with shielded metal arc welding (SMAW) process. The aim is to obtain the surface without illicit cracks, with hardness ranging from 320 up to 400 HB. After induction heating, the specimens are cooled alternately with air and water. Decreased speed of quenching results in avoiding the occurrence of illicit splashes, while the hardness is maintained within the prescribed limits.

3. M. Jodkowski, J. Łabaj, J. Brzóska, D. Jama
Binder fraction reduction in non-ferrous metals concentrates briquetting process. The research results on a method of reducing the amount of binder applied during formation of metal concentrates are presented. Research was done on a model copper concentrate, which was mixed in assumed mass fraction with binder, as well as binder with addition of waste polyols. Such mixtures were formed and tested using static compressive strength, both immediately after forming and after the assumed seasoning times: 24, 96, 192 and 336 hours. The results confirm the possibility of binder dose lowering using high-efficiency system of binder dispersing with small addition of waste polyols and by homogeneous mixing of the binder with the material. In all examined cases increase in seasoning time influenced mechanical strength of the formed shapes advantageously.

4. J. Korol, M. Kruczek, M. Pichlak
Material and energy flow analysis (MEFA) – first step in eco-innovation approach to assessment of steel production. The main goal of the study was to evaluate material and energy flow analysis (MEFA) of steel production. The application of umberto universal software to devise MEFA for the steel production was presented. The material and energy flow analysis of steel production includes a range of technologies through each unit process in integrated steelmaking route in Poland. Modelling MEFA helps a high level of technology to be reached through the effective use of resources and energy.

5. J. Łuczak, R. Wolniak
Integration of quality, environment and safety management systems in a foundry. The management systems in the Foundry in question were integrated by means of a quality management system according to ISO 9001 standard. This means that the quality management system is a basic management structure in the enterprise, into which elements of environment management and work safety management have been incorporated. In pre4sented paper we describe some problems of management system integration in metallurgical industry.

6. S. Gil, W. Bialik, J. Ochman
Analysis of fuel savings in metallurgical furnaces with protective atmosphere. In the paper, a case of improvement in energy efficiency of a rollway-continuous furnace used for heat treatment in production of cold-drawn tubes as well as gas savings resulting from application of modern burners for radiant tubes was considered. For the investigated furnace, energy balance calculations were performed for the currently operating status as well as following replacement of burners for modern devices with better parameters of combustion and recuperation, which showed a significant reduction in fuel consumption. The burners ensure uniform temperature distribution along the radiant tube, stable operation, high energy efficiency (also in high temperature furnaces) and low emissions.

7. D. Klobčar, J. Tušek, M. Bizjak, S. Simončič, V. Lešer
Active flux tungsten inert gas welding of austenitic stainless steel AISI 304. The flux assisted tungsten inert gas (A-TIG) welding of 4 (10) mm thick austenitic stainless steel AISI 304 in the butt joint was done using commercially available active flux QuickTIG. The influence of welding position and weld groove shape was analysed regarding penetration depth. A comparison of microstructure formation, grain size and ferritic number between TIG welding and A-TIG welding was done. The A-TIG welds were subjected to bending test. A study shows that A-TIG welding increases the weld penetration depth.

8. E. Kardas, Z. Skuza
The assessment of the efficiency of the use of raw materials in the blast furnace department of steel mill. The quality analysis of raw materials used in pig iron production is presented in this paper. Two kind of raw materials containing Fe are used in this process: sinter and pellets. Then, the influence of the quality of these materials on the effciency of blast furnace process is presented. The effciency of the process is determined by selected parameters of the process.

9. C. Kolmasiak, E. Staniewska, A. Kisiołek
The concept of using selected output elements of the metallurgical process. Modern metallurgical plants work in the environment conditioned by a number of factors. First, the economic effect, that leads to the use of optimal technological solutions and process to achieve the maximum productivity at the lowest cost is important. On the other hand, obtaining of appropriate quality of products with optimum profitability should be taken into account. In addition, metallurgical company should take into consideration the impact of factors on the work environment and natural environment at each stage of production. In the paper the classification of the waste stream in selected metallurgical process is presented. In addition, an attempt to determine how to use the selected items was made.

10. M. Warzecha, A. Hutny, P. Warzecha, T. Merder, B. Jędrysiak
Research methodology of inclusions removing from steel flowing through the tundish. Obtaining high quality steels mainly depends on the quantity of non-metallic inclusions contained into it and this, in turn, to a large extent on the structure of the flow in the tundish. Optimisation of the flow of liquid steel through the tundish makes it possible to control the trajectory of inclusions and thereby to improve the conditions of their outflow into the slag layer. The following article presents an analysis of research opportunities of the inclusions removing process in the tundish resulting in reconstruction of the own research facility.

11. L. Čamek, P. Lichý, I. Kroupová, J. Duda, M. Korbáš, J. Beňo, F. Radkovský, S. Bliznyukov
Effect of cast steel production metallurgy on the emergence of casting defects. The paper documents metallurgical possibilities of high alloy cast steel production in open induction medium frequency furnaces and an electric arc furnace in a gravity die casting foundry. The observation was focused on the emergence of gas defects in steel castings. The content of gases achieved during the metallurgical processes was evaluated for every unit of the production equipment and the casting ladle before casting into disposable sand molds. The sand mold area was considered to be constant. The aim was to evaluate the current metallurgical possibilities of affecting the content of gases in high alloy cast steel in the current technical conditions of the foundry.

12. V. Pečínková, Z. Lenčéš, Z. Jonšta
Gass presure sintered Si_3N_4 – $MgSiN_2$ composites. Si_3N_4 and $MgSiN_2$-based ceramic composites have excellent thermo-physical and mechanical properties, however with limited industrial applications. In this paper the preparation of $Si_3N_4/MgSiN_2$ composite by gas pressure sintering (GPS) is described and some of the mechanical properties like Vickers hardness and indentation fracture are characterised and compared with hot pressed (HP) samples. The 15,3 GPa hardness and 7,6 $MPa \cdot m^{1/2}$ fracture toughness of GPS composites was slightly lower compared to HP samples (16,5 GPa, 8 $MPa \cdot m^{1/2}$).

13. K. Kaczmarska, B. Grabowska, D. Drożyński, A. Bobrowski, Ż. Kurleto, Ł. Szymański
Modified polysaccharides as an alternative binders for foundry industry. Polysaccharides constitute a wide group of important polymers with many commercial applications, for example food packaging, fibres, coatings, adhesives *etc*. This review is devoted to the presentation of polysaccharide application in foundry industry. In this paper the selected properties of foundry moulding sand and core sand containing different polysaccharides as binders are presented according to foreign literature data. Also, author's own research about effect of using moulding sand binder consisting of modified polysaccharide (modified starch) or its composition with non-toxic synthetic polymers are discussed. Based on technologies taken under consideration in this paper, it could be concluded that polysaccharides are suitable as an alternative for use as binder in foundry moulding applications.

14. A. Issagulov, N. Ospanov, A. Bayssanov, Ye. Makhambetov, D. Issagulova
Studying possibility of smelting refined ferromanganese grades using silicon aluminium reducer. In the given article there are presented the results of smelting refined grades of ferromanganese using silicon aluminum reducer. There is established the possibility of smelting medium – carbon ferromanganese of the FeMn80C20LP grade (ISO 5446-80). The extent of extraction and effective use of basic elements reaches 51,1 – 51,2 % of manganese, 54,5 - 59,8 % of silicon and 82,5 - 89,5 % of aluminum.

