

**1. L. Dahil**

**Research on vibration damping on computer power supply box made of castermid material.** In this study, our aim is to eliminate disadvantages that occur due to vibration. Therefore it has been made of the power supply box castermid material. In this study used both experimental and finite element methods analysis. For this purpose, the effects of the power supply box made directly of castermid material and the power supply box made of metal on damping of the vibration and which one of them is more effective were investigated, and the results were compared by Finite Element Method (FEM) results. As a result, it has been concluded that the castermid box created less noise than existing box did and it has damped the vibration more.

**2. J. G. He, Y. Li, X. X. Xue, H. Q. Ru, X.W. Huang, H. Yang**

**Cyclic voltammetry study of Ce(IV)/Ce(III) redox couple and Ce(IV)-F complex in sulfuric acid medium.** In this paper the electrochemical behaviors of Ce(IV)/Ce(III) redox couple and Ce(IV) - F complex in sulfuric acid medium were studied by cyclic voltammetry using a platinum electrode. Both of the Ce(IV)/Ce(III) couple in Ce(IV) solution and Ce(IV) - F complex is a quasi-reversible process, and gives a linear correlation between the peak potentials and square root of scan rates, showing that the kinetics of the overall process is diffusion controlled. The complexation of cerium(IV) and fluoride is favorable for the oxidation of Ce(III). The kinetic parameters such as diffusion coefficients, anodic transfer coefficients and rate constants were studied.

**3. H. Pavolová, S. Khouri, M. Cehlár, L. Domaracká, M. Puzder**

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

**4. P. Wicher, F. Zapletal, R. Lenort, D. Staš**

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

**5. L. Blacha, J. Brzóška**

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

**6. H. H. Yu, X. Li, Z. G. Yuan**

**Synthesis and characterization hollow spherical  $\text{La}_{0.7}\text{Sr}_{0.2}\text{Ca}_{0.1}\text{Co}_{0.9}\text{Fe}_{0.1}\text{O}_{3-\delta}$  (LSCCT) for cathode of solid oxide fuel cell (SOFC).** Hollow spheres structures of  $\text{La}_{0.7}\text{Sr}_{0.2}\text{Ca}_{0.1}\text{Co}_{0.9}\text{Fe}_{0.1}\text{O}_{3-\delta}$  (LSCCT) have been synthesized via hydrothermal method using carbon spheres as template. The structure and electrical conductivity of obtained samples are characterized by X-ray diffraction (XRD), scanning electron microscope (SEM), transmission electron microscope (TEM) and direct current (DC) four-probe method respectively. The results show that hollow spheres structures of LSCCT with the mean particle size of 0,9 - 1,2  $\mu\text{m}$  is single perovskite. The electrical conductivity of the samples is higher than 100 S/cm from 600 to 800 °C and can meet the demand of the electrical properties for the cathode materials.

**7. M. Gombár, J. Kmec, M. Badida, L. Sobotová, A. Vagaská, A. Badidová**

**Analysis of physical factors on chosen properties of anodic alumina oxide (AAO) layers and environment.** In the contribution is evaluated an impact of physical factors of anodizing process, namely the temperature of an electrolyte, anodizing time and voltage, on the change of values of Vickers microhardness and thickness of formed layer of experimental materials A199-5. By increasing of electrolyte temperature, the values of layer microhardness and thickness layer increase, namely about 0.78 % at the increasing of electrolyte temperature by 1 °C. By lengthening of anodizing time grows the value of layer thickness, but only to the value of the critical deposition time, when chemical dissolution of the layer start to be more prominent. By voltage increasing, values of layer thickness and micro-hardness are increased in the range of the used experimental values.

**8. J. Calus Moszko, B. Bialecka, M. Cempa-Balewicz, H. Świnder**

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

**9. B. Gajdzik, J. Sitko**

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

**10. H. Golaś, A. Mazur, B. Mrugalska**

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

**11. S. Gil, J. Ochman, W. Bialik**

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

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

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

**13. L. I. Cioca, L. Ivascu**

**Investigating occupational diseases in the metallurgical industry.** The paper presents the trends in the evolution of occupational diseases in Romania in comparison to the EU and the US, as incidence of occupational diseases, their interrelationship with the exposure to occupational risk factors in the working environment, the dynamic changes over time of the traditional structure and of the hierarchy framework of employees' check-up regarding the risk factors. The analysis covers the period 2010 - 2015 and was made in quantitative terms (statistical data) and qualitative terms (study concerning the causal factors of the employee's work environment). The data are presented as absolute figures and the average annual incidence rates are presented per 100 000 people employed in this industry.

**14. J. Machnik-Slomka, P. Kordel**

**Significance of technological entrepreneurship and creativity in metallurgical enterprises.** This article presents the categories of technological entrepreneurship and creativity that constitute a new perspective on developmental mechanisms of contemporary enterprises. These mechanisms are of particular significance in relation to industrial enterprises, including metallurgical ones. For the purposes of this publication the significance of technological creativity and entrepreneurship is described with the examples of metallurgical enterprises.

**15. A. V. Todorut, L. Paliu-Popa, D. Cirnu**

**Interdependence between iron ore production and maritime transport.** The maritime industry plays an important role in international trade, transporting a total of 10,1 billion tons of merchandise in 2015, representing over 80% of all global trade, with dry cargo estimated to account for over two thirds of the total seaborne trade. Bulk carriers supply the raw materials needed by the steel industry and container ships transport the steel products. Demand and supply for seaborne transport is influenced by trends in global economy and worldwide demand for commodities. The paper analyzes the most important economic determinants in the supply of metallurgical raw materials, highlighting the importance of the shipping sector.

