CROATIAN METALLURGICAL SOCIETY
HRVATSKO METALURŠKO DRUŠTVO

5th INTERNATIONAL
5. MEĐUNARODNI

SYMPOSIUM OF CROATIAN METALLURGICAL SOCIETY
SIMPOZIJ HRVATSKOG METALURŠKOG DRUŠTVA

S H M D '2002.

MATERIALS AND METALLURGY
MATERIJALI I METALURGIJA

The 5th International Symposium of Croatian Metallurgical Society
"Materials and Metallurgy" is held as a part of:

- 50th anniversary of the foundation of Technical University of Košice, Metallurgical Faculty and BERG Faculty,
- 50 years experience of the Tubes production in Željezara Sisak - Nova d.o.o.,
- 40th anniversary of the foundation and publication of the Journal *Metalurgija*,
- 10th anniversary of the foundation of Croatian Metallurgical Society (from Society of Engineers and Technician Željezara Sisak - 1957 y.).

SUMMARIES OF LECTURES
SAŽECI PREDAVANJA

ŠIBENIK, CROATIA, June 23-27, 2002.
ŠIBENIK, HRVATSKA, 23.-27. lipnja 2000.

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5th INTERNATIONAL SYMPOSIUM OF CROATIAN METALLURGICAL SOCIETY MATERIALS AND METALLURGY
PETI MEĐUNARODNI SIMPOZIJ HRVATSKOG METALURŠKOG DRUŠTVA MATERIJALI I METALURGIJA
SUMMARIES OF LECTURES - SAŽECI PREDAVANJA

PLENARY LECTURES

1. W. Schwenzfeier, M. Philipp, O. K. Harrer; *Institut für Verformungs-kunde und Hüttenmaschinen, Montannversität Leoben, Österreich*
Simulation in der Metallurgie. Die vorliegende Veröffentlichung umreißt in groben Zügen die Grundlagen der Simulation sowie den Weg vom realen Problem zum Modell. An einigen Fallbeispielen ist der Einsatz der Simulation in der Metallurgie gezeigt. Ablaufsimulation, Parameterstudien sowie Simulationen zu Produkteigenschaften werden erklärt. Die Entwicklung von neuen Verfahren mittels der Simulation ist ebenfalls beschrieben.

2. A. Smolej, E. Slaček*, R. Turk; *Faculty of Natural Science and Engineering, University of Ljubljana, Ljubljana, Slovenia, *Impol, Aluminium Industry, Slovenska Bistrica, Slovenia*
State and Development of some Wrought Aluminium Alloys for Special and General Applications. Aluminium is introduced into use in all industrial fields. Demands for lighter and stronger semi products and products are driving force for continuous improvement of standard alloys in regard of composition, properties, and manufacturing technologies. The competition with non-metallic materials demands further development of new aluminium alloys. The paper presents a short review of development of some aluminium wrought alloys intended mainly for rolled products. As the first group, Al-Li-X and super plastic alloys are described, both being used for specific purposes. The second group consists of alloys which were developed on the basis of standard alloys, and are intensively used for series products like wrapping and packing materials, and automobiles.

3. H. Hiebler; *Institut für Eisenhüttenkunde, Montanuniversität Leoben, Österreich*
Entwicklung und Stand des LD-Verfahrens. Entwicklung des LD-Verfahrens und Anteil an der Welt Stahlproduktion - Verfahrenstechnische und metallurgische Merkmale des LD-Prozesses - Abbrand von Kohlenstoff und Verschlackung der Eisenbegleitelemente - Zustand von Schmelze und Schlacke zu Blasende - Schlackenverwertung und Umweltschutz - Leistungsdaten von LD-Stahlwerken.

4. Ľ. Mihok, G. Lešinský*; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia, *U. S. Steel Košice, Košice, Slovakia*
Environmental Control in Integrated Steelworks. The paper deals with Integrated Prevention and PoIlution Controll (IPPC) directive and its application in steelmaking industry. The Best Available Techniques (BAT) principle is defined as the one of the most important tools of IPPC. Next four fundamental iron and steelmaking processes are discussed from the point of view of specific pollution to environment: production of iron ore sinter, production of pig iron in blast furnace, basic oxygen steelmaking, electric arc steelmaking, and BATs for the proccsses are defined.

5. R. Kawalla, W. Lehnert; *Institut für Metallformung, TU Bergakademie Freiberg, BRD*
Prozeß-, Anlagen- und Produktentwicklungen Beim Walzen von Stabstahl und Draht. Der Bedarf an Stabstählen und Drähten in Art, Menge und Qualität hat sich in der Vergangenheit wesentlich verändert. Die Fortschritte in der Walzwerkstechnik waren und sind ausschlaggebend, daß bemerkenswerte Qualitätsverbesserungen anvisiert und erzielt werden konnten. Für die Zukunft kann vor allem eine weitere Verschärfung der Maßstäbe an die Produktqualität prognostiziert werden. Technologisch kommt bei allen Stählen der werkstoffgerechten Temperaturführung beim Walzen eine besondere Bedeutung zu. Die Zuverlässigkeit der Prozeßführung ist sowohl ausschlaggebend für das erreichbare Qualitätsniveau als auch für die Treffsicherheit, mit der die Qualitätsparameter bei den verschiedenen Walzerzeugnissen erzielt werden können. Mit Hilfe integrierter Prozeßmodelle, die die werkstoffspezifischen, verfahrens- und anlagentechnischen Besonderheiten gleichermaßen berücksichtigen, können Technologien simuliert, bewertet und optimiert, die Walzprozesse präzis gesteuert werden. Der wissenschaftliche Erkenntnisstand der Modellierung und Simulation beim Warmwalzen hat einen hohen Stand erreicht und ist nunmehr auch für das Walzen von Stabstahl und Draht relativ weit fortgeschritten. Er bietet die Basis für nachhaltige technisch-technologische Innovationen.

6. K. - E. Hensger; *SMS Demag AG, Düsseldorf, Germany*
Processing of Advanced Structural Steels on CSP Plants. Compact Strip Production (CSP) is an process established for the effective manufacture of advanced hot strips. Leading CSP producers put the production emphasis on high-quality grades, and consistently restricting the processing of low-quality grades for competitive reasons. The paper focuses on two major subjects: first: materials processed in CSP plants and examples of application of CSP hot strip are given. After a short overview a closer look to the processing of HSLA grades in CSP plants is taken. These high strength grades with Y. S. up to 600 MPa are manufactured in CSP plants on large scale and with great reliability, second: steel group of interest here - multiphase steels is about to be processed in CSP plants. Requirements on material properties for this new product group are given, which deal with the relationship between microstructure and properties and go over to the metallurgical microstructures. Special focus on DP and TRIP grades is given.

7. M. Jenko, D. Mandrino, M. Milun; *Institute of Metals and Technology, Ljubljana, Slovenia*
High Resolution Auger Spectroscopy in Metallurgy: An Advanced Technique for Surface Analysis. A brief review of the high spatial resolution Auger electron spectroscopy (HRAES) and its usage in metallurgy is presented. A combination of HRAES and X-ray photoelectron spectroscopy makes a powerful combination to resolve a large number of problems encountered in metallurgy. Several selected examples of such problems studied in the authors' laboratory are presented: influence of surface active impurities on the surface properties and structure, chemical composition of nano-scaled inclusions, homogeneity of oxide layers formed by decarburization, chemical composition of inter- and intra-grain surfaces obtained by fracture in vacuum and interfacial study of 19Cr-13Ni austenitic stainless steel after treatment at elevated temperatures.

8. D. Fleš; *Secretary of the Department of Technical Sciences, Croatian Academy of Sciences and Arts, Zagreb, Croatia*
Materials for the New Millennium-Synthetic Inorganic, Semi-Inorganic, and Organic-Inorganic Hybrid Polymers. The properties of mineralogical and covalent inorganic polymers are brieffy described in the introductory part. Glass is an important polymer made up of rings and chains of silicate units which contain negatively charged oxygen atoms neutralized by positive metal ions. Glass and few other mineralogical types of inorganic polymers,

like aluminum oxyde, could be fabricated into fibers and used as insulating materials, and as reinforcing fibers in composite materials. Most rocks, bricks, concrete and ceramics belong to mineralogical polymers which are of great importance as construction materials, but their application is often limited because they are not flexible, elastomeric and resistant to impact. The most important covalent polymers are poly(organosiloxanes) and poly(organophosphazenes). Poly (organosiloxanes) contain chains of silicone-oxygen atoms with two methyl groups attached to silicon atoms. Silicone polymers have low glass transition temperature of -130 °C. Temperature of elasticity of silicone rubber is from -30 °C to 250 °C. They strongly repel water and are used as corrosion inhibitors of metals. An important field of application of silicones is in medicine and in preparation of medical devices. In continuation, there are briefly described the properties and application of poly(phosphazenes) and poly(sulfur nitride). After that, several examples of organic-inorganic hybrid polymers are listed, illustrating the variety of existing and possible new commercial applications of these new materials. The following applications of hybrid polymers are described: silane block copolymers for contact lenses, acrylate tin copolymers for marine antifoulant coatings, scratch resistant automotive coatinas and preparation of microporous silica.

9. E. Kalinushkin, I. Mamuzić*, Yu. Taran, L. Tykhonuk; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine, *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*
Steels of Peritectic Type: Peculiarities of Structure, Alloying Technology and Use. The article presents analysis of phase transformation characteristics, primary structure formation, alloying technology and usage of steels, which undergo a peritectic transformation during their solidification.

10. P. Rybár, T. Lazar, H. Hamrák, M. Demčák, D. Domaradský; *BERG Faculty, Technical University of Košice, Slovakia*
An Application of a High-Temperature and High-Pressure Reactor. A prototype of a high-temperature and high-pressure reactor on oxygen-hydrogen flame used for gravity separation of multiple mineral components mixture is already in its second year of development. This equipment, appliyed in a high temperature range, is able to treat the waste of some industrial technologies, which are of multiple component nature.

11. I. Vitez, I. Budić; *Mechanical Engineering Faculty, University in Osijek, Slavonski Brod, Croatia*
Trends Predominating on Conferences of European Organisation for Quality. European annual conferences on quality (EOQ) have been held continuously since 1957. Total number of 45 conferences has been registered till 2001. This paper gives a concise review on topics and mottos of the 10 last conferences, their way of reasoning, final messages and trends in quality management.

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REVIEW OF THE PAPERS OF MATERIALS - SECTION "A"

The materials section includes 135 lectures (Poster section). The principal authors (first author) are from 11 states:

- Ukraine (31 lectures)
- Russia (26 lectures)
- USA (1 lecture)
- Slovenia (14 lectures)
- Italy (1 lecture)
- Croatia (11 lectures)
- Slovakia (36 lectures)
- Czech Republic (3 lectures)
- Romania (4 lectures)
- Poland (6 lectures)
- Belaruss (2 lectures)

The topics of scientific and professional research are investigation of metalic materials, microstructure and properties:

PMPT - Physical metallurgy and phase transformation (papers no. **1-12**)
PBMM - Properties and behaviour of metallic materials (papers no. **13-29**)
ICM - Investigation and control methods (papers no. **30-45**)
CCP - Corrosion and corrosion protection (papers no. **46-55**)
CMS - Computer modelling and simulation (papers no. **56-61**)
STP - Surface technology and properties (papers no. **62-70**)
NMM - New metallic materials (papers no. **71-80**)
SPS - Solidification processes and structure (papers no. **81-83**)
WP - Weldments properties (papers no. **84-88**)
SHTS - Structural and heat treatment steels (papers no. **89-98**)
NFA - Non ferrous alloys (papers no. **99-110**)
PCM - Powder and composite materials (papers no. **111-115**)
SS - Stainless steels (papers no. **116-118**)
IA - Intermetallic melts (papers no. **119-120**)
MM - Metallic melts (papers no. **121-122**)
WT - Working technology (papers no. **123-126**)
CI - Cast irons (papers no. **127-130**)
HTT - Heat treatment technology (papers no. **131-132**)
PM - Polymer materials (paper no. **133**)
CM - Ceramic materials (paper no. **134**)
MET - Modern elaboration technology (paper no. **135**)

F. Vodopivec, Institute of Metals and Technology, Ljubljana, Slovenia

"A" MATERIALS SECTION

1. M. P. Kashchenko, A. G. Semenovih, V. G. Chashchina; *The Ural State Forest Engineering University, Ekaterinburg, Russia*
Interpretation of Features of a' Martensite Orientation Relations in Cryston Model. Within the framework of the concept of cryston (carriers of the localized shear) the observable morphological characters of strain-induced martensitic crystals in the iron-based alloys are analyzed. The process of stability losses of initial g phase is bound to the deformation that is transferred by cryston. It is considered that this deformation promotes the Bain's one. The role of the main order parameter plays the relative volume change. The morphological features of α' martensitic crystals are also considered. They show itself the abnormal disorientation of planes including orientation relationships (OR). The observable features have had natural interpretation by the accounting of possible lattice rotation around axis selected by cryston carriers of threshold deformation.

2. A. P. Klimenko, A. I. Karnaukh, G. Ju. Stanchitz, V. A. Solnushko, A. I. Mikhalyov; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Effects of Resonance Occurred by Electromagnetic Fields on Phase Transformations Process. Resonance electromagnetic fields action has following effects: speed-up phase transformation process and process of re-crystallization. Resonance effects cause sufficient changes of steels microstructure and they also lead to irregular phase transformations.

3. M. P. Tonkovič, L. Kosec*, J. Lamut*, V. Gontarev*, Z. Samardžija;** *Post-secondary School for Mechanical Engineer, Novo Mesto, *Faculty of Natural Science and Engineering, University of Ljubljana, **Institut Jozef Stefan, Ljubljana, Slovenia*
Mechanism of the Oxidation of Fe-C-Si-Al-Zr Alloys. Mechanism of the oxidation of the thermal-resistant Fe-C-Si-Al-Zr alloys was investigated at high temperatures. For the analysis three samples series: L1, L2 and L3, had been annealed at 1100 °C. After annealing the samples were investigated on oxide thickness increase. They were analysed by optical and electron microscopes. In case of the small zirconium content at L1 sample, the graphite lamellae and only a significant amount of zirconium carbide in the ferrite matrix have been observed. At higher zirconium content (the L2 and L3 series) graphite lamellae and particles of ZrC have been observed. During annealing an oxidation of graphite and ZrC took place. The oxidation of ZrC into ZrO_2 is direct and progressive. Evolving CO gas formed pores around ZrO_2. Under sufficient amount of dissolved oxygen the oxidation of aluminium took place too. Al_2O_3 precipitaties in CO-ferrite interface filling up the formed pores. Finally the interaction between ZrO_2 and Al_2O_3 took place and formation the of $ZrO_2 \cdot Al_2O_3$ retarded further oxidation.

4. N. V. Goncharova, T. M. Makhneva; *Institute of an Applied Mechanics, Ural Branch Academy of Sciences, Izhevsk, Russia*
Criteria of Creation of new Ferrite Alloys with Nitrous Austenitic Structure. The fact of increase of absorption of nitrogen in a high-temperature γ-phase at the thermal treatment in a hermetic volume is the basis of creation of economically doped biphase ferrite alloys with stable austenitic structure. The creation of nitrous austenitic structure is possible by of dissolution of a sufficient amount of nitrogen in γ-phase and holding it in a solid solution for a long time, giving high stability to supercooling and duration in a wide interval of temperatures as a guarantee. A method of thermodynamic simulation, in which the equilibrium composition of an studied system was supposed to correspond, to a maximum of system entropy, was used as theoretical approach to the solution of a problem. The absorption of nitrogen in alloys at various temperatures was examined from the point of view of thermodynamics of absorptive processes. The simulation of the nitrogen absorption in a wide interval of concentrations of chrome and temperatures of existence of γ-phase allowed to construct diagrams of nitrogen solubility, and so to determine requirements, at which diffusion of nitrogen into an alloy in a hermetic volume occurs, and to formulate criteria to invent new alloys with the stable nitrous austenitic structure. Ferrite alloys with nitrous austenitic in the structure, have higher corrosion quality in comparison with pure ferrite ones.

5. L. Cristea; *University "Politehnica" Bucharest, Bucharest, Romania*
The Kinetic Process of Decomposition of Supersaturated Solid Solution on AlNi with Low Ni Content obtained by Rapid Quenching from the Melt. The paper presents a monoplastic structure of a metastable solid solution of Ni in Al with a degree of super saturation approx. 80 x, applying the rapid quenching of the Al-0 48 wt % Ni alloy melt. The decomposition of this solution was examined during isothermal annealing by means of electrical resistivity measurements. The kinetics of decomposition process permitted to obtain the constant "K" at different temperatures and these results have been introduced in the Arrhenins relation as temperature dependence of the reaction rate.

6. V. I. Myravyov, V. I. Merkulov, N. A. Semashko, A. V. Yakimov, A. V. Frolov; *Federal State Unitary Enterprise "Komsomolsk-na-Amure Aviation Industrial Company by Name of Y. A. Gagarin", Komsomolsk on Amur, Russia*
Influencle a Regulating of Concentrated Dislocation Distribution on Properties of Metals and Alloys. Two different ways to increase the materials strength are well-known from the dislocation theory. One of them is to obtain the absolutely defect-free (dislocation-free) crystals, which have strength similar to theoretic strength. And another is to make the high-dislocation structures by technological methods (plastic deformation, thermal and thermo-mechanical treatment, alloying and others). If the critical concentration of dislocation density is formed, some parts of metal and alloy are oversaturated by dislocations in consequence of uneven distribution of structure defects. This process breaks solidity in form of submicrocracks, it decreases a strength by (20 - 30) % and increases a plasticity, higher temperature of tempering correspond to lower ultimate strength and greater plasticity. The purpose of this research is to find the influence of technological processing methods of a mutual increase both strength and plasticity.

7. A. I. Gordienko, V. V. Krylov-Oliferenko; *Physical-technical Institute of National Academy of Sciences of Belarus, Minsk, Republic of Belarus*
Continuous Recrystallisation Annealing of Low-Carbon Steel. The effect of heating and cooling parameters on properties of a cold-rolled heavy-deformed low-carbon steel was investigated during the process of a continuous annealing. The material used for investigation was 0.8 kg of steel 0.25 mm thick with 90-92 % degree of deformation in a rolled condition. The above-mentioned parameters included the heating rate, temperature and time of intermediate isothermal holding, the heating temperature and time of isothermal holding at this temperature, the cooling rate as well as temperature and time of intermediate isothermal holding in the process of cooling. The cooling conditions were shown to have a major effect on the state of a steel under study. The cooling rate that ensured the conditions favorable for the development of an overageing process was determined.

8. V. Krylov-Alefirenka, S. Isakov, V. Filippov; *Physical-technical Institute of National Academy of Sciences of Belarus, Minsk, Republic of Belarus*
H**igh-Speed Subrecrystallization Annealing of High-Carbon Steel.** The investigation was made of the relationship between the mechanical properties of a heavy-deformed low-carbon steel and heating rate and temperature. The material used for investigation was a cold-rolled wire of 1.0 mm and 0.9 mm in diameter. The heating was carried out according to two schemes. In the first scheme the heating was done at the rate of 350 - 450

°C/s up to the maximum temperature and then the samples were immediately immersed in water. In the second scheme the heating was first carried out at the rate of 350 - 450 °C/s and then the heating rate was lowered down to 60 - 80 °C/s at an intermediate temperature. The mechanisms responsible for variation of ultimate strength and elongation were determined dependent on the heating parameters. It was shown that the lowering of a heating rate could lead to both increase and decrease of an investigated steel plasticity up to an entire embrittlement. The determination was also made on the temperatures which caused the heating rate lowering as well as of those which ensured achievement of a maximum plasticity of a steel while retaining its strength characteristics.

9. N. T. Egorov; *Donetsk National Technical University, Donetsk, Ukraine*
Mechanism and Structural Peculiarities of Austenitization of Low-Carbon Steels with Initial Ferritic-Pearlitic Structure. The peculiarities of process of austenitization of low-carbon steels with initial ferritic-pearlitic structure are studied. It is established, that nucleation of austenitic near defects of structure in α-phase may occur more intensively than inside the pearlite on ferrite-cementite boundaries. It is the matter of fact that migration of carbon is possible not only in direction "cementite-austenite-ferrite", but in "cementite-ferrite-austenite". The oriented formation of austenite on ferrite grain boundaries was found. Austenite crystals grow intensively along certain crystallographic planes. It shows widmanstatten nature of such α-β transformation. Development of it causes the formation of subgrain structure. The established mechanism of austenitic transformation in low-carbon steels is used for development of intensive technologies of heat treatment of rolled plates for general application.

10. S. Rešković, S. Vodopivec*, V. Novosel; *Stelworks Sisak, Sisak, Croatia, *Institute of Metals and Technology, Ljubljana, Slovenia*
Behavioiur of Niobium at Reducing of Not-drawn Welded Tubes. In the work are presented the resu1ts of the changes of niobium bonds in carbon nitrides and their affect on the change of the structures along the reduction phases of hot-drawn high frequency longitudinal welded tubes. In addition to the classical ways of chemical analysis, metalographic microanalysis and Vickers hardness, the method of diffraction of x-rays is also used. The results obtained indicate inter-affect of strengthening and softening mechanism.

11. M. Kollárová, A. Leško*, I. Sinaiová, Ľ Parilak; *Institute of Materials Research of SAS, Košice, Slovakia, *Research and Development Institute of U. S. S. Košice, Slovakia,*
Phase Evolution in Galvannealed Coatings on Steel Sheets. The morphology development of hot dip galvanized steels after annealing has been investigated. Three industrially manufactured hot dip galvanized steel sheets of various chemical compositions, mainly the carbon contents changed, namely titanium stabilized IF, law carbon Al-killed and microalloyed steels were used. The additional heat treatment was carried out at three different temperature s 450, 500, 550 °C and for 10 and 60 seconds holding times to monitor the morphology and kinetics of intermetallic zinc-iron phases development in the zinc coatings. Temperatures for annealing were chosen with respect to the parameters of industrial galvannealing process. For all three steels, iron concentration dependences on the distance from interface steel-zinc coating for different temperatures and times are given. In all cases, the highest temperature, 550 °C, and the longest holding time, 60 seconds converted the entire zinc layer to the most iron rich intermetallic phase.

12. V. P. Rombakh; *Lugansk Pedagogical University, Shoreline, USA*
Heteropauling Model of Metal, Its Crystallisation, Strengthening and Fracture. New atom parameters named: fersman, goldschmidt and pauling entered. It was shown, that refraction and electronegativity of the atom is evaluated by the algebraic equations through fersman atoms and energy cation-anion interaction-through their difference. According to this model, the metal consist of atoms of different configuration of electron shell (Heteropauling model). The new kind of domain and valency charing waves are considered. On the basis of the model the mechanism of crystallization, strengthening and fracture of metals is offered and the series of experimental facts, related to the metal fraction with mechanical, heat, electron and laser impacts explained.

13. I. V. Ushakov, V. A. Feodorov*; General Physics Department, Tambov State University, Tambov, Russia*
Investigation of Damage and Plasticity of Thermally Treated Metallic Glass in Condition of Local Loading. The present study is focused on the investigation of endurance to cracking and morphology of destruction of annealed metallic glass (MG) in conditions of localloading. The material used in the present work was MG 82K3XCP, with thickness 30 μm. Before testing MG was annealed T_{an} = 373 - 1073 K. Local loading was made by Vickers pyramid. It was found, that morphology of destruction depends on temperature of annealing and on loading of the indentor. The mechanism of crack initiation is discussed. The linear dependencies of endurance to cracking from value of loading were determined. It was established, that endurance to cracking of MG, annealed in the temperature range of 748 - 888 K, was Iowered exponentially.

14. O. V. Sosnin, V. E. Gromov, V. V. Kovalenko, E. V. Kozlov, Yu. F. Ivanov, S. V. Konovalov; *Siberian State University of Industry, Novokuznetsk, Russia*
Physical Nature of Structure-Phase Transitions during Low-cycle Fatigue with Electrostlimulation. The action of optimum parameters on amplitude frequency and duration of powerful current impulses in process of low-cycle fatigue of stainless steel allows to increase the fatigue limit of strength up to 30 - 40 %. The effect of improving the steel properties by electrostimulation is largely connected with the nature of beginning the development of micro- and macrocracks. Crack path for cycle of tests in initial specimens is larger than in stimulated ones. The electrostimulation does not change the place of cracks development: as in initial specimen they are presented by innerphase and interphase boundaries of division, but it decreases their quantity. The development of γ ® ε transformation is lowered, the total characteristic of the whole complex of processes is the abrupt decrease in density of possible places of microcracks development in electrostimulated austenitic steel and a great difficulty in their movement. The whole complex of these processes shifts the distruction to the larger number of loading cycles.

15. S. V. Konovalov, O. S. Leikina, O. V. Sosnin, V. E. Gromov, V. Ya. Tsellermaer; *Siberian State University of Industry, Novokuznetsk, Russia*
Modification of Physico-Mechanical Properties of Steel Details by Current Processing. The action by current impulses is one of internal energetic actions bringing to modification of physico-mechanical properties. In this work the investigation of action duration by current (f = 20 Hz, I = 0 - 300 A) on change of physico-mechanical properties of specimens made of steel 40 is given. Primarily, the specimens were undergone by multicycle fatigue. In work it was also stated that the depence of ultrasound fatigue from number of loading cycles during multicycle fatigue of steel 45 is given by three-stage lowering curve itself. The relative change of ultrasound speed increases linearly with enlarging the time of current action. After current processing the structure has an appearance near to the initial structure. The dependence of microhardness on time of current action has a parabolic appearance. This parabolic dependence may probably be the result of one of two effects, i. e. the electroplastic and the heat ones. During current processing there is a decrease of regions size of coherent scattering. We found that during current action the increase of fatigue resource up to 28 % takes place.

16. M. M. Myshlyaev, M. M. Kamalov; *Baikov Institute of Metallurgy and Materials Sciences, RAS, Moscow, Russia*
Structure - Kinetic Principle for Superplasticity of Solid states. Mechanical behaviour at creep and superplasticity of fine grain zinc alloy and amorphous cobalt alloy under tension and of large grain and monocrystalline aluminium under torsion are discussed from unified positions. It is shown that realization of their superplasticity requires fulfilment of structure-kinetic principle.

17. M. M. Myshlyaev, M. M. Kamalov; *Baikov Institute of Metallurgy and Materials Sciences, RAS, Moscow, Russia*
Structure-Phase State, Mechanical Behavior and High Strain rate Superplasticity of the Eca - Pressed Aluminium - Lithium Alloys. The structure and phase state of rods subjected to the ECA-pressing under different conditions have been studied. A fine-grained structure bas been shown to form in the process of pressing. A mechanical behaviour bas been studied for ECA-pressed samples having different structural states. Mechanical behaviour of the 1420 alloy bas been studied in SP conditions. Dependencies of true strain rate on temperature, true stress and true strain for the deformation during hardening stage and stage of the monotonic decrease of true stress by increase of true strain have been established. Structural behaviour by SPD conditions bas been studied. The data showing intra-grain sliding during the hardening stage and dynamic recrystallization with participation of grain boundary sliding and grain boundary migration during the stage of the monotonic decrease of true stress have been detected.

18. B. Kosec; *Faculty of Natural Science and Engineering, University of Ljubljana, Ljubljana, Slovenia*
Preheating of Dies for High Pressure Die Casting of Aluminium Alloys. Die design, material selection, and thermal stress fatigue due to the cyclic working process (heat checking), as well as to low and inhomogeneous initial die temperature, contribute to the failures and cracks formation on/in dies for high pressure die casting of aluminium alloys. In the presented investigation the intensity and homogeneity of the temperature field on the working surface of the die during preheating process were checked by thermographic measurements. The efficiency of the preheating process was analysed with the use of non-destructive metallographic examination methods, and numerical stress-strain analysis.

19. I. I. Kurbatkin, N. A. Belov, Y. N. Raikov, V. V. Antipov; *Joint-Stock Company "Institute Tsvetmetobrabotka", Moscow, Russia*
Elaboration of Special-Brass Alloys with Increased Working Properties for Automobile Industry. Brass alloys are widely used in production of various synchronizer details in transmission gear box. That is why brass-alloys must have a complex of important characteristics: work at high dynamics load, high strength and wear-resistance. This combination of properties can be achieved by brass alloying, and by some methods of heat treatment. We defined phase compositions and temperature phase transformation with the help of thermal analysis, X-ray and metallographic examinations. We also studied their properties concerning alloy compositions and working conditions of materials. Our investigation gave: 1) structures of Cu-Zn-Mn-Al-Ni, Cu-Zn-Mn-Al-Si, Cu-Zn-Mn-Ni-Si alloy systems; 2) mechanical and working properties of the special-brass alloys for automobile industry.

20. A. Kozlovsky, Uy. Taran*, M. Staroseletsky*, S. Gubenko*, Uy. Projdak*, V. Esaulov*, A. Shramko, M. Iskov, A. Derugin; *Niznedneprovsky Tube Rolling Plant, Dnepropetrovsk, Ukraine, *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
The Behaviour of Non-Metallic Inclusions in Wheel and Other Steels During Laser Treatment. Steels containing non-metallic inclusions, which influence the character of strengthening during laser quenching are presented. In the matrix near inclusions proceed relaxation processes, included high quickly local shear-rotational deformation and elements of the return and recrystallization. The character of steels strengthening depends on types of the inclusions and matrix, and also high quickly transformations. The peculiarity of non-metallic inclusions consist of the local matrix saturation by components of inclusions, localization of phases and structural transformation in matrix and also of development of interphase stresses on the inclusion-matrix boundaries and in the matrix near inclusions owing to distinction of extension (compression) coefficients of the matrix and inclusions. All inclusions bring about strengthening of steel, however they are one of the causes of micrononhomogeneous distribution of stresses. During plastic deformation after laser treatment it was discovered the appearance of local diffusional microwelding of the inclusions with steel matrix, leading to change of the state of interphase boundaries and mechanism of the microckraks formation near non-metallic inclusions.

21. J. Šaderová; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
Assessment of the Dynamic Load in the Hoisting Ropes During Operations. The hoisting wire ropes can be loaded by the maximal static load, it's value must correspond to the safety value according to the safety regulations. The starting points for calculation of the load are the nominal values of the individual component's forces acting on the rope. During work, on the rope are acting dynamic forces too. The intensity of the dynamic forces can be find out by the indicator of tension in the tope which is used to obtain the actual forces acting on the hoisting rope. The instrument works on the tensometric principle. The output of obtained loads is digital or graphical with using a special software. The obtained actual loads varying during the motion of the rope were compared with the nominal value. Measurements confirmed the existence of the dynamic forces in the hoisting rope.

22. E. Stroffek, J. Krešák, P. Peterka, S. Kropuch*; *BERG Faculty, Technical University Košice, Košice, Slovakia, *Slovak Testing Center for Steel Wire Ropes-SKTC-147, Košice, Slovakia*
Quality Monitoring and Durability of Steel Wire Ropes. The quality monitoring of products before they are used in operation is prescribed in Slovakia by No. 264/99 standard. For users is important not only quality of products, which is certified by the declaration of conformity, but also the durability. Users perceive the durability of products as one of the quality requests. In detailed declaration of conformity for steel wire ropes it's not seen the test of products durability. The best indicator about condition of steel wire ropes is integral tension test. For this purpose, tension machine KREPET-BME 2500 was constructed in our Testing Center SKTC 147. The construction parameters of this tension machine permit tests of steel wire ropes, textile ropes and chains up to the load of 2500 kN and up to 6 m length of testing sample.

23. S. A. Nikulin, V. G. Khanzhin*, A. B. Rojnov*, P. O. Skorobogatov; *Moscow State and Alloys Institute, Moscow, Russia, *Komsomolsk on Amur State Technical University, Komsomolsk on Amur, Russia*
Mechanisms and Kinetics of Zirconium Cladding Tubes Corrosion Fracture in a Iodine Containing Environment. The Acoustic Emission (AE) - tests of tube specimens of industrial zirconium alloys for SCC with a localized zone of contact of a material with an aggressive environment were conducted. With the help of joint analysis of AE, fractography and metallography of corrosive damages, the mechanisms and kinetics of corrosion fracture of zirconium alloys E635 and E110 in iodine - methanol solution were determined. The process of SCC in these materials begins with pits formation on a specimen surface, and corrosion cracks nucleated at these pits, are also developed on a specimen surface. The pits and cracks on a specimen surface serve as a place of iodine diffusion inside of a material, where intergranular cracking of several stages begins. In this article, influence of chemical composition, and structure and texture of cladding tubes of zirconium alloys on propensity for SCC is also investigated.

24. A. M. Zlygostev, B. N. Maryin, A. I. Pekarsh, A. V. Chernyshev; *Federal State Unitary Enterprise "Komsomolsk-on-Amur Aircraft Production Association", Komsomolsk on Amur, Russia*

Electro Erosion Perforation of Sheet Articles of Titanium Alloys. A set of research works on development and introduction a of process of electro erosion perforation of sheet articles of titanium alloys bas been carried out. Process conditions, of optimal capacity and wear of tool electrode, have been obtained on machining with built-up multicomponent electrodes. A multiplycity of stages of perforation process has been revealed and current pulse parameters for each stage of machining have been defined. Electric modes and hydraulic ones have been related to each other. Metallographic examinations have showed a tendency of titanium alloys to form erosion-resisting carbides over a wide range of process conditions. A built-up electrode of copper and machining attachments for multicontouring have been designed. A range of special-purpose equipment has been worked out. The electro erosion perforating process has been introduced at a number of plants with special-purpose application.

25. A. K. Tikhonov, P. Chenderei, N. I. Sardajev, U. M. Palagin; *JSC “AVTOVAZ”, Institute of management, marketing and right, Togliatti, Russia*

Application of Steels with Boron for Manufacturing Details of a Forward Drive (Case of the Internal Hinge) of Automobiles of a VAZ 2108, 2109. Researches of details (case of the internal hinge) made from steels 19HGN (TU 14-1-2252-92) and 16HGR (C-0.17 %, Mn-0.79 %, Cr-0.89 %, B-0.001 %, Si-0.25%) are given. Form of details is obtained by cold volume punching (CVP), which was carried out on (direct extrusion, landing, opposite extrusion, drawing) on punching machines of firm “Bret”-France, and “Berfild”-England. Level of hardening in CVP process (after each transition) using steels 16HGR and 19HGN was estimated on hardness (HRB). Thermo-chemical processing (TCP) was carried out by unit “Holcroft”. The static tests have shown, that the moment appropriate to a limit of fluidity for steel 16HGR makes 3300 H^*_M, was appropriate to strength of 3590 H^*_M. During dynamic tests of a detail from steel 16HGR have sustained more than 200 thousand cycles loading have been done.

26. M. Kupková, S. Strobl*, M. Kupka, H. Danninger*, E. Dudrová;** *Institute of Materials Research of SAS, Košice, Slovakia, *Institute of Chemical Technology of Inorganic Materials, TU Vienna, Vienna, Austria, **Institute of Experimental Physics of SAS, Košice, Slovakia*

Static Compression and Resonance Vibration Tests on Cellular Materials Gravity Sintered from Hollow Bronze Spheres. The cylindrical and rod-shaped specimens were prepared by gravity sintering from Cu-Sn hollow spheres. On these samples, both static compression tests and measurements of resonance frequencies were performed. The compressive stress-strain curves revealed the features characteristic for a closed-cell ductile cellular solid. The removal of in general open porosity among loosely packed closed metallic hollow spheres was recognized as the principal mode of plastic deformation. The approximative effective moduli of elasticity were determined for cellular materials under consideration by means of the measurements of resonance frequencies on rod-shaped specimens.

27. A. Povrzanović; *Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Zagreb, Croatia*

Analysis of Reasons for Bending of Ship Engine Piston Rods. A very serious problem was found out regarding bending at the application of a larger number of forged piston rods in two-cycle ship diesel engine of a total weight of 190 tons. The consequence of bending was jamming of engine cylinder (529 mm) and engine (850 kW/cal). Comprehensive researches of piston rod forging (2000 kg), indicated heat treatment of forging as a possible reason for bending. After several variants of heat forging treatments, with a view to reduce residual stresses, an important reason of bending was found out due to the way of surface treatment by turning. Manifold performed measurements of residual stresses after different turning regimes indicated the optimum regime of surface treatment involving grinding. The indicated regime of treating was completely successful.

28. M. Kupková, M. Kupka*, S. Strobl, G. Khatibi***, M. Kabátová, E. Dudrová;** *Institute of Materials Research of SAS, Košice, Slovakia, *Instititute of Experimental Physics of SAS, Košice, Slovakia, **Institute of Chemical Technology of Inorganic Materials, TU Vienna, Austria, ***Institute of Physical Chemistry - Materials Science, University of Vienna, Austria*

Effective Flexural Moduli of Bars Containing Cellular-Material Layer. Rectangular bar-shaped sandwich-like samples consisting of a cellular-material core between two ordinary-material layers were prepared. Cellular materials were made of ferrous and bronze hollow spheres. Using these specimens and testing method based on flexural vibrations, differences were observed in effective modulus, values determined by means of vibrations parallel and perpendicular to layers. Information on distribution of material throughout the bar cross section was obtained by metallographic studies. Thickness of particular layers, values of “parallel” and “perpendicular” effective flexural module, and expressions derived for quasilayered bars were used to evaluate the effective Young’ s module of material of particular layers. Reasonable agreement was found among results obtained for various samples.

29. V. Marušić, M. Bošnjak*, I. Vitez; *Faculty of Mechanical Engineering Slavonski Brod, University of Osijek,Croatia, *Croatian Railway, Zagreb, Croatia*

Analysis of Factors Affecting Exploitation Properties of Rolling Stock Brake Shoes. The effect of chemical composition, structure and hardness vales of rolling stock brake shoes to wear was analyzed. Testing of samples taken from brake shoes produced out of different charges was carried out in a trybological device 2070 SMT-1. By monitoring of the friction moment, strain and temperature under conditions of dry friction of samples against counterpart made of the same material as the brake shoes of the rolling stock, it was established that the wear depends significantly more on chemical composition and the structure than on the hardness value of the brake shoes.

30. N. Ganev, I. Kraus; *Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Prague, Czech Republic*

X-ray Diffraction Stress Characterisation of Surface Layers of Polycrystalline Materials. The aim of this contribution is to present capabilities of X-ray diffraction stress analysis of surface layers of polycrystalline materials. Practical usefulness of the outlined experimental technique is illustrated with recent experience of X-ray laboratory of the CTU Faculty of Nuclear Sciences and Physical Engineering in Prague in the field of engineering applications of residual stress measurements in metals and ceramics. Special attention is paid to identification of stress gradients within the penetration depth of used radiation and assessment of elastic constants used for residual stress evaluation. This research is a part of the project supported by the Grant Agency of the Czech Republic (Grant No 106/00/1477 and No 106/02/0612).

31. N. V. Dvornicova, M. O. Matveyeva, A. U. Proydac, B. V. Klimovich; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Runtgen Structural Analysis of Nitrides and Carbonitrides in Alloyed Steel. Samples were subjected to saturation by nitrogen in a current of ammonia, at: 550 °C, 800 °C, 1000 °C. In a superficial layer the contents of nitrogen changed within the limits of 1.05 - 7.73 %. The decomposition of carbonitrides and nitrides phases occurs in an interval of temperatures 2010 - 2044 °C. The technique allowing to establish quantity of nitrides and carbonitrides is developed. On the basis Runtgen structural analysis allocated nitride and carbonitride phases were analysed. Nitrides and carbonitrides of titan were estimated by relative intensity of lines at 2.44 and 2.12 Ã (TiC) and 2.468 and 2.141 Ã (TiCN). The contents of titan, nitrogen, carbon in the allocated phases were determined by a method of the element analysis. The distribution of nitrogen containing phases and their influence on physico-mechanical properties of alloys was also investigated.