15. A. V Todorut, L. Paliu-Popa, D. Cirnu, V. S. Tselentis
Interdependence between iron ore production and the maritime transport. The maritime industry plays an important role in international trade, transporting a total of 9,84 bilion tons of merchandise in 2014, representing over 80 % of all global trade, with dry cargo estimated to account for over two thirds of the total seaborane trade. Bulk carriers supply the raw materials needed by the steel industry and container ships transport the steel products.Demand and supply for seaborne transport is influenced by trends in global economy and worldwide demand for commodities. The paper analyzes the most important economic determinants in the supply of metallurgical raw materials, highlighting the importance of the shipping sector.

16. P. V. Kovalev, S. V. Ryaboshuk, A. Z. Issagulov, V. Yu. Kulikov, Sv. S. Kvon, Y. P. Chsherbakova, G. I. Sultamurat
Improving production technology of tube steel grades in converter process. There is studied the nature of formation and features of evolution of nonmetallic inclusions in the course of steel-smelting processing of converter steel of the tube grades (22GYu, 10G2FB, 09GSF).There are defined the critical parameters and developed technological recommendations on decreasing impurity of metal by nonmetallic inclusions : there is increased the calcium to aluminum ratio that are introduced for deoxidation and modification, there is recuced the time interval between addition of aluminum and calcium in the melt, there is corrected the total time of secondary refining and taken the measures for decreasing the secondary oxidation of the melt in pouring.

17. S. Medić, J.Groš, A. Horvatić, Ž. Kondić, L. Maglić
Measurement of casting parameters in $ZnAlCu_3$ molds created by additive technology. This paper examines the parameters of casting ZnAl4Cu3 alloy (volume, castability, density and occupancy of the mold) in mold made additive technology. Molds made by additive technology are: cheaper in production of a small number of castings, geometrically more accurate and faster made. From obtained results of this paper it is clearly seen that printed mold must be protected with thermal coating because liquid adhesive of powder otherwise evaporates during casting and creates additional moisture in the mold, as it was noted.

18. S. Gil, J. Ochman, W. Bialik
A thermal study of pipes with outer transverse fins. This paper provides results of thermal investigations on pipes with outer transverse fins produced by placing a strip, being a form of helical spring which functions as a radiator, on the basis pipe. The investigations were carried out at the facility that enables measurements with respect to both natural and forced convection. Performance of the investigated pipes was assessed in relation to a non-finned pipe and a pipe welded with the use of Metal Active Gas (MAG) technology. The experiments have shown that the finned pipe welding technology does not markedly affect their thermal efficiency, which has been confirmed by performed model calculations, while the welding technology has a crucial impact on their operating performance.

19. A. Kmita, J. Zych, M. Holtzer, J. Mocek, S. Piasny
Ecological water-based protective coatings for moulds and cores of iron castings. The aim of the investigations was the development of the protective coating and the method of its preparation intended for foundry moulds and cores. The selection of the proper surface-active agent, allowing graphite wetting by water in order to form homogenous water composition with the remaining components of the coating, was especially important.

20. T. Lis, K. Nowacki, H. Kania
Determination of physico-chemical properties of fine-grained waste from the cleaning of iron casting. In the European Union one of the most important activities are the recovery and recykling of waste including foundry waste. In the article waste arising from production of iron casting were presented. Selected physico-chemical propierties of iron-bearing waste were defined. Opportunities of waste management are related to their chemical constitution as well as some physical properties. On the basis the results of research the solutions of foundry waste management were proposed.

21. A. Kmita, A. Roczniak, M. Holtzer
The identification of pyrolysis products of the alphaset binder with gas chromatography/mass spectrometry. Pyrolysis-gas chromatography-mass spectrometry (PyGC/MS) was used to identify the major organic products created by pyrolysis of the ALPHASET binder components: hardener/catalyst, resin and cured resin. During the casting process, the cores and moulds are subjected to intense heat from the molten metal. As a result the organic components undergo thermal decomposition and produce a number of complex organic compounds. In this study, the organics were tentatively identified by GC/MS after pyrolysis of the components at 700, 900 and 1100 °C.

22. R. Radić, Ž. Milošević, S. Jurić, S. Čudić
Flotation of ores and waste waters. World generally requires a very high standard of pollution control, and mining companies pride their organisations as being examples of excellence in this field. Hydrometallurgical mining processes decrease the production of gas and solid pollutants into the atmosphere and maximize the recirculation of solvents at every level of waste waters treatment. The extra electrowinning of metal using the circular hydrometallurgical process ensures that the maximum amount of mined metal is recovered. Reducing pollution helps to improve company profitability.

23. I. Špička, M. Heger, O. Zimný, Z. Jančíková, T. Tykva
Artificial intelligence based model for optical control of heating furnace. In practice, however, a certain level of downtimes causing deterioration in economic indicators cannot be avoided. The article demonstrates how one can use elements of artificial intelligence for the creation of suitable simulation models that would work in real time. These models could be used to reduce the negative impact of downtimes by correcting the temperature in each zone of the furnace. The corrections could be then calculated on the basis of predictions of heat curves of the processed material and subsequent optimization, along with using the elements of artificial intelligence.

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24. A. Mitovski, N. Štrbac, D. Manasijević, M. Sokić, A. Daković, D. Živković, Lj. Balanović
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29. B. Opyd, K. Granat, D. Nowak
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32. P. L. Żak, D. Kalisz, J. Lelito, M. Szucki, B. Gracz, J. S. Suchy
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33. J. Jezierski, K. Janerka
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34. B. Arh, F. Vode, F. Tehovnik, J. Burja
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35. F. Tehovnik, J. Burja, B. Arh, M. Knap
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36. P. Podržaj, B. Jerman, D. Klobčar
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37. V. Petrescu, D. Dobrotă
Influence of parameters of welding regime on metallographic structure of materials from a joint welded in corner in „T" form, Metalurgija, 54 (2015) 2, 390

38. V. Marušić, I. Samardžić, I. Budić, L. Marušić
The possibility of tribopair lifetime extending by welding of quenched and tempered stainless steel with quenched and tempered carbon steel, Metalurgija, 54 (2015) 2, 399

39. L. Řeháčková, S. Rosypalová, R. Dudek, J. Kukutschová, J. Dobrovská
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40. H. F. Wang, J. J. Lu, K. F. Chen, H. L. Duan
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41. P. Warzecha, M. Warzecha, T. Merder
Analysis of liquid steel flow in a multi-strand tundish using numerical methods, Metalurgija, 54 (2015) 3, 462

42. H. J. Wu, Y. Xu, Z. R. Huo, F. Yue, P. Y. Lu
Physical modeling of oscillation effect on fluid flow in mold, Metalurgija, 54 (2015) 3, 465

43. J. Dobránsky, P. Baron, V. Simkulet, M. Kočiško, J. Ružbarský, E. Vojnová
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44. J. Dobránsky, P. Baron, M. Kočiško, L. Běhálek, E. Vojnová
Solving depressions formed during production of plastic molding, Metalurgija, 54 (2015) 3, 496

45. M. Szega, L. Blacha, W. Stanek
Methods of mathematical modeling for evaluation of energy management of blast-furnace plant, Metalurgija, 54 (2015) 3, 499

46. A. Bhattacharyya, J. Schenk, G. Rantitsch, C. Thaler, H. Stocker
Effect of alkaline elements on the reactivity, strength and structural properties of blast furnace cokes, Metalurgija, 54 (2015) 3, 503

47. K. Janiszewski
Microscopic investigations of axial zones of continuous casting ingots, Metalurgija, 54 (2015) 3, 507

48. M. Copur, A. Turan, M. N. Eruslu
Effects of chills on the solidification pattern of an axial steel cast impeller, Metalurgija, 54 (2015) 3, 515

49. I. Bozgă, I. Sărăcin, G. Paraschiv, O. Pandia, I. C. Andronie
The influence of melted material proprieties over the characteristics of welded jointings made from steel OL 52.4K, Metalurgija, 54 (2015) 3, 535