**16. D. Wang, Z. Zhao, G. L. Tan, S. Zhang, Q. Wang**

**An investigation of the decomposition mechanism of calcium carbonate.** This paper focuses on investigating the decomposition mechanism of calcium carbonate. The non-isothermal thermal decompositions of calcium carbonate under vacuum and flowing nitrogen atmosphere have been studied by thermogravimetric analysis. With the application of the advanced nonlinear isoconversional method, the determined activation energy for each condition is dependent on the extent of reaction. Based on the dependences, a process involving two consecutive decomposition steps has been simulated. The simulation results match the experimental results of flowing nitrogen atmosphere. Results indicate that the decomposition of calcium carbonate undergoes the process of the formation of the intermediate and metastable product.

**17. J. Węgrzyn, A. Mościcki, T. Borecki**

**Determination of the content of silicon carbide by mass balance and analysis of oxygen and carbon content.** The paper presents the results of calculations of silicon carbide content in residue samples of carbothermic reduction of  $\text{SiO}_2$  after 6 hours. The content of SiC was calculated in two ways. The first from mass balance equations of samples and analysis of oxygen content. The second from analysis of oxygen and total carbon content. The values calculated by the two methods are similar. The total and free carbon content was determined according to procedures described in PN-EN ISO 21068-2:2010P and additional free carbon content at temperatures higher than recommended by the standard. The sum of calculated values of  $\text{SiO}_2$  and SiC contents revealed measured excess of free carbon content.

**18. L. León, G. León, J. Senent, M. A. Guzmán**

**Comparative study of copper (II) removal/recovery from aqueous solutions by bulk liquid membranes containing six different carriers.** The removal/recovery of metals from secondary sources is an interesting research field from both economic and environmental view points. In this paper we study the removal/recovery of copper(II) from aqueous solutions by bulk liquid membranes through a carrier mediated transport mechanism using six different carriers. The efficiency of the different carriers is analyzed based on the values of different transport parameters (flux and permeability through feed/membrane and membrane/product interfaces) and on the percentages of copper (II) removed from the feed phase, recovered in the product phase and accumulated in the membrane phase.

**19. Š. Salokyová, J. Dobránský, A. Panda**

**Monitoring the intensity of mechanical vibration during the processing of chrome steel 14109.** Article deals with the examination of the effect of cutting parameters on the occurrence and size of mechanical vibration on three selected measured points during the processing of chrome steel. It also includes execution, experiment evaluation in this field and comparison of measured vibrations acceleration amplitude values according to the standards. The results of the measurement serve for early identification of a defect, which has great effect on the smoothness and efficiency of the machine. The article concludes with the proposed new findings from the measured values evaluation and formulated new recommendations for the operation in production system with lathe turning technology. The measured experimental values of the acceleration amplitude of mechanical vibrations were compared with theoretical values.

**20. K. Semrád, K. Draganová**

**Methodology for repeated load analysis of composite structures with embedded magnetic microwires.** The article processes issue of strength of cyclically loaded composite structures with the possibility of contactless stress measuring inside a material. For this purpose a contactless tensile stress sensor using improved induction principle based on the magnetic microwires embedded in the composite structure has been developed. The methodology based on the E-N approach was applied for the analysis of the repeated load of the wing hinge connection, including finite element method (FEM) fatigue strength analysis. The results proved that composites in comparison with the metal structures offer significant weight reduction of the small aircraft construction, whereas the required strength, stability and lifetime of the components are remained.

**21. W. Walke, M. Kaczmarek, M. Staszuk, M. Basiaga**

**Influence of purge, time of waiting and  $\text{TiCl}_4$  dosing time in a low-pressure atomic layer deposition (ALD) reactor on properties of  $\text{TiO}_2$  layer.** The aim of the study was to evaluate the influence of the ALD process parameters on mechanical properties and corrosion resistance of  $\text{TiO}_2$  layer. The  $\text{TiO}_2$  layer was deposited on stainless steel surfaces at constant temperature  $T = 200\text{ }^\circ\text{C}$  and number of cycles  $n_c = 500$  ( $g \approx 25\text{ nm}$ ). The applied methodology consisted of potentiodynamic and impedance studies, as well as adhesion test. The obtained results were the basis for selection of surface

treatment method for stainless steel implants for contact with blood. Appropriate parameters of surface treatment realized by means of the ALD method is of significant importance. It will contribute to the development of technological conditions of specified deposition parameters of TiO<sub>2</sub> layers on steel implants.

**22. T. Karkoszka**

**Environmental assessment of the hot-dip galvanization processes.** Processes of the hot-dip galvanization, refraining from application of dangerous chemical substances together with the necessity of ensuring the high temperatures, both pose a special threat to the environment. Therefore, the subject of analysis was environmental impact of the hot-dip galvanization process. Here has been done the identification and the assessment of the environmental aspects as well as has been pointed at the key-aspects requiring the special supervision. The developed assessment methodology can be applied by each of the organization wanting to master the processes by minimizing their environmental influence.

**23. A. Zhiguo, L. Zhengfang, F. Tianhua, Q. Jianjian**

**The study on an automotive refill opening cap preforming process based on single point incremental forming.** In this paper, the preform of an automotive refill opening cap is manufactured through the incremental sheet forming (ISF) with large rigidity because of the lower thickness reduction percentage, and the production cost is reduced. Four processing parameters, including the preforming height (PH), the preforming press amount (PPA), the preforming tool diameter (PTD) and the preforming angle (PA), are optimized by orthogonal tests and response surface methods, and the max thickness reduction percentage (MTRP) is taken as the test target. Results: The optimal processing parameters include a PH of 15 mm, a PPA of 0,5 mm, a PTD of 8 mm and a PA of 40°.