32. F. G. Ceschini, M. Rogante*; *Nuovo Pignone SPA, Firenze, Italy, *Engineering Office, Civitanova Marche, Italy, *Nuclear Engineering Laboratory, Faculty of Engineering, University of Bologna, Italy*
Feasibility Study for the Characterisation, of an Axial Compressor Wheel of a Heavy-Duty Gas Turbine by Neutron Techniques. The wheel of the axial compressor of a heavy-duty gas turbine can have internal residual stresses, due either to the manufacturing process, or to the operating conditions. In this paper, the results of a feasibility study for the characterisation of such component are reported. In particular, the same study confirms the feasibility, by using neutron technique to measure internal residual stresses in correspondence of the teethes, and to characterize the material by micro-structural way, especially related to the precipitate distribution.

33. N. A. Semashko, E. V. Lanovenko, V. V. Lanovenko, A. V. Frolov; *State Technical University, Komsomolsk on Amure, Russia*
Research of Phase Transformations in Titanium and Titanium Alloys by Ultrasonic Method. Experimental researches of the acoustic properties of titanium materials in a broad temperature range are presented in this paper. Sound velocity (*C*) and damping factor (a) were also investigated. These physical characteristics of material contain extensive information on structural, magnetic and other transformations in metals and alloys. The researches were carried by with an ultrasonic pulse method. Samples of a pivotal type and a cold zone sensor were applied. Velocity of sound describes the forces of atom's interactions that determine rigidity of a material. The damping coefficient characterizes the ability of material to irreversible dispersion of elastic strain energy and allows to define a degree of relaxation of stresses that arises at the grain boundaries at polymorphic transformations, ferromagnetism, etc.

34. P. Strunz, J. Zrník*, V. Vrchovinsky*, A. Wiedenmann;** *Institute of Nuclear Physics, Rež near Prague, Czech Republic, *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia, **Hahn-Meitner-Institut, Berlin, Germany*
Small-Angle Neutron Scattering investigation of long-termed Microstructural changes Thermally exposed Ni-base Superalloy EI698VD. In this study, emphasis was placed on investigation of long termed structural stability of wrought nickel base superalloy and its effect on followied creep behaviour. In order to investigate structural stability of the superalloy the specimens were exposed up to 25 000 hours at temperature of 650 °C and 430 °C prior the creep. The result of testing have shown that long time isothermal exposure at temperature of 430 °C up to 25 000 hours changed the alloy deformation ability and creep life decreased. SANS (small-angle neutron scattering) technique revealed significant changes of morphology of gamma prime precipitates already after a short thermal exposition. The resulting parameters on size distribution, mean size and mean distance among the precipitates made evidence that they increase with thermal exposure.

35. A. V. Syasev, V. B. Vesselovskiy, I. Mamuzić*, *Dnepropetrovsk National University, Dnepropetrovsk, Ukraine, *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*
Approximative Analytical Method of the Problems Solution of Thermoviscoelasticity for Diphasic Bodies with Mobile Border. The approximative analytical computational method of revolutions of diphasic body, when the motion of a boundary of phases occurs owing to thermoexchange with environment is designed. The solid phase represents a viscoelastic stuff, and fluid-ideal incompressible fluid. The offered method allows with the help of a variation principle of Gibbs, at given external thermal and mechanical effects, to determine tight-strained state in a body, temperature field and law of motion of a boundary of phases, thus allowing interaction interference of temperature and mechanical fields on parameters of phase change.

36. A. V. Syasev, A. A. Kochubey, E. A. Makarenkov*; *Dnepropetrovsk National University, Dnepropetrovsk, Ukraine, *National Metallurgical Academy, Dnepropetrovsk, Ukraine*
Continuous Escalating of Body of Revolutions from a Visco-elastic Stuff in a Case of the Non-linear Law of a Creep. A problem about formation of tight-strained state of barrel located under operating of internal pressure is considered. The escalating of a stuff occurs on an external lateral area. An initial and increased stuff are described by equations of state of a growing of old heterogeneously visco-elastic stuff, and the connection between deformations and pressure is non-linear. Using a principle of superposition the Volterra ratio for definition of tight-strained state in the barrel at different intensity of escalation is obtained.

37. V. B. Vesselovskiy, A. V. Syasev, V. Y. Klim; *Dnepropetrovsk National University, Dnepropetrovsk, Ukraine*
Thermoviscoelasticity of Deforming Restricted Rod with Allowance for Nonlinearity of the Thermal Characteristics. The problem about definition of temperature and mechanical fields in a restricted rod from a visco-elastic stuff in a case, when the thermal characteristics depend on temperature is considered. With the help of a step-by-step method the ratio of mechanical and temperature fields in a rod from time with allowance for their interaction interferences are obtained. The step-by-step method allows to reduce the solution of non-linear problems and to set of the solutions of linear problems for each time period. From interval to interval the thermal parameters change by a stepwise mode. The connection between intervals is implemented by initial conditions.

38. I. Kladarić, I. Vitez, D. Krumes; *Faculty of Mechanical Engineering, University of Osijek, Slavonski Brod, Croatia*
Establishing Structural Changes as a Result of Plastic Deformation of Ductile Casting. With the purpose to determine method to study structural changes as s result of plastic deformation of ductile casting, it was started whit fact that it wasn't possible to determine borders of grains of residual austenite by metalography methods, and also not possible to determine the amount of residual austenite before and after cold deformation, neither the occurrence of some transformation. Because the residual austenite is not ferromagnetic, and by transformation into martensite, austenite becomes ferromagnetic, it might be possible, to apply indirect method of measuring magnetic properties and so to determine the transformation of residual austenite.

39. I. Lesso; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
Entropy at Measuring the Young's Modulus of Material. This article compares the classical method of measuring Young's modulus of the material with the newly developed method from the viewpoint of entropies. Indirect measurement of Young's modulus by using the physical law and hybrid measurement technology exhibits high sensitivity and accuracy.

40. A. Mockovčiaková, B. Pandula; *Faculty of BERG, Technical University of Košice, Košice, Slovakia*
Study of the Relation Between the Static and Dynamic Module of Rocks. Non-destructive techniques based on the propagation of ultrasonic wave through the elastic medium were used for determination of dynamic modulus of selected samples of rocks in laboratory. The calculated values of dynamic modulus were compared with values of static modulus determined on the samples tested by applied loading.

41. N. A. Semashko, R. F. Krupscy, A. V. Kupov, V. M. Boyko, V. A. Lizogub; *Komsomolsk on Amur Aircraft Production Association, Komsomolsk on Amur State Technical University, Komsomolsk on Amur, Russia*

Method of Acoustic Emission Magnetic-agitation at the Control of Thermo Verification of Machining Steel's. At magnetic fero-magnetic's reversal of materials a reorganization of structure is displayed, connected with spasmodic displacement of borders, as a result of which the acoustic waves (acoustic issue magnetic-agitation AEM) are generated. In the paper is shown, that the energy of a signal AEM E^*_{AEM} linearily grows with increase of intensity of magnetic field H_e reversal. The corner of an inclination of dependence $E^*_{AEM} = f(H_e)$ to ordinates varies with microstructure changes in a material of a sample. The researches were carried out on modeling samples executed from steel 45 in form of prismatic bar of the size of 3x3x160 mm subjected to thermal processing. The results of research have shown that parameter AEM $\Delta E^*_{AEM} = \Delta H_e$ correlates with micro hardness HB of samples and can be used as parameter of the operative control at thermal processing of steel's.

42. N. A. Semashko, A. V. Frolov, V. I. Merkulov, D. V. Melnikov, G. N. Semashko; *Federal State Unitary Enterprise "Komsomolsk-na-Amure Aviation Industrial Company by Name of Y. A. Gagarin", Komsomolsk on Amur, Russia*

Application of Dimension-free Acoustic Emission Parameters for Prediction of OT-4 Alloy Limit Characteristics. The method of acoustic emission (AE) is widely and effective used to test and diagnosis of ability of materials and constructions. A shortcoming of well-known methods is a dependence of results upon parameters of a equipment used. The other approach to this problem is proposed by this paper: there are used dimension-free parameters. This parameters are a result of analysis the AE information at the early stage of deformation. The impulse shape coefficient ($K_s=E/U_m^2\tau$, where E - the energy of AE impulse, U_m - the pulse amplitude, and τ - the long (time) of impulse) and the power factor ($P=E/\tau$) are calculated by analysis. All registered AE impulses are separated into four group depending on volume of "Ks" and "P" coefficients. Authors found the correlation dependence between the n_4/n_3 coefficient (where n_4 and n_3 are the number of AE impulses 3rd and 4th groups) and the ultimate tensile strength of OT-4 titanium alloy. A relative separation of AE impulse allows authors to work up a number of prediction methods, which can give the limit of mechanical properties of materials.

43. K. A. Makarov, A. I. Pekarsh, B. N. Maryin; *Komsomolsk on Amur Aircraft Production Association, Komsomolsk on Amur State Technical University, Komsomolsk on Amur, Russia*

Calculation of Residual Stresses in a Detail After Removal Loads Under Bending to a Punch. The determination of the stressed-deformed condition (SDC) of a details after removal of a load at deformation has important value both on a fabrication stage, and at maintenance. To determine residual SDC in details, it is necessary to know SDC in it at load. Therefore, at the solution of the given problem, it is necessary to investigate two stages: determination SDC under bending bars and after removal of a load. The material of deformable bar is isotropic. By mass and inertial forces is neglected. The partition of processes of bending and unloading on enough great number of stages allows to use the theory of small elastic-plastic deformations at each stage with allowance for SDC of a preceding stage. By such an approach it is possible to consider, that deviators of stresses and deformations are proportional. Using obtained mathematical model, it is possible with rather high accuracy to calculate a field of residual stresses, which is confirmed by experimental researches.

44. Y. Sidor, F. Kovac; *Institute of Materials Research SAS, Košice, Slovakia*

Quantification of Microstructure and Evaluation of Mechanical Properties in Non-oriented Electrical Steels. This paper presents an original method of the estimation of average grain size at microstructure of broad grain size distribution and the parameter describing the homogeneity of microstructure. The coefficient of microstructure homogeneity is defined. The mechanical properties of non-oriented electric al steels are predicted using new equation of grain size estimation.

45. J. Grum, D. Zuljan; *Faculty of Mechanical Engineering, University of Ljubjana, Ljubljana, Slovenia*

Frequency Analyses of a Signal of IR Radiation from the Cutting Front and Surface Profile Height in Laser Cutting of Low-Carbon and Austenitic Stainless Steel. In the paper it is proved that an analysis of macrographs showing surface-profile corrugation of the laser cut in austenitic stainless steel as well as in low-carbon steel can be used to confirm and analyze thermal phenomena at the cutting front. The paper gives a comparison between power spectra of the voltage signal of the infrared (IR) radiation and power spectra of the surface-corrugation profile for different steel grades, different specimen thickness, and various input energies. High frequencies of the voltage signal of IR radiation and in the surface profile height were compared with the coefficient of high frequency of the voltage signal.

46. E. E. Chygyrynets', A. P. Stovpchenko, I. M. Kovalenko*; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine,* Holding company "Intermet", Dnepropetrovsk, Ukraine*

New Natural Polymeric Filler of Anticorrosive Paint Coating. The investigation of new effective methods for metal protection from corrosion is a very urgent task. The new corrosion-resistant filler from natural polymer materials made from fruit stone wastes of peach, grapes, apricot, and shells of walnut was developed by the authors. The developed first coat has very wide area of application and is irreplaceable at repair of metal structures. The mechanism of increasing of a coating resistance (containing developed filler) is based on formation of a film consisting a non-soluble chelate complex between filler compound and iron ions on metal surface. The researches of physico-chemical properties of water extracts from stone waste fillers were also carried out: molecular mass of components, surface tension of liquid - gas interface, work of adhesion to metal, and wetting angle and electrochemical parameters. Data obtained allow to develop a technology of effective filler manufacture from stone wastes and to apply them for a high-quality first coat of high corrosion-resistant properties.

47. J. Malina, N. Dolić, F. Unkić; *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*

The Influence of Potential Sweep Rate on Electrochemical Characteristics of Hypereutectic Al-Si Alloy. The electrochemical characteristics, pitting potential E_{pit} and repassivation potential E_{rep} of as-cast Al-Si alloy were determined in 0.01 M NaCl with the aim to find the most reliable experimental conditions for evaluation of pitting resistance. Anodic polarization measurements in stationary, quasistationary and potentiodynamic conditions have shown that pitting behaviour is significantly influenced by the sweep rate, i.e. the higher the scanning rate was, the hysteresis loop and E_{rep}, were higher too.

48. M. Tandler, L. Vehovar, A. Vehovar; *Institute of Metals and Technology, Ljubljana, Slovenia*

Prediction of the Life-Time of Austenitic Stainless Steels under Stress Corrosion Cracking Conditions. A good many research has been performed an the stress corrosion cracking of different types of steel and alloys in various corrosive media, with the objective to clarify the mechanism and solve the problems of stress corrosion cracking, which can result in dangerous kinds of damage to structures made from such materials. It has recently been found that the steady-state elongation rate (i_{ss}), determined from corrosion elongation curves under constant load, can directly be used for life-time prediction and as a criterion at assessing the sensitivity of metals to stress corrosion cracking. For this reason corrosion elongation curves were obtained experimentally at different stress levels, and the relationships between the influencing parameters i_{ss}, t_{ss}/t_f and t_f were analysed. The anodic current density at the tip of the stress corrosion crack was also calculated.

49. L. Vehovar, A. Vehovar, M. Tandler; *Institute of Metals and Technology, Ljubljana, Slovenia*
The Corrosion Resistance of Austenitic Stainless Steel Alloyed with Nitrogen. The results of corrosion investigations have shown that, even in a very aggressive medium, the austenitic nitrogen-enriched stainless steel NTR50, which was solution heat treated at 1150 °C/ quenched - i. e. steel with interstitially dissolved nitrogen in the austenitic base, passivizes directly at a low anodic current density. This is not a case for the comparative AISI 316L stainless steel, although the pitting potentials of both materials are similar. However, significant differences exist between the repassivation capability of nitrogen-enriched steel and that of comparative AISI 316L steel, which can be attributed to the role of nitrogen. Investigations of the passive film confirmed that nitrogen, in the form of N^{3-} and NH_4+ ions, acts as an inhibitor of the corrosion process. This means that the time for the onset of corrosion pits, which are usually the source of stress corrosion cracking, was extended. Due to rapid changes in the character of the electrolyte in the corrosion crack and the repulsive action of the N^{3-} ions towards the aggressive chloride ions, the growth of the crack is either prevented or greatly retarded.

50. J. Ševčíková, J. Kocich; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*
Contribution to the investigation of corrosion properties of the Ni-Ti alloy with shape memory. Responsible application of metals with shape memory needs to know degradation processes taking place during their exploitation in real conditions. The contribution investigates corrosion properties of an Ni-Ti alloy containing 55.2 % Ni and 44.8 % Ti in physiological salt solution (0.9 % NaCl at 40 ± 1 °C). The performed laboratory tests found out a high corrosion resistance of the material used mainly in human medicine for implants. by measuring the electrochemical characteristics it could be acknowledged that this is related to the formation of a passive state on the alloy surface during its exploitation.

51. P. Horňak, F. Matsuda*, H. Kimoto*; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia, *JAPEIC - Japan Power Engineering and Inspection Corporation, Ibaraki, Japan*
Effect of Corrosion Pits on Material Degradation in Simulated Conditions of Nuclear Boiling Water Reactor Environment. (BWR) Carbon steels are widely used as material for the structural part of nuclear Boiling Water Reactor (BWR). This paper deals with the influence of corrosive pits on degradation of STS 410 carbon steel in simulated BWR environment. It was confirmed that the corrosive pits, which are produced in corrosive environment of high temperature and water pressure are responsible for fatigue crack initiation and propagation process, mainly at low strain rates and higher dissolved oxygen contents. Therefore research was focused on corrosive pits occurred on the specimen's surfaces. Relationship was obtained between mean pit diameter and crack occurrence for different testing cycles in conditions which simulated real service of nuclear power plant. Distribution of corrosive pit size seems to be the Gaussian statistical normal distribution in many cases.

52. A. Ševčík, J. Ševčíková, M. Hagarová; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*
Corrosion Product Layer Protection Efficiency of Low Alloyed Weathering Steel, with Increased Corrosion Resistance to Atmospheric Corrosion. Composition, microstructure and properties of the protecting surface layers - patina on the low alloyed steels of CORTEN type and on an unalloyed steel used for comparison in real and laboratory conditions of atmospheric corrosion were presented. Determination the influence of chemical composition and microstructure of the steel and corrosion parameters as well as on the protecting properties of corrosion products on the steel are also given.

53. E. Peryga, H. Bala, S. Wiewiórowska; *Faculty of Materials Processing Technology and Applied Physics, Technical University of Częstochowa, Częstochowa, Poland*
The Protection of Alloy Steels in Corrosive Medium by Layers of Selected Conductive Polymers. Not passive steel alloys in hydrogen ion, medium have been submitted to acid-corrosion. In a passive state a risk exists of the local corrosion. For that reason the tests of layers of formation of conducting polymers base were done. The aim of the work was concerned with the preparation of the protection layer on the base of palianilian which is permeable for chlorine anions. The wolfram compounds decrease the flexibility of aluminum and stainless steel on local corrosion. The preparation of layers containing wolfram oxide was proposed in the work and the possibility of adhesive layers like this on 2H31 steel have been also analyzed.

54. J. Billy, F. Simcak, L. Mikolaj, D. Dadejova, A. Bobenic; *U. S. Steel, Košice, Slovakia*
Properties of Coated Steel Grades of USSK Production. Paper deals with mechanical properties and coat parameters of Hot Dip Galvanized and Prepainted steel grades. Typica1 application of HDG steel in automotive industry and prepainted in architecture will be described. Results of different types of corrosion test will be reported. Properties of Tin Plate products mainly for packaging will be mentioned, with respect to different grades and standards. Trends in production development of coated products will be discussed as well.

55. Z. Kolumbić, D. Krumes, I. Vitez; *Faculty of Mechanical Engineering, University of Osijek, Slavonski Brod, Croatia*
Computer aided Electrochemical Quantities Monitoring during Pipe Specimens Corrosion. A problem of accurate recording of measurement results appeared during a performed complex long term pilot plant experimental research of hot dip galvanized pipes corrosion in warm potable water. After the short introduction, first part of the paper describes the pilot plant with original settings of the pipe specimens, prepared from zinc, steel and hot dip zinc coated steel. Second part of the paper is devoted to the computer aided system for monitoring: a) slow changes of mixed electrode potential of specimens and b) fast current density changes after switch off and switch on of short circuits between different specimen couples.

56. Ju. N. Taran, A. I. Mikhalyov, A. I. Derevjanko, T. E. Vlasova, V. E. Khrychikov; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Structure Formation Model for Hardening Process of Metals. This paper presented results of modeling investigation of dynamics of formation of fractal clusters as fragments of hard phase in the hardening process of metals. According to computer experiments results the estimation of influence of diffusion coefficient on the fractal dimension and radial closeness of growing clusters is got. It is shown, that in space between the growing clusters and border, securing forming each of them in the exclusive region of fusion, arises tip. The comparison of the results of design with the prognosis on the basis of the theoretical model and data of thermophysical experiments are presented.

57. A. I. Mikhalyov, D. A. Mikhalyov, D. A. Lysyj; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Classifier of the Metalo-Graphic Microstructures with the Usage of the Kohonen's Neural Net. The objective of the research are photos of metalographic microstructures. The aim of the work is to select of algorithm and elaboration of software for effective classification of texture images with the help of neural nets, and also to research the classification process exactness and reduction of processing time with texture images. At research a classifier built on Kohonen neural net was used. Results of the research was employed for classification of the photos of metalographic microstructures, which were obtained by digital photoscanner.

58. Ju. N. Taran, A. I. Michalev, A. I. Derewianko, T. E. Wlasowa, W. W. Pomulew; *Nazi Metallurgische Akademie von Ukraine, Dnepropetrovsk, Ukraine*

Die Fraktalmethode von Klassifizierung des Stahles nach der Größe des Kornes. Es ist gezeigt, daß integrale Charakteristiken des Verhärtungsprozesses entsprechen den Angaben der heizungsphysischen Experimenten. Es ist bewiesen, daß die Abschätzung des Fraktalaußmaßes in Mikrostrukturen hängt von den Verhältnissen des Verhärtungprozesses in der Metalllegierung von gleichem chemischen Bestand zusammen, und gilt als ein Gradmesser der Größe des Kornes, der von der Vergrößerung in einer breiten spanne nicht abhängt. Auf der Grundlage der gegebenen Methodik war ein Rechnerprogramm bearbeitet, das den Außmaß der Fraktalgröße als ein zahlenmäßiges Kriterium der Klassifizierung des Stahles und den Legierugen nach der Größe des Kornes abzuschätzen vermag.

59. A. A. Kochubey, I. Mamuzić*, A. V. Syasev; *Dnepropetrovsk National University, Dnepropetrovsk, Ukraine*, **Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*

Mathematical Model of Growth of Diphasic Cylindrical Bodies with a Fluid Phase on the Inside. The mathematical model of growth of the barrel of round cross section with a fluid phase on the inside, under internal pressure is offered. The stuff of a solid phase is described by equations of state of a growing heterogeneous of visco-elastic stuff, and fluid-ideal incompressible fluid. Owing to thermoexchange of external lateral area of the barrel with environment, a part of a liquid stuff passes in a firm modular condition and so continuous passing of a stuff in solid. Using, jointly, main ratio of mechanics of a deformed solid and the theories of heat conduction, relations an mechanical and temperature fields, and also analytical expression for the law of motion of a solidified front, was obtained.

60. E. Stroffek, J. Krešák, P. Peterka, S. Kropuch*; *BERG Faculty, Technical University Košice, Košice, Slovakia, *Slovak Testing Center for Steel Wire Ropes-SKTC-147, Košice, Slovakia*

Mathematical-Physical Model for Determination of Durability of Steel Wire Ropes. For users of the steel ropes it is very important to know in advance the prediction of durability of steel wire rope on real machine and required condition. The prediction of durability for actual steel wire ropes is very important for producers of ropes in order to be able to determine guarantee period. For this purpose the mathematical-physical model of steel wire ropes was established, using which measured data of actual rope were compared with the same model rope construction. Comparison of results with real values determinate by fatigue tests of steel wire ropes indicate, that by using this model it is possible to predict durability of ropes with the sufficient accuracy.

61. A. I. Y. Najajreh, D. Marasova; *Faculty BERG, Technical Univerzity of Košice, Košice, Slovakia*

Damaging a Steel Wire Ropes and their Modeling by Program Cosmos. Solving problems connected with damaging the steel wire ropes depends on understanding laws of this phenomenon. Knowledge on this phenomena is possible to be gained either by experimental research or by numerical model, which enables to determine the distribution of stress and strain in a suitably selected cross-section of a steel wire. The paper starts by defining the problem, determining the boundary model conditions and continues by modeling of stress-strain states in the steel wire. In this case the finite element method - FEM is used. In the conclusions of the article table results of the numerical modeling aimed at solving the problems connected with damaging the steel wire are given. The COSMOS/M BASIC System includes GEOSTAR, a CAD-like pre- and postprocessor, together with static, thermal and dynamic analysis capabilities.

62. M. Brezigar, B Kosec*, F. Pavlin*; *Iskra Avtoelektrika d. d., Šempeter near Gorica, Slovenia, *Faculty of Natural Science and Engineering, University of Ljubljana, Ljubljana, Slovenia*

Thermochemical Treatment of Steel Forgings. In the Slovenian company Iskra Avtoelektrika using the process of cold forming, a great number of different steel forgings are manufactured. A lot of them are during their exploitation exposed to the high mechanical and temperature loads. The corresponding mechanical and temperature properties of the steel forgings are achieved by a thermochemical treatment in a device produced by the firma CODERE, Switzerland. The basic aim of our research is to present the procedure of optimisation its function with emphasis on choosing all adequate parameters, such as atmosphere composition and temperature. As a practical example the thermochemical treatment procedure of steel forging - pinion No. 16.920.633 will be presented. The efficiency of the treatment will be analysed with the use of metallographic examination methods, chemical analysis, and microhardness measurements.

63. S. I. Pinchyk, E. E. Chygyrynets', E. I. Shifrin*; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine, *Niznedneprovski Pipe Rolling Mill, Dnepropetrovsk, Ukraine*

The Technique of Surface Treatment of Steel Pipe before Covering with Protective Paint Coating. The technology of hot-rolled steel pipe surface treatment was directed to increase of anticorrosive protection at storage and transportation. The protective properties of traditionally used paint-and-varnish coatings that are reduced because of intensive growth of rust under the paint film. The technology of preliminary passivation of hot-rolled pipe surface before covering it with paint-and-varnish coating compound for passivating and optimal concentration were developed by the authors. This technique of pipe surface passivation allow to increase the period of protective validity, of traditional paint-and-varnish coating.

64. Yu. A. Dinnik, A. G. Saginor, V. G. Sova, A. V. Pischida; *National Metallurgical Academy of Ukraine, Dnepropetrovsk,Ukraine*

Hammers of an improved Construction for Rigging Rotary Hammer Crushers such as DMRE 14.5 x 13 and DM 1500 x 1500. The basis of a method of hammers of heightened hardness preparation is the electroslag techniques that foresees the basic body of a hammer to use special crystallizers with usage of new materials. As alloying agents the carbides of high-heat metals, in particular, chromium carbides permit to obtain hardness of hammer working surfaces at 350 - 400 HB. Besides on a working surface of a hammer may be surfaced the layer of a wear resistant material of 3 - 4 mm thickness of hardness exceeding 550 HB. The developed method of hammers fabrication foresees a possibility of both multiple recovery of propulsive mass of a hammer, and touchdown hole after it their wears out. Hammers, manufactured by the above described method, pass industrial trials and are exploited at process Zaporozhye, Donetsk, Enakievo and Alchevsk.

65. E. Zdravecká, J. Trpčevská*, J. Suchánek;** *Faculty of Engineering, Technical University Košice, Košice, Slovakia, *Faculty of Metallurgy, Technical University Košice, Košice, Slovakia, **AGT Praha, Praha, Czech Republic*

Surface Characteristics in Tribological systems by AFM. Tribological properties of thermally sprayed coatings and also PVD coatings depend on coating technology and on the coating chemical composition. The wear test results and the surface charctenstics obtained by atomic force microscope (AFM) are presented in this study.

66. S. Tuleja, M. Hagarová; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*

Properties of PVD Coatings applied on Titanium Alloys. Due to high reactivity of titanium and its ability to create thin continuous passive surface layer, titanium and its alloys exhibit high corrosion resistance in many agressive environments. Some applications of titanium alloys need

higher wear properties or improved corrosion resistance to special conditions. PVD coatings are used for modify titanium surface properties. In the paper corrosion properties of TiN and $TiAl_3$ layers in NaCl solution at ambient temperature and in air at higher temperature are given.

67. J. Kubicki, B. Piekarski; *Institute of Materials Engineering, Technical University of Szczecin, Szczecin, Poland*
Aluminium Protective Coatings Produced on Creep-Resisting Steel directly in a Casting Mould. In the paper the structure of the Al-Cu and Al-Si coatings and their ability to protect casings made of cast steel GX25NiCrSi36-17 against carburization are described. For the structural examinations of the coatings the following techniques were used: optical and electron microscopy, X-ray microanalysis, X-ray diffraction and quantitative image analysis. On the basis of the obtained results it can be stated that Al-Cu or Al-Si coatings produced by casting method can provide a temporary protection of cast elements subjected to high-temperature corrosion. It was also found that the structure and properties of coatings depend on some production parameters. These dependencies are presented in a form of statistical models allowing the authors to work out the selection principles of the process parameters.

68. A. Drotlew; *Institute of Materials Engineering, Technical University of Szczecin, Szczecin, Poland*
Characteristics of Wear in Solid Particle Stream of Ferritic Fe-Cr-C Alloys. The studies have been conducted on a series of high chromium cast irons with the contents of Cr and C in the range of (15 to 47 %) and (0.6 to 2.2 %) respectively. The characteristics of wear due to erosion by the solid particles stream at 450 °C, in accordance with Bitter's theory, have been worked out as a function of angle of incidence of erosive particles. All the tested alloys can be divided into 3 groups depending on the shape of their wear characteristic. It was stated that the kind of mechanism involved in wear has changed if carbon and chromium contents were reversed. Changes in contribution of microcutting and fatigue mechanisms in damage process are discussed.

69. S. A. Kunavin; *State Research Center NPO TSNIITMASH, Moscow, Russia*
Optimization of Low-Carbon Steel Properties with Help of Combination Surface Hardening. The influence of combination surface hardening (involving laser alloying of the surface with nitride-forming elements V, Cr, Mo and Al followed by nitridation of the entire alloyed layer) on low-carbon steel structure is investigated. The next number of factors have an effect the technological parameters for laser thermochemical treatment, the radiation power density and the amount of the coating deposited on the surface to be treated, the type of alloying nitride-forming element, the nitridation regimes, and a character of the steel surface treatment (the zones of treatment with and without overlapping). The best properties (mechanical ones, fatigue fracture resistance, residual strength, corrosion and heat resistance) are achieved upon nitriding the surface of steel 20 alloyed with V and Cr.

70. J. Grum, M. Žnidaršič; *Faculty of Mechanical Egineering, University of Ljubljana, Ljubljana, Slovenia*
Microstrusture, Microhardness and Residual Stress Analysis after Laser Surface Cladding of Low-Carbon Steel. The paper describes on-line measurement of thin and flat specimen changing during laser alloying and measurement of alloy specimen after treatment. During laser remelting and alloying SiC, Stellite 6 and Stellundum 481 powder, which dissolves and disperses, was added to the parent metal of low-carbon steel. Experiments were performed with high-temperature resistance measuring rosettes. Strain was monitored from the beginning to the end of the remelting and alloying process, i. e., to a temperature of 50 °C at the lower side of the specimen; therefore, during the remelting and alloying process, the changes in temperature at the lower side of the specimen were measured with two Ni-NiCr thermocouples. Other very important properties are the size and distribution of the residual stresses in the thin remelted and alloyed specimen, i. e., machine part, because they strongly affect its operational efficiency. The paper analyzes the results obtained from the viewpoint of minimum final strain of the specimen with the desired variation of residual stresses.

71. Yu. N. Koval, V. V. Nemoshkalenko; *G. V. Kurdyumov Institute for Metal Physics, N. A. S. U., Kiev, Ukraine*
"Smart" Materials Based on Multistage Martensite Transformation. Smart materials are subject to very spread investigation but it is difficult to realize their practical feedback. In this report some attempts to find methods of feedback realization for alloys with more than one trPe of martensitic transformation are made. Report show experimenta1 data, devoted to multistage martensitic transitions in such alloys as Cu-Sn, Zr-Cu, Zr_2NiCu and others. The main question was: "How the relation between different type of martensite helps to organize the feedback ?"

72. V. N. Varyukhin, E. G. Pashinskaya, V. V. Pashynsky*; *Donetsk Physical-Technical Institute NASU named after Galkin A. A., Donetsk, Ukraine, * Donetsk National Technical University, Donetsk, Ukraine*
Investigation of Possibility of the Fibrous Titanium Aluminide Composite Manufacturing. We have studied the possibility of intermetallic parts production from the blanks of pseudo-alloy, obtained by the common hydroextrusion of titanium wire and aluminium elements. Using of 3-stage regime of pseudo-alloy production, the diameter of filaments was 1 - 15 microns. The pseudo-alloy bulks were investigated by the methods of optical microscopy, X-ray spectrum analysis and measurement of microhardness. The kinetics of intermetallide formation was studied at temperatures 700, 800, 900, 1000 °C during exposure from 25 minutes to 4 hours. At 700 °C noticable amount of intermetalide (15 - 20 %) was fixed after exposure 3 hours. After following increasing of exposure up to 4 hours at 700 °C the size of needles decreases and brittleness increases. At 1000 °C the grain size increase by 2 x (7 - 33 microns).

73. A. G. Kirichenko, N. F. Kolesnik; *Zaporozhye State Engineering Academy, Zaporozhye, Ukraine*
New Capabilities of Iron Carbide Obtaining. The interaction of iron ore with gas mixtures $CO + H_2 + H_2O$ was studied. The optimum requirements for iron carbide obtaining are determined. In solid yields of interaction alongside with Fe_3C the X-ray crystal analysis detected other iron carbides (Fe_5C_2, Fe_2C, $Fe_{20}C_9$), α-Fe, FeO oxides, and also free carbon in the form of graphite of different morphology - (flakes and nanotubes). As useful source of carbon monoxide for this process can serve exhausted gases of carbothermic processes, for example, top smokes of ferroalloy production in electric boards (up to 88 %).

74. N. Grechanyuk, V. Osokin, I. Grechanyuk, V. Borisenko*, V. Bukhanovsky*, N. Rudnitsky*, A. Bukhanovsky;** *The Research and Producing Company "GEKONT", Vinnitsa, Ukraine, *Institute of problems of strength NASU, Kiev, Ukraine, **National Technical University of Ukraine "KPI", Kiev, Ukraine*
Structure and Physico-Mechanical Properties of Composite, Condensing from a Steam Phase, Materials Cu-Mo-Zr-Y in a Wide Range of Temperatures. Developed was a unique electron-beam equipment and technology for materials for electrical contacts. The materials (Cu- 8 ... 14 mas. % Mo- 0.05 ... 0.1 mas. % Zr- 0.05 ... 0.1 mas. % Y), not containing Ag, W, CdO, obtained by high-speed electron-beam evaporation of metals and subsequent condensation of a steam flow in vacuum on a substrate heated up at 870 ... 910 K were used. The new technology causes formation of special micro-layer with thickness of alternating layers from 0.1 up to 0.4 mkm, owing to which the contacts have higher physico-mechanical and operational properties in comparison with the standard ones. Basic advantages of a new materials is: is doesn't contain silver and consequently is

rather cheap, it at 1.5 - 3 x exceeds Ag-CdO composition in durability, provides high reliability of contacts operation, the maximal switch-current is up to 4200 A, the developed material exceeds all existing electrotechnical materials in radiating stability, thermal stability, wear resistance, has a high heat- and -electrical conductivity, and replaces berylliums bronze. The new material is certified in Ukraine and Romania and widely used for manufacturing contacts at: of the electro transport, lifting facilities, port and ship cranes, mine equipment, any other electro technical devices, which contain relay, actuators, contactors, slip rings etc.

75. L. Boyko; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
GASAR - New Porose Metals for Industry. Recently a new techno1ogy was developed in Ukraine resulting in GASAR - process. Gasars are porous materials made by casting with hydrogen application. A discussion covers the conditions necessary for nucleation and growth of gas phase in nickel-hydrogen system at gas eutectics solidification. Ordered porous structures are shown to develop when gas bubbles nucleate interdendritic shrinkage cavities at solidification front. The effect allows to obtain a regular gas eutectic structure named GASARIT. Mechanical and physical properties of nickel gasar were experimentally investigated. It was found to possess higher strength, plasticity, thermal conductivity, and lover resistively compared to powder metallurgy porous metals owing to its anisotropic porous macrostructure. Gasars are also capable for hydrogen storage and to reduce metal erosion. These results form the basis to produce porous materials with a honeycomb structure for application in industry as lightweight construction materials.

76. J. Durišin, J. Kavuličova, D. Ivanova, G. Sučik, M. Škrobian, D. Hršak*; *Faculty of Metallurgy Technical University of Košice, Slovakia, *Faculty of Metallurgy University of Zagreb, Sisak, Croatia*
Decreasing of Melting Temperature of δ-Iron by the Effect of Admixtures. The paper deals with the calculation of temperature of liquid phase in the Fe-X binary systems according to the Le Chatelier-Schröder equation. Two cases are considered in the calculations: a) equilibrium of pure δ-iron with ideal melt of admixture containing iron, b) ideal solid solution of δ-ferrite with ideal melt of admixture containing iron. Decrease of melting point of δ-iron in the binary systems is calculated as the difference between melting point of pure δ-iron and melting point of δ-iron containing 1 wt. % of admixture. The results of the case a) are summarized in the form of periodic table. Decrease of melting point of δ-iron for the multi-component system (steel) is calculated as the sum of melting point decrease of the individual binary systems.

77. Yu. A. Dinnik, A. G. Saginor, V. G. Sova, A. V. Pischida; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
New Iron Antifriction Alloy. The "know-how" technology was developed as well as industrial tests of new iron antifriction alloy (with spherical or graphite flake). New alloy passes antifriction properties which enables it to substitute the goods from cooper alloys. The index of hardness and wear resistance of iron alloy is above on 30 - 40 % and in 1.5 - 2.0 times, accordingly. The goods manufactured from developed new iron antifriction alloy successfully serve at process equipment for mining and metallurgy.

78. L. Cristea, R. R. Pitiescu*, B. Popescu, M. Teleanu; *University "Politehnica" Bucharest, Bucharest, Romania, *Institute for Non-ferrous & Rare Metals, Bucharest, Romania*
The Synthesis of Nano-Powders Accomplished using by Different Physical, Mechanical and Chemical Methods. Hydrothermal processes have been recently reported as a attractive route in the synthesis of both zirconia powders and films. The present paper presents some aspects regarding the micro-structural evolution of zirconia nano-materials obtained via hydrothermal process starting from soluble peroxide precursors.

79. M. Branzei, D. Gheorghe, M. Feder*; *University "Politehnica"of Bucharest, Bucharest, Romania, *AFERRO SA Bucharest, Bucharest, Romania*
Quantitative Characterization of some MnZn Ferrite with Percent Variation of Bi_2O_3. The studies were made on a ferrite of the following chemical composition: Mn - 0.54, Zn - 0.37, Fe - 2.06, O - 4, with increasing addition of Bi_2O_3 from 0.01 wt. % to 0.5 wt. %. Samples were obtained using the conventional ceramic technology. The raw materials (αFe_2O_3, Mn_3O_4, ZnO), after mixing were dried and presintered at 800 °C for 1 hour in air, and then mixed with an increasing quantity of Bi_2O_3 (0.01 - 0.5 wt. %). We examined the influence of sintering temperature in correlation with the sintering time on grain size, which influence the loss factor of the material. The quantitative analysis revealed the modification of the structure and porosity which is in direct relationship with magnetic and electric properties.

80. J. Zrník, I. Mamuzić*, F. Vodopivec;** *Faculty of Metallurgy, Technical University of Košice, Slovakia, *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia, **Institute of Metals and Technologies, Ljubljana, Slovenia*
Trends and Developments of Functional Materials. This paper presents the major trends and reviews developments in functional materials including semiconductors, optical fibres, solar cells, magnetic and superconducting materials. These materials are a rapidly developing activity and are the object of a great deal of current research and development investment. Examples include photosensitive materials and a range of modern opto-electronic materials involving compound semiconductors which will probably form the basis of a second microchip age.

81. P. Mrvar, M. Trbižan, J. Medved; *Faculty of Natural Sciences and Engineering, University of Ljubljana, Ljubljana, Slovenia*
Solidification of Aluminium Cast Alloys Investigated by Dilatation Analysis. The investigations have made using the following modified and unmodified aluminium alloys: AlSi7Mg, AlSi10Mg and AlSi12Cu. By dilatation and cooling curves, the derivate cooling curves of the cast sample and mould (made by Croning process) the segregation of the silicon phase in the eutectic reaction has been detected respectively. The air gap between mould and cast sample, and the influence of the modification on the formation of the intensive contraction have also been determined.

82. M. Fujda, M. Longauerová; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*
Microstructure and Impurity Segregation in Centre Zone of Continuously Casted Slabs. Microstructure and impurity segregation was analysed in thickness centre of continuously casted slabs of three low carbon steels with different Cu content produced by continuous casting at a curved machine. The central parts of slabs showed uneven ferrite-pearlite microstructure with grains of different size and form. Concentration of dentrimental impurities (Sn, Sb, S, P) significantly raised in the slab center owing to segregation in steel crystallisation process. FeMnS or MnS inclusions are increasingly quantity concentrated in the centre of cross section of slabs. They are arranged on ferrite and pearlite grain boundaries and also in interior of grains. Interdendritic porosity was also observed in central section of continuous casted slabs. Difference in Cu content of the analyzed steel have not effects on the microstructural character at central zone of slabs.