50. M. Dunđer, I. Samardžić, T. Vuherer
Weldability investigation steel P 91 by weld thermal cycle simulation, Metalurgija, 54 (2015) 3, 539

51. K. Major - Gabryś
Biodegradable materials as foundry moulding sands binders, Metalurgija, 54 (2015) 3, 591

52. S. Żymankowska-Kumon
The BTEX emission from moulding sands with furan resin dependence on the VOC content and loss on ignition, Metalurgija, 54 (2015) 4, 607

53. L. Socha, Z. Hudzieczek, V. Pilka, Z. Piegza
Comparison of steel desulphurisation at homogenisation station with physical modelling results, Metalurgija, 54 (2015) 4, 611

MATERIALS – SECTION "C"

1. P. Kawulok, I. Schindler, R. Kawulok, S. Rusz, P. Opěla, J. Kliber, M. Kawuloková, Z. Solowski, K. M. Čmiel

Plastometric study of hot formability of hypereutectoid C – Mn – Cr – V steel. Formability of hypereutectoid C-Mn-Cr-V steel in hot condition was investigated with use of plastometric methods. A wide range of deformation temperatures 1 300 - 640 °C for hot tensile tests was proposed with use of nil-strength temperature (NST), determined by special plastometric method, and as well as with use of the calculated temperatures of phase transformations during heating of the investigated steel. Ultimate tensile strength of the investigated steel was increasing exponentially with the decreasing deformation temperature. Ductility of the investigated steel in hot condition increased with the increasing deformation temperature up to the temperatures ranging from 1 150 to 1 250 °C, after which a sharp decline of formability took place in investigated material.

2. R. Kawulok, I. Schindler, P. Kawulok, S. Rusz, P. Opěla, J. Kliber, Z. Solowski, K. M. Čmiel, P. Podolínský, M. Mališ, Z. Vašek, F. Vančura

Transformation kinetics of selected steel grades after plastic deformation. The aim of this article was to assess the impact of previous plastic deformation on the kinetics of transformations of four selected steels. The research was conducted with use of the universal plastometer GLEEBLE 3800, when Continuous Cooling Transformation (CCT) and Deformation Continuous Cooling Transformation (DCCT) diagrams of selected steels were constructed on the basis of dilatometric tests. The research confirmed that the strain accelerates the particularly the transformations controlled by diffusion. Bainitic transformation was accelerated in three of the four steels. In the case of martensitic transformation the effect of the previous deformation was relatively small, but with clearly discernible trend.

3. J. Borowski, J. Sulej-Chojnacka, H. Jurczak, D. Leśniak, H. Dyja

Susceptibility Testing for Welding of AlMg alloys intended for extrusion. The objective of research was to determine the weldability, using Tungsten Inert Gas (TIG) of extruded sections made of hard-deformable 5xxx series aluminum alloys with differing magnesium content, i.e. AlMg3, AlMg4,5, AlMg5, AlMg7. Welded joints were obtained as a result of a welding process consisting of several steps. Only welds characterized by very good appearance and quality were selected for tests. As a result of conducted research, TIG welding parameters were determined for sections with a thickness of 8 mm. It was observed that alloys of differing Mg content are characterized by high weldability and do not exhibit a significant reduction of the yield point. Moreover, joints exhibit uniform hardness distribution in the welded joint and heat-affected zone. Tensile strength is reduced.

4. I. Jandrlić, S. Rešković, F. Vodopivec

Determining the amount of Lüders deformation in niobium microalloyed steel. The article presents the results of measuring the amount of deformation during the formation and propagation of Lüders bands through the deformation zone. The amount of deformation was determined by applying the visioplasticity method with digital image correlation, and analyzing the captured images with the MatchID software package. Results show that during the formation of Lüders bands the deformation of 0.004 mm/mm was achieved. Also, it was determined that during the propagation of Lüders bands through deformation zone, the sample was deformed for the amount of 0.05 mm/mm.

5. S. Mróz, P. Szota, A. Stefanik, G. Stradomski

Theoretical and experimental analysis of the possibility of employing the groove rolling process for the manufacture of Mg/Al bimetallic bars. The paper presents the results of investigation into the possibility of employing the groove rolling process to produce round Mg/Al bimetallic bars. Based on the theoretical and experimental analysis it has been found that one of the main rolling process parameters influencing the quality of bond between the bimetal components is the initial stock temperature. In spite of using Mg/Al bimetallic stocks distinguished by high bond strength, cracks and delaminations occurred at the bond boundary in the transition layer in samples rolled at a temperature of 400°C. Lowering the rolling temperature to 300°C considerably reduced the occurrence of cracks in the regions of the bond transition layer. In a sample taken from band rolled from stock that was characterized by a bond without a transition layer, cracks were completely eliminated.

6. R. Mola, S. Mróz, P. Szota, S. Sawicki

Analysis of the plastic deformation of two-layer Mg/Al materials. The paper presents the results of physical modelling of the plastic deformation of the two-layered Mg/Al material using the Gleeble 3800 metallurgical processes simulator. The tests were performed for two temperatures, 300 and 400°C, and for two strain rates, 0.1 and 1.0 1/s. Based on the analysis of the investigation results it was found that as the strain rate and temperature decreased, the intermetallic phase yielded; a distinct thinning of the intermetallic phase layer occurred in the zone directly affected by the anvil. The number of cracks also decreased. The testing results have revealed that it is possible to plastic deformation the two-layered Mg/Al material at low strain rates and low temperature.

7. K. Laber, H. Dyja, A. Kawałek, S. Sawicki

Determination of characteristics of plasticity of selected medium and high-carbon steel grades in hot torsion test. This study presents results of the examinations aimed at determination of rheological properties of selected grades of medium and high-carbon steel grades (C45 and C72D). The examinations were carried out for the hot torsion test using STD 812 torsion plastometer. The results of experimental studies were approximated with the function used for determination of yield stress depending on strain, strain rate and temperature. The study allowed for development of mathematical models of rheological properties of steel grades studied in the analysed scope of parameters of strain and temperature.

8. A. Gryc, T. Bajor, H. Dyja

The analysis of influence the parameters of rolling process in three high skew rolling mill of AZ31 magnesium alloy bars on temperature distribution. The work presents the results of numerical investigations of AZ31 magnesium alloy bars obtaining by the rolling process in a three high skew rolling mill. An analysis of impact the magnitude of inflicted deformation on temperature distribution in the material was made. The calculations were made using Finite Element Method for 3D deformation state taking into account thermal phenomena that occur during applied deformation scheme. Theoretical investigations were made for two variants of deformation, one temperature of the process that equals 400°C and four rolling rates of 25, 75 and 100 rev/min.

9. A. Kawałek

The effect of relative deformation on the energy-force parameters in the asymmetrical plate rolling process. The paper presents the results of asymmetrical plate rolling in the finishing rolling stand of a 3600 mill. The investigation was carried out for S690Ql steel sheets. Tests were conducted for two types of the asymmetric rolling process. In the first case, the asymmetry of the process was introduced by varying the speed of the upper working roll, while in the second case, two types of asymmetry were introduced simultaneously by reducing the rotational speed of the upper roll and reducing the diameter of the lower roll. Based on the obtained results it has been found that the simultaneous introduction of two types of asymmetry significantly reduces the energy-force parameters of the process, and regardless of relative deformation applied, it yields also a straight rolled plate.