**24. D. Malindžák, P. Kačmár, B. Zatwarnicka-Madura, D. Zimon**

**The continual chemical changing aspects in metallurgy production scheduling.** Due to keeping the continuous changes of the chemical composition of alloys in the sequence of manufactured products it is required to apply a specific approach at creation of models of production scheduling. The production schedule is created for the workplace continuous process at first, and then the following production schedules of work are derived for another workplaces. The model was implemented in the company RS Slovakia s.r.o.

**25. M. Pástor, P. Trebuňa, F. Trebuňa, F. Šimčák**

**The failure analysis of the holder of a crusher moving knife.** The paper deals with the analysis of the causes of knife holder failure. The holder is a part of the car tyre shredding equipment. Based on the evaluation of the operating conditions of the machine, examination of the condition of the knife holder after the failure, analysis of the fractured surface, as well as the material properties of the examined structural elements, it was possible to draw conclusions as to the reasons of eventual failures.

**26. P. Trebuňa, M. Pástor, F. Trebuňa, F. Šimčák**

**The analysis of failure causes of the rotor shaft of steam turbines.** The rotors of steam turbines belong to the extremely loaded parts of turbo generators due to various mechanical and thermal influences during their operation. The following paper presents the results of the analysis of failure causes of the rotor shaft of a steam turbine with the power of 6,43 MW, which occurred after approximately one year of operation. The analysis was performed on the basis of the analysis of the chemical composition and microstructure of the material, the mechanical properties of the material under static and fatigue loading, as well as operational loading of the critical location of the shaft, using numerical and analytical methods. The conclusions about the possible causes of the shaft failure were drawn on the basis of the results obtained.

**27. J. Kondela, S. Jacko, L. Vizi**

**Spatial variability change of MgO content in Jelsava magnesite deposit (Slovakia).** The presented paper deals with the study of the spatial variability changes of MgO content within the Jelšava magnesite deposit in Slovakia. The geostatistical structural analysis was used to study the spatial variability changes of the MgO content within three mining sectors A, B and C, localised in different parts of the deposit. The results show some important connections between the variability of MgO content and the structure setting of the deposit with utilization for the magnesite processing in the metallurgy.

**28. P. Trebuňa, A. Petriková, M. Pekarčíková, M. Petrik, R. Popovič**

**Economic evaluation of investment project in the area of sheet metal processing.** The article is oriented on the process modelling in selected company. The aim of the process modelling is a possibility to prevent the formation of future risks as a consequence of a wrong decision concerning a capital project. The analysis of actual state in society with the focus on the means of processing the lamination using computer numeric control technology is also a part of article. Based on the analysis mentioned above, the selection and the definition of the capital project have already been carried out. Final section evaluates the capital project using methodology of economic indicators by means of economic indicators of effectiveness and brings a decision whether to accept or refuse given investment.

**29. J. Suchacek, A. Samolejova, P. Seda**

**Metallurgy in the Czech Republic: A spatio-temporal view.** The objective of this paper is to introduce the stochastic input-output model of the impact of metallurgy sector on the Czech economy. Contrary to original input-output model, which is of deterministic nature, we reckon with interval estimates of the development of metallurgy sector. They help us to surpass deterministic impediments when analyzing and forecasting the possible developmental tendencies of metallurgy sector in various economies.

**30. L. Paliu-Popa, I.E. Chirtoc, G. Buşan, A.V. Todoruş**

**Interdependence between the steel castings and manufacture of machines and equipment.** Starting from the fact that the metallurgical industry is the main supplier of raw material both for the equipment and machines industry, as well as for the car industry, this paper analyses, by means of the regression function, to what extent the quantity of casting of steel was influenced, on the one hand by the manufacture of machines and equipment, and on the other hand, by the manufacture of car body. Data subject to the study were related to the period January 2002 – June 2016 (174 months) and was conducted both at the level of the European Union, as well as at the level of the main countries manufacturing steel at its level, namely: Germany, Italy, France and Spain.

**31. A.V. Todoruş, D. Cirtina, L.M. Cirtina**

**CO<sub>2</sub> abatement in the iron and steel industry - the case for carbon capture and storage (CCS).** The steel industry is amongst the most energy-intensive industries also consuming large amounts of coal and emitting significant volumes of carbon dioxide (CO<sub>2</sub>). Studies indicate that steelmaking accounts for 6 - 7 % of world anthropogenic CO<sub>2</sub> emissions, and 27 % of the total emissions of the world's manufacturing sector. Steel manufacturers have responded to sustainable resource use and development adopting several measures attaining a reduction in energy consumption of 60 % in the last 50 years. The paper discusses Carbon Capture and Storage (CCS) as a CO<sub>2</sub> mitigation option, after the 2015 Paris Climate Conference (COP 21) and in relation to the European Regulation for CO<sub>2</sub> measurement, reporting and verification.

**32. A. Garbacz-Klempka, M. Wołoszyn, T. Dzieńkowski, Z. Kwak, P. Długosz, K. Saja**

**The technology transfer of non-ferrous alloys casting during the middle age.** The article reports on the findings from the metallographic analysis of 13<sup>th</sup> c. archaeological objects from Chełm (eastern Poland). The group submitted for analysis includes jeweller's dies used in the production of women's ceremonial ornaments, crucibles and bronze ornaments. The Mongol invasion of 13<sup>th</sup> c. had caused craftsmen from central areas of East Europe to flee and seek shelter in the western parts of Rus. It may be safe to interpret the finds from Chełm as the remains of a jeweller's workshop, the site of casting and working copper alloys and silver. The analysis of the technology used in casting copper alloys and silver in the jeweller's workshop were made using optical microscopy, X-ray spectroscopy and X-ray radiography.