83. J. Kavuličová, D. Ivánová, G. Sučik, M. Škrobian, T. Laco, D. Hršak*, J. Ďurišin; *Faculty of Metallurgy, Technical University of Košice, Slovakia, *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*
Analysis of Binary Fe-X Phase Diagrams by the Le Chatelier-Schreder Equation. This paper deals with the calculation of temperature of liquid phase in the Fe-X binary systems according to the Le Chatelier-Schreder equation. Two cases are considered in the calculations: a) equilibrium of

pure δ-iron with ideal melt of alloying element containing iron, b) ideal solid solution of δ-ferrite with ideal melt of alloying element containing iron. Decrease of melting point of o-iron in the binary systems is calculated as the difference between melting point of pure δ-iron and melting point of δ-iron containing 1 wt. % of alloying element. The results of the case a) are summarized in the form of periodic table. Decrease of melting point of δ-iron for the multicomponent system (steel) is calculated as the sum of melting point decreases of the individual binary systems.

84. V. P. Gagauz, V. E. Gromov, V. I. Danilov, L. B. Zuev, V. Ya. Tsellermaer; *Siberian State University of Industry, Novokuznetsk, Russia*
The Strength of Welded Joints of Blast Furnace Jackets. The strength properties of welded joints of blast furnace jackets from 09G2S steel (C £ 0.1%, Mn = 1.8%, Si < 1%) depending on way of welding and time of operation are investigated. The results of complex researches of different types of welded joints in blast furnaces allow to confirm that the joints are especially unsuccessful if made by hand horizontal welding both electroslagged one and without flux. Besides the law plasticity in welded joints the holes of size up to 1.5 mm are found. The more reliable welded joint was obtained by automatic vertical electroslag welding. Here, the welded on metal basically is deformed and broken down. Such joint was operated successfully during 16 years.

85. Yu. Yu. Zhiguts; *Uzhgorod National University, Uzhgorod, Ukraine*
Grey and White Special Termite Cast Iron. The aim of the work was setting up the possibilities to get high quality machine building materials (thermite grey and white special cast irons) using ways which combine selfpropagating high temperature synthesis and metallotermy. On the basis of metallotermic burdens designed by microsmelting the technologies of synthesis of grey, chilled and special thermite cast irons were made. At investigation of auxiliary features special attention was paid to wear resistance and workability of synthesized materials. The designed compositions of thermite mixtures are also suitable for technology of thermite foundry additions of high temperature gradient. The work done allows us a general conclusion that the methods themselves are suitable for production of any black alloy.

86. J. Malina, M. Malina. Vj. Novosel-Radović*; *Faculty of Metallurgy, University of Zagreb, Sisak, *Steel Work Sisak, Sisak, Croatia*
Fracture Characteristics of Welded Steel under the Influence of Absorbed Hydrogen. In order to explain why the welds charged with hydrogen at the inter-critical heat affected zone (HAZ) failed in tensile tests. Fractographic analyses of the welded specimens were carried out for base metal and HAZ. Micrographic investigations on cracked specimens showed that the HAZ introduced by welding influenced the crack path. The crack plane followed the longitudinal trace of the structure developed along the fusion line. Morphology was characterized by a number of micro cracks which are places for hydrogen gathering. Root crack was initiated and propagated along the fusion line region of HAZ, i. e. the weld start and weld stop were "pulled out" from the HAZ.

87. Z. Beloševič, M. Gojić*; *Steel Works, Sisak, Croatia, *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*
Mechanical Properties of Seam Welded Pipes after Cold Drawing. In this work the results on testing microstructure and mechanical properties of seam welded pipes made of St 37.2 steel grade after cold drawing are given. The seam welded pipes ∅ 42.4 x 3.6 mm were obtained from the hot-rolled sheet (thickness of 3.6 mm) by means of a high-frequency induction welding. After that the pipes were cold drawn by means of tube drawing benchs VK 160 and 315/3, respectively. Pipes ∅ 24 x 3.0 mm were obtained by two cold passes. After both passes the normalization of pipes at 920 °C was carried out using the protective atmosphere ($CO + H_2$ at 20 vol. %) at the passing rate of 20 m/h. Pipes with a homogeneous ferrite microstructure were obtained and mechanical properties in accordance with DIN 2393 are found.

88. V. Vokál, A. Výrostková; *Institute of Materials Research of SAS, Košice, Slovakia*
Influence of Postweld Heat Treatment on the Microstructure of P91 and T22 all Weld Metal. Low alloy steel T22 (2.5Cr-lMo) and P91 (9Cr-lMo-0.2V) were used to produce weld coupons. After welding, the post weld heat treatment (PWHT) at 720 °C for 3h and for 760 °C for 2h were used, respectively. The aim of the work was to evaluate the influence of PWHT on the microstructure and mechanical properties of the all weld metal. Light microscopy and STEM/EDX (carbon extraction replicas) were used to evaluate microstructure and phase composition. Mechanical properties studied included hardness, tensile strength values and Charpy toughness. Heat treatment of the steel T22 resulted in the tempering of original bainitic-martenzitic microstructure and precipitation of mostly non-equilibrium carbide phases. Heat treatment improved ductility of P91 steel more significantly than that of T22 steel.

89. A. Prelošćan, F. Vodopivec*, I. Mamuzić; *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*, **Institute of Metals and Technology, Ljubljana, Slovenia*
Fine grained structural steel through controlled hot rolling. The result on investigation of fine grained structural steels microstructure at hot rolling conditions is given. Billets of 55 mm thickness were heated to 1200 °C and rolled starting at this initial temperature to obtain a rolling temperature interval from 1050 °C to 760 °C. From the rolled plates of 16 mm thickness specimens for optical microscopy were prepared by conventional way. The portions of precipitates of aluminium (AlN) and niobium carbide (NbC) were determined using a modified halogen extraction method. The result of the investigation indicates that no grain size decrease could not be expected if the rolling plates are performed significantly below the austenite to ferrite transformation temperature.

90. A. G. Demidovskaya, I. G. Dolisitskaya, A. Y. Proidak, I. E. Lev; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Investigation of Vanadium Nitrides in Low-alloy Steels. Vanadium nitrides refer to refractory material, which are of great importance. Complex of physical - chemical properties, is formed by dispersion strengthening of steels with vanadium nitrides. For optimization of chemical composition of steel it is necessary to know the state of nitrogen and vanadium in steel. So the authors investigated the influence of heat-treatment on quantity and composition of vanadium nitrides formed in low-alloy steels. Nitrides were taken out of steel and studied by electro-chemical phase analysis. Quantity, composition, specific surface and type of nitrides elementary cells were distinguished. Temperature intervals of vanadium nitrides formation during surface nitrogenation of vanadium - containing steels were also determined.

91. M. Buršák, I. Mamuzić*, J. Micheľ, J. Hidvéghy; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia, *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*
Strength and Plasticity of Hot and Cold Rolled High Strength Weathering Formable Steel Sheets. Mechanical properties, and fatigue resistance for a low carbon Corten type steel sheet with improved corrosion resistance are studied. The mechanisms of atmospheric corrosion is analyzed for low alloyed steel and compared to that of Corten type steel. The influence of two to five years exposition to atmospheric corrosion is shown. Statistics on mechanical properties are given for a 2 to 6 mm steel sheet. Fatigue properties were tested by bending flat test pieces. The ratio $\sigma Co/R_m$ was compared before and after exposition to atmospheric corrosion. Properties of cold-rolled steel after annealing process and subsequent

smoothing are also given. Efficient improvements in the rolling production technology are possible. The change in properties by atmospheric corrosion are valuable application data.

92. J. Zrník, T. Kvačkaj, Z. Nový*, V. Vrchovinský, J. Krušinský;** *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia, *ŠKODA VÝZKUM s. r. o., Plzeň, Czech Republic, **Metalurgia, a. s., Dubnica nad Vahom, Czech Republic*
Medium Carbon Microalloyed Steel for Potential Crankshaft Application. There is a continuous demand, especially from automotive industry, for cheaper components and also a for alternative materials, e. g. castings and composites. In response, the steel industry has developed microalloyed steels which offer reduced processing cost for forging and bar products. These steels gained the desired mechanical properties during controlled processing by precipitation hardening. The medium carbon microalloyed steel C35MnV doped with vanadium and titanium have been selected to control forging of the crankshaft. The different cooling rates of forgings as well as the forging isothermal annealing were introduced to yield mechanical properties due to variability of gained structures. The microstructure analysis and mechanical testing of forgings providing a data on toughness and tensile properties were carried out to evaluate the applied forging schedule parameters. The mechanical properties of microalloyed crankshafts imply that properly chosen forging process and forging parameters can result in improved properties of crankshaft and satisfy the requirements of automobile producers.

93. D. Krumes, I. Vitez, Z. Kolumbić; *Faculty of Mechanical Engineering, University of Osijek, Slavonski Brod, Croatia*
Influence of the Boron Phases on Materials Ductility. The investigations were performed on a low carbon steel and a low alloyed Cr-Mo steel specimens boronised using solid agent. The results of the surface layers investigations, obtained by the torsion and bending methods, indicate better ductility of the mono-phase Fe_2B boron layers then the binary-phase FeB + Fe_2B boron layers. This is especially the case at pieces under stronger mechanical and thermal influences, where the binary-phase layer has higher tendency to break-away, that to pile-up. Metallographic investigations of the boron layers were performed by light microscope and also using scanning electron microscope. For the boron layer type determination, surface layer of the specimens were investigated by the Röentgen diffraction method as well.

94. M. Buršák, J. Hidvéghy, M. Mihalíková; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*
Fatigue Properties of Steel Quality Corten at Different Loading Conditions. Steels quality CORTEN are low alloyed steels of higher resistance to atmospheric corrosion. They are used also for equipment which is subject to cyclic loading (shipping industry). Paper analyses the fatigue properties of steel quality CORTEN, of 3.5 up to 12.5 mm thickness which is alloyed by Cr + Cu + Ni in the range of 1 - 2 %. The yield stress is R_e > 345 MPa and ultimate tensile stress R_m > 485 MPa. Fatigue properties were analyzed by tensile cyclic loading and flat bending and torsion by symmetric varying vibration. The influence of sheet thickness, rolling direction as well as loading mode were studied on time-dependent part of Wöhler's curve. Loading mode has a significant influence on fatigue characteristics of tested steel. Ratio of fatigue limit to ultimate tensile stress for tensile cyclic loading equals 0.569 but for torsion equals to only 0.325.

95. J. Hidvéghy, M. Buršák, J. Micheľ; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*
Residual Stresses in Micro Alloyed Sheet Steels. Experimental program was realized on micro alloyed steel sheets with the yield point in the range of 300 up to 700 MPa and 8 mm thickness. The residual stresses were measured in the middle and margin parts of steel sheets, respectively. Results of measuring confirmed that by the increase of strength properties of steel sheets also the residual stress level increases. For steel with the yield stress of 700 MPa, on the upper surface of steel sheet the residual stress of 120 MPa was found. Results obtained shows that the residual stresses depend, on the place selected on a steel sheet. These stresses influence the processing of steel sheet as well as the mechanical properties which are related to steel surface. On the upper surface of steel sheet, where the residual tensile stress occurred, the fatigue crack initiation is about 80 % faster in comparison to the bottom part of steel sheet, where the residual compression stress exists.

96. V. Jurko, M. Matta; *U. S. Steel, Research and Development Center, Košice, Slovakia*
Properties of New HSLA Steels for Pipeline Production. One of the most frequent requirements for hot rolled steel, used at gas or oil pipelines, is low variation in mechanical properties. Some pipelines after assembling are pressed up to yield stress (YS) with the aim of stress corrosion reduction. This is possible only in the case of low variation of YS. Low variation of YS in steel production is assured by low spread of chemical elements and also by precise control of hot rolling and cooling. New possibilities are in control of finishing and coiling temperatures using actual chemical composition of hot rolled slab. During the last year the unified system helped not only to meet API 5L 2000 standard, but also to fulfill some additional requirements of pipelines designers (YS and toughness limits). As a result production of HSLA hot rolled coils for pipeline production during the year 2001 in U. S. STEEL Košice have expressively increased. This was possible by great progress in the stability and in the uniformity of mechanical properties.

97. J. Micheľ, M. Buršák, I. Mamuzić*; *Faculty of Metallurgy, Technical University of Košice, Slovakia, *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*
Creep Properties of Microalloyed Steels. Paper analyses the properties of microalloyed steels of S315 MC and S460 MC quality and carbon heat resistant steel of St.45.8 quality at higher temperatures in the creep conditions. The higher values of stress-rupture strength of microalloyed steels in the creep conditions (400 - 500 °C), which are comparable to stress-rupture strength of low alloyed steels, are mainly the result of the precipitation hardening.

98. A. Prelošćan, M. Prelošćan*, M. Šprišić, R. Križanić*; *Faculty of Metallurgy, University of Zagreb, Sisak, *Steel work Sisak, Sisak, Croatia*
Heat Treamtent of N-80 Steel with Modified Structure. The effect of heat treatment on the structure and characteristics of N-80 steel with modified chemical structure bas been studied. Bonding degree of as-rolled, -normalized, and -improved micro-alloyed elements bas been analyzed. It was found out that both the best mechanical characteristics and the structure were achieved on the as-improved steel.

99. V. Z. Kutsova, O. V. Shvets'; *National Metallurgy Academy of Ukraine, Dnepropetrovsk, Ukraine*
Microalloying of Aluminium Alloys. An effct of microalloying on the structure, phase composition and mechanical properties of the wrought Al-Cu-Si-Mn and cast Al-Si-Fe-Mn-Mg (siluminums) alloys was studied in the present research. The same mode of structure formation in wrought and cast aluminum alloys allow to suggest the same mechanism of microalloying of these alloys which is based on concept of solubility of microalloying elements in solid so1utions, on the basis of: basic components of the system (Al, Si etc.), change of atom-atom interaction in an alloy, which is resulted from formation of pair bonds n-X (n is a component of an alloy, for example, Al-X, Si-X, O-X etc.) and., as a consequence, change of phase equi1ibrium and transitions temperatures and branching of so1id solutions crystals and intermetallic phases.

100. V. A. Borisenko, V. V. Bukhanovsky; *Institute for Problems of Strength, National Academy of Sciences of Ukraine, Kiev, Ukraine*
High-Temperature Strength of Low-alloyed Molybdenum Alloys. The laws of variation have been investigated and established the characteristics of short-term strength, plasticity and the nature of fracture of alloys of molybdenum of systems Mo-Al-B, Mo-Re-B, Mo-Zr-B, Mo-Zr-Hf-B and Mo-

V-C with solid solution and combined strengthening, as well as by the strength of their welded joints depending on the material structural state and its governing manufacturing factors (welding method and conditions for welding and thermal treatment) in the temperature range from 290 to 2 270 K. Particular and generalized correlation relations have been established between the characteristics of short-term, long-term static strength, low-cycle strength and resistance to creep for the molybdenum alloys. The analytical expressions which enable one to make accelerated assessment and prediction of long-term strength, low-cycle strength and creep characteristics of materials from the results of short-term tests have been proposed and experimentally justified. The results of to investigations were used to improve the manufacturing technology and also for the calculations of strength of welded structures which operate under conditions of extremely high temperatures, aggressive gaseous media and erosion wear.

101. J. Zrník, J. Huňady, P. Horňák; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*
Nickel Based Single Crystal Superalloy CM 186 - potential Material for Blades of Stationary Gas Turbine. Single crystal (SC) of nickel based superalloy CM 186, has been developed for land-based power generation app1ications. The directional casting technique was used to cast the gas turbine blades. The metallography observations of as-cast blades revealed a dendritic solidification patterns with primary dendrite spines and secondary arms frequently branched. The higher magnification revealed the enriched interdendritic regions, where islands of eutectic were formed. The eutectic regions were enriched by Al, Ti and Cr and the dendrite trunk center by W, Ta and Re. In order to homogenize the dendritic structure the step-like heat treatment of SC castings was conducted where hold time and temperature were variables of process. Results on homogenisation treatment showed that for the successful homogenisation of the dendritic structure of casting the final temperature must be over 1300 °C. To avoid the incipient melting at local areas the slow heat-up rates or step-like successive temperature increasing treatment are recommended.

102. A. A. Alekseev, S. V. Bykova, M. I. Ermolova; The *All-Russia Institute of Aviation Materials, Moscow, Russia*
Phase Transformations under Single-Stage and Two-Stage Aging of the 6013 (AD37) Alloy. Sheets of 1.6 mm thickness produced from the an alloy, belonging to the Al-Mg-Si-(Cu) system, were studied in the work presented. The ratio of Mg, Si, Cu and additions in the alloy corresponded to the stoichiometric composition of the Q-phase. The lattice cell measurement data for the investigated alloy revealed monotonic lattice period change during agining. It was proposed to introduce a concept of a diffusion path (l_{ef}) for each of the properties according to the law: $l_{ef} / l_0 = \exp(-E_{ef}/ RT) \times (t / t_0)$, where l_0 and t_0 – constants of experiment; R - gas constant; T and t - temperature and ageing duration. It was shown, that it is possible to analyse the ageing processes by the dependence of each of the properties on its path of diffusion. Introduction of the diffusion path concept is convenient for analysis of stepped ageing, as each ageing step corresponds of the definite path of diffusion. Analysis of two-stage aging is presented in this work.

103. A. A. Alekseev, E. A. Lukina, M. I. Ermolova; *The All-Russia Institute of Aviation Materials, Moscow, Russia*
Non-Equilibrium δ" (AlLi) Phase Formation in Al-Li-Mg System Alloys. An Al-1.61 % Li-5.4 Mg + additions alloy aged at the 100 - 200 °C temperature range was investigated using TEM and X-ray techniques. It is shown by X-ray analysis data a non-equilibrium precipitates along with a metastable δ' (Al_3Li) phase in the 100 - 125 °C temperature range. The range of the δ"-phase existence was specified by TEM. The phase mentioned is observed as spherical particles uniformly distributed within the grain body, and in a non-uniformly manner along grain boundaries. That may be considered as a confirmation for presence of Li atoms in the δ"-phase. The δ"-phase elastic modules are small. It is possible to explain such a feature by an assumption that δ"-phase structure includes Li atoms with metallic electron bonds. Under next stage of aging at higher temperatures precipitates presumably of β' (Al_8Mg_5) are formed by a cellular decomposition mechanism. During latter aging stages δ', δ" and β-phases disappear and the Si(Al_2LiMg) phase forms. In the presented work a time-temperature transformation diagram for aging is constructed.

104. K. Mykhalenkov, D. Chernega, W. Reif*; *National Technical University, Kiev, Ukraine, *Institut für Werkstoffwissenshaften, Technische Universität of Berlin, Berlin, Germany*
Effect of Grain Refinement on the Structure and Tensile Properties of A356 Aluminium Alloy. The present contribution is within the conceptual framework of the previous studies on grain refinement of aluminium by master alloys, salts and its mixtures with particles of TiN or Ti(C, N). On the one hand, AlTi6, AlTi5B1 and AlTi5C0.1 commercially available master alloys were found to have a minor effect on the grain size and morphology of the eutectic Si. The A356 alloy treated by AlTi5Co.1 (2 wt. %) exhibit the maximum UTS - 315 MPa which is higher than that of initial alloy (285 MPa). On the other hand, the introduction of the mixture K_2ZrF_6 + TiCN does have a significant grain refining effect on the α - phase. However, such a treatment results in a decrease of UTS (170 MPa) in comparison with that of the untreated alloy. The formation of platelike silicides (viz. $TiSi_2$, $ZrSi_2$ or ternary Zr - Ti - Si) is believed to be responsible for the tensile properties deterioration.

105. E. V. Lysova, N. R. Bochvar, O. V. Botieva, L. L. Rokhlin; *Baikov Institute of Metallurgy and Material of Science, Moscow, Russia*
Investigation of Phase Composition and Properties of Al-Cu-Li-Sc Alloys. The phase composition of Al alloys with additions of Cu, Li, Sc and aged at temperatures 200 and 250 °C was studied by optical and scanning electron microscopy and by measurement of the hardness and mechanical properties. As a results of the investigation isothermal sections for quaternary phase diagram Al-Cu-Li-Sc at 500 °C and content of Sc = 0.6 mass %, Cu from 0 to 16 mass %, Li from 0 to 4 mass % were constructed. The change of hardness, ultimate tensile strength, tensile yield strength and elongation of Al-Cu-Li-Sc alloys in dependence on constitution and temperature were determined.

106. L. L. Rokhlin; *Baikov Institute of Metallurgy and Material of Science, Moscow, Russia*
Investigation of Mg-Base Alloys Containing Sm. Mechanical properties of extruded and heat treated magnesium alloys containing the rare-earth metal samarium were investigated. As other rare earth metals, samarium addition results in significant increase of strength properties of magnesium. The strengthening effect of samarium is higher than that of the well-known neodymium and samarium is more soluble in magnesium solid solution. Heat treatment of Mg-Sm alloys accompanied by Mg solid solution decomposition improves their strength. Magnesium alloys containing samarium demonstrate high level of strength properties both at room and at elevated temperatures as compared with well-known magnesium alloys: TS H" 320 MPa, with E (elongation) H" 5 % at room temperature and TS H" 250 MPa, and with E H" 20 % at 250 °C.

107. T. J. Dobatkina, L. L. Rokhlin; *Baikov Institute of Metallurgy and Materials Science, Moscow, Russia*
Investigation of the Mg-Y-La-Zn Alloys. Investigation of Mg-base alloys containing Y, La, Zn together in different combinations were conducted. The alloying elements are known to be effective strengthening additives to Mg. Structure and mechanical properties of the alloys prepared in form of hot extruded rods or hot rolled sheets were studied. Strength properties of the alloys containing 5 % Y with increasing La content up to 1 %, and increase of strength properties of the alloys containing 0.5 % La with increasing Y content up to 12 % are also studied. Tests of the alloys containing 0.4 % Zn showed continuous increase of the strength properties with increasing La content up to 1 %. The alloys containing optimal contents Y, La and Zn together indicated ultimate tensile strength up to 280 MPa at 10 % elongation.

108. S. Rzadkosz; *Faculty of Foundry Engineering, University of Mining & Metallurgy, Kraków, Poland*
Investigation of the Effectiveness of Nucleation Process in Aluminum Alloys and of Admixtures Effect on the Intensive Action of Composition of Salts on the Structure and Properties of selected Aluminum alloys. In the case of alloys characterized by the structure of solid solution α, the highest relative effectiveness of structure refining is observed after modification with materials based on compounds of titanium, zirconium and boron. A large-scale application in modification of the solid solutions have found the master alloys of the type AlTi, AlB, AlTiB and AlZr. The presence of mentioned elements and the form of intermetallic phases nucleating in liquid metal depend on the quality of modifiers and on the reaction that proceeds between the modifying slag's and liquid metal as well as with the admixtures included in the composition of a given alloy. Their effect on structure and properties is different and quite often is a subject of scientific studies. The application of a mixture of modifying salts exerts a favorable effect on the structure and properties of hypoeutectic and eutectic Al-Si alloys. It has been found that the effect of modifying salts depends on the effect of various other factors. Within the scope of the investigation an analysis was made as regards the action of a mixture of modifying salts in the presence of other admixture. Studies were made on the degree of refinement of the crystallites of solid solution and eutectic and on changes in the mechanical properties under the effect of some selected admixtures and microadditives in liquid metal. As the results of numerous studies it was indicated that microelements have a significant effect on modification and dispersion hardening process.

109. M. Torkar; *Institute of Metals and Technology, Ljubljana, Slovenia*
As Cast Microstructure and Recrystallization of Ni-Fe Alloy. The influence of the temperature of the melt to solidification and the hot workability of as east Ni-Fe alloy has been investigated. Lower casting temperature of the melt decreased the grain size. The samples were hot deformed and recrystallization process was observed. Recrystallization at hot rolling started already at 5 % rate of deformation. The alloy is sensitive to oxidation of the surface during heating.

110. S. Ivănescu, D. V. Dumitrescu, I. Popa, C. Gurgu; *Researcher Institute for Non Ferrous Metals, I. M. N. R., Bucharest, Bucharest, Romania*
The Influence of Microalloying upon the Structure and Technological Behavior of the Titanium Alloys. The specific elaboration procedures of the titanium alloys are the melting in the electron beam furnace and electric arc furnace with consumable electrode in vacuum. The ingots have a casting structure with course grains and the initial ingot's deformation is very difficult. An agent added in the alloy increases the capacity of hot deformation at temperature between 925 - 1260 °C with a deformation degree less than 30 % at the first stage without superficial cracks. The modifying agent can be: Yttrium, Rare Earth Metals or their combination. The influence of micro alloying on the casting structure of the alloy TiAl5Sn2.5 was established. The characterization of TiAl5Sn2.5 alloy with and without microalloying addition the following analyses are made: chemical analyses, macrostructural analyses and hardness.

111. V. V. Pashynsky, D. G. Sydorenko*, S. V. Trakimov*, V .P. Kashyryn*; *Donetsk National Technical University, Donetsk, Ukraine, *Scientific Production Company "Donix", Donetsk, Ukraine*
Producing of Hard Alloy Rolls for Modern High-Speed Rolling Mills by the Sintering under Pressure. Sintering under pressure (PS) in comparison with traditional sintering permits to reduce the duration of manufacturing period, and to obtain high density und low porosity. The equipment for realization of this process is simpler and less expensive than equipment for hot isostatic pressure (HIP). PS may be used to produce the large weight rolls (10 - 30 kg) from hard alloys on tungsten carbide base. Exceeding of optimal pressure for the given temperature causes the formation of non uniform distribution of binder and formation conglomerations of carbide grains. It practically has not the influence on hardness and bending strength but may decrease the resistance to crack development at thermal cyclic loading. Temperature-deformation and temporal regimes of PS for large-size parts were developed. They permit to prevent the formation of undesirable structures and obtain the complex of properties comparable with ones obtained by HIP process at much lower production cost.

112. E. Dudrová, M. Kabátová, Ľ. Parilák, R. Bidulský; *Institute of Materials Research of Slovak Academy of Sciences, Košice, Slovakia*
Effect of Sintering Conditions on Microstructure, Mechanical Properties and Failure of Fe-3Mn-0.7C Sintered Steel. Mechanical properties of Fe-3Mn-0.7C sintered steel were determined in tension and in bending following laboratory sintering at 1120 and 1200 °C for 60 min in dry H_2-rich atmosphere (dew point of -60 °C) and industrially at 1180 °C for 40 min in cracked ammonia with the dew point of -30 °C. The sintered microstructure is complex and heterogeneous formed by the products of diffusive and non-diffusive transformations. The oxide networks were identified in microstructures of specimens sintered in industrial conditions. The highest strength and plastic properties were recorded for Fe-3Mn-0.7C alloy sintered at 1200 °C in dry atmosphere: $R_{0.2}$ = 490 MPa, R_m = 642 MPa, bend strength of 1256 MPa, apparent hardness of 207 HV10, tensile and maximum bend strains were 1.02 and 0.82 %. The reproducibility of tensile and bend strengths data was high, characterized by Weibull moduli m of 15-31. The large pores or their agglomerates (50 - 70 μm in size) act as the failure originating sites in the tensile and bend specimens.

113. R. Turk, M. Knap; *Faculty of Natural Sciences and Engineering, University of Ljubljana, Ljubljana, Slovenia*
Assessment of the Strip-compression Test for Measuring Strength of Lammellarly Structured Layers at High Temperatures. Mechanical properties of composites are mainly determined by properties of incorporated fibrous materials. Carbon fibers are so far the only known fibrous material which has no phase transformation up to 2200 °C, and therefore are mechanically stable. These fibers must be protected against oxidation above 450 °C. This protection is nowadays the main object of investigations, and it demands constant control of mechanical properties of C composites in oxidizing atmosphere. Standard method for determination of strength of brittle materials is the tensile test since it encounters the least favorable mechanical loading conditions. In testing lamellarly structured materials, e. g. of C-C type, the available test specimens have a shape of strips of constant rectangular cross section. The cross section of the ingoing part (for clamping) of strip specimen must be reinforced. This is made by a sandwich bonding of shorter sections of the specimen on the ingoing side of specimen which is not efficient at higher temperatures since adhesive is not heat resistant and the bonds become loose. More successful was the application of the lateral strip-compression test which demands such a geometry of specimen and such a testing machine that buckling is avoided. Only local length of specimen is compressed in this test in such a way that strip segment of rectangular shape is laterally loaded along its thickness. Strip- compression test is control led by FEM- analysis.

114. Ľ. Parilak; *Institute of Materials Research of SAS, Košice, Slovakia*
Microstructural Nature of the Mechanical Properties of Sintered Materials. The theoretical aspects of microstructural nature of strength and fracture properties of iron based sintered materials are presented in the paper. Strengthening contributions of individual microstructural components and of chemical composition are quantified. Special attention is paid to the influence of porosity on the mechanical properties in general, and theoretical models with analytical description are elaborated. Specific examples are presented on selected iron based sintered systems. The results allow the prediction of mechanical properties on the basis of porosity state and selected microstructural parameters.

115. J. Dusza, P. Sajgalik*, M. Steen, E. Semerad***;** *Institute of Materials Reseaich of SAS, Košice, Slovakia, *Institute of Inorganic Chemistry, Slovak Academy of Sciences, Bratislava, Slovakia, **Institute for Advanced Materials, Joint Research Center, Petten, The Netherlands, ***Austrian Research Centers, Seibersdorf, Austria*

Mechanical Properties of a Si_3N_4 + SiC Nanocomposite at 1350 °C. Mechanical properties of a hot pressed silicon nitride/silicon carbide nanocomposite and reference monolithic Si_3N_4 has been investigated at 1350 °C in air using different mechanical tests; fracture toughness, dynamic fatigue and stepwise loaded low-cyclic fatigue and creep. Fractography was used for the measurement of the size / shape of the slow crack growth (SCG) area and for the study of the fracture origin and fracture micromechanisms during the SCG propagation. The fracture toughness increases as the loading rate decreases in both the Si_3N_4+SiC nanocomposite and monolithic Si_3N_4. The increase was more enhanced in the monolithic material. Both, stress corrosion cracking and creep damage mechanisms have been identified in the monolithic ceramic tested at law loading rates but the mechanism responsible for specimen failure was stress corrosion cracking. The Si_3N_4+SiC nanocomposite exhibits higher creep resistance and higher resistance against crack initiation and growth during the low-cyclic fatigue than the monolithic silicon nitride.

116. B. Piekarski, M. Garbiak; *Institute of Materials Engineering, Technical University of Szczecin, Szczecin, Poland*

Influence of Nb and Ti Additions on Microstructure and Mechanical Properties of Annealed Ni-Cr Cast Steel. The influence of additions of Nb and/ or Ti on mechanical properties of cast steel type G-X30NiCrSi 30-18 after annealing at 900 °C/ 300 hrs has been presented in this paper. The contents of Nb and Ti have been changed up to 2% and 1% respectively. The equations describing the changes of R_m, $R_{0.2}$ and A_{10} at the temp. of 20 and 900 °C as a function of Nb and Ti contents in an alloy have been determined. The obtained results show that the additions have disadvantageous influence on the investigated parameters and this particularly concerns Ti. Nb and Ti contents change both the composition and the morphology of the phases being precipitated in this alloys.

117. M. I. Gasik, Yu. S. Proydak, I. S. Semenov, A. E. Taranenko*; *National Metallurgical Academy of Ukraine, *Institute of Metal Physics of NAS of Ukraine, Dnepropetrovsk, Ukraine*

An Investigation of 110G13L High Manganese Steel melt Structure. One of the major causes for failure in-service of austenite manganese steel 110G13L is a formation of ε-HCP martensite. Previous investigations have shown the interconnection between characteristics of melt with phase transformation in solid state. In order to develop the improved manufacturing practice of 110G13L steel, the X-ray investigation of melt structure was conducted. The comparison of the data with radii of different allotropic forms of iron, (ferrite BCC - 0.2866 nm and austenite HCP 0.359 nm) extrapolated form 293 K to the experiment temperatures, indicates that 110G13L melt structure has HCP symmetry. At temperature increase form 1 773 K to 1 923 K the first peak becomes higher more symmetric, which is interpreted as to result from increase of HCP groups portion in the melt. There are also noticeable changes in second peak form - with temperature increase from 1 773 K to 1 923 K the separation into two sub-peaks, corresponding to the 3rd and 4th NN spheres in HCP lattice, becomes less pronounced. Summarizing the information obtained, in cou1d be stated that increase of inter-atomic distance caused by rise of temperature and increase of held time will decrease probability of hazardous solid-state phase transformations in high manganese steel.

118. B. Piekarski, M. Garbiak; *Institute of Materials Engineering, Technical University of Szczecin, Szczecin, Poland*

Effect of Nb and Ti on Microstructure and Mechanical Properties of 30% Ni / 18% Cr Cast Steel after Annealing. The study discusses the microstructure and mechanical properties of eight tested 0.3 % C -30 % Ni - 18 % Cr cast steels stabilized with niobium and titanium after annealing at the 900 °C / 300 h cycle. The niobium content in the cast steels varied from 0.0 to 2.0 % and that of titanium from 0.0 to 1.2 % by weight. Microstructure was examined using both light microscope and a scanning electron microscope with Link IS-IS attachement as well as an X-ray diffractometer. Depending on the chemical composition of cast steel, the following phases were identified: carbides of MC and $M_{23}C_6$ type and a phase rich in silicon, nickel, niobium and / or titanium, which is supposed to be a phase G. Relationships between the microstructure and mechanical properties of cast steel at 20 and 900 °C were examined as well.

119. S. E. Pavlikhin, B. A. Chudinov, R. R. Gabitov, M. I. Shevchenko, V. A. Panin*; *AVTOVAZ Research Centre, Institute of management, marketing and right, Togliatti, Russia, *JSC "MOTOPROM", Togliatti, Russia*

Wear Resistance of TiAl Intermetallic Valve Rods with Different Types of Coatings. The new trend in using the perspective materials such as TiAl intermetallic alloys for production of one of the most tensest and responsible detail of car engine - valve - is presented in this article. These intermetallic alloys are high strength and heat resistant ones but have got poor wear resistance. Researches were devoted to searching the wear resistant coating made by ion-plasma or gas thermal methods with purpose to select more wear resistant one. Microstructure of coatings on valve rod surface and their hardness were studied and discussed. Photos of microstructures from metalographic specimens are given. The tests were conducted on specialized test machine, modeling conditions of pair "valve-valve guide" work. Results of these tests are given and discussed. It has been shown that application of TiAl intermetallic alloys with ion-plasma coating allows to increase valve wear resistance as well as pair "valve - valve guide" resistance as a whole.

120. F. Lofaj, F. Dorčáková; *Institute of Materials Research of SAS, Košice, Slovakia*

The Effect of Lanthanides on Viscosity of RE-Si-Mg-O-N Glasses. Compressive creep behavior of RE-Si-Mg-O-N glasses (RE = La, Yb and Lu) with equivalent amount of lanthanides was used to determine temperature dependence of their viscosities in temperature range from 800 °C up to 915 °C. Softening temperature was found to depend on the ionic radii of the corresponding lanthanide. Reduction in ionic radii between La and Lu, which is known as lanthanide contraction, resulted in ~ 30 °C increase in softening temperature and increase in the apparent activation energy. These effects can be explained in terms of the increase of the cationic field strength. Introduction of lanthanides with different ionic radii is an effective method for the control of mechanical properties of glasses and ceramics containing such glasses at elevated temperatures.

121. K. Kossyrev, K. Marushkin, S. Alikhanyan*, S. E. Olsen;** *Moscow Steel and Alloys Institute, Russia, *Kurnakov Institute of Inorganic Chemistry, Moscow, Russia, **Norwegian University Of Science and Technology, Trondheim, Norway*

Determination of Component Activities in the Cr-Si-C and Cr-Fe-Si-C Melt. The purpose of the investigation is an experimental dermination of the component activities in the Cr-Si-C and Cr-Fe-Si-C systems. The measurements were done using the mass spectrometric technique. Activities of chromium and iron were determined from experimental results for the following systems: Cr-Si-C_{sat} at 1600 °C and Cr-Fe-Si-C_{sat} Cr/Fe = 4.0 and 1.5) at 1550 °C. Silicon activities were also determined from experiment by measurements of the partial SiO, pressure. SiO is formed by the minor interaction of the melt and effusion cell material. The mass-spectrometric method does not allow measurement of the carbon activity and was calculated from the experimental results of chromium and silicon activities.

122. J. Bažan, Z. Adolf, J. Leitner*; *VSB-Technical University of Ostrava, Ostrava, Czech Republic, *Institute of Chemical Technology, Prague, Czech Republic*

Research of Thermodynamics of Equilibriums of Fe-C-O-X Systems. At solution of project LN00B029 of Ministry of Education of Czech Republic, calculations of influence of chemical composition of steels (influence of Cr, V, Al, Mo, Mn) on equilibrium of Fe-C-O system at temperature s 1500 and 1600 °C in dependence on pressure were done. Calculation of the course of elements content for differently set initial conditions is also a part of calculations.

123. A. B. Yuriev, V. E. Gromov*, V. Ya. Chinokalov, V. Ya. Tsellermaer*; *Joint Stock Company "West Siberian Steel Works", Novokuznetsk, Russia, * Siberian State University of Industry, Novokuznetsk, Russia*

Thermal Strengthening of Large Diameter Fixtures in Line of Rolling Mills. The technology of thermal strengthening of large diameter fixtures (40 mm) from low-carbon and low-alloyed steels in line of rolling mills are developed. The obtaining of high mechanical properties is achieved by change of speed and temperature of rolling, quantity and order of including the sections of forced water cooling (pressure of 5 - 10 atm). The speedy cooling after rolling results in forming the section of structural composite rolling. After strengthened surface layer 2.25 mm thick, consisting of products of martensite break-down (sorbite tempering and pointed pearlite), there is the transitive zone of 2 mm depth from ferrite and inclusions of dispersed carbide and the initial of ferrite-pearlite structure in centre of care. The additional subcooling after the third stand increases the total thickness of strengthened layer.

124. P. Wangyao, J. Zrník, T. Kvačkaj, V. Vrchovinský, Z. Novy*; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia, *COMTEST FMT s. r. o., Pilsen, Czech Republic*

Recrystallization Process to modify the Structure and Creep Behavior of Solution Strengthened Nickel base Superalloy. It was found that annealed microstructure resulting from only one or two steps of hot working of NiMoCr alloy was not uniform throughout specimens as desired. The breaking down of casting ingot structure by hot working could not provide enough uniform recrystallized grain structure of alloy. The uniformity of microstructure increased with higher amount of introduced deformation. The creep tests were carried out to evaluate the high temperature creep resistance of modified structure at temperature of 710 °C and showed creep lifetime to increase with cold reduction increased in range of 4.8 - 15 % reduction. In case of highest reduction applied the amount of the stored energy was critical which resulted in more uniform and fine recrystallized grains structure, owing to the slight decrease in creep lifetime.

125. A. Čižmarová, J. Micheľ, J., Buršák, M. Nový*; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia, *Faculty of Mechanical Engineering, Žilina, Slovakia*

Influence of Strain Rate on Properties of S-MC Micro Alloyed Steel. Paper deals with the influence of strain rate on behaviour of studied steels at higher strain rate levels. Experimental program was realised on sheet steels quality of S315 MC (yield stress R_e > 315 MPa) and quality of S460 (R_e > 460 MPa), micro alloyed either by Nb or Nb + V, 8 mm thick. It implies from the results that the strain rate up to 10^{-2} s^{-1} does not affected the homogeneity of plastic deformation, which is very significant result. The strain rate in the range 10^{-4} - 10^{-1} s^{-1} only very slightly affect the basic mechanical properties of tested steels. Influence of frequency on fatigue properties of selected steels is also given. Comparison of fatigue properties at 30 Hz and 20 kHz was done as well.

126. P. Wangyao, J. Zrník, V. Vrchovinský, T. Kvačkaj. J. Kasl*, Z Novy;** *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia, *Škoda Research Institute Ltd., Pilsen, Czech Republic, **Complete Technologies Service: Forming & Heat treatment (COMTES FHT), Pilsen, Czech Republic*

The Role of Hot Working on Creep Strength of Annealed NiMoCr Alloy. Grain size which uniform coarse grain sizes favors creep strength and crack growth resistance. Optimization and control of uniform grain size and morphology can be obtained by recrystallization. Up to present, the microstructure evolution during the hot working of ingot of the NiMoCr alloy, is still under development. In this present work, an effort is given to develop and the processing which could give a uniform recrystallized grain structure. To modify microstructure to increase mechanical properties including creep, LCF and TMF, were utilized at experiment. The creep behavior of differently modified structures of NiMoCr after various hot working conditions and series of annealing time was investigated. Creep tests were performed at stress level of 160 MPa and temperature of 710 °C. The results of creep tests showed that creep characteristics such as strain rate and lifetime were greatly dependent on the initial hot working conditions.