10. V. A. Andreyachshenko, M. K. Ibatov, D. A. Issagulova

Influence of initial porosity to process ECAP of powder materials. There was studied technology of processing Ti-6Al-4V powder material with various original density by using method of equal channel angular pressing. The device with the 90, 120 and 135° angled joint channels was used for research. A deformation was conducted at room temperature. It was found that the most favorable stress-strain state is formed in the instrument, where the angle of channel joints equal to 135 degrees. The maximum compression in instrument is reached at 90 degree angle of the channel joints, but it needs more deformation force. To obtain pressed material it is recommended to use high cycle ECAP for any configuration.

11. V. A. Andreyachshenko

FEM simulation of the fullering in device with movable elements. A stress-strain state formed in billet by fullering in instrument with movable elements was studied in this paper. It is determined that the compressing stresses prevail in studied instrument; they improve quality of the processed billets. Even maximum main normal stresses have compressing characteristics at slight tensile stresses. The stress-strain state was studied by using a computer simulation method, which was performed in DEFORM 3D software. The obtained results confirm the efficiency of new instrument in processing cylindrical billets.

12. F. Vode, J. Burja, F. Tehovnik, B. Arh

Lumped parameter model with inner state variables for modeling hot deformability of steels. Experimentally obtained stress, strain and strain rate on cylindrical hot compression test are used for classical description of hot deformability. Three existing lumped parameter models and one newly proposed model without inner state variables are compared. Parameters of each model are determined by nonlinear least square fitting. The result show approximately same prediction accuracy for deformation stress regardless the model used. The main reason for poor prediction accuracy is in fact that inner states of steel (grain size, static and dynamic recrystallization, ...) are not considered . Therefore, an approach to improve deformation stress prediction accuracy is presented by introducing lumped inner steel-state variables.

13. T. Miłek

The effect of upsetting ratio on mechanical properties for hydromechanically bulged axisymmetric components made from copper tubes. The paper presents experimental results of investigations of hydromechanical bulge forming of copper axisymmetric components whose relative wall thickness was $s_0/D= 0.045$. The deformation ratio of material in paper was defined as relative upsetting ratio $\Delta l/l_0$ (where Δl – the punch displacement, l_0 – initial length of tube). The investigations produced liquid pressure and force profile in hydromechanical bulge forming of copper axisymmetric components with different relative ratios $\Delta l/l_0=0.054\div0.109$. The research aimed to determine the impact of upsetting ratio on mechanical properties for hydromechanically bulged axisymmetric components. The mechanical properties of material were determined by tensile strength R_m and percentage reduction of area Z. The tensile strength R_m increased and the percentage reduction of area Z decreased together with increase in the upsetting ratio $\Delta l/l_0$.

14. P. Beraxa, Ľ. Parilák

The physical and tribological properties of TiCN coating deposited to cold forming tool. The cold forming tool life is limited in particular, by the surface hardness and resistance to abrasive wear. In the case of our tool there is a strong abrasive wear in the contact of tool and material being processed. Our goal was to increase the lifetime of tool used for production of steel seamless reducers by surface modification while improving the quality of manufactured reducers. An analysis of the production process highlighted the need for a comprehensive solution, and it changes the base material used for the production of tools along with application of CVD coating. For the following innovative tools we have applied TiCN coating and realized a various experimental tests to determine its physical and tribological properties, coating morphology and GDOES analysis of the chemical composition of TiCN coating. The result of this innovation was a significant increase in tool life.

15. M. Ridzoň, M. Mojžiš, P. Buček, P. Bella, Ľ. Parilák

Analysis of mechanical properties, formability and stress-strain states in the production of tubes with contoured internal surface. One of the priorities in company Železiarne Podbrezova in area the development and optimization of technological processes forming is the production of tubes with contoured internal surface. Characterized by a spiral rib on the inner surface and are used in boilers or in heat exchangers. The effect of these tubes is highly evaluated especially for use in boilers in coal-fired plants and operating at sub-critical pressures. The paper deals with the technological process of forming tubes with contoured internal surface, specifically the analysis of mechanical properties, formability of tube and describes the stress-strain states in cross-section tubes in DEFORM 3D simulation environment.

16. M. Suliga, R. Kruzel

The influence of lubricant carrier and lubrication conditions on mechanical-technological properties of high carbon steel wires. In this paper the effect of the type of soap powder and lubricant carriers on lubrication conditions in multipass drawing process of high carbon steel wires has been determined. The wire drawing process was conducted in industrial conditions by means of a modern multi-die Koch drawing machine. For wires drawn on borax and phosphate lubricant carriers the mechanical-technological properties have been carried out, in which yield stress, tensile strength, uniform elongation, number of twists and number of bends were assessed. It has been proved that the application of phosphate lubricant carrier and also the rotary die in the first draft in an essential way improve the lubrication condition in high speed multipass drawing process and makes it possible to refine the mechanical properties of wires.

17. R. Kruzel, M. Suliga

The impact of the heat treatment parameters on patenting line on mechanical-technological properties of steel cord wires. In the paper the influence of modification of patenting process on steel cord properties has been assessed. It was found that the wires of pearlite structure, in comparison to the wires of pearlite-bainite structure, characterized much better properties which is confirmed by higher tensile strength by more than 12 %, higher by 1,6 % the number of twists and higher by 3,6 % the number of bends. It was found that weaving steel wire cord causes a decline in its exploitation properties, which should be associated with an additional deformation of the wire in the cords manufacturing and the size of the decline depends on the type of wire structure.

18. P. Bella, P. Buček, M. Ridzoň, M. Mojžiš, Ľ. Parilák

Experimental validation of a numerical model of cold drawing of multi-rifled seamless steel tubes. In this paper, numerical simula-tion of multi-rifled tube drawing is being compared with the experiment regarding the dimen-sions of grooves on the inner surface of the tube. For numerical simulation, DEFORM 3D software has been utilized. The numerical model considered drawing of a hollow feedstock with dimensions 36 mm OD × 8 mm WT into the multi-rifled tube with dimensions 28.60 mm OD × 6.27 mm WT. The resulting inner surface exhibited a consistent inner grooving with a good match between numerical results and experimental results, obtained by optical 3D scanning. Based on the verified model, further optimization of various technological parameters can be made, providing an effective method for enhancing product quality and lowering production costs.

19. A. B. Naizabekov, H. Dyja, T. Bajor, S. N. Lezhnev, K. V. Tsay, A. S. Arbuz, N. Gusseynov, R. Nemkaeva

The effect of cross rolling on the microstructure of ferrous and non-ferrous metals and alloys. The cross rolling is the one of most perspective method of refinement microstructure metals by severe plastic deformation method. This method gives ability to get the long length billets. However, deformation and trajectories of the metal is very heterogeneous across the section of the rolled piece. This paper presents the FEM simulation of hot cross rolling and experimental study of the effect of the cross rolling on a different three-roll mills on the microstructure of ordinary structural alloy steel, stainless steel and technical copper in different zones of the bar. Analysis showed significant structure refinement in all cases. The best result was achieved on the stainless steel, and shown the formation of equiaxial ultrafinegrain structure on the bar periphery.

20. E. Bobruk, M. Murashkina, X. Sauvage, R. Valieva

Microstructure and ductility of binary Al-Zn aluminum alloy after severe plastic deformation. This work demonstrates that processing by SPD leads to the formation of UFG structure in the Al-Zn alloys and leads to improved ductility. The supersaturated solid solution in alloys is decomposed during SPD processing resulting in nucleation and growth of a secondary phase precipitates, formation of segregations of alloying elements. It is proposed that the atomic mobility could be significantly enhanced during SPD especially thanks to the high vacancy concentration, solute drag by dislocations, pipe diffusion along dislocations or grain boundary diffusion. We have systematically investigated such dynamic precipitation phenomena in Al–Zn alloys at different SPD processing regimes.