**33. T. Sadilek**

**Regional distribution of the metallurgical industry in the Czech Republic.** The aim of the article is to present the regional distribution of the metallurgical industry in the Czech Republic and to describe the specific factors which determine the localization of the industry in Czech regions. In order to achieve that goal, traditional tools of regional analysis are used, such as concentration analysis, used in business-to-business marketing, which does not describe the absolute size of the industry, but its relative size, focusing on the relation between the employees in the metallurgical industry and the total number of employees in a certain region. The sample consists of all the working ironworks and steelworks, foundries, and rolling mills operating in all the regions in the Czech Republic. Nowadays, the metallurgical industry still plays an important role in the Czech economy; the highest coefficient of its concentration is in the Moravia-Silesia Region.

**34. K. Nowacki, T. Lis, H. Kania**

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

**35. M. Cioca, L. Ivascu, L. I. Cioca**

**Safety performance indicators in the metallurgical industry using web programming.** Sustainable development has a significant impact today in Romania and worldwide. In this context, risk assessment becomes mandatory for enterprises. This paper analyzes the situation of occupational risks in the metallurgical industry in the European Union, Romania, and the United States and highlights the main causes for work accidents in Romanian metallurgical industry. The analysis covers the period 2010 - 2016. The data collected from Romania is compared to the data related to the European Union and the United States. Moreover, the paper aims to present an occupational risk assessment tool, which is customizable for each area of activity. The last section of the paper discusses the research results and limitations.

**36. J. Vveinhardt, W. Sroka**

**Mobbing and harassment in the steel enterprises.** Mobbing and harassment are widely analysed in organizations providing various services but are little studied in the companies undertaking industrial activities. Therefore, the aim of the paper is to diagnose the prevalence of mobbing and harassment in the steel enterprises. The case study analysis of the largest steel producer in the world, and specifically its division in Poland was used to determine the prevalence of these phenomena. It was found out that the said company is the example of the ethically and socially responsible organization. However, the interviews indicate that single cases of mobbing and harassment activities (though relatively rare) were also observed. They were distributed among three groups of employees: 1) those who do physical work (are directly engaged in the production process); 2) employees involved in the administrative activity and sales; and 3) managerial staff.

**37. N. Zeelanbasha, V. Senthil, B. Sharon Sylvester, N. Balamurugan**

**Modeling and experimental investigation of LM26 pressure die cast process parameters using multi objective genetic algorithm (MOGA).** This present investigation deals with pressure die casting process to produce an automotive valve closer component with better mechanical properties such as micro-hardness(HV), surface roughness ( $\mu\text{m}$ ) and porosity (%) on LM26 by varying intensification pressure ( $\alpha$ ) Kgf/cm<sup>2</sup>, shot velocity ( $\beta$ ) m/s and pouring temperature ( $\gamma$ ) °C. Using response surface methodology (RSM), the optimal parametric combination is found to be  $\alpha$  (186,68) Kgf/cm<sup>2</sup>,  $\beta$  (0,599) m/s and  $\gamma$  (662,93) °C for multi responses (121,18) HV, (0,93)  $\mu\text{m}$  and 0,017 % can be achieved corresponding to highest desirability of 0,73. The optimized results were obtained by the Pareto-optimal solutions using multi objective genetic algorithm (MOGA) provides flexibility to select the best setting depending on suitable applications.

**38. P. Srisattayakul, C. Saikaew, A. Wisitsoraat**

**Effects of hard chrome and MoN-coated stainless steel on wear behaviour and tool life model under two-body abrasion wear testing.** The objectives of this study were to investigate the effect of the electroplated hard chrome (HC) and the MoN-coated AISI 316 stainless steel coatings on weight loss under two-body abrasion wear testing and to predict the tool life of both materials used as a fishing net-weaving machine component, namely the hook. Both materials were used to carry out the wear experiments under two-body abrasion behavior. These specimens were wear tested with the in-house wear testing apparatus base on ASTM: G133-05 standard. The Taylor's equation was used to formulate the tool life model whereas the Monte Carlo simulation was used to predict the tool life of the machine part. The results showed that the MoN-HC exhibited higher wear resistance than that of the HC.

**39. L. Dahil**

**Effect on the vibration of the suspension system.** In order to determine the damping effect of shock absorbers in vehicles, different vehicles acceleration values were measured while they were passing over speed bumps at different speeds. The vehicles' vibration magnitudes caused by road roughness were analyzed. In this study the measurements were conducted with two different vehicles, multiple drivers and at different speeds. The vibration values were determined with a HVM 100 device, in different field conditions and at 20 - 40 and 60 km/h by transferring the results to the system. According to the results of statistical analysis damping effect of the shock absorbers in the vehicles changed in different speed ranges and field conditions and it was seen that driver's performance was significantly affected due to the vibration.

**40. T. Bakalár, H. Pavolová, S. Khouri, I. Pristášová**

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

**41. P. Pastorek, P. Novák, P. Kopas, M. Močilan**

**Finite element analysis of bond behavior in a steel reinforced concrete structure strengthened carbon fibre reinforced polymer (CFRP) strips.** The article deals with the analysis of influence of carbon-fibre reinforced polymer (CFRP) on stress distribution in a steel reinforced concrete beam loaded by four-point bending flexural test. Simulation of the delamination is modelled by FEM with a cohesion zone material model. Distribution of cracks with CFRP strengthening is analysed, too. Finally, the fatigue life tests analysis was executed for the steel specimen (W.Nr. 1.0429 – concrete steel), which was used in the reinforced concrete beam. The fatigue test results are used to plot the fatigue life curve.