127. G. Slynko; *Zaporozhye National Technical University Ukraine, Zaporozhye, Ukraine*

The Research of Influence of Thermal Processing on Structure of Phosphorus Cast-iron. The phosphorus cast-iron as a construction material may be offered for wide using in machine-building, for parts that work in conditions of frictions, increased temperatures, and static and dynamic loading. In this connection, data about influence of thermal processing on that structure and property have a scientific and practical interest. The cast-iron with plate and spherical graphite, with 0.02 - 0.97 % content of phosphorus is investigated. The perlites, ferrites and sorbites structures of metal matrix was obtained by heat treatment of casting block.

128. F. Tehovnik, M. Doberšek, B. Koroušič, B. Arh, D. Kmetič, V. Dunat*; *Institute of Metals and Technologies, Ljubljana, Slovenia; *Litostroj, Ljubljana, Slovenia*

Nonmetallic Inclusions and Microstructure of High Chromium White Iron with Addition of Rare-Earth Elements. The rare-earth elements such as cerium, lanthanum and neodymium form highly stable oxygen compounds preferentially of the Me_2O_3 type were studied. The thermochemical stability of these oxides slightly increases with increasing atomic number of the elements. In the frame of our investigation project the influence of rare-earth elements on the nonmetallic inclusions and microstructure of high-chromium white cast iron has been investigated. It has been demonstrated that rare-earth elements can change the nonmetallic inclusions and microstructural characteristics of white iron containing about 15 mas. % Cr. The content of cerium, lanthanium, and neobijum in high-chromium white iron is 0.22 - 0.34 mas %.

129. D. Kmetič, B. Arzenšek, F. Tehovnik; *Institute of Metals and Technology, Ljubljana, Slovenia*

Failures of High Chromium White Iron Fire Grates. The fire grates of bark and wood fired boiler were examined by metallography. Fire grates were made of high chromium white iron alloyed with nickel and molybdenum and were mounted in the as-cast state. In the combustion chamber the fire grates was not uniformly temperature loaded. On the one part the destabilization and transformation of austenite to martensite OCCUI due the overheating of this area of the fire grate. The high temperature oxidation was faster too. On the area of the degradated fire grate the oxide layer is cracked and peeled off. The oxide layer peeled off because of thermal shocks due to injecting water into the screw elevator. These are the reasons for degradation of the fire grate.

130. P. Mrvar, M. Trbižan, J. Medved; *Faculty of Natural Sciences and Engineering, University of Ljubljana, Ljubljana, Slovenia*
Kinetics of the Eutectoidal Transformation in the As-cast Spheroidal Graphite Cast Iron. The research has been carried out by a special solidification dilatometer, which was adjusted for the examination of solidification in as-cast state and of solid-state transformation of cast-iron alloys. The kinetics of the eutectoidal transformation of the S. G. I. has been confirmed also by the in-situ quenching experiments. The eutectoidal decomposition of austenite, which proceeds by a stable reaction into ferrite and graphite ($\gamma \rightarrow \alpha$+graphite) or/and by metastable one into pearlite ($\gamma \rightarrow \alpha+Fe_3C$), has been studied by reading the dilatometric and the differential dilatometric curves. Expansions as functions of temperature and time were presented on the dilatometric curves. The eutectoidal transformation has been analyzed by the evaluation of dilatometric curves, metallographic analysis and analysis of chemical compositions. The kinetics of the ferrite, graphite and pearlite growth has been determined in the as-cast state by quenching.

131. O. M. Ivasishin, V. V. Nemoshkalenko; *G. V. Kurdymov Institute for Metal Physics, N. A. S. U., Kiev, Ukraine*
Advanced Methods of Heat Treatment of High Strength Titanium Alloys. High strength titanium alloys are used extensively in the aerospace industry. The high strength of titanium alloys can be prepared and balanced by careful termomechanical processing and heat treatment, and so microstructural evolution is controlled and defined at three structural levels: a beta-grain size, intragranular morphology of phase constitnents and atomic structure of alpha and beta solid solutions. It is shown in this paper that novel rapid heat treatment of alpha+beta and beta titanium alloys, which includes rapid heating of alloys with initial equiaxed microstructure into single-phase beta field is able to produce desirable microstructural forms, primarily due to careful control of the beta-grain growth in single-phase beta-field. Also rapid heating yields refined intragranular microstructures due to the action of microsegregation of alloying elements in the high-temperature beta-phase.

132. J. Grum, M. Zupančič, S. Božič; *Faculty of Mechanical Engineering, University of Ljubljana, Ljubljana, Slovenia*
Analysis of Thermal and Transformational Residual Stresses after Different Quenching Handlings. The paper deals with the results of experimental investigations of residual stresses occurring after quenching of 42CrMo4 heat-treated steel specimens having different masses. The specimens with two different square cross-sectional areas, i. e., of 25x25 mm and 35x35 mm respectively and of the same length, i. e:, 50 mm, were chosen. Such specimens permitted the investigation of the quenching process and residual stresses occurring after quenching from the viewpoint of the influence of specimen mass. For an efficient study of this influence, only one quenching agent was selected, i. e. a 15 % polymer water solution. The influence of transformational residual stresses was investigated with different quenching procedures, i. e. from temperature T_A = 860 °C and T_q = 620 °C. To measure the residual stresses, the relaxation method was used, involving gradual mechanical removal of the hardened layer in which the deformation of the specimen was measured by resistant strain gauges. The experimental procedure describes the determination of thermal stresses (T = 620 °C) and combination of thermal and transformational stresses (T_A = 860 °C) respectively.

133. V. M. Polikarpov, E. M. Antipov*; *General Physics Department, Tambov State University, Tambov, Russia, *Topchiev Institute of Petrochemical Synthesis of Russian Academy of Sciences, Moscow, Russia*
Theoretical Analysis of Structure of Polyvinil Trimetilsilane. The material used in the present work was polyviniltrimetilsilane. It was established, that after heating and stretching the material had hexagonal lattice, a = 1.13 nm, with conformation disordering c ~ 0.56 nm. The analysis of the structure was made on the base of experimental data and computer procedures. The results were checked with help of reverse task.

134. G. Sučik, D. Hršak*, T. Kuffa; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia, *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*
Preparation of "Low Cost Sialons" from the Diatomaceous Earth by Carbothermal Method. The aim of the present study is to present the results of testing of diatomaceous earth as a potential raw- material for production of "low-cost sialons" by carbothermal nitridation. The tested diatomaceous earth (DE) was found to be a suitable precursor for Si_3N_4 synthesis, because of law Al_2O_3 to SiO_2 ratio. First of all, the DE was pretreated using several physical methods. Then the Al_2O_3 content was increased by addition of additive (Al_2O_3, $Al(OH)_3$ or $(CH_3COO)_3Al$). Carbothermal nitridation of the mixtures of pretreated DE and amorphous carbon was realized in a horizontal tubular reactor using a flow of N_2 + NH_3 gases at 1450 °C / 24 hours, The composition of the nitridation product was determined using the X-ray diffraction analysis. The best results were obtained using a co-precipitated aluminum acetate SiAlON phase has not occurred in presence of Al_2O_3 or $Al(OH)_3$ addition.

135. N. Grechanyuk, I. Mamuzić*, P. Shpak; *Scientific Production Enterprise, Gekont, Ukraine, *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*
Modern Electron-Beam Technologies of Melting and Evaporation of Materials in Vacuum, by used "Gekont"-Company, Ukraine. In this reviews modern ways and examples of operational use of electron-beam technologies are submitted in brief. Also are described its advantage and prospect for the development. In the article examples of successful operational use of electronbeam technologies in applied material science and industry are also given.

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REVIEW OF THE PAPERS IN PROCESS METALLURGY - SECTION "B"

Total 121 papers were submitted to Process Metallurgy section. They can be subdivided into 16 groups:

- production of coke: 5 papers - **1**, **2**, **3**, **4**, **5**;
- production of pellets and iron-ore sinter: 4 papers- **6**, **7**, **8**, **9**;
- blast furnace metallurgy: 10 papers - **10**, **11**, **12**, **13**, **14**, **15**, **16**, **17**, **18**, **19**;
- production of steel by direct reduction: 4 papers - **20**, **21**, **22**, **23**;
- production of steel in oxygen converter: 6 papers - **24**, **25**, **26**, **27**, **28**, **29**;
- ladle metallurgy: 5 papers - **30**, **31**, **32**, **33**, **34**;
- production of steel in electric arc furnace: 2 papers - **35**, **36**;
- continuous casting of steel: 10 papers - **37**, **38**, **39**, **40**, **41**, **42**, **43**, **44**, **45**, **46**;
- non-ferrous metals metallurgy: 11 papers - **47**, **48**, **49**, **50**, **51**, **52**, **53**, **54**, **55**, **56**, **57**;
- casting and foundries: 16 papers - **58**, **59**, **60**, **61**, **62**, **63**, **64**, **65**, **66**, **67**, **68**, **69**, **70**, **71**, **72**, **73**;
- production of ferroalloys: 3 papers - **74**, **75**, **76**;
- refractory materials for metallurgy: 9 papers - **77**, **78**, **79**, **80**, **81**, **82**, **83**, **84**, **85**
- thermal energetics: 11 papers - **86**, **87**, **88**, **89**, **90**, **91**, **92**, **93**, **94**, **95**, **96**;
- environmental problems of metallurgy: 15 papers - **97**, **98**, **99**, **100**, **101**, **102**, **103**, **104**, **105**, **106**, **107**, **108**, **109**, **110**, **111**;
- welding: 4 papers - **112**, **113**, **114**, **115**;
- general problems of metallurgy: 6 papers - **116**, **117**, **118**, **119**, **120**,**121**.

Production of coke. The papers in this part deal mainly with quality of blast furnane coke and with conditions of the carbonisation process. Coke structure, heating rate of carburisation and metallic components in coke composition were studied. Study of high temperature coke degradation in blast furnace stack is also very important.

Production of pellets and iron-ire sinter. The papers in this part are directed to production and characteristic of «self reducing» pellets, i. e. Pellets from iron ore concentrates and pulverized coal.

Blast furnace metallurgy. Various aspects of blast furnace process, blast furnace construction and quality of pig iron are discussed in papers in this part. Problems of natural gas substitution with noncoking coal, development of new type of blast furnace tuyere are interesting. Methods for prediction of sulphur partition between slag and pig iron, theory of pig iron dephosphorisation by slag and study of titanium and vanadium contents concern with pig iron quality. Automatic system for blast furnace control and model of the hearth hydrodinamics concern with blast furnace performance.

Production of steel by direct reduction. New technologies for direct reduction processes are considered and discussed in papers in this part. New unit for direct reduction, consisting of shaft furnace and finishing chamber, and new plasma source for direct reduction are presented.

Production of steel in oxygen converter. Three papers concern oxygen converter charge: new material consisting of pig iron and oxides, prereduced pellets, and converter flue dust briquettes. Two papers concern the process of pig iron refining itself. Important issue of liquid metal hydrodinamics in converter bath is presented in one of them, the second one presents possibilities of indirect measurement of melt temperature in the converter.

Ladle metallurgy. The papers deal with various aspects of ladle metallurgy purposes and processes. Refining effect of calcium on reduction of phosphorus, sulphur and non-ferrous metals contents in steel is conidered. Similary, different methods for steel desulphuration in ladle by injection of time powder based mixtures are discussed. More general paper discusses influencing of steel cleanliness by different methods and technologies of ladle metallurgy.

Production of steel in electric arc furnace. The papers reflect present state of steel production electric arc furnace when the furnace itself is mostly used only for charge melting and treatment of steel melt is performed in ladle. The papers discuss functional and technologic performances of electric arc furnace and methods for measurement and regulation of oxygen activity in steel melt.

Continuous casting of steel. Three topics are covered by papers in this part. The first one is tundish metallurgy, including construction details in tundish, covering slag in tundish and tundish nozzle clogging. All these aspects are characterized from the cast steel cleanness point of view. The secon one concerns characteristics and working installation of continuous casting mould. The third one concerns with surface and internal defects in steel slabs and their relation to conditions of continuous casting.

Non-ferrous metals metallurgy. Specifics of the papers in this part is they do not concern with common non-ferrous metals. They are directed to production and preparation of different zirconium components from zirconia based sands, to production of titanium oxide and separation of bismuth by hydrometallurgy processes, to refining of secondary silver alloys and secondary gold alloys. One of the papers deals with hydrometallurgic treatment of polymetalic modules from Pacific bottom.

Casting and foundries. Researches of different problems in foundries are presented in the papers in this part. The problems discussed in the papers concern problems of quality of castings from metal saturated composites, influence of alloying elements on eutectic transformations in white cast iron, influencing of austenitic manganese steel castings, relieving of internal stresses in casting

Ľ. Mihok, Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia

by surface treatment. Very important paper presents calculation of thermal fields and heat transfer problems in casting. Recovery of foundry sand is another important problem presented. More general paper informs about quality control system in production of cast iron castings.

Production of ferroalloys. All three papers in this part concern with manganese ferroalloys production. Two of them deal with production and composition of low phosphorus slag for manganese ferroalloys, the third one presents mathematic model of ferromanganese production.

Refractory materials for metallurgy. Different kinds of refractory materials are conditions of their applications in metallurgical furnace and ladles are discussed. Wear mechanism of MgO-C refractories and coal - tar pitch as a binder for low carbon MgO-C refractories are discussed. Methods of assessment of high-alumina and fireclay refractories quality are presented. More general paper informs about magnesite reserves in Slovakia.

Thermal energetics. The papers in this part are oriented to fuel combustion processes in various metallurgical thermal installations and to process of magnesite clinker firing. Methods for influencing of NO_x formation at natural gas combustion and effects of continuous fornace profile on fuel consumption are presented. Optimalisation of firing process og magnesite clinker in rotary kiln and mathematic model of cooling system or rotary kiln are described. Interesting problem of scale formation on surface of steel bloms heated in a pusher-type furance are treated.

Environmental problems in metallurgy. Both more general and specifically oriented paper are presented in this part. The more general ones comprise comparison of different metallurgical technologies from environmental aspects point of view, reduction of air pollution in aluminium producing plant, reduction of air pollution from sinering plant, noise recuction methods, environmental legislative and environmentaly oriented production in Slovak Republic. More detailed problems of zinc-coated steel scrap and its use in steelmaking charge, use of zeolites for air cleaning.

Welding. All four papers describe problems of welding with triple - wire and multiple - wire electrodes.

General problems of metallurgy. The papers present mostly local and national experience in restructuring of metallurgical industry. The state of restructuring of Czech steel industry is predented together with information about changes in organisation structure of restructured metallurgical factory. General aspects of coal utilisation in metallurgy are presented, also application of logistic elements in strategy of supplies in discussed. Important information about metallurgy in Balkan countries related to transition phase of the economy is presented.

“B” PROCESS METALLURGY SECTION

1. A. J. Kucková, M. Frohlichová, Ľ. Mihok, Z. Weagová; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*
Effect of Coal Charge on Structure and Quality of Coke. Consumption rate of coke in production of pig iron is also influenced by its structure as it takes part on a coke strength and reactivity. The coke structure, i. e. construction of walls and porosity of coke is connected to coal grades in the charge, to qua1ity of charge and carbonization conditions. The paper presents the results of quantitative microscopic measurements of the walls and pores ratio of the coke made both from laboratory charges and from plant charges of different compositions. Based on a plant experimental results relations between the qualitative parameters of coal charge and coke structure were derived. Influence of coke structure on its grain size, strength parameters and reactivity was also evaluated. By comparison of coke structure before and after NSC tests decrease of coke compactness in relation to its qualitative parameters was determined as well.

2. A. J. Kucková, M. Frohlichová, Z. Weagová; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*
Effect of Carbonizing Process on Quality of Blast Furnace Coke. Besides coal charge quality, temperature and coking time are the main factors influencing the carbonizing process course in coking chambers and, consequently, production and quality of coke. The paper presents results of coke qua1ity evaluations, produces in U. S. Steel Košice, under changing conditions of the carbonization. Under non-standard conditions of carbonization, when coking time was 30 hour or even more, the coke was produced at different heating rate. The changes in coking times and temperatures of heating walls reflected on structure changes of produced coke. It influenced the strength parameters of M40, M10 and CSR coke grades, reactivity and main grain size of blast furnace coke, as well. On the basis of results analysis the knowledge of changing conditions of carbonization effect on coke quality were gained and optimum conditions of coke production were specified.

3. M. Legin-Kolar, A. Rađenović; *Faculty of Metallurgy Sisak, University of Zagreb, Sisak, Croatia*
Demetalization of Metallurgical Coke by High Temperature Treatment up to 2000 °C. One of the most important indicators for metallurgical coke quality and application is presence and content of metallic and non-metallic constituents. This paper reports the results of an investigation of the concentration of Si and Ca and types of their chemical compounds present in industrial manufactured metallurgical coke. The coke samples were subjected 2 and 4 hours to high - temperature treatment at 1200, 1600 and 2000 °C; heating rate was 10°C/min. The results of the investigation showed that during the heat treatment of coke samples same metallic microconstituents partially separated and also transformed their compounds. Before heat treatment silicon were present in the form of oxides (SiO_2-α quartz) and silicates ($3Al_2O_3{\cdot}2SiO_2$ and $3CaO{\cdot}2SiO_2$), while calcium was present as CaO and CaSO4. At 1200 °C was identified a new type of silicon - SiO_2-α crystoballite; calcium was in form $2CaO{\cdot}Fe_2O_3$, $CaO{\cdot}Al_2O_3$ and others. The very stable SiC was identified after temperature treatment at 1600 and 2000 °C. To know the chemical types of metallic compounds in coke is very important for selection of treatment of their separation. The high temperature treatment is one of the methods of successful coke demetalization.

4. A. Konstanciak; *Faculty of Materials Processing Technology and Applied Physics, Technical University of Częstochowa, Częstochowa, Poland*
High Temperature Investigation on the Properties of Blast Furnace Coke. The coke transport to the blast furnace is presented in this work. The methods to take coke samples from blast furnace were verified. The examination of influence of temperature to coke (subjected to laboratory tests reproducting to a certain extent, the conditions prevailing at the blast furnace tuyere level of the blast furnace) was established to be a responsible factor for degradation of coke. It was possibll to describe the following parameters characterizing the structure: L_c - the crystallite height in the range 1.5932 - 3.2620 nm, L_a - the crystallite width was 2.82013 – 5.7737 nm and crystallinity factor W_k was in the range of 0.147 - 0.77014.

5. A. J. Kucková, M. Fröhlichová, L. Fröhlich; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*
Graphite Deposits in Coking Chambers. In coke productions, pyrolitic carbon is formed and deposited in coking chambers during coal carbonization. Graphite depositis impair coke ovens operations. Results of graphite deposits evaluation, situated in area close to the door, the walls and in upper area of coking chambers are presented in the paper. Evaluation of graphite deposits occurence is made on the basis of chemical analysis, x-ray diffraction analysis and microscopy. Expected course of the formation and gradual growth of the graphite deposits is presented. Next, analysis of effects of heading temperature, brickwork condition, charge density, coal charge parameters, cokable properties, petrographical structure and type composition on the formation of graphite deposits in plant conditions is described.

6. V. P. Movchan, D. A. Kovalyov*; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, *Central Mining Bbonification Combine at Krivoy Rog, Ukraine*
Mathematical Model of Grate Process used for Induration of Iron Ore-carbon Bearing Pellets. The authors report on the development of a mathematical model to describe the complete grate iron-coal bearing pellet duration process. In particular, the effects the varying of basic physico-chemical reactions: magnetite oxidation, limestone reaction, gasification of carbon and the reduction of iron oxides are given. The rate of change of the pellet-bed temperature is a function of these reactions. The results increase our understanding of how the heat distribution in the firing system varies under different operating conditions, especially due to carbon content in the pellets.

7. N. D. Vanjukova, L. V. Kamkina; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
“Self Reducing” Pellets for the Blast Furnace. The technology of “self reducing” pellets production was developed. The process consisted of mixing and pelletising of iron oxide fines and pulverized coal, drying the pellets, and of induration of iron ore-coal bearing pellets in the sintering like process. The variability of the rest carbon content inside the burned pellets between 0.8 % to 1.5 % is a fundamental characteristic of this pellets. More than 21 000 tons of those “self reducing” pellets were produced at the North mining bonification combine (Krivoy Rog, Ukraine) and melted in blast furnaces in Petrovsky Steel Works (Dnepropetrovsk). It was established, that one percent of rest carbon substitutes 3.5 % of coke due to intensification of the reduction process in the reserve zone of the blast furnace.

8. V. B. Vesselovskiy, E. V. Vnukov*, G. T. Tsygankov*; *Dnepropetrovsk National University, Dnepropetrovsk, Ukraine, *Dnepropetrovsk State Chemical and Technological University, Dnepropetrovsk, Ukraine*
Non-steady Warm-up and Restoration of Agglomerated Iron-ore Stuffs in the Blast Furnace. The model of calculation of thermo-and massexchange agglomerated of iron-ore stuffs. The model is constructed on the basis of multiphase problem of Stefan with allowance for thermo- and massexchange phenomena called as sources and sinks of heat, which are determined by the development of physic-chemical processes, inside different layers. The laws of motion of borders of layers are determined by the way of ratio of Arrenius type. The solution of a problem is achieved by a method of finite differences. Matching of outcomes with numerical and experimental data by other authors have shown the satisfactory coordination. The obtained outcomes have allowed to establish the optimum sizes of iron-ore stuffs.

9. C. Bulancea, V. Mirea, R. Margarit, P. Volintiru; *University “Politechnica” of Bucharest, Bucharest, Romania*
Double Layered Iron Ore Pellets Behavior during Reduction-Swelling. In the present article an attempt has been made to study the reduction behavior of double layer pellets consisted of a iron ore core and a non-coking coal mixture within a shell around iron ore. The parameters studied are reduction temperature, carbon/iron oxide ratio and reduction time. The results show that the effect of reduction temperature on degree of reduction is strongest, followed by reduction time and carbon/iron oxide ratio. Self-reducing pellets containing iron ore and charcoal were reduced under argon at different temperatures. Pellets measuring 9.0 mm and 15.5 mm diameter were tested. The change in volume was related to the reaction fraction, reaction temperature and the size of the pellet. Scanning microscopy images of the reduced pellet have shown that swelling is due to the formation of whiskers of iron during the wustite to iron step of reduction.

10. V. V. Severniuk; *Union of Industrialists and Owners, Dnepropetrovsk, Ukraine*
Theoretical reasons of the Measures for the Material and Power Reduction in Iron Production. The lecture is devoted to the description of the most effective and measures for coke rate decrease and substitution of natural gas with noncoking coal and other fuels at the Ukrainian blast furnaces. Some of the suggestions are realized: the optimization of sizes of the blast furnace burden materials; the new mode of the converter slag reprocessing and utilizing; the new system of coke treatment before the charging of coke into the blast furnace; the computational search of the burden composition that ensures the minimum cost-price of blast furnace iron and takes into account the indexes of each burden material quality and all the desirable limitations.

11. V. P. Lialiuk; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Blast Furnace Hearth Operation under the Different Conditions of Smelting. Depart from the theoretical and experimental research, there is the reason to substitute the kinetic energy for the complete energy of the blast jet as the main criterion for the optimization of the blast furnace tuyere diameter. The original model of the blast furnace hearth hydrodynamics allows to diagnose the hearth breakouts and to determine the necessary controlling influences for liquidation of them. The analytical research of the efficacy of the coke and natural gas replacement by other fuels became the basis of the nontraditional solutions for the coke rate lowering and natural gas replacement in the blast furnace process.

12. A. K. Tarakanov; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Mathematical Models in the Blast Furnace Control. Specialists of the National Metallurgical Academy of Ukraine and “Krivoroghstal” Steel Combine created at the blast furnace of 5 000 m^3 volume the complex automatic system that realizes: monitoring, heat and gas dynamic control of the process, the original processing of the thermo-viewer “Spiroterm” information, the interactive engineering calculations and simulation parts of the blast furnace process and the automatic control of charging. The lecture is devoted to the brief description of the mathematical models that are the basis of that system.

13. V. S. Tereshchenko, A. G. Velychko, V. P. Ivashchenko; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Blast Tuyere with Gas-Jet Radiator for Blast Furnace. The tuyere construction for blast furnace, enabling increase the increase of a blending degree and completeness of combustion of steam-and-gas mixture is developed. The tuyere is supplied with a fitting pipe with the resonator (gas-jet radiator). The resonator is fixed on the target end of the gas-intake tube and is executed as a core with closed-bottom cylinder by forming with an internal surface of a fitting pipe a radial clearance, the area of which section makes 1.2 - 1.5 areas of section of a tube. The axis of a fitting pipe is located bevel way 45 - 50 degree to a direct axis of the tuyere, and cross point of axes - on distance 0.8-0.9 diameters of the working channel of the tuyere from its end. The maximal degree of blending is reached at pulsations frequency of 1.2 10^4 Hz. At the further increase of a pulsation frequency the degree of blending is reduced, which is connected to increase of sound absorption in gases.

14. K. G. Nizyaev, B. M. Boitchenko, A. G. Velichko, A. N. Stoyanov; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Cast -Iron Desulphurization by Magnesium, Reduced from Oxide under Layer of Liquid Metal. At the Dnepropetrovsk plant the experiments on cast-iron desulphuration by magnesium, reduced from its oxide under the layer of the liquid metal in the electric arc was conducted. Cast-iron of the composition of C 3.70 - 4.10 %, Si 0.7 - 1.8 %, Mn 0.5 - 0.8 %, S 0.020 - 0.050 % was processed. Reduction of magnesium was made by silicothermal method and the thermal power of electric arc was used as energy source. A reduction mixture was prepared by mechanical mixture of the crushed components, such as magnesite metallurgical, ferrosilicon 65 %, graphite silvery, limestone. The liquid glass was used as a binder. From these components the cylindrical block was formed, during pressing the parallel electrodes were installed in block, which were made from sheet carbonaceous steel of usual quality of 4 - 6 mm thickness. The welding transformer of alternating current HIST - 2000 was used as a electric source. Voltage on the electrodes during processing was 40 - 45 V, and 700 - 900 A current. The processing duration was 6 - 11 min. with intensive metal circulation in the block immersion zone. During experiments the degree of desulphuration of cast-iron was 15 - 30 %.

15. V. Shatokha; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Comparison of Evaluation Methods for Sulphur Partition Between Slag and Metal at Blast Furnace. Prediction of sulphur partition between slag and pig iron in the blast furnace hearth is an important tool to achieve high quality of production and to choose the appropriate slag regime for different operation conditions. Methods of slag sulphide capacity evaluation with special attention to optical methods were discussed. Comparison of blast furnace practice and calculation using different methods for corresponding conditions gave different sulphur partition results. The most suitable method for sulphide capacity and sulphur partition was proposed. The value of sulfur partition deviation in the blast furnace hearth from thermodynamic equilibrium is about 2.1 - 3.6 x, dependent on operating conditions.

16. M. Matveyeva, V. Bespalko, E. Zhilenkova; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Development “Economyalloying” of Heat Resistant Pig-iron of Increased Operational Properties. In heat resisting alloys aluminium cast iron contains till 29 - 32 of % of aluminium. The presence in the structure of pig-iron of a plenty aluminium complicates process of melting. Graphite at crystallization of pig-iron, results in increase of number of eutectic colonies and reduction of their sizes. It favourably influences on mechanical, first of all, strengths of property of cast pig- iron. The data are processed on the computer by the mathematical model of dependence of properties of pig-iron from on its chemical structure.

17. S. Borkowski; *Faculty of Materials Processing Technologie and Applied Physics, Technical University of Częstochowa, Częstochowa, Poland*
The Temperature Decrease of the Cast Iron Treated by Injection. An out of furnace treatment of the cast iron using compressed air to make up powdered additions is connected with endothermic effects. The results of the cast iron temperature decrease under conditions of the natural self-cooling as well as after the compressed air injection at various depths and time have been presented in the work. One can point out that the temperature decrease of the liquid cast Iron during a fore blowing is proportional to the depth of the lance draught. An application of the protective

coating (a graphite layer of slag as a covering) reduces 20% of the temperature decrease of the treated cast iron. Same active methods of the experiments planning have been used in the research.

18. Z. Adolf; *VSB Technical University of Ostrava, Ostrava, Czech Republic*
Thermodynamics of Chosen Reactions Proceeding on Phase Interface. In the frame of project No. 106/01/0364 under financial support of Grant agency of Czech Republic a theory of pig iron dephosphorisation by slag at its fining by oxygen is developed. On the basis of thermodynamic regularities and experimental experiences dephosphorisation mechanisms are formulated considering a fining technology and presence of another elements dissolved in iron (Mn, Si, C). It issues from results of the work, that mechanism and depth of dephosphorisation determines the activity of oxygen in slag ($\alpha_{(FeO)}$) and activity of oxygen adsorbed on the interface slag-metal ($\alpha_{[O]}^{ads}$). Activity of oxygen in metal is dependent on chemical composition of metal and temperature.

19. R. Budzik; *Faculty of Materials Processing Technology and Applied Physics, Technical University of Częstochowa, Częstochowa, Poland*
Titan in the Process of Pig Iron Smelting. In connection with future utilization of magnetite-titanium ores deposites in Poland in the region of Suwałki, the tests were performed to get information regarding the influence of titan and vanadium admixtures on the quality of pig iron and the run of blast furnace process. As a blast furnace charge, there were used magnetite-titanium concentrates similar to the ores deposited in the Suwałki region. These tests consisted of iron ores sinter production and its usage in the process of preparation of foundry pig iron. The amount of TiO_2 charged into the blast furnace was equal to 10 kg/Mg of pig iron. It was ascertained that the quality of sinter remained the same, but the output of sinter was lower by approx. 4 %, compared to the production of sinter without TiO_2 addition. These tests have proved the possibilities of utilization of titanium-bearing magnetite-concentrates in the partion up to 10 kg/Mg of pig iron, which gives possibilities to take advantages of entire deposit of titanium-bearing magnetite ores in Poland, using the blast furnace technology.

20. V. P. Ivashchenko, A. G. Velychko, V. S. Tereshchenko; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Plasma Technology for direct Reception of Particularly Low-Carbon Metal. The plasma technology of direct reception of molten metal from agglomerated iron-ore raw materials was developed and experimentally tested. Feature of the offered technology is the post-treatment of metal on a final stage of the melting process by hydrocarbon gas, converted in plasmotrones. Thus it is necessary to change size of the charges of oxygen and natural gas ratio in the plasma-generating mix on 0.01 - 0.10 the his stichometrical value. Process of low-carbon metal reception proceeds in two stages: at the first stage by post reduction of iron from a melt by converted gas ($H_2 + CO = 95 - 96$ % at a ratio $CH_4/O_2 = \alpha = 1.8 - 2.0$) with receive of the molten metal which a carbon content is not lower than 0.005 - 0.010 % and at the second stage the a carbon depletion of metal. Time of a blowing through of metal is determined by a necessary degree of a carbon depletion. The application of the offered technology enables the following advantages: - a high capacity way of reception of low-carbon metal immediately from ores, - after-treatment of metal in special units is excluded, - the losses of iron with slag is reduced and the necessity for a deoxidation of the smelted metal disappears.

21. V. P. Ivashchenko, A. G. Velychko, V. S. Tereshchenko; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
The Intensification of Processes of Heat and Mass Transfer in Stack Unit for Direct Reception of Metal. The reduction-smelting process is carried out in the unit consisting of stack and the post reduction chamber. In stack and post reduction chamber plasmotrones are installed, working using a mix of natural gas and oxygen. With the purpose of intensification of heat and mass transfer processes, plasmotrones in stack are located in regular intervals of the section, alternating with each other, in two groups. In the first group - with electrical power 75 % from total, they are placed at height from backstone of stack equal 8 - 11 nozzle diameters and bevel way 30 - 35 ° degree to a horizontal plane. In the other group - bevel way is 10 - 12° to a horizontal plane and at height 3 - 4 nozzle diameters from the backstone of stack. Due to such location of backstones, the conditions for removal of low-activity zones, and location of hot reducing gas, increased the efficiency of the total process.

22. A. G. Velychko, V. P. Ivashchenko, V. S. Tereshchenko; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Technology and Unit for Direct Reception of Molten Steels. In National Metallurgical Academy of Ukraine the technology and construction of the unit for direct reception of a molten steel is developed. The unit consists of two interdependent parts - shaft furnace with inclined lining walls and the post reduction and finishing chamber, joined with the furnace by the channel. With the purpose to increase the productivity of the unit, organization of a continuous process and abatement of the charges by ton of steel, the post reduction and finishing chamber is supplied of water-cooled partition, dividing this chamber on two bathes with a ratio of volumes: $V_2/V_1 = V_{melt}/\Sigma V_{reduct}$ (V_1 - volume the first bath; V_2 - volume of the second bath; V_{melt} - the iron-ore material smelting rate; V_{reduct} - total speed of reduction). In lateral walls of both bathes at distance of 0.45 – 0.6 heights of a bath from hearth plasmotrones are fixed, and in the second bath at distance of 0.5 - 0.7 of its heights from hearth the notch for a slag tap is equipped. While the products of smelting fill-up of the second bath volume, reduction processes in the first bath are finished. During new filling of the first bath the melt in the second bath will execute similar work. As a result of such organization of melt treatment the overall economics of the aperation unit is improved and it is possible to organize a continuous process of reception of molten metal.

23. C. Kolmasiak, R. Budzik; *Faculty of Materials Processing Technology and Applied Physics, Technical University of Częstochowa, Częstochowa, Poland*
Investigations of gas Permeability of the Charge in the Reduction Process of Iron Ores by Hard Coal. An increased interest in new methods of pig iron production, which do not require usage of coke leads to searches for substitutes of coke as the reducing agent. The purpose of the study was to investigate the change of the gas permeability of different types of coal as a result of phenomena occurring in the processes of reduction of iron ores, in order to evaluate the suitability of various Polish coals for these processes. ‘The article describes the methodology of examination of gas permeability of a hard coa1 bed in a stream of hot reduction gases. Tests were performed in a model testing furnace. As the test material hard coal types 32, 33 and 34 from selected Polish coal mines were used.

24. J. Siwka, W. Derda; *Faculty of Materials Processing Technology and Applied Physics, Technical University of Częstochowa, Częstochowa, Poland*
Synticom® as a New Charge Material in Steel making Processes. Structural changes in the world’s metallurgy, imply new alternatives for iron-containing materials, e. g. Synticom®. This is a composite material composed of an alloy of iron with carbon (pig iron) and iron oxides (pellets, agglomerate, comminuted ore, etc.). By using this material, the course of oxidation-reduction processes in steel making installations can be controlled. The paper presents the characteristic and results of using the Synticom® in steel making processes. Numerous advantages of this materials over the currently used steel scrap and also over its equivalents are demonstrated. The results of industrial tests carried out, as well as manufacturing practice, indicate definitely that enriching a charge with the Synticom® brings about many benefits both in the electric steel making process and in steel smelting in the oxygen converter. The use of the Synticom® in the charge effectively improves steel quality as well.

25. V. M. Dusha, V. M. Boychenko, A. A. Dzuba; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Prereduced Pellets Cooling of Converter Melt. The National Metallurgical Academy of Ukraine made a large scale research for utilization of prereduced pellets instead of metallic scrap and iron ore. So the completely original charge: cast iron and direct reduced iron, is the base for high steel quality. The mechanism and kinetics of using of the prereduced pellets by converter bath was studied; the kinetics of pellets solubility in iron carbon solution dependent on their size and composition was also determined, regulations of charging prereduced pellets solubility in iron carbon solution in dependence on their size and composition was done and regulations of charging prereduced pellets into converter and technology of melting in general were worked out as well. During industrial testing of technology worked out the authors ascertained that prereduced pellets cooled the converter melt and their influences decreasing of harmful impurities and nonferrous metal is impurities thus improving the quality of cast metal.

26. P. Marek, K. Kostúr*, M. Gera, M. Laciak*; *U. S. Steel, Research and Testing Institute, Košice, Slovakia, *Faculty BERG, Technical University of Košice, Košice, Slovakia*
The System of Indirect Measurement of Temperature During of the Melt in LD Converter. Temperature at steel making process in converter is very important variable and is not continually measured during this process, because there are not suitable sensors available. Therefore in world are permanently developed various methods for its measurements. In paper are described same so called models for indirect measurement and compared from the standpoint of accuracy. Best precision has a system based on continuous adaptation of the model. The system provides direct measurement of some variables (temperature, concentration of converter gas, ...) and it computes the temperature of the melt by 4 sec interval. This information serves to control the melt.

27. D. Baricová, Ľ. Mihok, P. Marek*; *Faculty of Metallurgy, Technical University of Košice, Slovakia, *U. S. Steel Košice spol. s. r.o., Košice, Slovakia*
Recycling of Oxygen Converter Flue Dust into Oxygen Converter Charge. Converter flue dust is a very iron-rich material that contains up to 90 % of ferric oxide. Its recycling via sinter and blast furnace charge is impossible because of high Zn and Pb contents, which is the reason why all converter flue dust is dumped. This material after briquetting can be recycled into oxygen converter charge. Volatile elements, Zn and Pb, enter the flue dust and do not deteriorate the quality of produced steel. By this way Zn and Pb levels in flue dust gradually increase and after 20 or 30 cycles flue dust has to be removed from the process. Iron from the flue dust is utilized in the converter process. Recycling of converter flue dust has no negative effects on the converter refining process, but the increase of Zn in converter slag was recorded. Economic effects are related to the utilization of iron from converter flue dust and by decrease of dumping costs. Recycling of max. 3 tons of converter flue dust briquettes into 190 t oxygen converter charge is recommended.

28. K. Kostúr, M. Laciak; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
The Adaptation of Model for Indirect Measurement of Temperature of Molten Steel in LD Converter. The model for continuous indirect measurement of temperature of melt is necessary to upgrade regularily. In paper are described principles of adaptation of the model for indirect measurements. The principles based on theory of storage of melts gave the best results. The accuracy of indirect measurement depends on number of melts in storage and frequency of adaptation. The algorithm of adaptation is explained. This adaptation guarantees that the differences of measured temperatures between the model and a thermocouple was less than 0.85 %.

29. A. J. Dreus, I. Mamuzić*; *Dnepropetrovsk National University, Ukraine, *Faculty of Metallurgic, University of Zagreb, Sisak, Croatia*
The Mathematical Modeling of a Liquid Metal Flows by Cas Jet and Electromagnetic Forces. Development on influence of electrical current in LD-process for increase of its efficiency will be carried out. One of effective method of research of convective transfer processes is mathematical modeling. In the present work the mathematical model and algorithm of calculation of hydrodynamics and heat transfer in a bath with liquid metal is offered. Influence of electromagnetic forces, numerical techniques and computer programs are developed. Two constructive circuits of an electrical current influence on a liquid bath are also investigated. The results of numerical study of a field of speed in metal bath are performed. It shown, that the electrical current and circuit of an arrangement of electrodes influences hydrodynamics of liquid metal.