21. M. Murashkin, E. Bobruk, N. Enikeev, G. Raab, R. Valiev
Microstructure, mechanical properties, electrical conductivity and heat resistance of Al alloys after ECAP-conform processing and drawing. This work presents the results of the study of the UFG structure produced as a result of ECAP-Conform processing in Al-Mg-Si and Al-Mg-Zr alloys. The regularities in the variation of the mechanical properties, electrical conductivity and heat resistance of UFG alloys, depending on their chemical composition and features of the produced UFG states, have been investigated. It has been shown that the formation of specified UFG structures ensures achieving a combination of their high strength and electrical conductivity, as well as heat resistance. The possibility of producing UFG conductors from Al-based alloys through ECAP-Conform processing followed by cold drawing has been demonstrated.

22. S. Dobatkin, Yu. Estrin, S. Galkin, V. Serebryany, M. Diez, N. Martynenko
Ultrafine-Grained High Strength Mg-Al-Zn-Mn Alloy After Radial-Shift Rolling. Radial-shift rolling (RSR) of the Mg-4.4%Al-0.9%Zn-0.4%Mn(wt.%) alloy was carried out with gradual reduction of diameter from 58 to 15 mm (true strain – 2.63) and reduction of deformation temperature from 420 to 150°C. With decreasing of rolling temperature reduction of the grain size is observed. A final state of the samples at the rolling temperature 150°C represents relatively uniform UFG structure with the average grain size ~1.5 micron. Reduction of grain size at decreasing of rolling temperature changes the rolling texture to axial prismatic texture. With reduction of the grain size the strength increases up to YS =200 MPa, and UTS=330 MPa.

23. M. A. Nikitina, A. V. Ganeev, V. D. Sitdikov, R. K. Islamgaliev
Investigation of the effect of SPD processing on the structure and properties of martensitic steel. The aim of this work is the formation of an ultrafine-grained (UFG) structure in the steel EI-961Sh of the martensitic class by severe plastic deformation (SPD) processing. SPD techniques enable producing bulk materials with a grain size below 1 μm and predominantly high-angle grain boundaries, which ensures a combination of unique characteristics of strength and ductility. The structural features of the produced UFG samples will be studied by transmission electron microscopy and X-ray structural analysis. Tensile mechanical tests at room and elevated temperatures will be performed. The thermal stability of the UFG structure will be investigated.

24. G. I. Raab, F. Z. Utyashev, A. G. Raab
The relationship of strain and structural states during SPD. The nonconformities of the estimation of the strained state SPD methods by the analytical formulas, which traditionally are used in metal forming, are established. So the calculated values of the accumulated deformation can differ several times for one structural state. The reason for the nonconformity in indicated the fact that at the basis of formulas for calculating the degrees of deformation different components of tensor of distortion are used. Examples of calculation in the amount of the accumulated deformation of the contribution of rotary mode and its influence on the formation of grains are shown.

25. S. V. Dobatkin, O. V. Rybalchenko, A. Kliauga, A. A. Tokar
Structure and Properties of Cr-Ni Austenitic Steels after Shear Strain. The structure and properties of ASTM F138 and Cr-Ni-Ti steels after HPT at the range of 300 – 450°C and after ECAP at 400°C were studied. Shear strain produces nano- and UFG structure with grain size less than 125 nm after HPT and grain-subgrain structure with structural elements of 100- 400 nm after ECAP. Due to obtained microstructure yield strength of steels after HPT significantly increases. After ECAP the strength characteristics of steels are lower than those produced by HPT. The fatigue limit of both steels is virtually equal and exceeds the initial level by almost a factor of 2.

26. D. V. Shangina, N. R. Bochvar, M. V. Gorshenkov, S. V. Dobatkin
Structure and properties of ultrafine-grained Cu-Cr and Cu-Cr-Zr alloys produced by high pressure torsion. Low-alloyed copper-based alloys have excellent thermal and electrical conductivity in combination with moderate strength. Severe plastic deformation (SPD) can further enhance the strength of these alloys by forming an ultrafine-grained (UFG) structure. Alloying of Cu-Cr alloy with zirconium decreases its average grain size from 209 nm to 141 nm after high pressure torsion (HPT). It is shown that Cu_5Zr particles supress the grain growth in UFG structure more effectively than the Cr particles and provide additional hardening during aging. A combination of quenching, HPT and following aging of Cu-0.5%Cr-0.08%Zr alloy allowes obtaining simultaneously high-strengh and electical conductivity (HV=2.26 GPa and 69 % IACS).

27. M. Suliga
The influence of drawing speed on surface topography of high carbon steel wires. In this work the influence of the drawing speed on surface topography of high carbon steel wires has been assessed. The drawing process of ϕ 5,5 mm wire rod to the final wire of ϕ 1,7 mm was conducted in 12 passes, in industrial conditions, by means of a modern Koch multi-die drawing machine. The drawing speeds in the last passes were: 5, 10, 15, 20 and 25 m/s. The increase in drawing speed causes a decrease in surface roughness of wires. Significant smoothing of the surface of the wires drawn at a speed of 25 m/s confirm the parameters of amplitude, spatial and geometric structure of the hybrid surfaces which are from 20 to 50% lower than those obtained for wires drawn at a speed of 5 m/s.

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28. P. Skubisz, Ł. Lisiecki, J. Sińczak
Studies of the quality and cost-effectiveness of a novel concept of open-die forged powerplant main shaft, Metalurgija, 54 (2015) 2, 339

29. K. Laber, H. Dyja, M. Kalamorz
Analysis of the technology of rolling 5,5 mm-diameter wire rod of cold upsetting steel in the morgan block mill, Metalurgija, 54 (2015) 2, 415

30. Z. Pater, J. Tomczak, T. Bulzak
Experimental study of rotary compression for hollow parts, Metalurgija, 54 (2015) 2, 419

31. G. I. Raab, A. G. Raab, V. G. Shibakov
Analysis of shear deformation scheme efficiency in plastic structure formation processes, Metalurgija, 54 (2015) 2, 423

32. A. Dziubińska, A. Gontarz
Limiting phenomena in a new forming process for two-rib plates, Metalurgija, 54 (2015) 3, 555

33. Z. Pater, J. Tomczak, T. Bulzak
Numerical analysis of the skew rolling process for main shafts, Metalurgija, 54 (2015) 4, 627

34. Z. Gronostajski, M. Kaszuba, M. Hawryluk, M. Marciniak, M. Zwierzchowski, A. Mazurkiewicz, J. Smolik
Improving durability of hot forging tools by applying hybrid layers, Metalurgija, 54 (2015) 4, 687

35. M. Ullmann, F. Berge, K. Neh, R. Kawalla
Development of a rolling technology for twin-roll cast magnesium strips, Metalurgija, 54 (2015) 4, 711

36. M. Jabłońska, I. Bednarczyk, K. Rodak, A. Śmiglewicz
Study of the structure of intermetalics from Fe - Al system after the hot rolling, Metalurgija, 55 (2016) 1, 67

37. S. Rešković, I. Jandrlić, F. Vodopivec
Influence of testing rate on Lüders band propagation in niobium microalloyed steel, Metalurgija, 55 (2016) 2, 157

38. G. I. Raab, L. A. Simonova, G. N. Alyoshin
Tailoring the gradient ultrafine-grained structure in low-carbon steel during drawing with shear, Metalurgija, 55 (2016) 2, 177

39. M. Janjić, M. Vukčević, Z. Jurković, N. Šibalić, S. Savićević
Physical modelling and numerical finite element method (FEM) simulation of forging in open die of alloy AlMgSi0,5 , Metalurgija, 55 (2016) 2, 181

40. Z. Pater
A thermomechanical analysis of the multi-wedge helical rolling (MWHR) process for producing balls, Metalurgija, 55 (2016) 2, 233