**42. S. Spadlo, W. Depczyński, P. Młynarczyk**

**Selected properties of high velocity oxy liquid fuel (HVOLF) - sprayed nanocrystalline WC-CO Infralloy™ S7412 coatings modified by high energy electric pulse.** The paper presents a brief study of selected properties of HVOLF-sprayed nanocrystalline WC-Co Infralloy™ S7412 coatings modified by the application of a high energy electric pulse. The anti-wear coatings were applied on carbon steel with the use of High Velocity Oxy Liquid Fuel (HVOLF) spraying system TAFA – JP-5000. The process was modified by the application of the SST France & Vision Lasertechnik device WS 7000 S. The resultant type of coatings may be applied to increase the abrasive wear resistance of tools and machine parts. The properties of the powders and coatings were studied using metallographic methods and EDS analyses. The microhardness and nanohardness of the resultant layers were measured and Young's modulus of elasticity was determined.

**43. M. Górska, R. Prusak**

**Identification and assessment of the need to improve the operation of production systems in the metal sector enterprises.** In this paper an attempt was made to identify the areas of metal products manufacturing processes that require improvement. Determination of such areas may become a source

of a lot of valuable information for the enterprise, enabling the development of its improvement directions. The results of survey allowed also to define a model of implementation importance for tasks contributing to the metal sector enterprises improvement.

**44. V. D. Sekerin, M. N. Dudin, S. V. Bank, A. E. Gorohova, Y. G. Lesnykh**

**Vertically integrated holdings in the system of developing the national complex of iron and steel industry of Russia.** This article shows brief results of analyzing the competitiveness of Russian vertically integrated holdings and independent enterprises of the iron and steel industry. Besides, it indicates key areas of this industry development in the external and internal market aspect. The promotion of Russian iron and steel products on the external market can be successful only if the production of enterprises is refocused from creating products of low technological conversions to creating products of high technological conversions.

**45. I. Mamuzić**

**Achievements of Croatian Metallurgical Society (CMS) 1952 – 2017 y.** The goal of this the Article is to give an overview of the foundation, development and achievements of Croatian Metallurgical Society (CMS) from Society of Engineers and Technicians of Steelwork Sisak (SETSS) 1952 – 2017 (65 years) With monitoring of goals and tasks of CMS, the main activities of the Society are also set out: First, history of the metallurgy on the territory of today Croatia in the term 6.000 y till today, with many Articles, Studies etc. In this way, Croatia was ranged between Countries where metallurgy as important technical branch, has a written document on this history. Second, publishing of the Metalurgija Journal, International Symposiums „Materials and Metallurgy“ (was 12 with 5.013 Lectures), and productive cooperation with an array Institutions in Croatia and abroad (over 70)

**46. X. T. Zhao, Q. H. Pang, Z. J. He, Y. F. Wu, J. H. Zhang**

**Granularity collocation of single coal on comprehensive combustion of blends.** The combustion of anthracite and bituminite blends with different bituminite particle size was investigated with thermogravimetric analysis (TGA). It is indicated in the results that the increase of bituminite particle size may influence the pyrolysis of blends and consequently the decomposition of blends moved to higher temperature zones with the increase of bituminite particle size. However, the negative influence of specific area is not that significant to some bituminite and anthracite mixtures, the comprehensive combustion behavior of blends was stable when particle size of some bituminite PC was increased from 0,074 mm to 0,150 mm.

**47. W. Z. Lv, K. Liu, R. W. Zhang, L. Cheng**

**Structural analysis of  $C_{an}O_{n-1}S$  cluster of dolomite desulfurization.** Using first-principles calculation method and comparing the difference between the free energy, the binding energy and electronic energy, the paper obtained  $Ca_nO_{n-1}S$  clusters is possible by the presence of CaO to CaS desulfurization process. Compared with the  $(CaO)_n$  clusters,  $Ca_nO_{n-1}S$  clusters is in the lower energy side and the reaction has a tendency to lower energy spontaneously. As an excessive state,  $Ca_nO_{n-1}S$  clusters forms before the nucleation CaS. According to analyze HOMO-LUMO energy difference, its chemical activity is higher than  $(CaO)_n$ .

**48. G. D. Liu, K. Liu, H. T. Zhang**

**Study of desulfurization with magnesite desulfurizer under hot metal pretreatment.** In this paper, MgO 38 %, C 10 %, Al 12 %,  $Fe_2O_3$  34 %,  $SiO_2$  + CaO 5,3 %,  $CaF_2$  0,7 % as the new desulfurizer ratio composition. Adding FeS, heating in a high temperature furnace, and then studying the reaction product composition by phase analysis. Found that the formation of MgS, indicating that the new desulfurization agent can be used for desulfurization. When the temperature is the same, the higher the initial sulfur content, the higher the desulfurization rate of the new desulfurizer. When the initial sulfur content is constant, the desulfurization rate increases with the temperature increasing. Desulfurization is mainly concentrated in the first 15 minutes, the best desulfurization temperature is 1 500 °C.

**49. S. Vellingiri, V. Senthil, N. Zeelanbasha**

**Modelling and multi objective optimization of LM13 aluminium alloy squeeze cast process parameters using taguchi and genetic algorithm.** This present investigation deals with squeeze casting process in order to produce a component with good mechanical properties such as micro-hardness (VH), tensile strength ( $R_m$ ), and density ( $\rho$ ) on LM13 by varying squeeze pressure (P), molten temperature ( $T_m$ ) and die temperature ( $T_d$ ). Taguchi experimental design L9 orthogonal array was used to determine the signal to noise ratio. The results specified that the squeeze pressure and die preheat temperature are the most influencing parameters for mechanical properties improvement. Genetic algorithm (GA) has been applied to optimize the casting parameters that simultaneously maximize the responses.