30. V. P. Cherevko, A. N. Stoyanov, M. P. Plukalo; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Injection Technologies of Desulfuration of Steel in a Ladle by Powdered Lime based Mixtures. At metallurgical combinates of Ukraine the industrial researches on the injection of powdered mixtures on the lime base using different technological schemes were conducted. A ladle steel processing is executed by powdered lime and its mixture with spar (at the ratio 4:1) after usual argon blowing. The consumptions of powdered reactants amounted 0.38 - 3.57 kg/t at pace of supply of 60 - 110 kg/min, and carrying gas 0.7 - 1.3 m^3/min. The content of sulfur in metal before and after processing was at a level 0.016 - 0.025 and 0.006 - 0.016 % accordingly. The injection of powdered lime during a tapping from the converter, the deoxidation and processing of steel with lump solid mixtures was worked out. The supplying of powdered lime was made through the blast device sliding shutter with the consumption of 0.8 - 2.3 kg/t, and carrying gas ~ 1.0 m^3/min. At injection of powdered lime in metal and ladle addition of mixtures, a desulphuration degree reached 60 - 65 %. The degree of usage of slag refining capacity in a ladle is increased up to 0.52 at the consumptions of powdered lime up to 2.0 - 2.3 kg/t. Thus, performed researches have shown, that injection processing of metal by powdered slag-forming mixtures on the basis of lime is an effective means to desulfuraization of steel. At the consumptions of powdered refining mixtures of 0.68 - 3.57 kg/t of steel the degree of desulfuration amounted from 30 up to 70 %.

31. B. Arh, B. Koroušić, F. Tehovnik, J. Triplat, M. Klinar*; *Institute of Metals and Technologies, Ljubljana, Slovenia, *Iron work ACRONI Jesenice, Jesenice, Slovenia*
Manufacturing of Non-Oriented Electrical Steel. Eletrical steels have special physical properties which make them suitable for application in the manufacture of electric equipments and appliances with rotating magnetic fields. Precise technologies and metallurgical processes united with technical development and investment in new equipment and plants place the Acroni Jesenice at the same world quality level as other leading manufacturers of electrical steel. In the Acroni Jesenice takes place the production of non-oriented electrical steel finally annealed - dynamo steel in a 85-ton OBT and VOD set-up. Metallurgical work, like adjustment of chemical composition, desulphurization by top slag and deoxidation, is performed during the treatment in a ladle furnace at a defined temperature, supported by inert gas bubbling. Further steps like dehydrogenation, denitrogenezation and final trimming of steel, are carried out under vacuum during a tank degassing treatment. An important precondition for the successful usage of a secondary metallurgical unit is that the unit is well integrated in the production process.

32. L. Martínek, J. Fila, J. Bažan*, K. Stránský, S. Gregorová;** *ZDAS, a. s., Žďár nad Sázavou, Czech Republic, *VSB-Technical University of Ostrava, Ostrava, Czech Republic, **Technical University of Brno, Brno, Czech Republic*

Influence of Secondary Metallurgy Effects on Metallographic Cleanliness of Steel. In the frame of solution of grant project 106/01/0365 of Grant agency of Czech Republic operational research on influence of three various production technologies and secondary metallurgy of carbon steel on mechanical properties, micro-cleanness and gas content was done. At research were applied and verified the following technologies: EAF LF VD, EAF LF, EAF with subsequent atmosphere casting and casting in vacuum.

33. J. Bažan, W. Derda*; *VSB Technical University of Ostrava, Ostrava, Czech Republic, *Technical University of Czestochowa, Poland*
Refining Effects of Calcium. In the frame of solution of grant project 106/02/0415 of Grant agency of Czech Republic under pressures of 0.6 MPa and temperature 1550 °C laboratory research of refining effect of calcium and its alloys presence and chemical composition of refining slags on reduction of phosphorus content, sulphur and non-ferrous metals in steel were performed. Influence of lining refractory material was also monitored.

34. S. Jeronko, S. Bykovskykh, V. Tischenko, E. Tsyhmistro, P. Bykovskykh; *The Scientific and Producing Company “Apeks”, Donetsk, Ukraine*
Using of Tuyeres Slotted in Casting Ladles for a Steel Bottom Blowing. The design features of blow devices are describes. The devices is supplied with tuyeres slotted and is assigned for a bottom blowing of steel by gas-powder mixes. The results of their using in steel foundries of metallurgical plants of Ukraine are shown also.

35. A. Ioana, A. Nicolae, D. Constantinescu, D, Dumitrescu, S. Ivănescu; *Science and Engineering Materials Faculty, University “Politehnica” of Bucharest, Bucharest, Romania*
The EAF’s Improved Driving Possibilities. The main goal of the electric arc furnace (EAF) which is an important technological aggregate in a steel plant - is a high quality steels production at the best costs (minimum) - and is directly dependent on the correct realization of the “constructive variables” - “functional variables” - “technologica1 performances” correlation chain. Even from the beginning of the EAF’s application (the electric arc’s coupling and striking) the furnace’s are dependent on and must be corre1ated with the construction and functional variab1es. So, if the load assures a stabile electric arc from the very beginning, the melting is released with the help of the automatic adjustment plant in the circuit, with a medium value tension and it is gradually increased. This paper shows an original variant for optimization of the functional and technological performances of the e1ectric arc furnace (EAF), using mathematic modeling of respective processes.

36. W. Derda, J. Siwka; *Faculty of Materials Processing Technology and Applied Physic, Technical University of Częstochowa, Częstochowa, Poland*
Regulation of the Oxygen Activity in Liquid Steel before Tapping in the UHP Electric Arc Furnace. The modern technologies of steel melting in electric arc furnaces are characterized by the use of large quantities of gaseous oxygen, normally of 20 to 30 Nm^3/t of steel. During the melting of low carbon steels and when using poor quality scrap, the proper regulation of the concentration of oxygen dissolved in liquid metal prior to the tapping of steel and its further processing outside the furnace becomes increasingly important. The article presents the results of direct measurements of oxygen activity in liquid metal for different variants of charge composition, including also the use of Synticom®, HBI, and DRI. Variations in the chemical composition of slag formed in the furnace were analyzed, particularly regarding their oxidation potential. A correction of the amount of oxygen blown in, as well as of the type and amount (mass) of material used for slag foaming was given. The information obtained was used for the optimization of preliminary ladle steel deoxydation during tapping in order to improve the metallurgical purity of manufactured final products.

37. A. N. Smirnov, V. V. Nesvet*, E. N. Smirnov; *Donetsk National Technical University, Donetsk, Ukraine, *Dneprovsky Iron & Steell Works, Dneprodzerzhinsk, Ukraine*
Big Sequence Casting for 6-strands Bloom and Combine Bloom-Billet CCM in Bof Shop. One of the important indexes for casting exploitation CCM is index of product quality from 1 ton liquid steel. This index can be considerably improved during 16-20 hours from one tundish. The behavior of tundish system refractory during long sequence continuous casting and peculiarity steel f1ow motion between tundish and mould for 6-strands CCM were studied. During experimental investigations it was determined that high quality stoppers and submerged nozzles can provide necessary duration of casting without additional actions. In this case most important point is maximal lifetime of submerged nozzles which is connected with both special conditions of casting and manufacture quality.

38. A. A. Minayev, E. N. Smirnov, A. N. Smirnov, M. V. Grigoriev*; *Donetsk National Technical University, Donetsk, Ukraine, *Comp. “Vizavi”, Donetsk, Ukraine*
Optimization of the Scheme of Manufacturing Billet for Future Re-Rolling Responsible Purposes from Continuous Metal Casting. At continuous melting of low-carbon (0.08 - 0.16 % C) steel a group of problems connected with propensity last to formation of large quantity surface and undersurface cracks appear purpose. The results of quality researches of the billets for re-rolled products from low-carbon (0.08 - 0.16 % C) continuous cast steel, used for manufacture of complex shaped sections are presented. As a result of research of the manufacturing technology and quality of the billets from continuous cast steel it was shown, that the level, achieved in Ukraine, to ensure parameters of service properties according to the requirements of the leading world ship registers. Real confirmation of the output made a certification of technology of steel making and production of “Dneprovsky Integrated Iron & Steel Works”, by GERMANISCHER LLOYD (Germany) and DET NORSKE VERITAS A. S. (Norway) on classes A32 and D32.

39. J. Pindor, K. Michálek; *Třinec Steel Work, Třinec, Czech Republic*
The Formation and Extent of Transition Zones in Continuously Cast Billets (at the Casting of Two Different Steel Grades). The sequential continuous casting of two different steel grades with different chemical composition leads to the development of so-called transition zones with mixed chemical compositions in the blank. Knowledge of the extent of these zones is prerequisite to the productivity rise of the process of the continuous casting of steel. The article reports the results of the plant trial focused on the verification of these zones in billets with quadrate cross section of 150*150 mm continuously casted in an eight-stream continuous casting machine in TZ, joint-stock company. The experiment consisted in cross alloying of two consecutive heats using Ni and Cu and consequential chemical analyses of these elements on the surface and the cross-section of finished billets. Based on the obtained concentration gradient, the extent of the transition zone for the given conditions of the experiment was defined. The trial results will further be used to render the set-up of numerical modelling using the program Fluent more accurate.

40. M. Pivovarči, A. E. M. M. A. Maksoud*; *Faculty of Metallurgy, Technical University of Košice, Slovakia, *Universität Padeborn, Germany*
Study of Factors Affecting Tundish Nozzles Clogging During the Continuous Casting. One of the most serious problems at continuous casting process of steel is the clogging of the tundish nozzles. During the steel making process which consists of melting (EAF) or oxidation of pig iron (BOF), using ladle metallurgy and continuous casting process, a lot of chemical reactions occur, due to which endogeneous and exogeneous non metallic inclusions are produced. Study comprises the following factors: effect of metal, refractory reactions product on the tundish nozzle clogging,

effect of slag, metal reactions product on the tundish nozzle clogging, effect of casting powder, metal reactions product on the tundish nozzle clogging, effect of the non-metallic inclusions produced during the secondary metallurgy in the ladle furnace on the tundish nozzles clogging, by studing optimum amount of Ca, Al, Ca/Al_{total} and S in the metal.

41. J. Rakoš; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*
Mathematical Model for Optimization of Continuous Slab Casting Mould Preparation. The article deals with the methods of preparation of differential descriptions of continuous slab casting mould preparation. Specific processes of drying and heating are analyzed as well. The article presents results obtained by discrete identification, and analysis of process responses. Resulting from the analysis, continuous differential models of partial processes are obtained. The results derived are suitable for optimization calculations.

42. V. Olbricht; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*
Mathematical Model of Solidification. The presented mathematical model evaluates in the real time the value of the heat flows in crystalliser's wall, calculates the thickness of the solid phase in any place of the primary part and provides the qualitative image on the temperature fielding of the cast. Elaborated mathematical model is universal one and on the basis of completed data (heat flow, geometry, cooling system, thermal and physical parameters) it is applicable to any type of crystalizer.

43. P. Kováč; J. Kijac, V. Masek*, P. Marek*, P. Kalmar*, K. Michalek;** *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia, *U. S. Steel Košice spol. s. r.o., Košice, Slovakia, **VŠB Technical University of Ostrava, Ostrava, Czech Republic*
Steel Cleanliness Improvement by Tundish Configuration Optimisation. In continuous casting process, liquid steel flows through the tundish, which is supposed to operate as a continuous refining finisher. To provide a functionality of such a device, a set of tundish metallurgy techniques must be applied, whose efficiency is conditioned especially with optimal symmetrical and dynamical melt flow. Flow optimisation can be achieved by the shaping of inside tundish configuration, using flow control devices, like turbulence inhibitors, impact pads, baffles, weirs, dams, etc. The theme of the present paper is the employment of a turbulence inhibitor, commercially known as TURBOSTOP™, together with a pair baffles & fiat impact pad in slab caster to improve steel cleanliness and a fluid flow phenomena in a two strands tundish.

44. J. Kijac, P. Kováč, E. Steranka, P. Marek, V. Masek*; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia, *U. S. Steel Košice spol. s. r. o., Košice, Slovakia*
The Current Status of Tundish Covering Slags in a Slab Caster Plant. Tundish metallurgy development, which has been focused on steel cleanliness improvement in last few years, affected also tundish slag systems. Molten slags are most suitable for both absorbing and refining functions of tundish cover slags, while a system of extremely low density does satisfy their isolating functions in the best way. Hence it is obvious, that it is not possible to assure the main functions using one sort of tundish covering slags. In addition, traditional acid slags, composed of rice glumes, are being replaced with basic covering slags, or combination of both types. In this work, we have tried to investigate the operation of tundish covering slag at slab continuous casters. A genesis of covering slag from applied cover powders and rice glumes, its refining and isolating functions have been investigated, as well as the changes of covering slag chemical composition during one tundish casting sequence. Effect of sequential insertion of covering powders and rice glumes on slag covering absorbing attributes during ladle operation was also investigated. Inherence of negative events (as are opened eyes and skulls on the tundish walls) as a sign of slag system malfunction was identified as well.

45. V. Mirea, C. Balescu, S. R. Margarit, C. Bulancea, P. Volintiru; *University "Politecnica" Bucharest, Bucharest, Romania*
Physical and Mathematical Modelling in Continuous Casting of Steel. Continuous casting process of steel includes many and complex phenomena to be analysed for modelled. The models currently being used are successfully at liquid steel flow, turbulence behaviour in tundishes, heat and mass transfer and at solidification structure, stress-strain data, control and prediction of steel temperature (thermal stratification), ladle before and during casting, mould flux flow etc. The modelling can he realized by physical or mathematical model. Melt flow, inclusion removal and heat transfer in tundishes and mould is physically modelled using a water model with tracer injections. Three-dimensional mathematical models are used to melt flow at tundishes and mould, solidification process, electromagnetic stirring, flux flow, prediction of nonmetallic inclusion, solving machine conflicts and secondary cooling zone. A combined model normally characterizes melt flow in continuous casting tundishes and mould.

46. Z. Adolf, R. Moravec, J. Šmid*, Z. Piegza;** *VSB-Technical University of Ostrava, Ostrava, Czech Republic, *TaM, area VÚHŽ Dobrá, Czech Republic,**Třinecké železárny, a. s, Třinec, Czech Republic*
Prediction of Quality of Continuously Cast Billets. In the frame of project No. 106/01/0366 under financial support of Grant agency of Czech Republic model of defects prediction of square billets of 150 x 150 mm on CCM No. 2 Třinecké železárny, a. s. was elaborated. Body of the model consists of materialization and more precise definition of relations between defects of billet, parameters of liquid steel in tundish and parameters of casting machine. The sense of model is minimization of defects of blanks, respectively formation of system for removing possible causes of defects still in the course of continuous casting of steel.

47. A. D. Ryabtsev, A. A. Troyansky, V. V. Pashynsky; *Donetsk National Technical University, Donetsk, Ukraine*
Investigation of the Possibility of Titanium Aluminization by the Electro-slag Remelting Process. It is shown that using of electro-slag remelting process in chamber furnace with noble gases atmosphere permits to produce the material of required chemical composition. The posibi1ity to obtain equi atomic titanium aluminization by the method of electros1ag remelting of combined electrode prepared from pure titanium and aluminum, under active calcium containing fluxes was studied in this work. Macrostructure of ingot may be controlled via changing of remelting process parameters (current, voltage, rate of melting). Investigation of the ingot macrostructure confirms their chemical uniformity. Material is of monophase structure of γ-titanium aluminise with small quantity of excessive phase $TiAl_3$ precipitations.The investigations show that sintering permits to obtain the fine recrystallised grain structure with low concentration of pores.

48. G. A. Kolobov, I. V. Matveev*, K. A. Petcheritsa;** *Zaporozhye State Engineering Academy, Zaporozhye, Ukraine, *Zaporozhye State Titanium and Magnesium Plant, Zaporozhye, Ukraine, **Titan Trade Ltd, Zaporozhye, Ukraine*
Small-Sized Coke as a Restoration in the Production of Titanium Slag. Production of titanium starts with melting of ilmenite concentrate in an ore-heating furnace, the obtained slag being dressed with titanium and metal being consisted mainly of iron. Special attention is pointed to the choice of qualitative restoration having a high reactionary ability, electro-resistance, specific density and minimum quantity of ash and volatiles. Anthracite with ash no more than 8 - 11 % and fraction no more than 8 mm is the most suitable for the melting of titanium slag. Its application facilitates the furnace stable work and conducts the melting in an optimal heating and electric regime obtaining high quality titanium slag. Small-sized coke compared to anthracite has higher content of moisture and ash and more porosity and less density. Anthracite replacement with small-

sized coke leads to a certain deterioration of technological processing data. However, on the other band, this replacement ensures the lowering slag production costs.

49. Yu. D. Baranov, Yu. S. Proydak*, A. F. Fedotovs'kyh, K. D. Hurkin, O. A. Pilitsyn, D. M. Baluta; *Vilnohirsk State Mining & Metallurgical Plant, Vilnohirsk, Ukraine, *National Metallurgical University of Ukraine, Dnepropetrovsk, Ukraine*

Ore Grains Yield Enhancement. At different zirconium compounds production from zircon sand (mineral is ZrO_2 SiO_2) ore grains are recovered with chlorination process. The zirconium sand chlorination process gives of silicon tetrachloride which is then used in production of silicon and other silicon containing compounds. As the market is saturated with different zirconium compounds and owing to the increasing demand for silicon tetrachloride, quartz (the mineral is SiO_2) is added to the charge mixture. One of the main reasons of a yield of silicon tetrachloride out of quartz is small surface of the feed material (quartz grain size is 250 μm) and this leads to low yield of ore grains: 15 %. When blending quartz powder instead of quartz sand the yield of ore grains was more than 50 %, chlorine consumption per one ton of final product reduced by 15 %. The data obtained proved that blending of quartz powder increases the ore grains yield into final product by four times, reduces the chlorine consumption and environmental expenses.

50. M. Bizjak, L. Kosec, B. Kosec; *Faculty of Natural Science and Engineering, University of Ljubljana, Ljubljana, Slovenia*

Synthesis and Characterisation of Rapidly Solidified Alloys. Melt spinning is one of the most commonly used processes for the production of rapidly solidified alloys. In the case of our melt spinner a jet of metallic melt is directed onto the surface of a fast rotating copper wheel (max. speed up to 35 m/s), and by varying the speed and the melt flow, tapes with a thickness range of 10 to 100 μm can be obtained. In the frame of the presented work, Al-Fe and Cu-Nb alloy ribbons were manufactured by the use of a melt spinner. The morphology of the as-cast structure, as well as the microstructural characteristics, were also observed.

51. Ľ. Rabatin, P. Vadász, K. Tomášek; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*

Metallic Impurities in the Refining Electrolysis Process of the Secondary Silver Alloys. Experimental study of the influence of metallic impurities on the Thump electrolytic process of the secondary silver refining is given. Estimation of metallic impurities concentration in the electrolyte (Cu, Zn, Pd, Ni, Au, Pt, Sn, Pb, Fe, Bi and Sb) on the purity of the cathodic silver and process of the silver electrolysis is also presented, and also the influence of the basic silver concentration in the nitric electrolyte on these processes. Palladium content in the silver electrolyte is the main factor which has the influence on the purity and quality of final cathodic silver.

52. P. Vadász, Ľ. Rabatin, K. Tomášek; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*

Refining Electrolysis of the Secondary Gold Alloys. Experimental study is given of the influence of metallic impurities on the Wohlwill electrolytic process of gold refining. Estimation of metallic impurities concentration in the electrolyte (Cu, Zn, Pd, Ni, Ag, Pt, Sn, Pb, Fe, Bi and Sb) on the purity of cathodic gold and process of gold electrolysis is presented. Estimation of the limiting concentrations of gold, copper and platinum in electrolyte at electrolytic processing is given as well, and also the influence of other impurities on the technological parameters of the gold electrolysis from the point of view of the limiting total content of impurities in refined gold (which is 0.1 wt. %).

53. Ľ. Rabatin, P. Vadász, K. Tomášek; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*

Metallic Impurities in the Process of Refining Electrolysis of the Secondary Silver Alloys. Experimental study of the influence of metallic impurities on the Thum electrolytic process of the secondary silver refining is presented. Estimation of metallic impurities concentration in the electrolyte (Cu, Zn, Pd, Ni, Au, Pt, Sn, Pb, Fe, Bi and Sb) on the purity of the cathodic silver and process of the silver electrolysis is given. Influence of the basic silver concentration in the nitric electrolyte on these processes is also given. Palladium content in the silver electrolyte is the main factor which has influence on the purity and quality of final cathodic silver.

54. D. V. Dumitrescu, S. Ivanescu, V Predica, D. Tanase, D. Taloi*, A. Ioana*; *Research Institute for Non Ferrous Metals, I.M.N.R., Bucharest, *University "Polytechnic" of Bucharest, Bucharest, Romania*

Contributions Regarding the Hydrometallurgical Separation of Bismuth from Anodic Slimes. The classical method for bismuth separation from the anodic slime is based generally on pyrometallurgical processes. It is already known that hydrometallurgical processes are more "environmentaly friendly" compared to the pyrometallurgical methods and decrease in duration of the process and energy consumption is also presented. The present paper describes the results concerning the establishment of bismuth separation and recovery from desantimonated anodic slime using a hydrometallurgical process. The researches were focused on bismuth extraction from desantimonated anodic slime by acid dissolution and its separation from solutions by hydrolysis. Metallic bismuth may be recovered by reduction melting of BiOCl precipitate.

55. J. Črnko; *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*

Composition and Properties of TiO_2 prepared by Hydrometallurgy. Properties of TiO_2 powder prepared by hydrometallurgy from the slag that was, together with pig iron, a product of red mud electromelting reduction were investigated using physico-chemical methods of analysis. The samples of TiO_2 powder contain high quantity of titanium compared with the used raw material - granulated slag. Investigating the mophology of the powder samples, it has been found out that aggregation of particles and forming of larger aggregates take place. They differ in form and size. A granulometric analysis of the powder determined a weight portion of the largest aggregates in it, as well as its specific surface.

56. D. Partenov, V. Stefanova, A. Avramov, M. Chimbulev; *Faculty of Metallurgy and Material Engineering, University of Chemical Technology and Metallurgy, Sofia, Bulgaria*

Hydrometallurgical Treatment of Polymetallic nodules from Pacific Ocean. In this paper a method for hydrometallurgical treatment of sea nodules was studied. The method involves leaching with sulfur dioxide, sulfide precipitation of non-ferrous metals and obtaining a solution of manganese sulfate to obtain electrolytic manganese. The 1eaching was carried out by a mixture of sulfur dioxide and air which was bubbled in slurry made from sea nodules and water solution of sulfuric acid. The reaction of leaching is exothermic. When the temperature of slurry reached maximum value the process of leaching was completed. The elimination of iron from solution is carryed out by the oxidation of Fe^{2+} to Fe^{3+} with manganese dioxide containing in sea nodules. The hydrolysis of ferric ion takes place at temperature 87 ± 2 °C and pH = 3.2 - 3.8. In this case the extraction of Cu, Ni, Co, Zn and Mn is over 94 % and only 2 % of Fe is passed into solution. Sulfide precipitation of non-ferrous metals is carried out with ammonium-sulfide solution at room temperature and intensive agitation. The copper was selectively by precipitated at acidity of 10-15 g/l H_2SO_4, while complete precipitation of Ni, Co, Zn was reached at pH = 6.5 - 7.1. The obtained solution of manganese sulfate contained around 35 - 40 g/l Mn and less than 0.00l g/l of non-ferrous metals and iron.

57. Ž. Živković, D. Živković, N. Štrbac, D. Grujičić*, B. Boyanov;** *Technical Faculty, University of Belgrade, Bor, Srbija i Crna Gora, *Department of Materials, Metallurgical, Mining and Geological Engineering, University of Idaho, Idaho, USA, **Department of Inorganic Chemistry, University "Paisiy Hilendarski", Plovdiv, Bulgaria*

Thermodynamic and Kinetic Analysis of the Processes in In-S-O System. Results of the thermodynamics and kinetics investigation of the processes in the system In-S-O are presented. Thermodynamics analysis was done based on the PSD $\log p_{O2}$-$\log p_{S2}$ and $\log p_{O2}$-$\log p_{S2}$-T diagrams constructed for SO_2 partial pressures of 10 - 10^5 Pa. Also, results of DSC analysis are given, including determined values for the specific heat and enthalpy of the processes investigated. Kinetic analysis was done by Daniels-Borchardt method, following the results of DTA-TG-DTG analysis performed under air atmosphere under non-isothermal conditions.

58. M. Mazankova; *Military Academy Brno, Brno, Czech Republic*

Calculations of Temperature Fields at Casting. A description of the mathematical model used for calculations of temperature fields in application at casting is given at the article. The accuracy of the presented model is evaluated on the basis of experimental measurements. The calculations of thermal fields and heat transfer problems related are presented. The finite difference method was used for calculations of thermal fields, heat fluxes, etc. lD to 3D calculations were introduced for different cases of tasks for praxis and basic research. The basis of the calculations is described in examples of practical output. Research present material properties necessary for setting of a database needed for calculations. The theoretical background for practical calculations is also described.

59. M. Mazankova, D. Constantinescu*, M. Novotny; *Military Academy Brno, Brno, Czech Republic, *University "Politehnica" Bucharest, Bucharest, Romania*

Study of Thermo-physical Phenomena at Casting and Rolling. The knowledge of the thermal processes during casting and rolling is important for the final quality. The calculations of temperature fields were used for casting and rolling of steel. The thermal stresses were evaluated during reheating. The calculations give possibilities to establish as uniform cooling conditions as possible, to optimise the shape of moulds of continuous casters, the heating process of semi-finished rolled product, etc. Modelling of thermo-physical phenomena in the technological processes of casting and rolling are also presented. The physical proprieties necessary to simulate the preparation of semi-finished product are analysed with the aim to prepare a data base for calculations.

60. J. Dańko, R. Dańko, M. Holtzer, *Faculty of Foundry Engineering, University of Mining and Metallurgy, Kraków, Poland*

Used Sands from Foundry Production as an Effective Way Toward Protection of Natural Silica Sand Deposits. The scope and purpose of the present study is to contribute to the research of allowing replacement of new silica sand in foundry production by the recovered sand. Used sands is regarded as an effective way of saving the natural silica sand deposits. Four different used sands were used to analyse the waste sand grains liberation from the bonding material adherent to them. Tests carried out in similar conditions revealed that the most effective sand recovery allowing full replacement of fresh silica sand by the recovered sand was obtained using furan resin binder and alkyd binder to the lesser extent for sands with sodium silica binder hardened by esther, and at the same level for sands with waterglass hardened by CO_2, and the poorest one for sands with phenolic alkaline resin binder hardened by CO_2.

61. G. Stovpchenko, T. Titova*; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine, *Dneprozderzhinsk State Technical University, Dneprozderzhinsk, Ukraine*

The Portion Pouring of Steel and a subsequent Micro alloying by Active Elements Additions. The tendency of deoxidation, micro alloying and modifying the steels techniques indicate that the influence on the melt before and during crystallisation process is a most effective approach. Authors developed the new techniques of active influence on the change of steel flow hydrodynamic in ingot and micro alloying addition. The hydrodynamic investigation of a two stage pouring shows that proposed techniques provides: - rapid mixing of axe zone, - penetration of added melt portion in bottom part of ingot and full blending of melt volume non-solidified to addition moment, preservation of initial surface layer. The experiments on the laboratory scale (15 kg) and commercial (8.4 t) ingots were made. The grade of addition adoption in melt was 1.5 - 2.5 times more then by ladle input methods. The proposed techniques of portion pouring is not difficult to realize and allow to increase the metallurgical quality of axial zone of ingots without micro alloying addition, only due to changing the pouring order.

62. K. Gawdzińjska, J. Jackowski*, L. Wojnar;** *Institute of Basic Technical Sciences, Maritime University of Szczecin, *Institute of Materials Technology, Poznań Technical University, Poznań, Poland, ** Institute of Materials Science Krakow, University of Technology, Krakow, Poland*

Porosity Identification of Casts from Metal Saturated Composites by Means of Computer Image Analysis. In research on the porosity of casts from metal saturated composites there is a need to identify the pores. Problem encountered here are connected with the following: - the difficulty in differentiating the pores from other structure components of materials, - the necessity of differentiating the porosity types resulting from non-saturation, gas occlusion and gas emission during coagulation and contraction of the matrix. The report presents research results conducted to identify the pores by means of computer image analysis with the application of an analyzing scanning computer.

63. K. Gawdzińjska; *Institute of Basic Technical Sciences, Maritime University of Szczecin, Szczecin, Poland*

Cast Metal Saturated Composites. Problems Concerning Quality. During research on the quality of casts from metal saturated composites a number of abnormalities were found out. These faults constitute an essential problem at operation. Faults were detected that cannot be classified with commonly accepted groups and described in norms applied for castings from classic materials. Faults of structure are typical for the casts discussed. The report discusses the above-mentioned faults, i. e. faults of matrix, reinforcement and their joint. The research was conducted on the example of reinforced aluminum composites pressed with short carbon and aluminosilicate fibres.

64. M. Matveyeva, O. Shapovalova; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Research of Influence of Alloying Elements White Pig-iron on Eutectic Transformation. With change of a alloying level and modifying elements the processes structure formation, temperature intervals of eutectic and eutectoid transformations change. By differential thermal analysis investigations of temperature of eutectic transformations in white cast iron under complex influence of carbon, manganese, nitrogen, titanium were studied. The most essential change of temperature of eutectic transformation and fluidity of melt in systems Fe-C-Cr-Ti-N, Fe-C-Mn-Ti-N was established. The appreciable influence of carbide formation elements of the investigated systems on hardness and structure of cast iron of different structures and morphology of structural components is also revealed.

65. M. Vasková, Ľ. Bobok; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*

Some Results of the Study of Forming Core Mixtures with Water Glass, Hardened by CO_2 Process. The water glass as the binder system in foundry mould and core mixtures finds increasingly superior application after certain decrease of their use. This conjectural process is connected

with removing of some negative properties of the water glass mixtures, mainly the collapsibility after casting, by modification of the water glass. The objective of this paper is to describe the change of the physical and chemical properties of water glass by its modification and the effect of the alternation of technological properties of forming and core mixtures containing water glass.

66. V. Yu. Seliverstov, N. V. Hrichikova; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Development and Investigation of the Process for Gas Dynamic Replacement of Melt from Gate System in Casting. The research and development of technology for adjustable gas dynamic replacement of liquid metal out of siphon gate in castings and ingots was given. Thermo temporal conditions of the process realization in response to various dimensions of siphon gate, physical properties of form and alloy material and duration of pouring have been established too. The distinctive feature of the offered devices is the sealing of gate system from the environment at the expense of filled alloy that hardens before the formation of the metal layer of a given thickness. That will improve shrinkage feeding of an axial zone of the cast, ensure the opportunity to carry out gas impulse treatment of metal in the foundry form, and blowing off crystallizing alloy with inert gas or gas with modifying powders.

67. A. Kochubey, E. Kravets; *The Dnepropetrovsk National University, Ukraine*
Hashing Liquid in a Rectangular Cavity. The problem of reception of a qualitative firm ingot with uniform internal structure from liquid remains urgent untill now. The defects, which reveal after products having cast (crack, chemical heterogeneity), are a consequence of the incorrectly generated crystal structure of metallurgical preparation during its hardening owing to insufficient hashing of liquid. Use of various kinds of a purge (for example, ground), requires increase of stability of units for a purge maintaining operation at high temperature modes, and also can result in cast defects (presence of gas cavities). In the article the mathematical model of process of hashing liquid in a rectangular cavity (with a ratio of the parties H/L = 0.5; 1.0; 2.0, where H, L - depth and width of a cavity accordingly) is offered at the expense of circulating movement basic and secondary whirlwinds, which are formed in liquid under action of a pressure of shift of external current. As a result of accounts carried out the method of finite elements receives fields of distribution of pressure, component of a vector of speed, and also picture of lines of a current in a cavity. In a cavity it is noticed the splitting of the basic whirlwind on two opposite directed secondary, of smaller intensity. That essentially reduces process of hashing liquid.

68. I. Budić, Z. Bonačić-Mandinić*; *Faculty of Mechanical Engineering, University of Osijek, Slavonski Brod, Croatia, *Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Zagreb, Croatia*
Effect of Surface Treatment on Wall Thickness and Residual Stresses (RS) in Castings. The article reports on results of operative testing, carried out with the purpose to establish the effect of number of passes of the casting through the shot peening machine on the wall thickness and RS of thin-walled grey iron castings. The investigation results have been presented in the form of tables and diagrams, and proposals for further research have also been offered.

69. R. Ulewicz; *Faculty of Materials Processing Technologie and Applied Physics, Technical University of Częstochowa, Częstochowa, Poland*
System of Quality Control in Process of Production of Casting Articles on Example of Casts from Spheroid Cast Iron. In the work opinions on form incompatibility were executed during process of production of casting articles from spheroid cast iron. Using the quality tools such as the Ishikawa diagram and the Pareto-Lorenz analyses can be often identified appeared incompatibility which then of cause were qualified. Identification of critical points of productive system was executed as well as range of correcting workings were qualified. On basis of dates from analysis of causes of occurrence of incompatibilities and appointed critical points system of quality control was worked out for serial production. Use of statistical receipt of casts in connection with active control of quality for serial production of casts from cast iron spheroid caused lower of level of incompatibility, and regarding economic aspect contributed to reduction of costs of production.

70. K. Siekański, S. Borkowski; *Faculty of Materials Processing Technologie and Applied Physics, Technical University of Częstochowa, Częstochowa, Poland*
Analysis of Nonconformance’s and Preventive Activities connected with Quality Improvement in Process of Castings Production. Casting as all complicated production processes has at risk of failures occurrence in entire process of preparation of the final product. It’ s very important an opposite inspection process in form of preventive activities, and making use of research techniques for better loss prevention. The paper shows some simple techniques which can be used in identification the main places of nonconformance’s formation in the process of casting articles production for heavy industry. It proves that the principal influence on casting articles quality have material factors, technology of production and also human factor.

71. C. Bratu, L. Cristea, L. Sofroni; *University “Politehnica” of Bucharest, Bucharest, Romania*
Researches Referring to the Chemical Composition Influence on the Casting Properties of Austenitic Manganese Steel. The paper presents the influence of the base chemical composition (C, Mn, Si) and of the secondary elements (Cr, Ni, Mo) to the casting properties (fluidity, shrinkage, contraction, tensile strength, cracks) of austenitic manganese steel. The correlation between the casting properties and chemical properties was made by experimental measurement and statistical technique.

72. V. Grozdanić; *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*
Solidification Simulation of Grey Iron Valve Housing in Sand Mould. The solidification simulation of the casting of relatively complex geometry - grey iron valve housing - has been presented in the paper. Mathematical model has been based on physical realistic assumptions, and has been solved by numerical finite difference method - implicit alternating direction method. Simulation of solidification has been performed so that the latent heat of solidification has been incorporated in the equation for specific heat of metal, and the temperature dependence of thermal properties of all materials in the system mould-casting-core have been taken. The solidification simulation of valve housing, that is the casting of relatively complex geometry which is a common example in foundry practice, enables the improvement of our knowledge about solidification process of such castings.

73. J. Grabian; *Maritime University of Szczecin, Szczecin, Poland*
Analysis of Reinforcement Saturation Conditions of Cast Metal Matrix Composites. An analysis was made of the first stage of production of casts from saturated metal composites which consists in the penetration of liquid metal into the depths of the reinforcement. For most of the materials applied filling of the composites is difficult because of poor wettability of the ceramic reinforcement by liquid metal. Pressure is the enforcing factor. It is casy to select this pressure when the shape and dimensions of the space between reinforcement fibres can be geometrically described; this occurs when the reinforcement fibres are ordered. For composites of disordered fibres it is practically impossible to describe the space geometry betwen fibres. It has been proved that the stage of filling the closed capillary spaces with metal formed by fibres touching one another is decisive in the saturation process. It has also been proved that the process of saturation of reinforcement with disordered fibres should be examined on a macroscopic scale.

74. A. A. Nadtochij, L. V. Kamkina, R. V. Ankudinov; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
The Features of Phosphorus Behaviour in Metal-slag System by Low-phosphorus Manganese Slag Preparation. From theoretical calculations, simulation with determined mathematical model using experimental researches of phosphorus reduction kinetics from manganese raw materials, the effect of various technology factors on the process of low phosphorus slag production was determined. It was shown that at electric melting it is necessary to receive the slag with optimal basicity and temperatures. It ensures to receive the low value of coefficients of phosphorus distribution ratio between slag and metal. Carbon has the utmost reduction ability in the studied system. The usage of active carbon-containing reduction agents intensified the reduction processes.

75. Ya. V. Stovba, Yu. N. Yakovlev, L. V. Kamkina, R. V. Ankudinov; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
The Study of Process of Carbon Ferromanganese Production by Mathematical Model. The static and dynamic mathematical model of the process of high-carbon ferromanganese production, taking in to account the non-equilibrium state of reactions and kinetics of oxide reduction by carbon, was developed. On the basis of numerical results, obtained by mathematical model, and experimental researches it was established that the expense rate of carbonat oxide melts reduction is a function of slag compound and of parameter of system equilibrium state. The flowing down of metal melt and slag oxide films along a solid charge surface plays the leading role in mass transfer between solid and liquid phases. The analysis of such process by mathematical model allowed to evaluate the effect of separate factors and of their combination.

76. V. A. Gladkich, A. I. Mikhalyov, V. F. Lisenko, T. E. Vlasova, D. A. Lysyj; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
The Cost Optimization of the Charge and the Composition of the Low Phosphorous Slag for Production High Qualitative Manganese Ferroalloys. The correlation between initial parameters and finals data bas been researched in dephosphorization of manganese ore by electrometallurgical method. The mathematical formulas are suggested for description of correlation and also parameters of the optimization. The model of cost optimization and computer program for this were worked out. The correction of the mathematical model and it's computer program were approved by real metallurgical practice on ferroalloys production and so determined the quantitative and qualitative characteristics of dephosphorization.

77. B. M. Boychenko, V. I. Pishida, V. M. Dusha, L. U. Minuailo*; *National Metallurgical Academy of Ukraine, Dnepropeterovsk, Ukraine, *Petrovsky's Metallurgical Plant, Dnepropeterovsk, Ukraine*
Mechanism of Periclase-carbon Refractories Wear of Oxygen Converters. The authors has found that a high stability of (MgO - C) converter refractories was conditioned by sharp reduction slag into refractories due to: using of periclase because its large diameter MgO crystals and so smaller crystal melt contact, and the crystalls themselves are very dense, high purity of raw magnesite and graphite, adding antioxidants into binder, using the synthetically phenol resin as a binder, increasing a pressure of refractories forming up to 2 000 t, and so its porosity and gas permeability was decreased and, increasing density and strength. As a result of decreasing of slag component migration into a refractory; a thickness of decarburised layer decreases to less than 1 mm against usual 5.6 mm. Owing to presented research the life of lining of 60 t converters increased from 300 to 1300 melts.

78. M. Polohárová, M. Havlík; *Faculty of Metallurgy, Technical University of Košice, Slovakia*
Statistical Assessment of the Quality of the High-alumina and Fireclay Refractories. Quality of the production and of the output products is in modem metallurgical plants guaranteed by software. This work is concerned with research of three qualities of aluminosilicate materials: ALKO 60A, ALKO 65M and KOSAM TB. Important is a statistical assessment of the physical properties of the materials: cold crushing strength, bulk density and apparent porosity. The purpose of this research is to simplify the assessment of the measured parameters by modern statistical methods and to reduce the cost of laboratory tests. Application of the statistical methods enables quick and effective realisation of corrective measures and subsequent enhancement of the quality.

79. T. Kuffa, G. Súčik; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*
Research of Pitch Binding MgO - Materials. Improvement of refractories for steel making based on MgO and carbon binder composite is in progress. This paper describes an on-going investigation of lower carbon containing MgO-C refractories without phenol resin binder in order to improve their strength, erosion resistance and lower phenolic fumes. As a new binder a pre-treated coal-tar pitch was used with the higher melting temperature and the lower volatile content. The samples have been treated up to 1000 °C and their cross tensile strength have been fixed up at the room temperature. The domestic pre-treated coal-tar pitch has shown the best results.

80. V. Vítek; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*
Simulation of the Temperature Field in Blast Furnace Hearth Refractory Lining in Dependence on the Lining Composition and Dimensions and Way of Cooling. In the paper there is a 2D mathematical model of steady heterogeneous temperature field in pig iron and refractory lining layers presented in the general form. Solution of the partial differential equations set is realised through the adequate set of net-differential equations. The course of isotherms is demonstrated on the selected refractory lining arrangement. Based on the change of the inside lining layer dimension, the shift of the isotherms is simulated with the aim to find out the conditions of "garnisage" - a thin solidified melt layer formation and so rising the heart lining life almost unlimitedly. The influence of the furnace outer coat cooling on the temperature field course is evaluated as well. The programme allows to solve problems of the duration of lining arrangement optimisation of hearths of cupola furnaces and shaft furnaces including melting processes. There is also possibility of its use (with small modifications) for refining melting furnaces and glass furnaces.