41. R. Kawulok, I. Schindler, P. Kawulok, S. Rusz, P. Opěla, J. Kliber, Z. Solowski, K. M. Čmiel, P. Podolínský, M. Mališ, Z. Vašek, F. Vančura
Transformation kinetics of selected steel grades after plastic deformation, Metalurgija, 55 (2016) 3, 357

42. P. Váňová, J. Sojka, T. Kulová, V. Vodárek, M. Sozańska, B. Chmiela, J. Lelątko
The effect of deformation on the change of hydrogen diffusion in C-Mn-Si-P trip 800 steel, Metalurgija, 55 (2016) 3, 361

43. P. Kawulok, I. Schindler, R. Kawulok, S. Rusz, P. Opěla, J. Kliber, M. Kawuloková, Z. Solowski, K. M. Čmiel
Plastometric study of hot formability of hypereutectoid C – Mn – Cr – V steel, Metalurgija, 55 (2016) 3, 365

MATERIALS – SECTION "D"

1. T. Karkoszka

Factors influencing the requirements fulfilment in the zinc coating processes. The aim of the analysis was the assessment of the zinc coating process with application of the authorial methodology which allows in the highest degree to reflect the threats occurring in this process. Findings of the analysis are as follows: factors influencing the requirements fulfilment in the zinc coating process are not only the significance and the probability of occurrence of the incompatibilities and the possibility of process supervision, but also the influence of the technological parameters realization on ensuring the specific requirements and technical difficulty of parameters realization.

2. H. H. Yu, X. Li, Z. G. Yuan

Synthesis and characterization hollow spherical $La_{0,7}Sr_{0,2}Ca_{0,1}Co_{0,9}Fe_{0,1}O_{3-\delta}$ (LSCCT) for cathode of solid oxide fuel cell (SOFC). Hollow spheres structures of $La_{0,7}Sr_{0,2}Ca_{0,1}Co_{0,9}Fe_{0,1}O_{3-\delta}$ (LSCCT) have been synthesized via hydrothermal method using carbon spheres as template. The structure and electrical conductivity of obtained samples are characterized by X-ray diffraction (XRD), scanning electron microscope (SEM), transmission electron microscope (TEM) and direct current (DC) four-probe method respectively. The results show that hollow spheres structures of LSCCT with the mean particle size of 0,9 - 1,2 μm is single perovskite. The electrical conductivity of the samples is higher than 100 S/cm from 600 to 800 ℃ and can meet the demand of the electrical properties for the cathode materials.

3. D. Wilk-Kołodziejczyk, B. Mrzygłód, K. Regulski, I. Olejarczyk-Wożeńska, K. Jaśkowiec

Influence of process parameters on the properties of ADI examined with the use of data mining methods. The article presents opportunities offered by the data mining analysis as applied to studies of the effect of process parameters on the mechanical properties of ADI. The applied methods of regression trees and cluster analysis allow for the detection of relationships between parameters and also allow determination of strength and form of the impact of different factors. The results of this study allow the creation of knowledge bases for systems supporting the decision-making process in technology.

4. A. V. Todorut, L. Paliu-Popa, V. S. Tselentis, D. Cirnu

SUstainable cost reduction by lean management in metallurgical processes. This paper focuses on the need for sustainable cost reduction in the metallurgical industry by applying Lean Management (LM) tools and concepts in metallurgical production processes leading to increased competitiveness of corporations in a global market. The paper highlights that Lean Management is a novel way of thinking, adapting to change, reducing waste and continuous improvement, leading to sustainable development of companies in the metallurgical industry. The authors outline the main Lean Management instruments based on recent scientific research and include a comparative analysis of other tools, such as Sort, Straighten, Shine, Standardize, Sustain (5S), Visual Management (VM), Kaizen, Total Productive Maintenance (TPM), Single-Minute Exchange of Dies (SMED), leading to a critical appraisal of their application in the metallurgical industry.

5. J. Svetlík

Application device a layer of oil film on the inside surface of tubes of different cross section. Technology solution relates to a device for applying a layer of oil film on the inside surface of tubes of different cross section. It is suitable for metallurgical and engineering applications, which must be applied oil film - the coating film over the inside surface of tubes of different cross-section and different length because of the corrosion protection, because of the disinfecting, reducing the surface friction of the inner surface, or other reasons. The formulation of this concept is applicable to a broad portfolio of type-pipes of different sizes and shapes of cross sections of different lengths. The technical solution falls within the area of mechanical engineering and metallurgy.

6. L. Blacha, J. Brzoska

The use of the balanced scorecard in evaluating the results of the innovations implemented in metallurgical companies. Implemenation of innovations is the main factor of development of companies competitiveness and effectiveness. Innovations result in creation of a value for both the client and the company. The article presents a method of evaluating the innovations implemented in industry which emphasises, on the background of qualitative changes, the measurable (quantitative) effects of various types of innovations. For the purpose of measuring the reults of implemented innovations the Balanced Scorecard was used. The method developed by the authors of the paper was used to evaluate results of the innovations implemented in metallurgical companies.

7. D. Burchart-Korol

Development of circular economy principles and life cycle impact assessment methods for steel industry. The main purpose of the paper was to present possibility of development circular economy principles and life cycle impact assessment methods for environmental pollution reduction and resources management improvement in steel industry. Efficient use of resources is critical to sustainable steelmaking. Different life cycle impact assessment (LCIA) methods was used for environmental evaluation. It was chosen the most appropriate LCIA methods for resources evaluation in steelmaking which followed the rules of the circular economy (CE). According to the circular economy reduce of raw materials, zero waste and encourages the materials reuse and recycling should be applied. Application of LCIA methods for assessment of applied CE principles for steel industry was performed.

8. P. Wicher, F. Zapletal, R. Lenort, D. Staš

Measuring the metallurgical supply chain resilience using fuzzy analytic network process. The article presents a methodology for measuring the metallurgical supply chain resilience, which enables finding key resilience capabilities and measurable criteria, and determining a level of the resilience. The methodology is based on Analytic Network Process (ANP), which is used to solve the complex decision-making problems, whose structures can be mapped as non-linear networks. Due to the fact that uncertain pairwise comparisons expressed by the fuzzy sets are considered the Fuzzy Analytic Network Process (FNAP) is applied. The methodology is verified on generalised model of a metallurgical supply chain. The SuperDecisions software was used for the application. The performed experiments show that FANP approach is highly suitable to measure metallurgical supply chain resilience.

9. F. Tošenovský, D. Vykydal, P. Klaput, P. Halfarová

Stochastic Optimization of Laboratory Test Workflow at Metallurgical Testing Centers. The objective of the paper is to design a way to shorten the time required to perform laboratory tests of materials in metallurgy. The paper finds a relation between the time to perform a selected test of materials and the number of technicians carrying out the test. The relation can be used to optimize the number of technicians. The approach used is based on probability theory, given that the amount of material to be tested is unknown in advance, and draws on the most powerful modelling techniques available involving the GEE procedure.

10. T. Bakalar, H. Pavolova, S. Khouri, I. Pristašova

Influence of additives on decrease of temperature of slag flow from energy coal in wet bottom boiler. This paper describes the features of the energy coal combusted in a power plant, its impact on energy production, while the possibility of using natural and secondary raw materials to modify the properties of energy coal. All selected types of additives (fluorspar, DSS, dolomite, and limestone) in admixture of coal have clearly proved their ability to reduce the pour point of the ash in the laboratory experiments.The highest decrease of the temperature at 5 % of the additive was achieved by fluorspar and dolomite from the temperature of 1 593 °C to the temperature of 1 307 °C. In terms of the economy and the availability of the additives the most suitable seems to be DSS.