**50. B. Oleksiak, G. Siwec, A. Tomaszewska, D. Piękoś**

**Silver recovery from the waste materials by the method of flotation process.** During the leaching process of zinc concentrates, the waste materials rich in various metals such as eg. silver are produced. So far no attempts of silver recovery from the mentioned waste materials have been made due to the lack of any method which would be both effective and beneficial. The paper presents some possibilities of application of flotation process in silver recovery from waste materials generated during zinc production.

**51. Y. F. Wu, Q. H. Pang, Z. J. He, X. T. Zhao**

**Thermogravimetric (TG) investigation on reduction of hematite powder with carbonized corn straw.** Microtopography and combustion characteristics of carbonized corn straw and pine charcoal as well as anthracite were investigated to compare the property of fuel and analyze the application of corn straw in industrial activity. The reduction process of hematite with different reducing agent was studied with thermogravimetric analysis. It is indicated in the results that the initial reduction temperature was lower when carbonized corn straw was blended with hematite and an ideal reduction rate can be achieved with a C/O of 1.1, while the reduction rate of pine charcoal to hematite was lower and higher C/O is needed for anthracite to obtain the same reduction rate.

**52. Y. L. Cong, Z. J. He, J. H. Zhang, Q. H. Pang**

**Experimental study on iron recovery by microwave carbon heat reduction-magnetic separation from red mud.** To explore new ways to recycle red mud, this paper study on iron recovery by microwave carbon heat reduction-magnetic separation from red mud. Using orthogonal experimental method, study the effect of carbon to oxygen ratio, microwave power, heating time and slag former ratio on recovery of iron. The results show that microwave power is the main factor affecting iron recovery. After optimized by orthogonal experimental results, in the case when carbon to oxygen ratio is 1,5, microwave power is 3 000 W, heating time is 45 min, slag former ratio is 5 %, the grade and recovery of iron reach to 64,58 % and 90,64 % respectively. Analyzed comprehensively by X-ray diffraction (XRD), Scanning Electron Microscope (SEM) and Energy Dispersive Spectrometer (EDS),  $Fe_2O_3$  in red mud is reduced to  $Fe_3O_4$  and Fe by microwave carbon heat reduction.

**53. J. H. Zhang, G. J. Hu, T. X. Xu, Q. Guo, Y. Wang, C. Tian**

**Effect of biomass addition on preparation of ceramsite made by fly ash.** In this paper, effect of biomass addition on preparation of porous ceramsite made by fly ash was studied. The results indicated that when the amount of biomass addition was increased from 15 % to 25 %, the porosity of ceramsite increased from 38,3 % to 46,7%, but excessive amount of biomass can affect other performances of ceramsite. Under this experimental conditions, the best experimental Scheme to preparation porous ceramsite is that the proportion of fly ash and clay is 5:5, calcination temperature 900 °C, amount of biomass addition 20 % and calcination time 40 min.

**54. G. Napoli, M. Paura, T. Vela, A. Di Schino**

**Colouring titanium alloys by anodic oxidation.** The present study is focused on analyzing the change of colors of anodized titanium and effects of applied electrolytic voltages on chromatics. The titanium specimens were anodize in 20 g/L citric acid and 20 g/L baking soda electrolyte by use of different voltages. The colors of anodize titanium were measured with a spectrophotometer and then evaluated in the CIELAB color space. It is found that different volt produces different colors. Anodizing in the range of 15 V to 150 V produces respectively a wide spectrum of color ranging from brown to fuchsia. It can be concluded that the colors of the anodize titanium are dependent upon the applied voltages.

55. X. C. Chen, S. S. Deng, M. Chen, W. X. Hua, S. Liao, S. Yao

**Simulation analysis of striation phenomena in abrasive water jet cutting (AWJC) process of AISI 304 stainless steel.** Abrasive water jet cutting (AWJC) technology has been widely used in metal processing field. However, the generation of striations deteriorates cutting quality. In this paper, Smoothed particle hydrodynamics (SPH) coupled Finite element method (FEM) is used to simulate and analyze the cutting process of AISI 304 stainless steel. The results show that the declining jet angle will result in uneven erosion of abrasive particles, which is caused by the generation of striation phenomenon. The research can deepen the understanding of striation phenomena in metal machining process.

56. J. Gonzalez-Gutierrez, D. Godec, R. Guráň, M. Spoerk, C. Kukla, C. Holzer

**3D printing conditions determination for feedstock used in fused filament fabrication (FFF) of 17-4PH stainless steel parts.** Fused filament fabrication combined with debinding and sintering could be an economical process for 3D printing of metal parts. In this study, compounding, filament making and FFF processing of a feedstock material containing 55 vol. % of 17-4PH stainless steel powder and a multicomponent binder system are presented. For the FFF process, processing windows of the most significant parameters, such as range of extrusion temperatures (210 to 260 °C), flow rate multipliers (150 to 200 %), and 3D printing speed multipliers (60 to 100 %) were determined for a constant printing bed temperature of 60 °C.

57. N. Zeelanbasha, V. Senthil, B. Sharon Sylvester

**An experimental investigation into the impact of vibration on the surface roughness and its defects of Al6061-T6.** Surface roughness is identified as an important response which is affected by the vibration of spindle and worktable. This paper is focused on the effect of machining and geometrical parameters such as spindle speed, feed rate, axial and radial depth of cut and radial rake angle on responses during end milling operation. Experiments were conducted on Aluminum alloy 6061-T6, based on Central Composite Design (CCD). Response Surface Methodology (RSM) has been used to develop the predictive models. The scanning Electron Microscopy (SEM) results indicates that the formation of surface defect on Al 6061-T6 are adhered material particles, plucking, feed marks, micro-pits and debris of microchips. Multi Objective Genetic Algorithm (MOGA) was used to predict surface roughness, amplitude of spindle and worktable vibration.