81. T. Kuffa, G. Sučik; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*
Research of Pitch Binding MgO - Materials. Improvements are given of refractories for steel making based on MgO and carbon binder composite. This paper describes an on-going investigation of lower carbon containing MgO-C refractories without phenol resin binder in order to improve their strength, erosion resistance and law phenolic fumes, during heat up. As a new binder a pre-treated coal-tar pitch with the higher melting temperature and the lower volatile content was applied. The samples have been treated up to 1000 °C and their cross tensile strength fixed up at the room temperature. The domestic pre-treated coal-tar pitch has shown the best results.

82. L. Lazić, P. Jelić, S. Pavlenić; *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*
Optimization of Refractory Lining Replacement on Section Furnace. The goal of the study is to establish the influence of wearing of refractory lining on energetic losses of the furnace caused by conduction of heat through the furnace's walls. Object of the study was sectional furnace, type SELAS, situated at the production unit of seam tubes at Željezara Sisak. Data for the calculation of heat losses were obtained by use of the infrared camera. In order to reduce production costs timely replacement of refractory lining was attempted to define by criteria of comparing the costs resu1ted by heat loss through the furnace lining with the costs of refractory lining replacement.

83. G. Sučik, D. Hršak*, T. Kuffa; *Faculty of Metallurgy Technical University of Košice, Košice, Slovakia, *Faculty of Metallurgy University of Zagreb, Sisak, Croatia*

Preparation of "Low Cost Sialons" from the Diatomaceous Earth by Carbothermal Method. Diatomaceous earth's (DE) from the deposits in the central part of Slovakia have been used to produce fired insulating bricks. The average content of SiO_2 and Al_2O_3 in the latter products is 65.2 wt. % and 15 wt. %, respectively. Both oxides being combined in the form of various minerals. The aim of the present study is to present the results of testing a diatomaceous earth as a potential raw-material for producing "low-cost sialons" by carbothermal nitridation. The tested DE was found to be a suitable precursor for Si_3N_4 carbothermal synthesis because of low Al_2O_3 to SiO_2 ratio.

84. A Mašlejová, M. Tatič, D. Fedakova; *U. S. Steel Košice s. r. o., Košice, Slovakia*

Anlysis of Failure Refractory Materials in Tundish. The continuous casting requires a wide range of refractory material to perform various functions and their selection depend upon the grades to be cast, tundish practice, casting duration and infrastructural facilities available. Increasing of productivity and reduction costs is possible by careful selection of the type of refractory materials. In the paper we analyzed character of various macrostructure and microstructure failure of refractory material used in tundish.

85. A. Csikósová, Z. Novek, K. Kameníková; *Faculty BERG, Technical University of Košice, Košice, Slovakia*

Marketing of the Magnesite Industry in Slovak Republic. The reserve base is 3 400 million tonnes of magnesium content. Identified world resources of magnesite total some 12 billion tonnes, and there are also large resources of magnesium-bearing substitutes such as dolomite, brucite and olivine. Furthermore, magnesium compounds can be recovered economically from well and lake brines and from seawater. The later, which contains 0.13% by weight of magnesium, is a major source of it. Slovakia belongs to most important producers of the natural magnesite with 1600 thousand ton of exploited raw magnesite, that is 11.4% of the world exploitation. Slovak magnesite with its geological reserves (734 million tones) participates on the world production of the magnesite clinker at 5%. Ratio of the clinker on the European market is 11%. The paper is directed to the analysis of marketing activities, and analyses the production possibilities of Slovakian magnesite industry.

86. L. Lukáč, M. Tatič*, J. Pisák*; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia, *U. S. Steel Košice spol s. r. o., Košice, Slovakia*

Hot Blast Stoves for Blast Furnaces in U. S. Steel Košice. The hot blast stoves belong among the largest heat consuming aggregates not only within the blast furnace plant, but within the frame of the entire company as well. Similarly as the blast furnace, which shall be for sure for long time the main facility for the iron ores refining, so its main supporting facilities - hot blast stoves shall pertain its position. The hot blast preheated in the hot blast stoves consume about 10 - 15 % of the total energy consumption in pig iron production. Therefore each hot stoves operation upgrading has the impact upon the pig iron prices.

87. A. Varga, J. Kizek; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*

Influence of Flue Gas Recirculation on NO_x Formation at Natural Gas Combusting. In the paper one of the possibilities for NO_x emissions reduction at combusting a gaseous fuel is described. Authors deal with influence of flue gas recirculation on the combustion process itself. By means of an experimental investigation of flue gas recirculation the model was prepared for the purpose. The aim is to apply the obtained results on a real thermal aggregate running on natural gas.

88. A. Varga, J. Kizek, G. Oravcová, L. Lukáč, Z. Zsigraiová; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*

Influence of Air Supply Redistribution on Thermal Regime of Heating in a Lumpy Charge Layer. The authors deal with influence of combustion air supply to the lumpy charge layer by applying a physical model of a shaft furnace. The redistribution of primary and secondary combustion air is analyzed taking into account changes of temperature field profile along layer height and cross section and along the thermal aggregate hight and cross section as well. From the charge heating point of view the influence of charge lumpiness and shagging charge velocity on thermal regime stability are analyzed as well.

89. Z. Zsigraiová; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*

Cooling System of Rotary Kiln for Magnesite Clinker Sintering. The complex thermal aggregate for magnesite clinker sintering consists of three main sets of facilities: a rotary kiln, cooler, trapping equipment linked together in one continuous by working counter-flow heat exchanger. To describe the system a mathematical model of processes running in the rotary kiln has been worked out with further aim to exploit it as a tool for the aggregate work modeling, simulation and optimization. In the paper author focuses on problems of a drum cooler sub system. The processes of sinter cooling and secondary air preheating by a heat transfer, media flowing and facility motion points of view, are considered and analysed as well. The contribution of the drum cooler mathematical model is in mathematisatiom of the drum cooler processes and its connection to the rotary kiln mathematical model, which allows to analyse and evaluate the complete thermal aggregate.

90. L. Lukáč, *M. Tatič, *J. Pisák; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia, *U. S. Steel Košice s. r. o., Košice, Slovakia*

Hot Blast Stoves for Blast Furnaces in U. S. Steel Košice, s. r. o. Hot blast stoves rank among the largest heat consuming energy aggregates not only within the blast furnace plant, but within the frame of the entire metallurgical company as well. Similarly as the blast furnace, which shall be for sure for long time the main facility for the iron ores refining, so its main supporting facilities - hot blast stoves shall pertain its position. The hot blast preheated in the hot blast stoves consume about 10 - 15 % of the total energy consumption in pig iron production. Therefore hot stoves operation upgrading influence pig iron price.

91. J. Spišák, D. Dorčák*; *Faculty BERG, Technical University of Košice, Košice, Slovakia *SLOVMAG, a. s. Lubenik, Lubenik, Slovakia*

Facilities of Increase Productivity of the Process of Firing Magnesite Clinker in a Rotary Kiln. The contribution presents an optimalisation of the process of firing magnesite clinker in a rotary kiln, it contains: increase of rotary kiln capacity at minimal total production costs. Authors of this contribution, define at optimalized facilities, first of all some precautions which include an investment character. To such precautions belong precautions regarding organization and control of technological process and its logistics.

92. K. Kostúr; *Faculty BERG, Technical University of Košice, Košice, Slovakia*

Optimization of the Heating Furnace. The heating furnace provides heating of seamless - drawn tubes. The aim is to optimize the lining (materials, the structure of hearth, the wall and crown). The objective function expresses the minimalization of total cost (running costs + investment) with respect to homogeneity of heating along of robe. Therefore this problem has been solved including regulation of burners. In paper is described the

mathematical model of heating, method of optimization and some results of the solution. The results of optimization were applied in Steel work Podbrezová.

93. J. Črnko, M. Kundak, M. Gojić, *Ž. Acs; *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia, *Steel Works Sisak, Sisak, Croatia*
Structure and Composition of the Scale on Steel Blooms Heated in a Pusher-type Furnace. Samples of a scale formed on steel blooms heated in a pusher-type furnace are investigated by optic microscopic examination and by X-ray diffraction method. The results of investigation by means of optic microscopy have shown that the scale consisted of a thinner outer layer and thicker inner layer. Thickness of the layers of the scale increases by the increase of the heating time of steel blooms. The inner layer of the scale is porous while the outer layer consisted of grain structure. By X-ray diffraction method it was found that both layers of the scale consists of FeO (wüstite), α-Fe_2O_3 (hematite) and Fe_3O_4 (magnetite). Possible reasons for the scale dropping off on the botton of the heating zone of the pusher-type furnace during heating of steel materials at temperatures of hot working were discussed.

94. A. Karić; *Faculty for Metallurgy and Materials Science, Zenica, Bosnia and Herzegovina*
Evaluation of Energy Consumption in Steel Production. Energy Consumption in Steel Industry especially at Integrated Iron and Steel Work of the low Production quality is the largest influence Factor of the Steel price. Only rational use of energy consumption provides in this case successful competition on the world market.

95. M. Kundak, J. Črnko, Đ. Nikolić; *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*
Effect of Continuous Furnace Profile type on the Consumption of Fuel. In Željezara Sisak there are two continuous type of furnaces of about the same working length but different longitudinal profile. Fuel consumption in the older continuous type furnace with partially slanted longitudinal profile and frontally installed burners in single areas is remarkably larger than the consumption in the newer one with a rectangular longitudinal profile and laterally installed burners in all areas except in the charge heating area. The mentioned difference in fuel consumption was the cause to relocate the burners and install them laterally in all the areas except in the area of charge preheating. On the basis of the plant records on the operation of the older furnace prior to the replacement of burners and afterward, a statistical analysis on fuel consumption related to furnace production capacity was performed. The results of the analysis have shown that after the relocation of burners in old furnace the consumption of fuel increased. This work indicates adding of air heat exchangers necessary for the fuel burning in the furnace. The results of the analysis show that in such a case both the older and newer furnace should have nearly the same fuel consumption.

96. A. Zlatarsky, V. Kirov, K. Yankova; *Industrial Heat Technology Branch, NIPRORUDA AD, Sofia, Bulgaria*
Modernization of Pusher Furnaces for Medium Section Mills. Rolling mill No. 500 a. STOMANA INDSTRY AD is designed for production of V-shaped steel, U-bars, long, round and square sections. The metal is heated before rolling in two triple-zone bilateral-heating furnaces designed by Stalproekt Moscow. The modernization of the furnace involves replacement of the existing combustion system by burners with adjustable torch length, direct-action valves to maintain the natural gas/air ratio, new design of the burner walls, and process control system with change of the assortment and output from 20 to 40 t/hour. The expected results are expected to be similar to those obtained upon refurbishment of the pit furnaces and continuous furnaces for slabs at Kremikovtsi AD and Stomana Industry AD: more than 30% reduction of natural gas consumption and 10 - 15 % increase of productivity.

97. N. F. Kolesnik, Y. P. Pavlenko; *Zaporozhye State Engineering Academy, Zaporozhye, Ukraine*
Electrofiltration - important Solution of Enwironment Problems in Metallurgy. Three kind of kettles for high-performance cleaning of gases: Venturi scrubbers ,fabric filters and electric separators were used. The main disadvantage at applying Venturi scrubbers is a high expenditure of energy. At usage of fabric filters reduces these expenditure at 3 - 5 times, but fabric filters and existing today electric separators have considerable overall dimensions and high cost. In electric separators, the drift of particles of a dust to precipitation welding rods amounted only centimeters per one second, but our equipment transported the dust with velocity of meters per second. Filtering materials withstanding temperature up to 500 °C, permitt to strip gases by electric separators up to heat-saving up boiler. We carry on the researches on neutralizing gaseous impurities in electric separators too.

98. M. Holtzer, J. Dańko, R. Dańko; *Faculty of Foundry Engineering, University of Mining and Metallurgy, Kraków, Poland*
Environmental Impact of the Use of Automotive Scrap as Charge Material in Steel-Making Processes. In the past few years, the use of zinc-coated sheets became quite popular, specially in automotive industry and household appliances, This, in turn, has resulted in a large volume of the zinc-containing scrap, thus increasing the content of zinc in the waste and secondary raw materials used by metallurgical p1ants. The continuous casting of steel, used on a wide scale also in Poland, reduces the volume of returns available at metallurgical plants. Large volumes of the zinc-coated scrap considerably increase zinc content in the dust collected from the melting installations, quite often to a level well above 16 %. This is a great obstacle in the safe dumping of dust. It has to be expected that within the next few years the amount of the zinc-coated scrap, both own and purchased, will considerably increase. Of the 6.5 mln tons of steel used every year by the European automotive industry, about 85 % bear corrosion-protective coatings. As a result of this, 1.2 mln tons of the zinc-coated scrap is every year directed to the recycling system. The shortage and the high price of the uncoated sheets, now reaching about 192 euro/ton, forces the metallurgical plants to use the zinc-coated sheets as a crap at half a price. This creates problems of both technical and environmental nature.

99. O. A. Gogenko, S. N. Kripak, Yu. S. Projdak*; *Scientific-Industrial Enterprise "Promtech", Dnepropetrovsk, Ukraine *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Effective Technology of the Use of Iron-Containing Secondary Raw Material. The introduction of technologies of iron-containing wastes (sludge of agglomeration and steel smelting, oiled slag) with the use of peat products with increased moisture- and oil capacity allows to obtain iron-containing secondary raw material having necessary physical and chemical properties. The iron-containing wastes are dehydrated under the action of capillary forces. The properties of peat are improved by preparation and artificial activation by a mixture of colloids and ampholytic surface-active substances, as a result of which the reorganisation of its structure takes place and the solid skeleton with the large absorbing surface is formed.

100. V. I. Tolmachov, E. P. Pavlova; *Zaporozhye State Engineering Academy; Zaporozhye, Ukraine*
Reference Directions of the Solution of Ecological Problems of the Metallurgical Plants. In Ukraine the release of the plants of an iron and steel industry in is compound about 30 % of all stationary polluters. In regions where of the metallurgical plants are placed this share is much higher. Till now the ecological situation is evaluated as total pollution. We present the release of pollutants to evaluate them in view of their toxicity and so there's opportunity and to estimate their harmfulness enough objective and to work out most rational, scientifically justified approach to present

these releases. So different metallurgical technologies can be compared on a nature protection urgency problems. The analysis of results of examinations carried out on the largest industrial centres of Ukraine, has shown, that eight most dangerous compounds from 98 % of releases in the atmosphere.

101. L. Cristea, N. Panait; *University "Politehnica" of Bucharest, Bucharest, Romania*
The Romanian "Ecometallurgy" in the Aluminium Manufacturing Plant: Present and Future. The paper present situation in the Romanian aluminium manufacturing plant regarding the pollution level of the air, water and soil. The researches concerning the methods of pollution level reducing have been studied.

102. I. Oprescu, S. Balescu, V. Mirea, A. Semenescu, V. Barbu; *University "Politehnica" of Bucharest, Bucharest, Romania*
Reducing the Polluting Potential of Sintering Iron Ore Plants. In the first part of the paper one presents an analysis of polluting emissions of an iron ore sintering plant, emissions resulted: from technological sources (CO, CO_2, NO_x, H_2O), in the flue gases, from secondary sources (dust resulted from secondary technological operations e. g. homogenizing sieving, etc.) and from transport (dust). In the second part of the paper one presents the correlations between the main variables of pollution effect, namely: sintering charge variables, the layer deposed in the sintering wagons and combustion process, sintering plant speed, the sintering process rate and the layer thickness, the equilibration of the fine retour particles. Finally, the elements and the specific measures for the "ecologysation" of the sintering installations are also given.

103. P. Rybár, D. Domarацký, L. Domaracká; *BERG Faculty, Technical University of Košice, Košice, Slovakia*
Utilization of Zeolite in Air Cleaning. Zeolite ion exchange capacity utilization to adsorb gases is a suitable main or supplement means for technologies which improve odour control and quality of air. Defined channel size selectively adsorb such gases as: ammonia, hydrogen sulphide, carbon monoxide, carbon dioxide, sulphur dioxide, water vapour, oxygen, nitrogen, formaldehyde and others. Owing to their availability, low price and the possibility of reusage, zeolite could be used in many industrial and work areas. Zeolite could be applied as a part of air conditioning system or as independent unit.

104. M. Uhrínová, M. Repášová*; *Faculty of Metallurgy, Technical University of Košice, Slovakia, *SPP a. s. Bratislava, Brancu Košice, Košice, Slovakia*
Regulation Noise Reduction Stations Possibilities. When assessing the natural gas consumption impact on the environment complexly and objectively one has to assess entire chain starting from its extraction through transport, storage, distribution and final use. The long distance pipe lines and regulation and compressor stations building may be the most adverse threat when not considered all the factors influencing the environment protection. Among them a serious problem represents the regulation and compression stations noise affecting working environment. One of the possibilities to reduce the regulation stations noise level and so to protect the environment represents their reconstruction. In densely inhabitated locations we propose the underground regulation stations which do not disturb the locality from the point of view of architecture. The ground coverage is a minimal one (about 3 x times less in comparison with the over-ground station) and the proposed solution is more appropriate.

105. Ľ. Floreková, M. Hanzelová, M. Benková, F. Michaliková; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
Environmentaly Oriented Quality Production. The questions of closing of industrial cycle from the side of the producer of the waste must be solved by systematical approach. The quality production doesn't apply only of the own technological chain also to the environment. If the production of the plant nowadays causes the damages to the environment, it gets a danger to its existence, because: public opinion turns against the plant production, strict regulations disgrace activity and from such regulations two principles result: all the time is needed to take account of the relationship of the plant and its effect on the environment, all the time is needed to have adequate profit, which a meaning for its existence. We refer on the area of environment as on a basic, complexes system, linked with the public.

106. M. Hanzelová, Ľ. Floreková; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
Waste Policy and Environmental Legislation in Slovak Republic. The intentions of the environmental policy in the area of the waste economy are not applied at the appointed frame. The process of the modernization of the production units is slow and doesn't bring the new environmentaly favorable technologies evaluating the waste. The elements of the environmental policy are accepted in the realm of mining of the mineral raw materials. Production of the waste as the indicator of the level of the utilization of the primary resources, reflects the economical and environmental level of their evaluation. Economic reasons increase the production of waste. A reduction of the waste production in the developed economics is an indicator of the change of the raw materials consumption (rationalization, reusing) or of the increase of the waste recycling.

107. M. Cehlár; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
Management Technology of Wood Waste for Energetic Purposes. Management and usage of biomass as an energy source has become a practical and reliable way of providing heat in the last decade in the countries, such as Austria, Germany, Denmark, or Sweden. Wood biomass is also cleaner, and regarding the permanently maintainable natural production, the source of energy, which does not exhaust environment, and it compared with natural gas, it is a more ecological fuel. For gradual achievement of this goal it is necessary to make the prices for fuel and energy real, to create a proper legislative, and economic and financial background, and systematically supported business activities. From the performed research the potential possibilities of the development of the management of use of renewable energy the is set by 2010.

108. J. Mačala, Ľ. Kozáková; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
Assessment of Air Pollution in the Slovak Republic. Statistical characteristics of the pollutants measured and the respective ambient air quality and standards, the latter ones characterizing unfavorable impact of air pollution on population, enable to assess air pollution level by individual sources. More complex air pollution classification may be provided by ambient air quality index assessment, considering cumulative effect of selected pollutants. The frequency of occurrence and duration of distinctive ambient air quality standards for signal imposing "warning" and "regulation" were assessed. For selected stations, the concentration diagrams were processed. Even the wind direction frequencies are assessed from meteorological stations, it was not always possible to assign the station to monitor all three pollutants for given location.

109. R. Antohi, P. Ancuta, D. Constantinescu*; *Automation Institute, Bucharest, Romania, *University "Politehnica" of Bucharest, Bucharest Romania*
System for Environment Quality Supervision of the Industrial Platforms. The system achieves technological control of pollution level in a zone with noxious generating units. The system assures all local environment data acquisition and processing and transmits them, via satellite, in the INTERNET network. In this mode, any user has access to actual data monitored. The system assures generally 10 noxious types monitoring. Particularly the system assures two noxious types monitoring (CO and CO_2) and is implemented on S. C. METAV S. A. Bucharest. The noxious concentration is

measured with the gas analyzer type INFRARED-2 delivered by GASTAR SRL Company. The transmission support is the low altitude satellite system named ORBCOMM. The system performs data acquisition and processing through ORBCOMM system and displays it on Web site as mediated-on-days and month noxious values. Also are displayed the increase over pre-alarm and alarm limits of measured noxious level emission.

110. T. Tsanev, M. Marinov; *Faculty of Metallurgy and Material Engineering, University of Chemical Technology and Metallurgy, Sofia, Bulgaria*
Agglomeration of Non-Metal Waste Materials. Chemical and metallurgical industries generate various disperse waste materials as a result of gas scrubbing or of the basic production process (such as catalysts). Their treatment will be more efficient if such materials have an adequate grain size. The possibility of increasing their grain size by a traditional metallurgical process - agglomeration - is of definite interest. This paper presents an attempt to agglomerate spent vanadium catalyst and defines the main process parameters.

111. M. Marinov, T. Tsanev, D. Dimitrova, N. Dishovsky; *Faculty of Metallurgy and Material Engineering, University of Chemical Technology and Metallurgy, Sofia, Bulgaria*
Investigation on Physical and Mechanical Indexes of Rubber Based Materials on the Basis of Waste Phases from Extraction Metallurgy. The purpose of the present paper is examination of the physical and mechanical characteristics of the rubber based on materials in which the waste phases from extraction metallurgy are used as functional fillers. Two groups of waste powders have been examined by introduction in nitride butadiene rubber matrix. The waste powders used as functional fillers have been characterized by chemical, X-ray diffraction and granulometric analyses. The physical and mechanical indexes of obtained rubber based samples are determined: by strength on extention, relatively stretch, Shors' hardness, and tension for 100 % sample deformation and specific bulk resistance. It has been observed the influence of granulometric status strengthening effect of the fillers investigated.

112. J. Tušek; *Welding Institute, Ljubljana, Slovenia*
Narrow-gap Submerged-arc Welding with a Multiple-wire Electrode. The article treats a completely new variant of narrow gap welding. First, nine different welding heads for narrow gap welding are described and shown schematically. The core of the article is devoted to a description and schematic representation of a unit for welding with twin-wire and triple-wire electrodes respectively and a description of technology for narrow-gap submerged-arc welding of thick work pieces. A macrograph of the weld is shown too, and basic optimum welding parameters for attaining a quality weld are given. Finally, main advantages of multiple-wire narrow-gap submerged-arc welding are stated.

113. J. Tušek; *Welding Institute, Ljubljana, Slovenia*
Factors Affecting Weld Shape in Welding with a Triple-Wire Electrode. The article describes the influences of welding parameters, modes of metal transfer through the arc and the number of wires applied on weld formation and final shape. Diagrams show the influence of current intensity and arc voltage while a figure indicates the influence of streaming and rotating metal transfers on the final weld shape. Diagrams and macro specimens, however, show the influence of the number of wires used on the weld shape and weld formation in submerged arc welding with a triple-wire electrode.

114. J. Tušek; *Faculty of Mechanical Engineering Ljubljana, Ljubljana, Slovenia*
Bridging of Welding Gaps in Welding with a Multiple-Wire Electrode. An investigation on bridging larger welding gaps between work pieces occurring in practice due to structural requirements or to defects in weld edge preparation is described. Same characteristic cases from practice where a larger root gap should be bridged or the space between two or three work pieces should be filled with a greater quantity of filler material are described. Submerged-arc welding with twin-wire and triple-wire electrodes was applied.

115. J. Tušek; *Faculty of Mechanical Engineering, University of Ljubljana, Ljubljana, Slovenia*
Submerged Arc Surfacing with a Multiple-Wire Electrode. Submerged arc surfacing with a multiple-wire electrode is a new process variant which has been rarely used, in spite of its numerous advantages in comparison to other processes, in practical applications. The unit for surfacing with the multiple-wire electrode differs little from a classic unit for submerged arc welding with a single-wire electrode. The difference between them is that in our unit several wires travel through a joint contact tube simultaneously. All of the wires are fed with the same rate and have a joint regulation and power source. In welding with the multiple-wire electrode it is possible to weld with two, three, four or even more wires simultaneously. In the joint contact tube wires of different diameters and different chemical composition and solid or f1ux-cored wires may be used. Mechanical properties of surfacing welds depend on the type of the parent metal and the filler material, welding parameters and the type of welding flux used.

116. A. Samolejová, J. Bilík; *VŠB - Technical University of Ostrava, Czech Republic*
Comparison of Czech Steel Industry Restructuring Case with the Restructuring of the American Steel Industry in the 20th Century. The Czechoslovak steel industry produced in 1989 16 mil. tons of crude steel. After the separation of Czech Republic from Czechoslovakia in 1993, it was necessary to reduce and at the same time to modernize the steel production. The experience of the American steel industry restructuring could be very useful at designing of a new concept of the Czech steel industry corresponding to the Czech national economy and to the restrictions of EU.

117. J. Bilík, V. Roubíček, V. Vilamová; *VŠB - Technical University of Ostrava, Czech Republic*
Actual Possibilities of Coal Utilisation in Metallurgical Industry. Dark and brown coal sources, technological, economical and environmental conditions of coal utilizations are presented. Some specific cases of realized and developed technologies applicable at commercial iron production are given.

118. A. Radziszewska; *Faculty of Materials Processing Technologie and Applied Physics, Technical University of Częstochowa, Częstochowa, Poland*
Umweltmanagement im integrierten Managementsystem. In Artikel wird, auf Beispiel Gußuntemehmen, die Bedeutung von Umweltmanagement bei Einführung des integrierten Managementsystems und sein Einfluß auf Markttätigkeiten des Unternehmens, vorgestellt. Es wird auch dargestellt, auf welche Weise Ökologie das Unternehmensmanagement und seine Ergebnisse beeinflußt. Es wird auch Tätigkeiten, die durchgeführt wurden, um Umweltmanagementsystem einzuführen, und Änderungen, die sie in Unternehmensmanagement und Betriebsgliederung hervorrufen, beschrieben. Es wird auch gezeigt, welche Faktoren das Bedürfnis von Ökologieanwesenheit in Umweltmanagement verursachen. Das sind Faktoren, die mit Normen ISO 14 000 und TQEM- Philosophie verbunden sind. Es werden auch die alternativen Möglichkeiten beschrieben, so daß man Grad von Erfüllung der Ökologieanforderungen messen kann.
119. E. Staniewska, W. Waszkielewicz; *Faculty of Materials Processing Technology and Applied Physics, Technical University of Częstochowa, Częstochowa, Poland*

The Estimations Element of Logistics in Administration of Reserves on the Example of Steel Work. Material supply in metallurgy concerns for very wide range of assortment. The different cost of receiving and different means to the production and quality of finished product are connected with them. The considerable share of material cost and maintenance costs of reserves are only some problems which decide about essential role of supply. The application of logistic elements in strategy of supply can be the essential instrument of rationalization of processes of material flow and administration of supply. In the work the areas of application of logistic in the range of supply on the example of steel work have been defined. The basis to determine the purchases policy was detailed analysis of supply situation and estimation of the position of enterprise in the market and the choice of strategy of storage of supply.

120. R. Budzik, R. Prusak, Z. Skuza; *Faculty of Materials Processing Technology and Applied Physics, Technical University of Częstochowa, Częstochowa, Poland*

Change in the Organizational Structure of a Restructured Metallurgical Enterprise on the Example of one of the Biggest Polish Steel Work. Among metallurgical enterprises active at present on the market a great concern about the simplification of the organizational structure can be observed. The main factor decisive for an enterprise’s choice to introduce changes in the field of organization and management are changes of conditions in its environment In addition to this, the managements of metallurgical enterprises mention also, as causal factors, a general crisis of an enterprise that manifest itself in a decrease of basic economic indices, inadequate adjustment of information and decision systems to the variable character of an environment and starting changes in other areas, such as engineering or economics. In this paper the effects of the restructuring of the organizational structure of one of the largest polish steelwork are presented.

121. A. G. Avramov; *Balkan Union of Metallurgists, Sofia, Bulgaria*

Metallurgy in the Balkan Countries during the “Transition” Phase of their Economy. When we describe the so-called “period of transition” of the economic development in the countries of the Balkan region (excluding Greece and Turkey), we have in mind mainly structural changes related to closing of inefficient industries and change of their ownership. These changes are going on at a quick pace in some of these countries (such as Bulgaria), while in other countries such as Srbia and Crna Gora they just start. The paper offered to your attention and reviews briefly the development of the metallurgy structural reform in some of the Balkan countries.

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

The Plastic Processing section includes 76 reports concerning different topics of scientific and professional research in plastic deformation processing. The greatest number of papers orginates from Ukraine (18) and from Slovenia (15); Slovakia, Poland, Russia, Romania, Serbia and Montenegro and South Africa are represented, too. Croatian metalurgists are represented with 18 papers. It is important to notice that part of reports is a result of domestic and international research collaboration.

An important and very characteristic issue in papers of this section are topics dealing with *steel tubes production* (papers no. **1, 2, 3, 4, 5, 6, 7, 8, 9, 10**). Practical and theoretical research has been done on the concept of reliability coefficient of welding joint for electric welded tubes, analysis of factors influencing seamed tubes quality, problems of lubrication and the mechanism of salt phosphate lubricant ingress in zone of tube deformation on a long cilindrical mandrel. The effect of chemical composition of micro-alloyed steel in the production of thick-wall tubes was also studied. Some papers give a survey on operation successfulness of seamless tube mill lines and prospects of tube industry and technology in Croatia and abroad.

The technology of *hot rolling of sheet steel* and different aspects of wiews are discussed in 8 papers (no. **11, 12, 13, 14, 15, 16, 17, 18**). The influence of temperature-deformation rolling parameters on the structure and technological properties of high-chromium boron steel is studied. The attention is paid to the control of finished products made by technology of hot (and cold) rolled sheets. The mathematical model and algorithm of calculation of a heat-stressed condition of rolls for hot-rolled steel under generalized conditions of heat interaction with environment are submitted.

Steel *wire drawing technology* (papers no. 19, 20, 21, 22, 23) is represented by papers dealing with results in research of the coefficient of friction in the deformation zone, technological lubricants, dies stability, wear and abrasion mechanism of dies and influences of many different factors. The influence of deformators construction (strengtheners) on residual stresses value of steel wire is researched too. Residual stresses investigations are made by application of the stress-strain curve. Features of surface microrelief development at drawn steel is determined by various modes of metal drawing preparation, as reported in paper (24).

As to the technology of *steel forging* there is a relatively great interest of investigators. Presented are eight papers concerning this technology (papers no. **25, 26, 27, 28, 29, 30, 31, 32**). A practial example of controlled forging and cooling in production of a crankshaft of micro-alloyed steel is given. Some theoretical studies have also been performed to achieve the main technological parameters and to find the best tool shape from the point of view of the quality of forged material. Also a practical example of mechanical properties improving by applying a special forging shema in the production process of shrouded large-sized arbors-pinions of higher hardness is shown. Some experiences of the application of HFS (Hot Forging Simulator) in achieving a high-quality reproduction technology of open-die hot forging on the 30 MN forge press are described and transfer of informations for controlling this forging press is given. Well known forgeability problem of steel with limited plasticity at higher temperatures is investigated by means of V-tool at open die forging. A paper concerning modeling methodology of spread prediction in hot open die forging process by means of simulation by numerical modeling with FEM is presented, too. Theoretical and experimental research with analysis of metal plastic flow with modeling of different forming proceses is presented in papers no. **33, 34, 35** with aim to minimise the influence of tools load on the configuration of the tool working zone and to achieve the contact quality.

Research of *rheological concept* at new technologies in metal forming (papers no. **36, 37, 38**) represents a new attempt for the development of energy saving technologies. There is a group of papers (no. **39, 40, 41, 42**) which give the prediction of deformation resistance of steel at hot rolling, simulation of forming process by torsion tests and analysis of multilevel simulation for determination of parameters while forming the metalic materials. Wokability of two steel grades was studied by measuring the effect of deformation temperature on mechanical properties and material flow.

The *behaviour of metal at plastic deformation* and the varieties of related topic is were of interest to many investigators. A use of method of following local thermomechanical states and their correlation with the aim to assure high-grade homogeneity of rolled strips is presented in paper no. **43**. Also the analysis of nonhomogeneous testing procedure of yield curves via differences of yield stresses applied is given in paper no. **44**.

Reliability of yield curves at deformation rates between 10 and 50 s^{-1} are studied by means of laboratory tests. Because of the fact that at higher rates is´s difficult to master that rate, an algorithm of rate control of test machine is presented in paper and evaluation of test results made by neuron networks for critical deformation rates (paper no. **45**).

In paper no. **46** flow stresses and plasticity at elevated temperatures of carbon and alloyed structural steels by means of hot torsion test are discussed. The temperature range of experiments was from 1073 to 1473 K. Stress-strain curves of steels established by tensile and compresion test are discussed in paper no. **47**. The comparison of stress-strain curves obtained by tensile test and by copression test is made for the same type of Ck 15 steel.

Paper no. **48** deals with activation energy for maintenance of plastic state of metal by thermaly activited process based on diffusion and recrystalisation which is determined by temperature and mechanicaly controled test in uniaxial stress state. Results based on the experiments of autors and application of a software for calculation of activation energy for plastic state is illustrated for the case of selected Al alloy.

A. Povrzanović, Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Zagreb, Croatia

The deformation mechanism of superplasticity at commercial A-204 duraluminum alloy is possible to achive without need of a prior thermomechnical treatment, according to paper no. **49**. Microstructural investigations made by the author have been show that the deformation mechanism mainly consists of intragranular slip which is differs from the classic mechanism of superplasticity by intergranular slip.

The grain boundary diffusion of polycrystaline and nanostructured materials on the development of plastic deformation during high temperature creep and superplasticity is discussed. Now experimental data on the investigation of the physical nature of high rate and/or low temperature superplasticity of nanostructured Al-Mg-Li alloys are presented in the article (paper no. **63**).

Technology and problems of *extrusion* are represented by six papers. A three-dimensional computer simulation based on FEM is developed and the task of thermo-viscous-plasticity is solved for a case of extrusion of the thin walled shape of soft Al 6000 alloy (paper no. **50**). Extrusion process parameters based on numerical simulations are decisive for high-grade extruded products. According to the paper no. **51** the development of numerical methods opens a region of possibilities for optimization of process parameters in a cheap and fast way.

Quite modern ideas to optimisation of Al alloys extrusion parameters are made by means of evolution and biology approach that is based on Artificial Neural Network (ANN) and Genetic Algorithm (GA). These ideas are submited in report no. **52**. An optimization is performed on extrusion of thick walled AlZnMn (7000) hollow section. The influence parameteres are treated as environmental conditions and combined with ANN.

A very actual problem of tool wear in hot extrusion of aluminium is elaborated in two papers (no. **53**, **54**). Two methods for wear resistance of tool are considered.

A study of radial gear extrusion according to the recent trend in near net shape foming is given in paper no. **55**. This paper deals with theoretical analysis of radial gears extrusion by two various methods: upper bound method, as analytical one, and FEM method, as numerical one.

About technology of *heat treatment* there are presented only two papers. The technological parameters of heat treatment strengthening, the water-based hadrening mediums and, the construction of cooling system are elaborated. This system allows to get service durability of hot deformation tool. Different nontraditional heat treatments are possible. These allow to raise dislocation density and reconfigurate it into polygonized or cellular substructure of tool metal working parts during oubsegnent tempering. The heat resistance and durability is about three times higher in comparison with the traditional heat treatment (paper no. **56**).

In the paper no. **57** a technical means on thermomechanical treatment technology and facilities for cooling plates after rolling are described. Due to a "water wall" cooling instalation with computerized operating system located on the mill plate it is possible to achieve required mechanical properties and flatness for special aims.

The influence of *cold deformation* on low-carbon steel durability is discussed in the paper no. **58** and according to the author it depends on the type of deformation and the initial metal conditions.

The influence of different parameters of heating in the vacuum furnace and cooling in the processes of hardening and tempering on the structural state of steel P6M5 and P0M5CT and on their mechanical and technological properties is studied. The efective condition of heat treatment provides rise of operation stability of this high-speed steels used for cold deformation tools (paper no. **59**).

The prediction of curvature of bimetalic plate Al-Cu during asymetrical cold rolling is discussed in the paper no. **60**. The experiment of cold rolling process of bimetalic plate was carried out at the temperature of 20^0C for 10, 20 and 25% relative rolling reduction. The influence of rotational speed ratio and the deformation value on change of curvature of bimetalic plate is determined.

The properties of joint in the bimetalic rods Cu-Al and Cu-Steel after explosive cladding and the process of rolling are given for relativly huge number of test specimens. The results of the research show a significant deviation in microhardness distribution in both layers near the joining border (paper no. **64**).

The cold (and warm) strong plastic deformation of low carbon steels is performed with the aim to study the formation of nanocrystaline and submicrocristalyne structure during the deformation. Authors give data of deformation performed, pressure, true strain and temperature of specimens during the deformation (paper no. **61**). Nanostructures in Al-Mg-Sc-Zr alloys after strong plastic (cold and warm) deformation are discussed in paper no. **62**. This ultrafine-grained material is of special interest because of its unusual properties. A plastic deformation was carried out by torsion. The deformation data are given in the paper.

A plastic deformation of billets of *titanium alloys* by means of the new high-effective method of deforming titanium with apllication of electric pulse impact is reported. Authors discuss the physical changes and phenomenon of healing the structure defects in the metal while deforming with an electric pulse impact. (paper no. **65**). Paper no. **66** is actually a second part of paper **65** discussing problems of most rational methods of heating titanium alloys for plastic deformation. Protection features of thick oxide film on the surface of titanium alloys provide not only high corrosion resistance but also prevent oxidation and gas saturation during the heating of the titanium billet up to some temperatures in the air, which is provided by high-speed induction or electrocontact heating during sheet billets forming. The technological process of forming the titanium alloys lining is patented.

There is a group of papers dealing with *different technologies of plastic deformation* used for industrial purposes (papers no. **67, 68, 69, 70, 71, 72)**. Paper no. **73** deals with problems of maintenance in a modern wire mill.

A good survey of special technologies of plastic forming of metal and alloys with general requirements on the quallity in the plastic deformation processes is given in paper no. **74**. The author deals with introduction of up-to-date technologies in steel sheet production, too. Paper no. **75** presents an interesting report of the reconstruction, modernisation and supervising of the Split Steelworks (Croatia). Paper no. **76** give also strategy and concept of revitalization and development of the Company "BH Steel Željezara" Zenica.

“C” PLASTIC PROCESSING SECTION

1. Y. V. Furmanov, V. M. Druyan, V. B. Furmanov; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
About the Necessity of Introduction the Concept of Reliability Coefficient of the High Frequency Welding Joint for the Electric Welded Tubes of Small and Middle Diameters. According to the facts mechanical testing of tubes it has been shown the need of introduction the reliable coefficients of the high frequency welding joint into the theory and practice of manufacturing the longitudinally electric welded tubs of small and middle diameters. There has been offered the method of calculation the reliability coefficient. The introduction of the reliability coefficients of the high frequency welding joint into the practice of the tube manufacturing will make it possible to conduct the comparative analysis of the products quality, manufactured by different tube plants and to distribute these products between customers more rationally.

2. M. Kundak, Đ. Nikolić; *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*
Analysis of Seamless Steel Tubes Production at the Sisak Steel Works. The paper deals with the production of seamless steel tubes at the Sisak Steel Works in Sisak, Croatia since 1992, i.e. during the war and the post-war years. Due to operation at a greatly reduced capacity the steel mill and the rolling mill have experienced great financial losses. Based on those negative factors a way of overcoming the current state of affairs in steel production has been examined. The cost of specific energy consumption is analyzed in respect to its share in the selling price of the product for the purpose of predicting the terms of operational profitability and reducing the financial losses caused by drop in the production rate below the profit-making level.