11. M. Gombar, J. Kmec, M. Badida, L. Sobotova, A. Vagaska, A. Badidova

Experimental analysis of the impact of physical factors on technological properties of aao layers and environment. In the contribution is evaluated the influence of physical factors of the anodizing oxidation process.The experiment was realised at three different current densities $J_1 = 3$ A.dm^{-2}, $J_2 = 4$ A.dm^{-2} and $J_3 = 5$ A.dm^{-2}. The microhardness was determined on polished metallographic samples by using 10 g of a load. The results showed, that

by increasing of values of physical factors in the frame of used values, also rise the conditional values of observed layer parameters, thus increasing the protection of the material and its resistance in the environment.

12. A. Myszkowski, W. Matysiak, D. Bartkowski
Evaluation the influence of rotational speed and feed rate of tool on surface quality of the shaped hole using Flowdrill technology. The paper presents results the influence of parameters edgetrimming holes using Flowdrill technology on selected properties of the hole surface. This study was conducted on three types of materials: aluminum, medium-carbon steel and copper. Various parameters of speed and feed rate were applied. Present specimens were prepared using CNC machine without and using intensive air cooling. It was found influence of processing parameters on surface condition of edgetrimming holes.

13. J. Całus Moszko, B. Białecka, M. Cempa-Balewicz, H. Świnder
Evaluating the possibilities of obtaining initial concentrates of rare earth elements (REEs) from fly ashes. The article presents the results of initial laboratory research into the possibilities of obtaining REE from fly ash from one of Polish powerhouses. In the work the authors have presented the results of investigations into the obtaining of initial REEs concentrations from fly ashes by physicochemical and hydrometallurgical methods. These investigations provide a basis for developing a technology of RRE recovery from fly ashes produced in the process of hard coals combustion.

14. H. Pavolová, S. Khouri, M. Cehlár, L. Domaracká, M. Puzder
Modelling of copper and zinc adsorption onto zeolite. Adsorption of Cu(II) and Zn(II) ions from metallurgical solutions has been studied and the adsorption capacity of zeolite (Nižný Hrabovec, SK) has been determined. Zeolites are characterized by relatively high sorption capacity, i.e. Cu(II) and Zn(II) can be removed even at relatively low concentrations. The experiments were realised in a batch system and evaluated using isotherms. According to the results of the experiments the adsorption equilibrium of Cu(II) and Zn(II) on zeolite was best described by Freundlich isotherm. The maximum sorption capacity was 1,48 and 1,49 mg/g for Cu(II) and Zn(II), respectively. The experimental results of this study demonstrate that zeolite is suitable for adsorption of copper and zinc from aqueous solutions at low concentrations.

15. D. Badulescu, A. Badulescu, A. Florea
Considerations on the (post) privatisation and corporate governance in the metallurgical industry in Central and Eastern Europe economies. Analysing the literature on the privatization and post-privatization process in Central and Eastern Europe metallurgy sector but also the specific results reported by the industry 25 years after, it can be concluded that the results are much more complex and far from the initial expectations. Privatization failed to lead to an effective corporate governance (in terms of ownership structure, independence of managers, market mechanism and minority shareholders' rights). Beyond the effects of the crisis and of the restructuring processes, the considerable vulnerability of metallurgical companies can be attributed to their excessive dependence on the strategies implemented by the large global groups, or to the lack of involvement of the state, both as minority shareholder, and as regulation authority.

16. H. Gołaś, A. Mazur, B. Mrugalska
Application of risk analysis and quality control methods for improvement of lead molding process. The aim of the paper is to highlight the significance of implication of risk analysis and quality control methods for the improvement of parameters of lead molding process. For this reason, Fault Mode and Effect Analysis was developed in the conceptual stage of a new product TC-G100-NR. However, the final product was faulty (a complete lack of adhesion of brass insert to leak) regardless of the previously defined potential problem and its preventive action. It contributed to the recognition of root causes, corrective actions and change of production parameters. It showed how these methods, level of their organization, systematic and rigorous study affect molding process parameters.

17. B. Białecka, K. Wierzchowski, A. Klupa, H. Świnder, J. Całus-Moszko, M. Cempa-Balewicz
Use of sulphuric acid in obtaining pre-concentrates of rare earth elements (REEs) from fly ash. Laboratory tests have been conducted so as to assess the possibility of using concentrated H_2SO_4 to obtain concentrates of REEs from fly ash produced in pulverized-fuel boilers. The subject of the study was the influence of temperature, material fineness and the use of ultrasounds on the conversion rate and efficiency of the process of leaching REEs from fly ash. The efficiency of each method has been assessed based on the concentration of REE ions. Changes in morphology and chemical composition of selected ash grains subjected to the process have also been determined by SEM/EDS method.

18. Š. Salokyová, J. Dobránsky, A. Panda
Monitoring the intensity of mechanical vibration during lathe processing. Article deals with the examination of the effect of cutting parameters on the occurrence and size of mechanical vibration on three selected measured points during the processing of chrome steel. It also includes execution, experiment evaluation in this field and comparison of measured vibrations acceleration amplitude values according to the standards. The results of the measurement serve for early identification of a defect, which has great effect on the smoothness and efficiency of the machine. The article concludes with the proposed new findings from the measured values evaluation and formulated new recommendations for the operation in production system with lathe turning technology. The measured experimental values of the acceleration amplitude of mechanical vibrations were compared with theoretical values.

19. W. Depczyński, L. Nowakowski, E. Miko, P. Hepner
Influence of porosity on machinability of sintered Fe Foam elements. The aim of the experiment was to study the machinability of porous metal foams formed by reduction of metal oxides during sintering. There was analysed the process of machining metal foams in relation to its porosity, mechanical properties, microstructure surface. These are the main elements of the design of machining processes elements made of metal foams. Metallic porous structure has been obtained as a result of sintering processes iron based Fe powders mixture and Fe (III) oxide space holder. Factors that have been tested include: geometrical shape of the sample, the geometric accuracy of the elements, the surface state after treatment depending on machining parameters and porosity of the metal foam.

20. W. Depczyński
Effect of carbon addition on the densification behaviour and microstructure evolution of sintered iron foam during pore formation process. The paper presents how carbon addition effects on densification behaviour and microstructure evolution of sintered iron foams. The technique of obtaining porous structures requires applying a metal oxide, easy to reduce by protective atmosphere, during the sintering process. This allows for combining irregular opened cellular structures. Metallic porous structure has been obtained as a result of sintering processes iron based powders mixtures with addition of copper catalyst and Fe (III) oxide as a space holder. Samples were sintered at temperature of 1130^{O}C and 50 min. long, in dissociated ammonia protective gas. The samples were studied on how the addition of carbon powder (0,8%÷2%) effects the porosity structure. The use of microscopy, SEM and LM allowed to analyze the changes in the structure of sintered samples.

21. B. Gajdzik, J. Sitko
Steel mill products analysis using qualities methods. The article presents the subject matter of steel mill product analysis using quality tools. The subject of quality control were bolts and a ball bushing. The Pareto chart and FMEA were used to assess faultiness of the products. The faultiness analysis in case of the bolt enabled us to detect the following defects: failure to keep the dimensional tolerance, dents and imprints, improper roughness, lack of pre-machining, non-compatibility of the electroplating and faults on the surface. Analysis of the ball bushing has also revealed defects such as: failure to keep the dimensional tolerance, dents and imprints, improper surface roughness, lack of surface pre-machining as well as sharp edges and splitting of the material.