58. Z. Horvat, V. Marušić, I. Samardžić, I. Opačak

**Influence of ploughshare surface layers on ploughing efficiency.** The paper presents comparison between standard ploughshares made of manganese steel 50Mn7 and the authors' ploughshares hardfaced with a layer of C-Co-Cr-Ni-Si on the same steel. The research was carried out by using two tractors with two four-furrow plough of the same power in a total of 360 working hours, and a total of 180 hours of ploughing with each ploughshare. Ploughshares were used to measure hardness, to analyse the structure and wear.

59. J. Kostalova, M. Bednarikova, M. Patak

**The required competencies of project managers in metallurgical companies in the Czech Republic.** This paper is focussed on the problems of competencies of project managers in the corporate practice of metallurgical companies in the Czech Republic. The authors aim to assess the requirements imposed on the position of a project manager from the point of view of the corporate management. The authors identify the basic areas playing a significant role in assessment of project managers' competencies. They represent procedures applicable within selection of a project manager. Subsequently, the authors present outcomes of a survey, these outcomes show requirements of corporate management represented by human resource department managers of metallurgical companies in the Czech Republic when recruiting project managers in practice.

60. M. Krneta, I. Samardžić, Ž. Ivandić, D. Marić

**Joining materials by metalock repair method.** This paper presents joining of material, usually of grey cast iron, by the metalock and masterlock joining methods. There is a complete joining procedure presented, which includes metalock keys and masterlock plate. Examples of successful applications of these two methods of material joining are presented within demanding reparation processes. The paper also elaborates comparison of tensile test carried out by using metalock repair method and welding on grey cast iron SL 25.

61. L. Dahil, A. Karabulut, I. Mutlu

**Application of different heat treatment to spheroidal graphite ductile iron (SGDI) and its effect for damping and mode shapes.** In this study, damping and mode shapes are investigated after the application of boro-tempering and austempering to the spheroidal graphite ductile iron. Samples were boronized and were austenized at 900 °C for 2 hours by pack cementation method. The samples were rapidly taken from that temperature and were tempered into salt bath at 250 °C and 375 °C for 1 hour. After the boro-tempering and austempering, the samples were cooled and at room temperature and were washed with plenty of water. The mode frequencies, damping ratios and mode shapes of these samples, which are exposed to different heat treatments, were acquired using the experimental modal analysis method (MA). It's seen that the frequency of sample, which was austempered at 250 °C and has a harder surface after the heat treatment, higher than the others' frequencies.

62. L. H. Feng, K. Liu, H. K. Liang, G. L. Liu

**Comparative study between traditional and coherent jet oxygen lance interaction with molten pool.** As an advanced nozzle and because of protective gas around the main oxygen hole, coherent jet oxygen lance can make the jet concentrated with higher kinetic energy. In this paper, a coherent jet oxygen lance is tried to be made with small oxygen holes around the main oxygen hole on the traditional oxygen lance. Flow characteristic of coherent jet oxygen lance and traditional oxygen lance are simulated by CFD software. The results show that, compared with traditional oxygen lance, the attenuation of coherent jet oxygen lance is slow on the center axis, impact depth is deep, the liquid region velocity is high in the center of molten pools, flow ability of liquid steel is good in molten pools. Coherent jet oxygen lance with the suitable lance height can replace traditional top-bottom blowing mode.

63. W. L. Guo, Y. H. Xu, D. Q. Cang, S. F. Ma, H. Tian, Z. J. Meng, X. X. Zhang

**Study on alkali liquor roasting and sulfuric acid leaching of bayan obo rare earth concentrate.** Take the roasted ore after the alkali liquor roasting and decomposition of Bayan Obo rare earth concentrate as the raw material, and use the sulfuric acid leaching to extract the elements including rare earth, thorium, tetravalent cerium, etc. The influence on the leaching of rare earth, thorium, tetravalent cerium made by the leaching conditions including mineral acid ratio, initial acidity, leaching temperature, and leaching time is researched. The result shows: when the mineral acid mass ratio is 1:1,1, the initial acid concentration is 6 mol/L, the reaction temperature is 90 °C, and the reaction time is 120 min, the gross leaching rate of rare earth is greater than 95 %, and the leaching rate of tetravalent cerium and thorium is greater than 97 %.

64. C. Kolmasiak, T. Wylecial

**Heat treatment of steel products as an example of transport phenomenon in porous media.** The paper defines the concept of porous charge and presents its general classification. The mechanisms of heat transfer that take place in this type of charge during heat treatment as an example of transport phenomenon were discussed. The main thermal property of porous charge is the effective thermal conductivity  $k_{eff}$ , which corresponds to the thermal conductivity of homogeneous substances. Introduction of the concept of the effective thermal conductivity substantially facilitates analysis of complex heat flow processes connected with heat treatment of porous charge.

65. A. Kozhevnikov, I. Kozhevnikova, N. Bolobanova, N. Kochnev

**Evaluation of power losses during stochastic changes in the current of the main drives of cold rolling mills.** This paper presents the analysis of the adverse impact of the current oscillations on electric power losses in the manufacture of flat rolled products. The results of mathematical processing of experimental data for the study of the influence of transient processes in the cold rolling mill electromechanical systems on the rate of power losses during rolling are discussed. The negative effect caused by power losses has been evaluated and focus areas to reduce the operational costs have been identified. In addition, technical measures aimed at minimizing oscillation processes during rolling have been proposed.