3. J. Selejdak; *Faculty of Materials Processing Technology and Applied Physics, Technical University of Częstochowa, Częstochowa, Poland*
Analysis of Factors Influencing Seamed Tubes Quality. The market economies and large competitiveness makes, the most important assignment for all the enterprises to maintain their customers. If an enterprise wants to solve this problem it has take care about the very best quality of its articles. In this paper quality problem which appear during compound technological production process of seamed tubes are given. This process is high frequency welding process. The quality of hatch material has large influence onto quality of seamed tubes. Steel tapes should not contain any nonmetalic inclusions. This fragile nonmetalic inclusions make the process of welding tubes difficult and have unfavourably influence onto quality of weld as well as of welding zone. The article gives results connected with these problems and the way of improvement in the near future.

4. V. N. Danchenko, I. Mamuzić*, P. V. Drozhzha; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine, *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*
Ingress of the Salt Lubricant on a Tube-Mandrel Contact of the Stands of Continuous Tubes Mill. The mechanism of the salt phosphate lubricant ingress in zone of the tube deformation on a long cylindrical mandrel was considered. Suggested mathematical model is based on the points of the hydrodynamic theory of lubrication. Data presented are concerned with a value of a salt lubricant layer thickness and friction factor between metal and mandrel at continuous hot rolling of tubes.

5. G. J. Gulyayev, Y. G. Gulyayev, V. M. Druyan*; *State Tube Institute, Dnepropetrovsk, Ukraine, *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Tube Industry of Ukraine: Results and Prospects. During the subsequent 100 years Ukraine has to turn into a world leader in tube production. The article give Power capacities and dynamics of production volume at Ukraine tube plants: Niezhnedneprovsk Tube Rolling Plant, Nokopol Yuzhnotrubny Plant, Dnepropetrovsk Tube Plant, Khartsyzk Tube Plant, Novomoskovsk Tube Plant, Luhansk Tube Plant, Mariupol Ilych and Steel Works, Dnepropetrovsk Metallurgical Plant “Kominmet”. Also, a distribution of Ukrainian tube export according to countries and regions (except to Russia) is given.

6. N. Devčić; *Stelworks Sisak, Sisak, Croatia*
Production of Seamless Tubes at Steelworks Sisak. The seamless tube rolling mill in Sisak started its production in the framework of the integrated iron and steel plant in 1952. Step-by-step-type construction of light, medium and heavy pilger train were finished in 1973 and so made possible the production of seamless tubes (diameter 21.3 - 355.6 mm) with a capacity of 150 000 t/y. Now are in operation medium and heavy section mills. Altrought obsolete they operate under the conditions of severe market competition. Only by introduction of up-to-dated technology, the production of seamless tubes at Sisak can persist in the future.

7. S. Rešković, M. Balenović; *Stelworks Sisak, Sisak, Croatia*
Production of Welded Tubes wilh Removed Underweld. Technology of underweld removing is not a new technology. In contrary, there is already a great deal of tubes with removed underweld. Their continuous production process is still burdened by a number of problems regarding the removal of underwelds at the production of hot-rolled weld tubes, and so some guidelines are given for the solutions.

8. S. Urbanek, R. Križanić, D. Nikolić*; *Stelworks Sisak, Sisak, Croatia, *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*
Statistical Analysis of the Level of the Operation Successfulness of Seamless Tube Mill Technological Lines at Steelworks Sisak. The analysis was made on the basis of statistical evaluation of incompatible tubes - defective tubes. The results were obtained by data processing and drawing the frequency chart of incompatible (defective) tubes and by Pareto-analysis. Based on the obtained results the trend of production successfulness which is not negative was found out.

9. D. Tkalčić; *Stelworks Sisak, Sisak, Croatia*
Installation of Tube Surface Treatment Technology for Cold Deformation in reactive Oil. The purpose of this technology is the possibility of production of cold-drawn tubes with high demands on surface quality. Degree of surface roughness at classical chemical treatment for cold tube deforming is in the range from N5 - N9. Demand on the surface quality of the tubes for the manufacture of cylinders and sock absorbers is between N3 and N5, i. e. middle tolerance of profiles Ra 0.1 - 0.4 maximum. So, the tube surface must be clean, bright and without phosphate residues. It may be acquired with the use of special oily agent that ensures in one operation both phosphating and lubricating of tube surface. The new agent remarkably simplifies the surface treatment for deformation process and enables both the most difficult tube working and a nice, bright appearance of drawn tubes. Another advantage of the agent is that the heat-treated tubes need not pass through the complete chemical treatment (pickling, washing out, ...). In addition, the products are temporarily protected from corrosion.

10. R. Križanić, A. Prelošćan*, N. Devčić, Š. Osmanlić, M. Prelošćan, V. Radović-Novosel; *Steel Works at Sisak, Sisak, Croatia, *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*

The Effect of Chemical Composition of Micro-Alloyed Steel on the Production of Thick-Wall Tubes. In this work, structural changes of steel at the production of as rolled seamless tubes, of size 85x9"x20.9 mm with quality grade N80 according to API Std SCT are given. The performed correction of chemical composition by decreasing the content of C and V, and increasing the content of Al and N enabled no uniform forming of fine-corn structure alongside the whole transversal cross section of robe wall and therefore the expected results were not achieved. This is why, on the basis of analysis of test results, the corrected chemical composition is proposed: addition of No and Ni and an increased portion of Nb. A remarkable decrease of S is recommended because of its distinguished negative effect on transversal ductility.

11. O. E. Braunstein, V. E. Gromov, V. V. Dorofeev, B. K. Zhuravlev, L. B. Zuev; *Siberian State University of Industry, Novokuznetsk, Russia*
Technology of Hot Rolling of Sheet Steel in Rolls of Variable Section and Ultrasound Control of Finished Products. During last years the processes of action on profile of rolling slit by means of axial displacement of working rolls having special S-shaped form in stands “quarto” and “sexto” are offered. The processes of sheet steel rolling in Laut stand “trio” including the use of rolls of variable section with axial and radial regulation are developed by us. Such profiling of rolls in strip mills provides the minimum transversal variations in thickness of sheets, reliable centering and restraining of feed on axis of rolling; the exclusion of “smoothing-out” passes, the minimum variation of deformation along width of feed for obtaining the plotted board sheets. The mechanical properties of sheet steel of 4 - 25 mm thickness are determined and the dependence of properties on temperature of rolling finish in a range of 700 - 860 °C are studied. The control of properties is added by measuring ultrasound speed. The correlation dependence between ultrasound speed and strength is given.

12. T. Kvačkaj, I. Pokorný; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*
Auto Body Sheets for a New Car Generation. This paper deals with the development of hot - and cold rolled sheets designed for automotive industry. The achieved properties of some grade sheets after simulation of technological processes in the laboratory conditions are compared to the common properties of individual sheet groups. The attention is paid to the processes of hot rolling with the accent to the ferritic rolling.

13. V. N. Bespalko, E. V. Zhilenkova; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Investigation of Influence of Temperature-deformations Rolling Parameters on the Structure and Technological Properties of High-chromium Boron Steel. Corrosions high-chromium boron steel application for production of containers to convey and keep waste fuels of cartridge nuclear power-station is presented. High-chromium boron steel answer requirements of special exploitation of articles. The influence of temperature-deformations parameters of rollings on structure formation, engineering ductility, impact strength of boron steel was investigated. The relation was established between structure making process of hot deformation and tendency to fracture of steel. The optimal parameters of deformations were defined.

14. E. Konstanciak, R. Budzik, W. Waszkielewicz; *Faculty of Materials Processing Technology and Applied Physics, Technical University of Częstochowa, Częstochowa, Poland*
The analysis and Control of Defectivities of Products made in the Heavy Plates Mill from the Aspect of Quality Management. Nowadays when the most important condition of the survival and development of company must satisfy the changing clients’ hopes, quality starts to be the important element of strategy of each firm which expects to achieve the success. At present, polish steel industry is in its stage of stagnation, so thus the improvement of the system of quality management in activity of metallurgical companies can be important element to make this situation better. However everybody has to remember: the elimination of defectivities and their sources just during manufacturing is very important step to get “high” quality products. In this article the analysis of defectivities of products at Heavy Plate Mill (one of the largest steel work in Poland form January, 1999 up to March 2000) was presented.

15. D. Constantinescu; *University Politehnica of Bucharest, Bucharest, Romania*
Thermal Stresses at Semi Finished Products Heating for Rolling. This paper gives analysis of thermal stresses in steel semi finished products heated in view of plastic deformation by rolling. This thermal stresses can highly influence the quality of the rolled products. When heating the metal two situations can occur. If the thermal stresses are under the flow limit of the steel the stresses disappear when the metal temperature became equal to the environment temperature. If the thermal stresses are over the flow limit of the steel, the remanent thermal stresses appear after regain of initial temperature. This remanent thermal stresses lead to metallic body deformation. If the thermal stress is about the flow limit then relation between stress and deformation has the shape of a hysteresis curve. Taking this aspects into consideration a theoretical and experimental study regarding the thermal stresses generation process and determining the critical values at which the metallic material cracks appears. The authors analyse the thermal stresses generation process using mathematical models and experimental data. The case of semi-final products with circular and rectangular sections are analyzed.

16. A. Kawalek, H. Dyja; *Faculty of Materials Processing Technology and Applied Physics, Technical University of Częstochowa, Poland*
Asymmetric Hot Rolling of Thin Plates in Continuous Rolling Mill. In this work, the analysis of asymmetric hot rolling process of band in two last stands of finishing group of plate rolling mill is presented. The analysis is used to obtain the range of admissible values of asymmetry coefficient for asymmetrical rotation speed of the rolls for adequate grade of steel and to guarantee the admissible flexure of the band on output from deformation zone and diminishing of the force pressure of the metal on rolls without overload to the drives of finishing group of plate rolling mill. A theoretical analysis of rolling process has been performed using Elroll and Forge2D software for band with final thickness: h_1 = 2.00 mm and h_1 = 6.00 mm. The range of rolling reduction used in the article is ε = 0.1 - 0.4 for stand Fl0. The coefficient of asymmetrical rotation speed of the rolls is varied between a_v = 0.95 and a_v =1.05. A verification and implementation of theoretical research of this process have been done in hot plate rolling mill of one of industrial plant.

17. R. Robič, R. Turk, P. Fajfar; *SŽ Acroni Jesenice d.o.o. Jesenice, Slovenia, Faculty of Natural Sciences and Engineering, University of Ljubljana, Ljubljana, Slovenia*
Stability of the Technology of Hot Rolling the Strips on the Steckel Rolling Stand as Consequence of High-Tech Process Control. Hot rolling mill in the company Acroni d.o.o. was modernized in 1996, and its start was in 1997. From the start of the rolling mill, this was the first greater intervention into the equipment of the hot rolling mill. Modernization consisted of mechanical change of the Steckel rolling stand by building-in hydraulic adjusting devices, system for bending working rolls, system for axial shift of working rolls, a very intensive cooling system for working rolls, and equipment for fast removing the working rolls. The old relay on logic of control of total process was substituted by modern many-level logic which consists of modern digital regulators of drive. In the years after the start of the modernized hot rolling mill, the experts of the Acroni Company in cooperation with external institutions have improved a great deal the regulation algorithms for the process control on the first level of control, algorithms for schedule of rolling, and algorithms for the stage of “self-learning” of mathematical models. Own technological knowledge was introduced that enabled the increase of capacity, but first of all also an improved quality of the hot rolling process.

18. V. B. Vesselovskiy, I. Mamuzić*, E. A. Scherbina; *Dnepropetrovsk National University, Dnepropetrovsk, Ukraine, *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*

Mathematical Modelling and Calculation of a Thermal Condition of Rolls of Hot-rolled Steel. The mathematical model and algorithm of calculation of a heat-stressed condition of rolls of hot-rolled steel under generalized conditions of heat interaction with environment are submitted. The model is constructed pursuant to the solution of problem Lyame’s about pressure in a tube under operating of interna1 and external pressure and solution of a problem of calculation of a temperature field of the compound barrel with an imperfect thermal contact. The solution of a problem is realised by a method of finite differences. The calculation indicates to the solution of a system of algebraic equations with a scalar matrix and usage of a sweep method. The matching of the obtained outcomes with experimental data known from the literature, demonstrates the satisfactory coordination.

19. A. M. Dolzhansky, V. S. Kovalev, O. A. Dolzhansky; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Research of Steel Wire Drawing Coefficient of Friction. The method of the coefficient of friction defined at wire drawing through the sectional die was improved. The instability influence of method main shortcomings are minimized. The information of weak friction parameters dependence on metal strength properties in the deformation zone was obtained. The parameters that determine friction dependence on deformation zone geometry, friction regime index and technological lubricant kind were fixed at steel wire drawing. The deformation zone form-factor notion was introduced and its connection with friction indices defined. The proportional band presence between friction stress and contact pressure average values was also determined. This results may be used in technology and equipment of wire-drawing calculation.

20. A. M. Dolzansky, I. N. Lomov; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

New Technology of Dry Low-carbon Steel Wire drawing. The examinations of different lubrication care-film components and dry lubricating matters at wiredrawing preformed after mechanical descaling are carried out. The definition of power requirements of wiredrawing with allowance for rational combinations of materials, that contain dry technological lubrication and requirements of their drawing is realized. The technology of dry wiredrawing low-carbon steel wire after mechanical descaling with continuous drawing dry lubrication care-film is designed. The technology has “know-how” principle. The rational spectrum of inventory hardware is defined. The working documentation to arrange industrial line is elaborated.

21. A. M. Dolzansky, G. V. Goloburda; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Increase of Dies Stability and the Path of Thermal Stresses Abatement at Wire Drawing. The known hypotheses of wear and abrasion mechanism as well as wear inf1uencing factors have been examined. It is shown, that the known calculating dependences of wire drawing instrument’s wear process do not consider joint influence of all factors. The uniform model of wear mechanism elaboration with reference to handling of metals by pressure, for wire drawing is now actual. The perspective way to solve this problem represents the registration of joint power and thermal loading influences while forming resulting stress. Earlier thermal stress was considered indirectly, because of complication of thermal field drag calculation during a wire drawing process. On a basis of known calculating dependences analysis and experimental data the formulas for thermal field definition and temperature stresses appearing in die while wire drawing process were deduced.

22. R. Kruzel; *Institute of Modeling and Automation of Plastic Forming Processes, Częstochova Technical University, Częstochowa, Poland*

Influence of Deformators Construction on Residual Stresses Value of High Carbon C-76 steel wires. In high carbon wire drawing process we are often in contact with metal p1asticity loss phenomenon as a result of strengthening during interaction of working stresses and residual stresses connected with defective internal structure or presence of artefacts coming from operations precedent to wire drawing. The subject of investigation is selected due to the importance of straightening operation in reference to final product. The influence of deformators construction on residual stresses values in high carbon wires are shown. Moreover, this work is an answer to question: which of used deformators is the most effective. Following strengtheners were used at investigations: 1. - two-planes seven-rolls, 2 - two-planes five-rolls, 3 - two-planes three-rolls, 4 - four-planes five-rolls (planes arrangement: horizontal-vertical-horizontal-vertical), 5 - four-planes five-rolls (planes arrangement: each 45°), 6 - three-planes five-rolls (planes arrangement: horizontal-vertical- horizonta1), 6 - three-planes five-rolls (planes arrangement: each 60°). 6 - two-planes five-rolls (planes arrangement: horizontal - vertical). Residual stresses investigations were made by application on the of stress-strain curve.

23. A. M. Dolzhanskiy, V. M. Druyan, M. Golja*; *State Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine, *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*

Technological Lubricants Research in Wire Drawing Process. Quantitative and qualitative influence on the lubricant formation on the principal drawing factors such as die and its construction, metal constrained yield stress, dividing of flow, roughness and speed, lubricant state of aggregation of matter, its humidity and part dimensions were investigated. Conformity of the experimental data to hydrodynamic model of dry soap lubricant entrapment was proven.

24. A. M. Dolzansky, D. U. Klyuev; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Features of Surface Microrelief Development at Steel Drawing. The basic formation tendencies of rod and wire microrelief with the account of anisotropy of their surfaces are determined at various modes of metal-drawing preparation, in particular, at use of roller discallers. The expediency of rotating die used for rod deformation after scale breaker is proved.

25. T. Kvačkaj, J. Zrník, V. Vrchovinský, *Z. Nový, **J. Krušinský; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia, *COMTECH-FTH, s. r. o. Plzeň, Czech Republic, **Metalurg, a. s. Dubnica nad Váhom, Slovakia*

Controlled Forging and Cooling for Crankshafts From Micro alloyed Steel. Medium carbon micro alloyed steel 3MnVS6 with vanadium addition was used for searching the effect of controlled forging (CF) and controlled cooling (CC) on mechanical and structural properties of crankshafts. Austenitization temperature was determined from the dependence AGS on reheating temperature on the level T_R = 1100 °C. Controlled forging was divided to two steps: deformation in spontaneous recrystallization region (T_{D1} = 1050 °C) and deformation in non-recrystallization region with some other final forging temperature (T_{D2} = 950 °C, 780 °C, 750 °C). Strategy of controlled cooling of forgings had following regimes: quenching to water or oil, free air cooling, cooling by air jet and isothermal holding on temperature with free air cooling. After optimization of CF + CC regimes were obtained following mechanical properties: $R_{p0.2}$ = 648 MPa, R_m = 944 MPa, A5 = 16.2 %, Z = 52 %, KCU 3 = 59.6 J·cm^{-2}, with complex phase structure: ferrite + perlite+ bainite, without using the heat treatment of crankshaft.

26. G. Banaszek, H. Dyja. S. Berski; *Faculty of Materials Processing Technology and Applied Physics, Technical University of Częstochowa, Częstochowa, Poland*

Choosing the Forging Parameters and Tool Shape from the Point of View of Improvement the Quality of Forging. The article discusses the effect of symmetrical and asymmetrical forging processes on the homogenization of the values of loca1 deformations within the entire cross-section

of forging. Theoretical studies have been performed for the triaxial deformation state, the results of which have been verified in laboratory conditions. From the tests, the values of the main technological parameters of forging have been determined and an appropriate group of tools have been proposed to be used for the anvil forging.

27. M. N. Basna, N. M. Basna, G. O. Podoprigora, Yu. A. Dinnik; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Production Process of Shrouded Large-sized Arbors - Pinions of Heightened Hardness and Longevities. The developed production process of shrouded large-sized arbors - pinions of heightened hardness and longevities is done by applying the forging schema of serrated bandages of billet containing 4 following: - forging of the cylindrical block with separation of a bottom and shrinkage part of an ingot with minimum degree of forming 2; - settling of billet and weaving of an opening with degree of forming 1.5; - stretching in the size lengthwise on a water-cooled mandrel expander with degree of forming 1.5; - expansion on a mandrel with degree of forming 1.3. The mechanical properties improving the forging are achieved at the expense of heightened degree of forming of metal and change of the shape of a grain elongated along a spherical surface generatrix barrel.

28. D. Tkalčić; *Stelworks Sisak, Sisak, Croatia*
Expanding of Production Programme for Automatic Hammer ŽS - 25 at Steelworks Sisak. The problem of forging the tube ends above 75 mm could be solved either by purchasing a new hammer ŽS - 25 or by reconstruction the existing one. The assortment of the tubes that should be forged above maximum part size (75 mm) is of thin-wall one (the ratio wall thickness diameter is 1:16). By use of clover-like point-tool the diameter may be reduced for 43%. As for technical characteristics of this-type engine tool, maximum robe diameter of the tubes to be forged is 100 mm. Trial tool is manufactured according to original documentation and proved to be extraordinarily applicable (test forging performed). However, other subsidiary devices (entering bench, control panel) are needed, because the old ones are sized according to the previous production programme.

29. G. Kugler, R. Turk, M. Knap; *Faculty of Natural Sciences and Engineering, University of Ljubljana, Ljubljana, Slovenia*
Transfer of Informations at the Control of 30 MN Forge Press. Open-die hot forging is the technology where physico-metallurgical state and shape of work piece constantly change during the technological process. Variations of states occur also due to allowed batch tolerances between starting ingots. Planning of such technology is unique not only for each shape of product but also for each manufactured forging of the same shape particularly. Reliable information's on state of ingoing material, workability in the range of temperature and mechanical loads in the planned technology are needed for automatic control of press, proper to clearly defined demands of buyer. Automatic forging process includes model studies of technology of each particular product by HFS simulator, optimization of forging parameters with instructions for control, control of performing the technology, and analysis. In such a process, an intensive exchange of informations takes place between the technology and the process computer that must be in each step well checked before further intended use. Presentation is aided with industrial experiences.

30. R. Turk, M. Knap; *Faculty of Natural Sciences and Engineering, University of Ljubljana, Ljubljana, Slovenia*
Experiences with Automatic Control of Forge Press. Application of HFS (Hot Forging Simulator) assures a high-quality reproduction technology of open-die hot forging on the 30 MN forge press. At present, all the operation s of forging the ingots to a maximal weight of 25 tons, which is still justified in regard to the quality, are computer controlled and simultaneously supervised. After verification of forging technology with model using local analysis of material flow, the technologist forwards the schedule of forging into operation. The program takes into account specific particularities of worked material and foreseen development of forging's properties based on previous obtained expert's knowledge, and it takes in account the previous successfully performed technologies for similar cases. Thermal model which indicates temperature state of forging during industrial forging process excellently supports the decisions on the number of forging steps as a consequence of possible time instabilities of the forging rhythm. Results indicate essential reduction of number of unsuccessful forgings or misforgings, respectively. Thus economic yield of forge shop is increased.

31. M. Knap, R. Turk; *Faculty of Natural Sciences and Engineering, University of Ljubljana, Ljubljana, Slovenia*
Introduction of V-Tool in Open-die Forging of Plastically Sensitive Steels. Workability of steels with limited plasticity at higher temperatures prolongs period of forging due to lower intensity of deformations that demands usually reheating or even frequent additional heating of forgings in the furnace. This has influence on the forgability, yield, and production costs (higher energy consumption and lower production capacities). Therefore V-shaped tool is applied in open-die forging process which effects the working, making hydrostatic stress state in which material can accept higher deformations without appearance of pull cracks. Directly applicable technological instructions for such a technology cannot be found in literature, therefore the forging process must be optimized by local and micro analyses of material flows. A case of forging a tool steel with law workability is presented.

32. M. Knap, R. Turk; *Faculty of Natural Science and Engineering, University of Ljubljana, Ljubljana,Slovenia*
Modelling of Spread in Hot Open-die Forging Process. Exact knowledge of spread in the hot open-die forging process is essential part of the automation of forging process. Spread can be obtained from industrial measurements only indirectly. That is why modeling, physical and numerical, is needed. Physical simulations were carried out on the Gleeble 1500 machine, a simulator of thermomechanical states, which enabled good control of, for spread, important parameters. Theory of similarity allowed geometry to change. Forging conditions and loads during the hot open-die forging were predicted on basis of physical simulations. Changes in geometry after the deformation were measured with an accuracy of 0.005 mm. Such an approach enabled to observe spread on whole workpiece cross-section and not only on the extreme points which was extremely important for verification of numerical model. Addition to physical simulation was represented by numerical modeling with FEM. Those results enabled local analysis of material flow during actual forging process and physical modeling. Importance of this method was also that it efficiently combines three elements: actual/true deformation processes, model/physical simulations and theoretical model.

33. M. Jurković; *Faculty of Engineering, University of Rijeka, Rijeka, Croatia*
Stochastic Modelling of Forming Process of Thin Walled Profiles from a Metal Strip. Processes modelling have a great importance in the wide range of technical sciences, technologies and manufacturing. Because of that, it tends to mathematical modelling of technical and technological problems increasingly, in order to establish the quantitative relationship between input variables X_i, and output effects of machining process $Y_i = f(X_i)$. The application of the thin-walled profiles of complex geometrical form is increased in the engineering industry, shipbuilding, automobile industry and processing one. The forming of thin-walled profiles is based on gradual material forming in the form of strip by passing it between a series of rotating rolls. The form modelling force has been performed for the three variables of process: profile forming angle, material thickness and yield strength of material. The obtained mathematical model describe well the force of forming process and tool loading.

34. M. Jurković, Z. Jurković; *Faculty of Engineering, University of Rijeka, Rijeka, Croatia*
Theoretical and Experimental Analysis of the Plastic Flow of Metal in Cold Rolling and Drawing Processes. In this paper the results of plastic flow metal modelling for three forming processes (cold rolling, roll drawing and matrix drawing) and original method to obtain the mathematical

model are given. Also, it gives a hypothesis for solution of metal plastic flow problems in cold rolling and drawing process of narrow strip presenting with two new plastic flow indicators i. e. geometrical K_{bg} and factorial K_{bf} one. The basic condition is that these two indicators are identical ($K_{bg} = K_{bg}$), and that enables an original plastic flow equation to be defined. By use of experimentaly obtained results and computer application this hypothesis bas been verified as well as the mathematical model of plastic flow. The results obtained indicate that the plastic flow of metals in a great extent depend on the state of stress in the deformation zone.

35. Z. Jurković, A. Hriešik; *Faculty of Engineering, University of Rijeka, Rijeka, Croatia*
The Influence of Geometrical Form of the Tool Working Zone on Loading Force by Plastic Forming Processes. The force of tool loading depends on the constructional parameters of tool working zone geometry (g), technological parameters of machining process (t), tribological parameters (μ), state of work piece material (m) and size of contact surface between tool and work piece (p), i. e.: F = F(g, t, μ, m, p). The performed research shows that the method of modelling can be successfuly used to define the form of the working zone of the tools of the forming process (stamping, deep drawing, extrusion, rolling, forging, etc.). This paper presents theoretical and experimental research on the dependence of the minimization of tools load on the configuration of the tool working zone and the contact quality.

36. G. G. Shlomchak, T. I. Firsova; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Criteria of Rheological Similarity of the Plastometric Curves Families. Based on analysis of the many parametric families of plastometric curves a graphic method has been developed to determine criteria of rheological similarity. This method allows characteristic graphic features of the rheologic curves families to construct criteria of rheological similarity for metals of any rheological group in the known ranges of change for degrees and rates of deformation.

37. G. G. Shlomchak; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Basis of Rheological Concept for Construction of New Technologies in Metal Forming. A number of formerly unknown phenomena have been revealed by the way of investigation by the methods of physical simulation for development of metal deformation with a complex rheology as a result of studying these phenomena an a new conceptual base for development of energy sawing technologies in the field of metal forming.

38. G. G. Shlomchak, N. A. Mironenko; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Deformation Anisotropy of Complex Rheological Metals Softening. By studying mechanisms of plastic change of form of rheological complex metals it was established that in measure of the softening development metal flows predominantly in direction of the main greater deformation.

39. F. Kovac, M. Dzubinsky; *Institute of Materials Research of SAS, Košice, Slovakia*
Prediction of Deformation Resistance of Low Carbon Steels During Hot Rolling. Deformation behavior of law carbon steels under hot rolling service conditions is predicted utilizing a combination of isothermic single step deformation test, anisothermic interrupted tests as well as hot rolling simulation tests using a torsion plastometer. The stress $\sigma_{0.05}$ at strain $\varphi = 0.05$ and the strengthening factor f_{str} are proposed to be used for the description strengthening/restoring process during repeated deformation.

40. M. Dzubinsky, F. Kovac, A. Petercakova; *Institute of Materials Research SAS, Košice, Slovakia*
Simulation of Forming Processes by Torsion Tests. A new form of equation for the prediction of steel deformation resistance under industrial hot rolling conditions is proposed. This new expression can be used for more accurate description of material deformation behavior at service conditions utilizing data from laboratory plastometer experiment.

41. E. Ch. Frank; *Faculty for Technologies, University of Pretoria, South Africa*
The Research in Plastic metal and Alloys Forming. The research nowadays is based on simulation testing methods. That is the combinations of research systems: Physical modeling, Physical simulation, Material process application and Computer aided simulation. Very important is analysis of multilevel simulation for determination of local parameters formation and metallurgical processes during forming of metallic articles.

42. T. Kvačkaj, M. Petro*, V. Zvarík*, J. Veselková*, V. Vrchovinský; *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia, *ŽP - Podbrezová, a. s. Podbrezová, Slovakia*
Steel Workability Assessment by Workability Limit Diagram. Workability of two steel grade (soft steel: 0.09 %, 0.4 % Mn, and hard steel: 0.18 % C, 1.2 % Mn) was studied. Effect of deformation temperature on mechanical properties and material flow were measured. Two axis deformation state was evaluated in different position. Material workability consideration was made by workability limit diagram of bulk deformation for two steel grade. Steel with lower content of C and Mn pessess a better plastic properties than the one with higher alloyed portion.

43. P. Fajfar, R. Turk; *Faculty of Natural Sciences and Engineering, University of Ljubljana, Ljubljana, Slovenia*
Assessment of Instability of Thermomechanical States in the Rolling during Hot Rolling of Strips on Steckel Rolling Stand. Modern on-line control of TVT technology has purpose to achieve homogeneous geometrical and materials properties of a rolling. Steckel technology is reversing technology, thus it possesses and causes nonhomogeneous thermomechanical working state s in the rolling interior, and consequently nonhomogeneous properties of rolling in longitudinal and lateral directions. Search for optimal schedule of rolling and control regime of machine demands a good model of the rolling process indicating local thermomechanical states, known influences on yield stress, and consequent development of microstructure. Paper presents method of following local thermomechanical states, and correlation assuring high-grade homogeneity of rolled strips.

44. R. Turk; *Faculty of Natural Sciences and Engineering, University of Ljubljana, Ljubljana, Slovenia*
Reliability of Yield Curves Based on Chosen Number of Tensile and Compression Tests. Limitation for compression tests is the friction on contact with compression tool which causes deviation from uniaxial stress state, and demands additional energy to overcome the friction. Limitation of tensile tests is the phenomenon of nonhomogeneous contraction, i. e. appearance of nonhomogeneous triaxial stress state. Results of those tests are the most frequently used techniques to determine yield curves for uniaxial stress states and to study development of microstructure during and after the plastic deformation. Thus every deviation from nonhomogeneous state of the test piece or the way of its mechanical loading limits the useful value of tests and consequently the reliability of obtained information's. Paper resents the analysis of nonhomogeneous testing procedures via differences of yield stresses. Algorithm which estimates those differences in sense of the definition of natural yield stress of metallic material is also given.

45. R. Turk, C. Nzobandora; *Faculty of Natural Sciences and Engineering, University of Ljubljana, Ljubljana, Slovenia*
Reliability of Yield Curves at High Deformation Rates between 10 and 50 s^{-1} . Majority of deformation processes is markedly nonhomogeneous which is also valid for the deformation rate. It influences local values of yield stress or yield stress curves, respectively. Deformation rate can in the

deformation zone of steady cross section, e. g. in extrusion, attain local values between 0.1 and 50 s^{-1}, therefore the workabilities in these states are studied with laboratory tests. Making tests at constant deformation rate can be mastered up to the rate of about 10 s^{-1}. At higher rates, even with computer control and a great skill, the deformation rate can be mastered only with a great effort. Paper will present algorithm of rate control of machine and the evaluation of test results by neuron networks for this critical range of deformation rates.

46. M. Golja; *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*
Steel Flow Stress and Plasticity at Elevated Temperatures of Carbon and Alloyed Structural Steels. This paper deals with the stress by steel flow and plasticity of steel at elevated temperatures. The results obtained by hot torsion test in the temperature range from 1073 K to 1473 K as well as by tensile test on carbon and alloyed structural steels for special application are presented.

47. B. Arzenšek, F. Tehovnik, D. Kmetič; *Institute of Metals and Technology, Ljubljana, Slovenija*
Stress - Strain Curves of Steels Established by Tensile and Compression Test. Successfulness of a technological process at making of metal products is dependent on deformation ability of the formed material, which is represented by deformation strength (stress-strain curves). The deformation strengths are established by compression or tensile test. The deformation strengths at compression test are established to high deformations. Weak side of mentioned work is heavily valuated friction work which must be considered at calculation of stress-strain curve made by compression test. At tensile test, where the friction work is zero, the deformation strengths are generally calculated only to low deformations. $\varepsilon = 10$ to 20 %. At both methods the deformation strengths are calculated by consideration of constant volume of material during the deformation process. The aim of this work was to develop the method of evaluation the deformation strengths by tensile test also at greater deformations because the tensile test is more convenient for ascertainment of deformation capabilities of materials. The method is based on consideration of constant volume and constant change of specimen cross-section in the part of reduction area. In the work comparison with compression stress-strain curve was made also. All the experiments were made on the same type of Ck 15 steel.

48. G. Kugler, R. Turk, T. Smole, M. Knap; *Faculty of Natural Sciences and Engineering, University of Ljubljana, Ljubljana, Slovenia*
Activation Energy for Maintenance of Plastic State - Part 1 (Selection of Experiments and Influence of Experimental Data Base). Thermally activated processes include lateral sliding which appears also at lower temperatures next to processes based on diffusion, such as e. g. splitting of edge dislocations, motions of dislocation jogs of screw dislocations, and recrystallisation. Activation of these processes has considerable influence on yield stress and limiting plasticity of material. Activation energy of plastic state, Q, is determined by carefully controlled temperature and mechanically controlled tests which should be as close as possible to uniaxial stress state. Paper presents experiences with selection of a suitable type of test (tensile, compression, torsional) and the method of evaluation of activation energy. Results are based on own experiments and application of improved version of software for calculation of Q. A case of selected Al alloy is applied as illustration.

49. L. Angelescu; *University Politehnica of Bucharest, Bucharest, Romania*
The Deformation Mechanism of Super-plasticity in a Commercial Alloy. Under certain process conditions some commercia1 alloys can be superplastically deformed without need of prior theromechanical treatments. This issue has been studied in the case of a A-204 duralumin alloy. Microstroctural investigations have been carried out by optic and electronic microscopy and X-ray diffractometry. The results showed that the deformation mechanism mainly consists of intragranular slip, in distinction from the classic mechanism of superplasticity, which is of intergranular slip.

50. A. A. Milenin, A. N. Golovko, I. Mamuzić*; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine, *Faculty of Metallurgy, University of Zagreb, Croatia*
The Application of Three-Dimensional Computer Simulation at Dies Developing for Extrusion of Aluminium Shapes. The automated system of three-dimensional computer simulation with use of FEM is developed. The model is based on the Euler approach. The function of Markov variation principle is used for derivation. The connected task of thermo-viscous plasticity is solved. The flat die is designed for extrusion of the thin-walled shape from a soft aluminium 6060 alloy.

51. P. Cvahte, P. Fajfar*, R. Turk*, M. Knap*, G. Kugler*; *IMPOL d.o.o. Slovenska Bistrica, Slovenia, *Faculty of Natural Science and Engineering, University of Ljubljana, Ljubljana, Slovenia*
Process Parameters of Extrusion Based on Numerical Simulation and Plant Measurements. Correctly selected process parameters of extrusion are decisive for high-grade extruded products because they essentially influence microstructure and mechanical properties of the product. They have as well also important role in optimal loading of the press. Optimal setting of the process parameters demands a lot of time, and simultaneously such operation in industrial conditions is expensive and time consuming. Development of numerical methods opens a region which enables optimization of process parameters in a cheap and fast way, but such optimization demands to know very accurate boundary conditions (tool temperature during extrusion, recipient temperature, material properties of extruded piece, and loading of press) which can be obtained by measurements of technological parameters and experimental determination of material properties. A case of extrusion of Al alloy of low workability is presented.

52. Ž. Lozina, F. Vlak; *Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split, Split, Croatia*
Optimisation of Aluminium Extrusion Process Parameters by Means of Evolution and Biology Based Approach. In this paper new approach for optimization of aluminum extrusion process parameters is proposed. This new approach is based on Artificial Neural Network (ANN) and Genetic Algorithm (GA). The artificial neural network (ANN) is trained on the extrusion experiment data to be able to describe complex dependencies between influence parameters and outgoing significant values. The influence parameters are treated as environmental conditions and combined with ANN, forward pass being the fitness function. Optimization is performed on extrusion of thick walled AlZnMg (7000) hollow sections. Optimization variables are billet temperature, extrusion rate and Zr content. The outputs are extrusion force, tensile strength and bending strength of the longitudinal welds. The results of investigation can be useful for industrial practice.

53. M. Terčelj, R. Turk, P. Cvahte*; *Faculty of Natural Science and Engineering, University of Ljubljana, Slovenia, *IMPOL d. o. o., Slovenska Bistrica, Slovenia*
Characterization of the Laboratory Tool Wear in Hot Extrusion of Aluminium. Laboratory testing of wear of the extrusion tools is much cheaper than direct determination of wear on true tools during the industrial operation. Its efficiency is expressed mainly as the control of influential parameters of the tribologic system, the way of mechanical loading, and the reduction of time needed for the estimation of tool life. In order to bring our testing conditions near to true physical characteristics of the hot extrusion process and to intensify the process of wear analysis, a test named ¨block on disc¨ was developed and applied to simulate true tribologic system during the hot extrusion of aluminium. The tool was nitrided and tested

in the new developed equipment at different testing conditions. Wear volume depended on the aluminium temperature and normal force was found. Time needed to reach sufficiently high wear volume was relatively short in comparison to other wear tests.

54. M. Terčelj, R. Turk; *Faculty of Natural Sciences and Engineering, University of Ljubljana, Ljubljana, Slovenia*
Study of Wear of High Wear Resistant Coated Tool for Extrusion. Extrusion is an industrially important method for manufacturing aluminum sections like rods, tubes, and wires. A block of aluminum (billet) is placed into container and forced to pass through the precisely made die opening. Wear of the die opening has important technological and economic significance since it determines shape, size, and surface finish of the extruded section and can make them less acceptable. In order to reduce the wear, PVD protective coatings were applied. Such coatings significantly reduced sticking of aluminum, adhesive wear and thermal fatigue wear. Extrusion dies coated with CrN deposited by PVD method were tested in industrial and experimental conditions. In order to bring our testing conditions closer to true physical conditions of the hot extrusion process and to intensify the wear analysis, a test called "block on disc test" was developed and applied to simulate a true tribologic system during the hot extrusion of aluminum. It was found that protection of extrusion dies with CrN coatings deposited by PVD method offers the following benefits: a) improved die life; b) improved die capacity at aluminum extrusion; c) reduced die correction time; d) shorter cycle times; e) no after-process correction; and f) reduced operating costs.

55. M. Plančak, M. Math*; *Faculty of Technical Science, University of Novi Sad, Novi Sad, Srbija i Crna Gora, *Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Zagreb, Croatia*
A Study of Radial Gear Extrusion. Gears and gear-like elements are manufactured predominantly by some of cutting technologies, but recent trends go towards application of metal forming operations. For smaller gears cold bulk metal forming operations are used (net shape or near net shape forming) and for the larger gears, hot rolling or hot forging technologies are applied. Application of metal forming technologies in gear and gear-like manufacturing offers technical and economical advantages when compared with cutting technologies. Various cold bulk metal forming techniques can be applied for gear manufacturing. In this paper theoretical analysis of radial extrusion of gears is given. Furthermore, experimental verification of the obtained theoretical results has been carried out. Two various methods of analyze is given, both used today in actual researches: upper bound method as an analytical one and finite element method as a numerical one.

56. L. N. Deineko, I. Yu. Krepak, E. I. Linrinenko, M. Yu. Arnbrazhey; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine, Productive Incorporation Yuzhny Machine-Building Plant (PIYMBP)*
Effective Technology of Heat Treatment Strengthening of Bulky Hot-Deformation Tool by nontraditional Solutions. Elaborated technological parameters of heat treatment strengthening, water-based hardening mediums and construction of cooling system allow to get service durability of hot-deformation tool (punches, pressing insertion pieces, etc) from half-heat-resistant grades of steel. Due to intensification of cooling hardening in high-temperature area the elaboration allows to raise martensite harden ability and to realize broken and dipping hardening or selective immersion method. Depending on the way of punch tool production the different nontraditional heat treatments are possible. This heat treatments allows to raise the dislocation density and reconfigurate it into polygonized or cellular substructure of metal of the tool working part during the followed tempering. It allows to increase its' heat resistance and durability, at 1.5 - 3 x in comparison with traditional heat treatments. The cooling system that uses water-based hardening mediums instead of quenching oil is elaborated. Ecologically clean cooling medium can be used at temperature below 110 °C.