22. K. Nowacki, T. Lis
Environment-friendly management of iron-bearing metallurgical waste. The main purpose of waste management should be reclamation of valuable raw materials and, consequently, protection of natural environment by reducing consumption of deposits and energy. The metallurgical industry generates considerable quantities of waste containing iron. This article addresses environment-friendly solutions for utilisation of such waste in the form of sludge and steelmaking dusts. What has been discussed is the impact of the technologies proposed on natural environment.

23. M. Kostelac, J. Tepić

Vibrations generation mechanism on trams. For trams moving on rails with shallow groove, resting on concrete sleepers or ground, exists many sources of vibrations with various wavelength. Dynamic forces which occur in the contact point between wheel and rail, because of wheel profile deformation and roundness deviation, generate vibrations with different wavelengths, which are spreaded through ground to nearby residential objects. Additional dynamic forces are generated during transition through crossings and switches or above poorly performed joints on rails. Uneven supports in curves or on the inclined routes may trigger additional transversal forces. Created frequencies of 4-8 Hz have very unfavorable influence on the surrounding and these cannot be considered as noise generated from vibrations in the frequency range 30-30 000 Hz.

24. A. Gessner

An approach for machining allowance optimization of castings in machine tool industry with the use of optical scanner. The publication demonstrates an application of optical scanner for optimization of casting machining. Two criteria of optimization were assumed: minimum volume of machined allowances and minimum number of machining passes. The research was carried out for a production series of machine tool castings. Their geometry was measured with the use of optical scanner, the obtained models were aligned with the reference one (CAD models) with the use of the best-fit method, the area of every single surface with machining allowance was calculated and finally the real allowances for the alignment were calculated. The optimization results concerning scale factors for both criteria were presented.

25. W. Walke, M. Kaczmarek, M. Staszuk, M. Basiaga

Influence of purge, time of waiting and TiCl4 dosing time in a low-pressure ALD reactor on properties of TiO2 layer. The aim of the study was to evaluate the influence of the ALD process parameters on mechanical properties and corrosion resistance of TiO_2 layer. The TiO_2 layer was deposited on stainless steel surfaces at constant temperature T = 200°C and number of cycles Nc = 500 (g ≈ 25 nm). The applied methodology consisted of potentiostatic, potentiodynamic and impedance studies, as well as hardness and adhesion test. The obtained results were the basis for selection of surface treatment method for stainless steel implants for contact with blood. Appropriate parameters of surface treatment realized by means of the ALD method is of significant importance. It will contribute to the development of technological conditions of specified deposition parameters of TiO_2 layers on steel implants.

26. I. E Uskova, N. L. Chekunova-Tomacheva

Creating conditions for the effective transformation of research results into practical activity of real sector of economy. An innovative mechanism is organizational and economic form of innovation activity implementation and facilitate its implementation, the search for innovative solutions, as well as the lever stimulate and regulate this activity. Innovative mechanisms should form functional innovation in its relation to stages of their life cycle. Under the functional securing means innovation, investment and financial security. Matrix structure, which allow to activate the innovation process and form a system of innovative mechanisms are mechanisms of organization, mechanisms of development and implementation, mechanisms of financing and incentive mechanisms for technology transfer.

27. N. L. Chekunova-Tomacheva, I. E. Uskova

Forms and methods of optimization of business procedures resource management research complex. Defining requirement of the market, the profitability for key market actors market actors realization of intellectual products: producer of equipment – the higher the profit; the consumer is the achievement of maximum economic effect from the introduction of innovations. It seems necessary to consider the problem of synthesis of market implementation of new material. Ideal scheme – crafted material in comparison with the analogue of higher quality with less cost. In reality, the difficulty in mastering the production of new material (the cost of research work, preparation of production, etc.) may lead to higher prices.

28. P. Odesskiy, I. Vedyakov, S. Gurov

Electric welding pipe profiles for unique engineering structures. Application of the round pipes of high strength in the construction of large-scale public buildings, stadiums, airports, etc. is effective in many respects: a minimum weight of structures, providing of the high resistance to influences and loads. It was installed in practice that the longitudinal welded pipes with diameters 530 - 1420 mm, with wall thickness of 10 - 50 mm, with a yield strength of 350 - 480 N / mm^2 possess of high engineering properties. By the chemical composition steels characterize by low carbon content (<0,1%) harmful impurities (S<0,010%; P<0,015%) and gases, therefore, they are welded good. Metal of pipes has a high resistance to brittle fracture with $KCV^{-40} > 100$ J/sm^2.

29. J. Machnik-Słomka, P. Kordel

Significance of technological entrepreneurship and creativity in metallurgical enterprises. Tis article presents the categories of technological entrepreneurship and creativity that consti-tute a new perspective on developmental mechanisms of contemporary enterprises. These mechanisms are of particular significance in relation to industrial enterprises, including metal-lurgic ones. Forthe purposes of thispublicationthe significance of technological creativity and entrepreneurship is described with the examples of metallurgical enterprises.

30. A. Saniuk, S. Saniuk

Areas of particular control in steel production – result of research. The market of steel production in Poland is growing rapidly, even with the decline recorded in Europe. Steel distribution market in Poland is very fragmented and the largest distributors are only a few percent share of the market. The biggest steel customers are construction and automotive segment. In this situation, there is a strong need to implement new methods and solutions which help to improve an effectiveness of steel production companies. The article presents the results of research related to the evaluation of enterprise effectiveness involved in the steel production. The new solution based on specially developed system of indicators is described. It allows the main areas of steel production to be controlled.

31. M. Górska, R. Prusak

An identification and the assessment of improvement need for production systems functioning in enterprises of the metal branch. The improvement of production process is a base of the competitiveness of the enterprise in the metal branch on the market. In the time of strong competition abandoning or the lack of improvement for areas requiring improvement can be fatal for the enterprise. Therefore there are some important actions contributing to the identification and assessments of the need for improvement in the area of producing the iron goods. In this study an attempt of identifications areas for production processes of iron goods that require improvement was made. The determination of such areas can become the source of many valuable information for the enterprise and it make possible to determine the directions of improvement. Results of research allowed also describing area of importance for tasks realization that contributing to improvement of chosen enterprises from the metal sector.

32. F. Tehovnik, F. Vode, J. Burja

Cracking of stainless steel molds for injection glass molding. During glass injection molding hot melted glass is injected in the stainless steel molds. The steel molds have to endure high temperatures and high temperature differences. The investigated molds cracked before their expected life time. A failure analysis was made and the reasons for cracking were found and scientifically explained. The facture surfaces were examined by macroscopic microscopic analysis. The fault resided in the lubrication of the mold and stress-corrosion reactions that were enabled by the given operating conditions.

33. F. Vode, J. Burja, F. Tehovnik

Classification and management of delays for continuous reheat furnaces in steel industry. Continuous reheat furnaces in steel industry are either used for heat treatment or for reheating prior to hot rolling/forging process. Variation of duration of hot rolling process is the main source of disturbances of stock reheating process. A systematic classification of delays dedicated for the closed-loop control of slab-temperatures is presented. Delays are basically divided in two groups: delay with unknown duration and delays with known duration. The later are further divided on four sub-groups with respect to the source of delay, where one group is delay due to hot rolling duration.

34. R. Galuszka, M. Madej, D. Ozimina, A. Krzyszkowski, G. Galuszka
The characterisation of the microstructure and mechanical properties of DLC coatings for biomedical applications. The paper presents the results of research of diamond – like coating of a-C:H type obtained by using a technique of physical vapor deposition (PVD) on the surface of CoCrMo alloy, commonly used for the elements of the endoprosthesis. The surface has been observed using a scanning electron microscope SEM. Analysis of the chemical composition and distribution of the different elements were performed using GDOES analysis (glow discharge optical emission spectrometry). It has been shown that the diamond – like coated elements are characterized by high hardness and good adhesion to the substrate.

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