57. V. I. Spivakov, E. A. Orlov; *Institute of Black Metallurgy by name of Z. I. Nekrasova, Dnepropetrovsk, Ukraine*
Improvement of Installation and Practice of Heat Treatment of Plates. In this paper technical means on thermo mechanical treatment technology and facilities for cooling of plates after rooling is described. In case of direct hardening and tempering of plates the cooling system have an maximum hight heat transfer coefficient ($\alpha \geq 2.0$ kW/m^2 ·K) in roller quenching machine under specific water consumption (SWC) up to 150 m^3/m^2/h. During of single heat treatment (without furnace tempering) interrupted cooling coefficient and SWC should be sufficiently less than 1.0 kW/m^2 ·K and 40 - 60 m^3/m^2/h respectively. Due to a "water wall" cooling installation with computerized operating system, located on the 3600 plate mill, it is possible now to achieve required mechanical properties and flatness of plates for gas pipelines, shipbuilding's, etc.

58. Y. V. Zilberg, S. G. Bratutin; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Influence of the Cold Deformation Type on Low-Carbon Steel Durability. The research of low-carbon steels hardening show, that at monotonous processes (rolling, flexing, stretching, extending of wire) it depends on type of deformation and metal initial conditions. The value of a limit of fluidity annealed in an initial condition of steel, determined on a stretching curves, appear in a number of cases. For metal after hot deformation (without heat treatment) the intensity of hardening is a little bit lower, than at annealed samples. The unmonotonous deformation to the opposite sides bending reduces length of a platfonn of fluidity, down to its disappearance, but does not influence size of a limit of fluidity.

59. L. N. Deineko, E. I. Litvinenko, I. Yu. Krepak; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine, Productive Incorporation Yuzhny Machine-Building Plant (PI YMBP), Ukraine*
Increase of Complex of Operation Properties of High-Speed Steels used for Cold-Deformation Tools. The steels P6M5 and P0M5CT (without tungsten) with its chemical compound and technological properties correspond to the aims of required structural state. In this work influence of the different parameters of heating in the vacuum furnaces and cooling in the processes of hardening and tempering on the structural and phase state of steels P6M5 and P0M5CT and on their mechanical and technological properties is studied. In the result of the experimental schedules of heat treatment of the punches the microstructure consists of small tempered martensite, small-dispersed even distributed carbides, without carbide network. The effective condition of heat treatment, provides rise of operation stability of the tools for 2 - 3 x in comparison with technology usually adopted at the plants. Proposed technology may be best realized by vacuum furnaces.

60. D. Rydz, H. Dyja, S. Berski; *Faculty of Materials Processing Technology and Applied Physics, Technical University of Częstochowa, Częstochowa, Poland*
The Prediction of Curvature of Bimetallic Plate Al-Cu during Asymmetrical Cold Rolling. In the paper, a problem solution of rolling Al-Cu plates by the numerical way is presented. In the development of new technologies in rolling of bimetallic plates there are many problems both with ensuring a uniform strain distribution and producing a straight band as well. Within research the numerical simulation was made at the Forge 2 program based on finite element method. The cold rolling process was carried out at the temperature of 20 °C for 10 %, 20 % and 25 % relative rolling reduction. The curvature of bimetallic plate was numerically controlled by changing the speed of one roll. In this article the numerical analysis of asymmetrical rolling processes of plate composed with two metal layers: Al and Cu has been done. The influence of rotational speed ratio and value deformation on change of curvature of bimetallic plate is determined.

61. S. V. Dobatkin, P. D. Odessky*, N. A. Krasilnikov, G. I. Raab**, V. N. Konenkova;** *Moscow State Steel and Alloys Institute, Technological University, Moscow, Russia, *Institute of Building Constructions, Moscow, Russia; **Ufa State Aviation Technical University, Ufa, Russia*

Cold and Warm Severe Plastic Deformation of Low-Carbon Steels. The present work was aimed to study the formation of nanocrystalline (d < 100 nm) and submicrocrystalline 100 nm < d < 1000 nm) structure in low carbon steels during cold and warm severe plastic deformation by torsion under high pressure and equal channel angular (ECA) pressing. The materials studied were 0.10 % C-Mn-V-Ti, 0.20 % C-Mn-Si-V and 0.25 % C-Mn-Si steels. Specimens of 10 mm in diameter and 1 mm in thickness were deformed by torsion under pressure of 6 GPa up to true strain of 5.9 at room temperature, 250 °C and 500 °C. ECA pressing of specimens with 20 mm in diameter and 100 mm in length was performed in 2 and 4 passes up to true strain of 2.1 at 550 °C using 90° cross channel angle.

62. S. V. Dobatkin, V. V. Zakharov*, T. D. Rostova*, N. A. Krasilnikov, E. N. Bastarache;** *Moscow State Steel and Alloys Institute, Technological University, Moscow, Russia, *All-Russia Institute of Light Alloys, Moscow, Russia, **Ufa State Aviation Technical University, Ufa, Russia*
Nanostructures in Al-Mg-Sc-Zr Alloys after severe Plastic Deformation. Ultrafine-grained (UFG) materials call for special interest because of their unusual properties. The increased interest to UFG Al-Mg-Sc-Zr alloys is caused by an opportunity of realization of high-speed and low-temperature super plasticity in them and a prospect of use these alloys in the aerospace industry. In the presented work the possibility of nanocrystalline structure obtaining in Al-Mg-Sc-Zr alloy with different content of Sc during severe plastic deformation is investigated. Plastic deformation was carried out by torsion under 6 GPa pressure using samples of 10 mm in diameter and 1 mm in thickness at temperatures 20, 200 and 400 °C. Samples were deformed by torsion in 1, 3, 5, 7 and 10 turns, that corresponded to the true strain ε = 4.1- 5.3 in the middle of the sample radius.

63. Yu. R. Kolobov, M. B.lvanov; *Institute of Strength Physics and Materials Science, Tomsk, Russia*
Grain Boundary Diffusion and Plasticity of Polycrystaline and Nanostructured Materials. The main role of the diffusion-controlled processes at the grain boundaries on the development of plastic deformation during high temperature creep and super plasticity is discussed. It was found that the activation of grain boundaries by the action of impurity grain boundary diffusion fluxes from environment leads to the acceleration of grain boundary sliding and rea1ization of short-time super plastic state in coarse-grained polycrystals. New experimental data on the investigation of the physical nature of high-rate and/or low-temperature superplasticity of nanostructured Al-Mg-Li allows are presented in the article.

64. H. Dyja, S. Mróz, L. Lesik, Z. Stradomski; *Faculty of Materials Processing Technology and Applied Physics, Technical University of Częstochowa, Częstochowa Poland*
Properties of Joint in the Bimetallic Rods Cu-Al and Cu-Steel after Explosive Cladding and the Process of Rolling. In the paper the micro hardness, the microstructure and the band strength of interface of bimetallic joint on the cross sections of the test bar have been investigated. For the experimental analysis, a bimetallic bar was manufactured using an explosive technique method and the process of rolling. For tests, 22 sets of specimens were prepared, each consisting of copper tubes (grade MI-E), rolled steel rods (grade St3S), drawn rods (grade 55) and aluminium rods (grade PA6). The copper tubes and the steel and aluminium rods had different diameters, owing to which different distances between the rods and the internal tube walls were obtained. The results of the research show a significant deviation in microhardness distribution in the both layers near the joining border.

65. E. A. Makarova, S. B. Maryin; *Federal State Unitary Enterprise "Komsomolsk-on-Amur Aircraft Production Association" Komsomolsk on Amur, Russia*
Effective Method of Plastic Deformation of Billets Made of Titanium Alloys. One of the most important directions in modem scientific research in the field of metal pressure treatment is development of new highly-effective methods of deforming the titanium alloys with application of electric pulse impact (EPI). During pulse electric current (PEC) the structure defects (cracks, exfoliations, etc.), appear in the process of plastic deformation, the result of which is temperature gradient between heated defective zones and not heated or low heated non-defective ones, which, in its turn causes generation of significant thermo elastic compression tensions on defective areas. Compound impact of these tensions and forces generated between parallel currents circulating around defects leads to healing the structure defects under conditions of intensification the diffusion processes. Simultaneously, during current pulse feed there occurs recrystallization in all multiple defective zones.

66. V. I. Muravyov, V. I. Merkulov, S. Z. Lonchakov; *Federal State Unitary Enterprise "Komsomolsk-on-Amur Aircraft Production Association", Komsomolsk on Amur, Russia*
Intensification of Processes of Titanium Alloys Parts Forming. At present, thermal impact at plastic deformation billet - is one of the main methods during manufacturing the parts of hardly-deformed titanium alloys. Investigation of the most rational methods of heating titanium alloys for plastic deformation is an actual problem. Protection features of thick oxide film on the surface of titanium alloys provide not only high corrosion resistance but also prevent oxidation and gas saturation during heating the titanium billet up to some temperatures in the air, that is provided by high-speed induction or electro contact heating especially during forming the sheet billets. On the basis of the developed classification of methods of heating the titanium billets for stamping the technological process of electro contact heating and forming the double curvature skin made of VT20 alloy, which provides: - 95 % usage of energy of direct electro contact heating; - heating and forming in the air, using protection features of thick oxide film against oxidation and gas saturation; - forming in "pretransformation" temperature range which provides super plasticity; - getting the skin panel with dimensions of 2 000x600x1.5 mm with higher strength, plasticity and low-cycle fatigue indexes. Technological process of forming the titanium alloys lining is patented (patent RU No 20221058, B 21 D26/02).

67. B. Grizelj, I. M. Kenter*, M. Math;** *Faculty of Engineering, University of Osijek, Slavonski Brod, Croatia, *Hochschule Bremen, University of Applied Sciences, Bremen, Germany, **Faculty of Engineering and Naval Architecture, University of Zagreb, Zagreb, Croatia*
Werkstoff - und werkstückgeometriebeeinflussung des Laserstrahlbiegens. Seit den siebziger Jahren ist durch die Einführung des Laserstrahls in die Fertrigungstechnik eine ganze Reihe neuer Verfahren entstanden. Einige dieser Verfahren sind Schweißen, Drehen, Fräsen, Bohren und Umformen. Gemeinsames Merkmal der lasergestützten Formgebungsverfahren ist die digitale Speicherung der Werkstückgeometrie in einem NC-Programm anstelle der analogen Speicherung und sukzessive Abarbeitung dieses Programms, die zusätzlich Steuermöglichkeiten während des Prozessablaufs ermöglicht. Weiterhin ergibt die Vorgehen eine sehr hohe Flexibilität hinsichtlich der Werkstückgeometrie, die im Bereich des RapidPrototyping genutzt werden. In diesem Vortag wird Werkstoff - werkstückgeometriebeeinflussung des Laserstrahlbiegens analysiert. Einfluss sind Bleckdicke, Längen der Biegkante und Biegeschenkel.

68. R. Kruzel; *Institut of Modelling and Automation of Plastic Forming Processes, Technical University of Częstochwa, Częstochowa, Poland*
Conical Pipe Envelope Formation Process. Conical pipes belong to a group of profiles which find broad application in various metal products. In a conical pipe envelope formation process the lengthwise tensile stresses and circumferential and radial compressive stresses act on deformed material, and at the same time circumferential stresses prevail, in the strain area the stress condition causes diminishing of outer diameter, increase

of wall thickness and slight pipe elongation. Plastically strained pipe undergoes the unnecessary non-dilatational strains that are greater on the outer surface than on the. inner one. In the process a pipe is put in rotations, and its radial straining take place through four rolls symmetrically arranged in relation to the deformed pipe. Location of the rolls in relation to the pipe is determined by the conical surface of the fixing sleeve connected with the body by a thread, so when the sleeve is set in rotations, this causes its axial displacement, and simultaneously starts radial shifting of rolls, and through that motion makes it possible to receive a conical pipe.

69. M. Golja, B. Prpić*; *Faculty of Metallurgy, University of Zagreb,Sisak, Croatia, *Felis d.o.o., Sisak, Croatia*
The Plastic Deformation Technology of the Cr-Ni Stainless Steel Sheets to obtain Containers for Food Industry. This paper presents and the plastic deformation technology of the Cr-Ni stainless steel sheets to obtain containers for food industry. The mechanical properties of sheets and steel flow stress dependent on cold deformation are investigated and presented in mathematical form.

70. M. B. Lutskyy, I. K. Dorogko, V. A. Lutcenko, A. A. Chichkan, K. M. Kozlov; *Joint Stoks Company "Alchevsk Iron & Steel Works" and Donbass Mine - Metallurgical Institute, Alchevsk, Ukraine*
Development of New Method of Design of Profile for Supporting in Mines. The analysis of existing methods and schemes of rolling of profile for supporting in mines is conducted. The features of deformation of roll are considered at rolling in section grooves. The new method of design combining gauge reduction and a stretching of vertical elements of a profile is offered. On the basis of an offered method technology of rolling special interchangeable profile on JSC "Alchevsk Iron & Steel Works", and run-in, was developed.

71. M. Golja, D. Drobnjak, D. Jakšić*; *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia, *TLM Šibenik, Šibenik, Croatia*
Mechanical properties of aluminum foils for application in food processing industry and packing. A review on aluminum foils and application in the food processing industry and packing have been described in the article. In its experimental part samples of aluminum foils in the food processing industry and packing of different thickness of 12 μm to 130 μm, of different alloys 8011 and 8079 and of different world manufacturers have been collected. Mechanical properties, strength and elongation have been examined on all samples. The results obtained are discussed and directions for the further examination given.

72. A. Buhvald, A. Vrečič, S. Triglav, M. Čevnik, A. Lagoja*, J. Novak*, S. Ažman*, P. Fajfar, R. Turk**;** *SŽ Metal Ravne d.o.o. Ravne na Koroškem, Slovenia, *SŽ Acroni Jesenice d.o.o. Jesenice, Slovenia, **Faculty of Natural Science and Engineering, University of Ljubljana, Ljubljana, Slovenia*
Manufacturing Wide Fiat Products Made of Tool Steel. World market of tool steels shows in recent time interest for tool-steel plates, Thus also Metal Company decided to give such product on the market. Manufacturing, working, and heat treatment of those steels is a very demanding task. Products must be without internal defects, a good homogeneity and purity of steel are demanded, microstructure must be fine-grained, carbides should be uniformly distributed through the microstructure. Thus these products can be very effectively made by standard technology of forging, i. e. rough forging in forge press and further rolling in rolling stands for wide strips. Because such rolling stands are not available in the Metal Company, it is decided to manufacture this product in cooperation with the Acroni Company in Jesenice where such equipment and experiences in rolling wide plates exist. Main assortment of wide fiat tools uses the most widely used tool grades, i. e. OCR12VM (W. Nr. 1.2379), OCR12 (W. Nr. 1.2080), OH236, OA2 (W. Nr. 1.2363), UTOPMO1 (W. Nr. 1.2343), UTOPMO2 (W. Nr. 1.2344), MERILO (W. Nr. 1.2842) in OW4 (W. Nr. 1.2510), UTOPNEX (1.2311), UTOPN (1.2312).

73. Y. A. Darda, M. B. Lutskyy; *Research-and-Production Enterprise "ETALON" & Donbass Mine - Metallurgical Institute, Doneck, Ukraine*
Perfecting the Service Conditions of Armature of Small - Sort and Wire mils. One of the defining factors influencing the stable work of modern small - sort and wire mills: productivity and quality and the cost price of output production is performance reliability and resource of operation of a lead-in roller armature. The existing constructions of lead-in roller boxes of different construction, including application of rollers, manufactured of different powdered materials and a cermets, augment operation expenditures, not ensuring necessary highteching of a resource and reliability of armature operationare given. For elimination of the deficiencies specified, the essentially new construction of a lead-in roller box and its elements is developed and introduced into manufacture on a series small - sort and wire mills of Ukraine, Moldova and Byelorussia. The offered construction has series of distinctive features, which allow substantially to increase in due time reliability of operation of armature, to increase duration of rollers, to improve output production quality and to lower industrial expenditures.

74. I. Mamuzić; *Faculty of Metallurgy, University of Zagreb, Sisak, Croatia*
Technology of Plastic Forming Metals and Alloys. The paper gives the requirements on quality of metals and alloys at plastic deformation process, as well as some examples of achievements in the world today. The article deals with introduction of modern technologies, such as CSP, ISP, CPR, of steel sheet production. Similar development is observed in manufacturing other product by plastic deformation of metals and alloys.

75. V. Živković; *Steelworks Split, Split, Croatia*
The reconstruction of the Split Steelworks. Steelworks Split is now in the stage of reconstruction, modernization and supervision, the contractor and supervisor is VÖEST - ALPINA Industrieanlagen, Linz, Österreich: steel - making and steel rolling mill. The paper gives the results of this reconstruction and modernization. (The paper will be held as "Presentation of firm" in Plenary session)

76. A. Mujezinović; *BH Steel Željezara, Zenica, Bosnia and Herzegovina*
Strategy and concept of revitalization and development of the company "BH Stell Željezara" Zenica. The steel production in Bosnia and Herzegovina has a long tradition, and industrial production started in year 1892 with construction of the first facilities in Zenica. Željezara "Zenica" with installed facilities ut to 2 million tons of steel and main producer of the long rolled and forged products in the area of ex-Yugoslavia, stopped its continuous production in year 1992 because of the well-known war circumstances. By forming of a new company "BH Steel Željezara" d.o.o. Zenica with introduction of the complete metallurgical - power resources of Željezara "Zenica" and foreign capital with share 50% : 50%, the implementation of voluminous program of reconstruction, revitalization and modernization of the production facilities and technologies has started. By installation of the brand-new production plants: electric arts furnace (EAF-100 t), ladle furnace for secondary metallurgy (LF-100 t), 6-strand continuous caster for billets, along with existing rolling, forging and power facilities on which the significant reconstructions and modernizations are being carried out also, "BH Stell Željezara" is being shaped to modern producer of the steel, long rolled and forged products, that is suitable for the market surroundings. The start-up of existing production line, with coking battery, blast furnance and converters (BOF) is postponed till the acquirement of corresponding prerequisites. (The paper will be held as "Presentation of firm" in Plenary session)

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REVIEW OF THE PAPERS OF METALLURGY AND RELATED TOPICS - SECTION "D"

Besides a great number af papers in basic scientific disciplines of the metallurgical branch the registered papers are from other disciplines adjacent to metallurgy and wider, that points at the significance and scientific complexity of the problems in the branch of metallurgy. In the section "D" there are papers from disciplines the problems of which are observed in the branch of metallurgy and, in the widest context, can be counted out as follows:
- Mineral engineering (mining and mineral dressing), 10 papers;
- Mechanical engineering, 1 paper;
- Marketing (& genaral economy) of metallurgical and related enterprises, 8 papers;
- Computer application, 4 papers;
- Other contributions, 5 papers.

Consequently, 28 papers all together the first authors of which come from four contries: from Slavakia 24 papers, from Poland 1 paper, from Ukraina 2 papers and from Bosnia and Herzegovina 1 paper. Classifying them according to disciplines we get a review of practical problems, because we believe that the offered papers reflect the present state.

Mineral engineering (mining and mineral dressing)
In this part of the Section "D" different aspects of topics are given, in particular:
No. **1**: Verificatian of Time-dependent Constants in Numerical Models of Heat Flow in Massive Environment;
No. **2**: Mathematical and Computer Modelling of Heat Flow in Rock Environment with Fractures and Anisotropy;
No. **3**: The Modelling of Time Dependent Parameters of Exploitation in Open-pit Mine;
No. **4**: Mining of Mineral Sources for Metallurgy from Slovak Karst;
No. **5**: Appliaction of Acoustic Signal at the Identification of Rotary Drilling Process;
No. **6**: Rock Abrasivity - a Significant Cost Factor for Mechanical Tunnelling;
No. **7**: Determination of Disturbances and Quality of Rock Massive by Impulse Dynamic Methods;
No. **8**: Exploration of Metallic Mine - Supports;
No. **9**: Optimisation Methods of Disintegration of Rocks by Rotary Drilling;
No.**10**: Study of the Hyperstene-Augitic Andesite Natural Form from the Ruskov Area and Remelting in Atmospheric Conditions.

Mechanical engineering
In this part of the Section "D", only one paper contributes on:
No. **11**: Fluid Flow in Sliding Bearings - the Cause of Self-exciting Vibration.

Marketing of metallurgical and related enterprises
In this part of the Section "D" different subjects on the marketing and economy are given and in particular:
No. **12**: Influence of Inching of the Solar Collector for the Energetic Profit;
No. **13**: Analysis of Utilization of Wind Turbines Systems in Conditions Košice's Fold;
No. **14**: Influence of the Form of Box Groove an Technical - Economic Factors of its Work;
No. **15**: Marketing Research Abroad;
No. **16**: Economical Evaluation of the Ecological Behavior Level of the Organization Unit;
No. **17**: Aktualisierung der mittelfristigen makroökonomischen Absicht;
No. **18**: The System of Management Covers the Whole Administrative Activity of the Firm;
No. **19**: The Financial Position of the Mining Firm.

Computer application
In this part Section "D", different aspects of the computer science application at solution of technological problems are given, at particular:
No. **20**: The Use of Computer for Optimisation of Driving with TBM and in Engineering Geology Survey;
No. **21**: The Principles of Process Monitoring Using Internet;
No. **22**: Methodology of Stability Determination by Deformation Monitoring;
No. **23**: Public Relations at Internet Case Study of Metallurgical Line in Poland and in the World.

Other contributions
In this last part Section "D", the following contributions are presented:
No. **24**: Comparison "Energy Facade" and Standard Form of Building Insulation;
No. **25**: Effect of Geothermal Water on Well Completion at Locality Ďurkov;
No. **26**: The Contribution Towards the Fire-Safety a Highway Tunnel Branisko (SR);
No. **27**: Digital Model of Košice City;
No. **28**: Using Virtual Reality Modelling Language in Underground Space.

J. Črnko, Faculty of Metallurgy, University of Zagreb, Sisak, Croatia

"D" METALLURGY AND RELATED TOPICS SECTION

1. P. Rybár, Š. Kuzevič; *BERG Faculty, Technical University of Košice, Košice, Slovakia*
Verification of Time-dependent Constants in Numerical Models of Heat Flow in Massive Environment. Numerical modelling of heat flow is determined by speed of heat distribution, physical properties and fracturing of massive environment. Constants, used with numerical models are dependent of used mathematical apparatus. Experimental measurement of heat flow on physical models is a viable way of correction and verification of time-dependent constant used in numerical models. In this paper various methods of experimental verification and correction of this parameters are presented.

2. P. Rybár, Š. Kuzevič; *BERG Faculty, Technical University of Košice, Košice, Slovakia*
Mathematical and Computer Modelling of Heat Flow in Rock Environment with Fractures and Anisotropy. Modeling of heat flow is a viable way of analysis and prediction of changes in thermal situation of massive rock environment. In this paper are presented various methods of mathematical modeling: from simple heat flow in rock masses to complex modeling with fractures, anisotropy and media flow. As an important relation in the environment is the factor of delay, various from the character of thermal gradient, from the rock environment, from characters of discontinuities and attendance of transport media.

3. P. Rybár, Ž. Kuzevičová; *BERG Faculty, Technical University of Košice, Košice, Slovakia*
The Modelling of Time Dependent Parameters of Exploitation in Open-pit Mine. Application of Geographic Information Systems is characteristics not only in science, but also in industry. Modern new technologies make possible capture of data with higher accuracy, speed and regularity than earlier. Informations are accumulated in relatively short time interval at the different hierarchical layers, including global layer. GIS allow tools for creating and manipulation of Digital Terrain Models, which are resource for modeling of time-dependent parameters of exploitation in open-pit mine. Created DTM can be component of deposit GIS and this GIS can be a part of complex model of deposit. After appending the information to deposit database and creating of kit-model of deposit (dividing of part of deposit to block-bricks, with defined representative account of modelled chemical component) the model can be a part of decision-making and process controlling process.

4. M. Zacharov; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
Mining of Mineral Sources for Metallurgy from Slovak Karst. In largest karst area of Slovak Republic, in Protected Landscape Area Slovak karst there are deposites of mineral sources that present a base for chemical industry, building industry, ceramics industry and the main base for metallurgical industry. The most important are deposits Včeláre and Gombasek. There is mined high-rate limestone (content $CaCO_3$ > 97%) used for agglomeration and as additive to blast furnace in metallurgy. Deposit Včeláre constitutes material base for the largest metallurgical factory, in Slovakia, U. S. Steel s. r. o. Košice.

5. F. Krepelka, M. Labaš, J. Futó*; *Ústav Geotechniky, Košice, Slovakia, *Faculty BERG, Technical University of Košice, Košice, Slovakia*
Application of Acoustic Signal at the Identification of Rotary Drilling Process. Monitoring of rock disintegration process at drilling, and scanning of input quantities: thrust *F*, revolution *n* and power input *P* and the course of some other output quantities: drilling rate *v* are needed to control of this process. The acoustic vibrations accompanying the drilling process are recorded by microphone placed in defined position in the acoustic space. The drilling device, the drilling tool and the rock are the source of sound. Specification of the new quantities, that characterize satisfactorily the disintegration process, in dependence on the thrust *F* and revolution *n*, derived from the scanned acoustic signal (processed by Fourier transformation), as they enable the control of rock disintegration process at drilling without the classic monitoring, that means without scanning of thrust *F* and revolution *n* is the aim of in the present research. The results from drilling in Ruskov andesite by impregnated diamond bit on the drilling stand are presented in this paper.

6. P. Vavrek, J. Ďurove; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
Rock Abrasivity - a Significant Cost Factor for Mechanical Tunnelling. A number of laboratory tests indexes are used for determination the abrasive properties of rock, including the Cerchar method and the standard ON 441121 applied in Slovakia. The principle of ON 441121 is based on the determination of volume and weight loss of five testing cylindrical bodies with the diameter of 3 mm, the length of 22mm and the hardness of 210 HB. The bodies move on the cross-section, i. e. on the face of the cylindrical rock sample. Method of Cerchar Abrasivity Test uses a volume loss of six steel conical testing bodies. The results of abrasivity determined according to the standard ON 441121 may be expressed by the index of. The rocks on the line of the pilot tunnel Višňové vary in their abrasivity.

7. B. Pandula, A. Mockovčiaková, F. Blaško, V. Miklúšová; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
Determination of Disturbances and Quality of Rock Massive by Impulse Dynamic Methods. The presented paper deals with determination of disturbances of rock massive on the samples and "in situ". According to the present knowledge, the disintegration process caused by blasting is mainly influenced by disturbances. The choice of a suitable method has been subjected to the requirement, that the method should be closer to the short-dynamic loading, which is characteristic for the action of blast energy on rock massive. From that reason the application of seismic as well as ultrasonic methods is suitable.

8. J. Ďurove, P. Vavrek, R. Mišicko*; *Faculty BERG, Technical University of Košice, Košice, Slovakia, *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*
Exploration of Metallic Mine - Supports. Metalic support is frequently used as underground excavation support, to provide an reinforcement of the rock mass, reducing the displacement at the boundary of the opening. This paper describes, by a stress - strain analysis, the calculation of renowed metals support for their use in the mine. The differences in strain of new and renowed metal beams are presented.

9. I. Lesso, J. Futo, J. Krepelka*; *Faculty BERG, Technical University of Košice, Slovakia, *Institute of Geotechnology, Technical University of Košice, Slovakia*
Optimisation Methods of Disintegration of Rocks by Rotary Drilling. The contribution gives the technical and algorithmic solution of the optimalization of rotary drilling. The global optimalization criteria requires the minimum specific energy on drilling and the maximum speed of drilling. The article presents the first results of research on the utilization of acoustic methods in indirect measurement of criterion function at the optimalization of these processes.

10. P. Rybár, M. Cehlár, M. Zacharov, K. Kyseľová*; *Faculty BERG, Technical University of Košice, Košice, Slovakia, *Faculty of Metallurgy, Technical University of Košice, Košice, Slovakia*
Study of the Hyperstene-Augitic Andesite Natural form from the Ruskov Area and Remelting in Atmospheric Conditions. The structural and

physico-chemical properties after remelting on a temperature over 1660 °C are established. The chemical composition and the microscopic changes in the structure of mineral were investigated.

11. V. Baričak; *Faculty of Mechanical Engineering, University of Tuzla, Tuzla, Bosna i Hercegovina*
Fluid Flow in Sliding Bearings - the Cause of Self-exciting Vibration. Due to rotor rotation fluid in bearing and/or seal is forced to rotate and so the rotating fluid force is generated. This force induce self-excited vibrations of very high amplitudes. Fluid induced self-excited vibrations model and their characteristics are discussed in the paper.

12. P. Tauš, R. Rybár; *BERG Faculty, Technical University of Košice, Košice, Slovakia*
Influence of inching of the solar collector for the energetic profit. The current equipments for the heating of the water by means of the solar collectors comprise the settlement of solar collectors without the alternative correction of camber of the absorption area toward the horizontal surface. For a consideration of the calculated parameters we give caloric balances for two types of the flat solar collectors, which represent the most medium and vintage qualitative category in Slovak market. By comparison of the output characteristic of the solar collectors with the fixed installation and the collectors, that trace the apparent movement of the Sun, we rate the energetic account. The energetic account of the solar collector with inching is about 30 % higher than the energetic account of the flat installed solar collector. By the financial calculation of the produced energy, by regard of trend growth of the price of energy we assess the maximal rate of the load for the inching equipment for one solar collector. These costs is possible to reduce for example by connection of the solar collectors into the sections with the common frame and the inching equipment. By the upgrade of the energetic output at the unit area of the absorber it is possible to reduce the pay-back period of the solar equipment.

13. P. Rybár, G. Fischer, D. Kudelas; *BERG Faculty, Technical University of Košice, Košice, Slovakia*
Analysis of Utilization of Wind Turbines Systems in Conditions Košice's fold. Slovakia includes 43 000 km^2 of mostly mountainous region with average wind velocities higher than 4 $m \cdot s^{-1}$ and where total wind potential of 1-3 TWh/year was estimated by Energy Institute (EGU). Low price of electrical energy and long payback period (which is comparable with the life time expectancy) did not stimulate the introduction of the wind equipments in the past. Analysis and simulations shows that in specified conditions the using of wind turbines systems is now feasible.

14. M. B. Lutskyy, I. K. Dorogko, V. A. Lutcenko, A. A. Chichkan, Y. B. Goreckyy; *Joint Stoks Company "Alchevsk Iron & Steel Works" and Donbass Mine - Metallurgical Institute, Alchevsk, Ukraine*
Influence of the Form of Box Groove on Technical - Economic Factors of its Work. Conducted analysis of work denoted condition of functioning the box grove and influences of their form on technical-economic factors. Installed advantages of grove with the double issue, when issue beside the bottom of grove is longer, than beside the connector. New box grove design with the double issue was given. Results obtained give rise to new design of the shaped mill "600" Alchevsk Iron & Steel Works and shaped mill "500" Enakievo Metallurgical Plant.

15. V. Pavlová, A. Lesniaková; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
Marketing Research Abroad. In present conditions the market economy is very important not only abroad, but also in Slovakia. Our organizations are motivated through the influence of the domestic market saturation, competition press, market globalization or new possibilities of the market in other countries to move their activities to the foreign countries. Information about decision of the entering to the foreign markets presents basic information, including very important source of information: marketing research. It presents receive, elaboration and interpretion of the information, that are necessary for identification about analysis of the marketing decision. Marketing research in model organization, that will be described in the presented paper, consists of four steps: problem definition, stating of the research goals, creation of the research plan, collecting of the information and analysis of information. Important results of the research are given to the management.

16. Z. Novek, A. Csikósová, K. Kameniková; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
Economical Evaluation of the Ecological Behavior Level of the Organization Unit. In the presented paper we analyze firm, that has four partial production processes, in which there is influence to the ecosystem at various level. During raw material exploitation there raise up the raw deposit dumps, as well of various semi products depots. During the muck elaboration there partial further production process includes dust creation from sub depots for intermediate goods. During heating elaboration the dust parts from technological and chemical process and transport systems occur. At clinker elaboration there is mainly secondary dustiness that is strongly increased during the year mainly wind blowing from north-south. Considering, that firm is situated in north side of the second biggest agglomeration of Slovakia, its inhabitants are impacted by consequences of primary and secondary dustiness. There is analyzed retrospective, present situation and perspective of ecological behavior of the firm and its economical evaluation.

17. D. Vitko; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
Aktualisierung der mittelfristigen makroökonomischen Absicht. Ihre Aufgabe ist es einen soliden Grund für Bildung eines mittelfristigen makroökonomischen Rahmens zu schaffen. (Im Einklang mit Regierungserklärung Nr. 354 vom 19. April 2001.) Sie spiegelt die mittelfristigen Grundabsichten der Fiskalpolitik wieder. Der Szenariocharakter setzt ein kollektiv hohen Erfolgsstandard der Absichtenerfülung des Transformationsprozesses und der Belebung des Wirtschaftswachstums voraus.

18. E. A. Erfan; *Uzhgorod Nationall University, Uzhgorod, Ukraine*
The system of management covers the whole administrative activity of the firm. The difficulties of the machine-building enterprise are greatly connected with nonefficient management. The necessity of improve the efficiency of management, increasing the productivity of labour, efficiency of production as well as decrease of expenditures demand restructuring of enterprises. The restructuring in the wide sense foreseen the complicity of changes but not only the change of only one of the spheres of function (marketing, finances or production, etc.); it is a permanent instrument of management, but doesn't realize the single aim; it may cover property transformations as elements of the changes; it is subjected to modification and spotting in the process of its realization. It is evidently today that machine-building enterprises for their survival at the market and to keep them competitive must make changes in their economic activities from time to time. Innovating direction of management systems, permanent renovation, direction to satisfaction of consumer needs must be the main in making changes.

19. K. Kameniková; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
Solution for Financial Position of the Mining Firm by Merger. Proper financial management is important tool for prosperity, competitiveness and financial management should contribute to the growth of effectiveness and economy of overall firm's activities. For analysis of the area of utilization of financial management tools, the Slovakian magnesite mining firms, that have very important position in Slovak industry are taken. Some firm's disability is connected with liquidity problem, as well as with unproper financial structure of firms. Therefore it is very important to

utilize every possible tool, provided by financial management, and so to overcome negative position. Financial management deals with various areas of finance and to solve the liquidity problem tools from the area of financial investment by the way of firms' merger - is needed.

20. V. Krúpa, E. Lazarová; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
The Use of Computer for Optimisation of Driving with TBM and in Engineering Geology Survey. A computer optimisation and monitoring system was installed on a driving machine while driving the exploratory gallery of highway tunnel Branisko (Slovakia). The system provided calculation of optimal parameters of driving process by determining the extreme specific energy (a criteria value of full profile driving) and calculation of many geotechnical characteristics of disintegrated rock mass. The calculation of geotechnical characteristics was possible, thanks to the created and proved model of the interaction between the disc head of the driving machine and the rock mass.

21. P. Horovčák; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
The Principles of Process Monitoring using Internet. The paper deals with the possibilities of internet utilization for process monitoring, task of monitoring implementation, technique of monitoring for dynamic method of data transfer and the most relevant conditions of real exchange of measured data between server and client. The monitoring of processes based on web technologies can be solved using the static or dynamic method by transfer of actual measured data from server to client. The dynamic method of transfer is based on creation of dynamic process course on the client side. Only separate measured values from process are transferred. This method exploits three partial steps: creation of the applet, creation of socket communication and construction of monitoring application. The server application was developed in Delphi and client's application was developed in form of Java applets. The communication is realized on socket base.

22. J. Sabová; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
Methodology of Stability Determination by Deformation Monitoring. To achieve a correct deformation monitoring it is necessary to adhere to key principles of the deformation investigation methodology and to ensure measurements on a high level. The most important aspects of the deformation methodology and some problems of testing procedure from the point of view of gnoseology are analysed in this contribution. Applying the given conclusions the results reliability can be enhanced.

23. A. Kisiolek, R. Budzik, C. Kolmasiak; *Faculty of Materials Processing Technology and Applied Physics, Technical University of Częstochowa, Częstochowa, Poland*
Public Relations at Internet Case Study of Metallurgical Line in Poland and in the World. The short history of development of the WWW Web and marketing online have been presented in the article. The work of Public relations as a tool of promotion-mix have been described. The WWW site has been characterized as a basic tool of communication in the Internet (using the examples of WWW sites in metallurgy in Poland and in the world). The target groups of Public Relations online and the rules of creation of the Internet press room have been described. Moreover, the most important problems of internal Public Relations have been characterized.

24. P. Tauš, R. Rybár; *BERG Faculty, Technical University of Košice, Košice, Slovakia*
Comparison "Energy Facade" and Standard Form of Building Insulation. A passive solar energy system for buildings is an interior conditioning system which efficiently utilizes the fundamental components of a building to collect, store and release thermal energy. This low maintenance system can be used to heat or cool a building and provide solar illumination while saving the equivalent of up to 40% of the energy used in a conventional building. Passive solar energy systems are virtually pollution free, unlike the coal and fossil fuel burning systems used with conventional buildings. Passive solar energy systems are low maintenance due to the fact that they have no moving parts. Because the main component of a passive solar energy system is the building itself, the system will last as long as the building. When a passive solar energy system is incorporated into the design of a new building it can be low in cost. Most passive solar energy systems are not visually undetectable. Passive solar energy homes look just like conventional ones.

25. J. Pinka, G. Wittenberger, M. Marcin, M. Sidorová; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
Effect of Geothermal Water on Well Completion at Locality Ďurkov. The geothermal energy is gaining more and more attention today. Slovakia follows the world trends has joined the countries which want to exploit the domestic geothermal sources. The results of geological research put Slovakia to the regions of the high geothermal potential. The project for the geothermal energy utilization in the area of east Slovakian Neogen is coming to the phase of production tests. This article is focused on the description of the every phase during this project starting with geological survey, followed by drilling of the geothermal wells and production tests and their evaluation. The article is also focused on the descriptions of every phase of geothermal water utilization and its direct influence on the well completion at locality Ďurkov.

26. V. Sedlatý, Š. Kemenyík, B. Jašková; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
The Contribution Towards the Fire-Safety a Highway Tunnel Branisko (SR). The contribution deals with problems of testing self - extinguishing ability of prefabricated Ferro-concrete slit drain canals and cleaning shafts, which will serve for linear drainage of road surface at tunnel Branisko. The part of the each typ of this prefabricated elements, produced by VAHOSTAV a. s. Company, is kerb, which is used to isolate the road from adjacent constructions. The cleaning shafts in addition contain submergible wall to prevent spreading the fire by flammable liquids. To analise the a project of fire-fighting-safety it was necessary to verify by experiment the self - extinguishing ability of the prefabricated elements.

27. Ž. Kuzevičová, Š. Kuzevič, P. Tauš; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
Digital Model of Košice City. In this paper is described the creation of digital model of Košice City by using of Geographic Information Systems GIS). GIS represents reality as a set of map layers and relationships between them. Digital model of urban built-up area, digital terrain model and information about infrastructure are starting point for many different analyses. This model was used to analyze of distribution of vibration and noise at different locations of built-up area, to shine analysis, to gaseous flow transport and to optimal location of systems for application of alternative and renewable energy sources.

28. P. Rybár, Ž. Kuzevičová; *Faculty BERG, Technical University of Košice, Košice, Slovakia*
Using Virtual Reality Modeling Language in Underground Space. Virtual Reality Modeling Language may be used for different application such as engineering and scientific visualization, multimedia presentations, entertainment and educational titles, web pages, and shared virtual worlds. VRML is capable of representing static and animated dynamic 3D and multimedia objects with hyperlinks to other media such as text, sounds, movies, and images. VRML browsers, as well as authoring tools for the creation of VRML files, are widely available for many different platforms. VRML supports an extensibility model that allows new dynamic 3D objects to be defined which allow application communities to develop interoperable extensions to the base standard. There are mappings between VRML objects and commonly used 3D application programm interface (API) features. This new progressive technology can be successfuly used at mining.