66. L. Li, K. Li, Q. Miao, A. Chen

**Carbochlorination of low-grade titanium slag to titanium tetrachloride in molten salt.** To verify the feasibility of carbochlorination of low-grade titanium slag in molten salt for the crude  $TiCl_4$  preparation, the thermodynamic analysis and experiments were conducted. Titanium slag, assaying 74,6

wt. % TiO<sub>2</sub> with high calcium and magnesium oxide impurities, was treated by optimized carbochlorination process in NaCl molten salt. The impurities in titanium slag were chloridized, and FeCl<sub>2</sub>, MnCl<sub>2</sub>, MgCl<sub>2</sub>, CaCl<sub>2</sub> and CrCl<sub>3</sub> can be collected in the furnace slag. Theoretical calculations and experimental studies reveal the feasibility and the percentage content of TiCl<sub>4</sub> in the products was over 98,8 wt. %.

**67. Y. J. Liu, M. G. Shen, Z. Q. Lv, X. H. Han**

**Study on insulation effect of hollow riser.** According to the air insulation, the use of riser hollow way to reduce the riser heat transfer, improve the riser insulation effect. In the experimental simulation, the corundum brick inner and outer wall and the air gap temperature were measured. The optimal air gap is 25 mm from the heat transfer theory and the outer wall temperature, but the insulation effect is not obvious. To further explore, proposed in the inner and outer walls to 25 mm as a unit into the insulation board improvement measures. The results show that the insertion of the insulation board can greatly reduce the temperature of the outer wall and improve the insulation effect. When inserting a heat shield, the heat flow can be reduced by about 50%. With the increase in the number of inserts inserted, the insulation effect is gradually increased.

**68. R. Moszumański**

**Components precise dispensing for low flowability mixtures.** The conception of precise dosing of multicomponent mixtures, some of which point out low flowability properties or lack of them at all. Laboratory tests of precise dosing were conducted in semi-automatic cycle with manual interruption of dosing and automatic cycle based on indications of electronic balance. The next step was to verify selected results on a test stand in a technical scale. On this basis, the component dispensing model system stand for the manufacture mixer was designed. Model dispensing research was conducted in a virtual environment.

**69. R. Servin, I. Calderón, A. Perez, F. Equihua, L. Falcon, M. Garcia, P. Orozco**

**Analysis of friction coefficient for a base steel 5 % Cr, applying variable loads of 196 N, 294 N and 392 N, and speeds of 0,18 m/sec, 0,36 m/sec and 0,54 m/sec.** The present study consists in analyzing the friction coefficient as a variable of the normal load and slip speed for 5 % Cr steel, by applying the Block-on-Disk method according to ASTM D2714. The friction coefficient increases linearly 23,25 % from 0,214 to 0,266 when the load is increased from 196 N to 392 N; the same phenomenon is observed when the friction coefficient increases 47,82 % from 0,23 to 0,34 when the slip speed increases from 0,18 m/sec to 0,54 m/sec. The friction coefficient increased by 23,25 % for an increase in the load from 196 N to 392 N, which corresponds to 100 %, while an increase of the friction coefficient of 47,82 % occurred by increasing the speed from 0,18 m/sec to 0,54 m/sec which corresponds to 200 %.

**70. D. Y. Tian, X. D. Shu, C. Xu**

**Mechanism research on eliminating voids in bearing steel ball by floating-pressure method (FPM).** To eliminate internal void and improve the mechanical properties of steel balls formed by skew rolling, the floating-pressure method (FPM) using high-pressure gas to compact void is applied in this paper. By establishing void closure mechanical model, effects of various factors on void closure are obtained. The change rule of microstructures and outline of steel ball is investigated using DEFORM-3D Finite element software, and results show that when void is entirely closed, steel ball diameter decreases by less than 2 %, and its dimensional accuracy is guaranteed; the dynamic recrystallization of the metal around void promotes the healing of micro-cracks. The FPM experiments are performed, which verify the accuracy of the finite element model.

**71. Kik T., Wyględacz B., Górka J.**

**Heat source models in numeric welding simulations.** Contemporary engineering software enables us to simulate welding process, achieving high convergence with real process, in case of both simple and complex structures. Welding numeric simulations gives us insight on influence of specific parameter change on end result. All this leads to decrease time and cost of production preparation. Welding processes in industrial application differ drastically with total power output, power concentration and volumetric distribution. This heat source parameters difference impacts temperature field distribution during welding and as a result joint parameters. Successful welding simulation needs a fitting model of heat source to achieve best results. Many mathematical models of welding heat sources were developed. Awareness of model types, ability to calibrate their parameter is key to preparing a successful welding simulation.

**72. R. Usenko, J. Busheyko, N. Stojčević**

**Ceramic shell forms based on quartz sand and materials of technogenic origin.** The levels of the main technological parameters of ceramic shell molds based on quartz sand and materials of technogenic origin for investment casting are established. The use of materials of technogenic origin for these forms makes it possible to increase the economic attractiveness of the technological process. The spent ceramic shell molds are partially regenerable and can be reused in the technology of shell mold making.

**73. R. Usenko, I. Bichevnik, I. Mamuzić**

**Porosity of ceramic shell molds.** It is established that the open porosity of the uncalcined (wet) ceramic shell mold on the basis of quartz sand and liquid glass is 12 ... 14% (by volume), after heating to 950-15 °C and cooling with oven to 20... 25 °C - 18 ... 27% (by volume). The increase in porosity in the calcined ceramic shell mold is due to the appearance in it of new capillary channels. The appearance of such capillary channels is caused by thermal expansion-compression of the material of the mold during its heating and subsequent cooling.

**74. A. Belyi, I. Vitez**

**Research influence of regulation cooling on the microstructure of rolling from chilled iron.** Established slight reduction in the number of cementite layer in the working roll and elevated its axial strength properties due to the thermal insulation zone forms from the environment.

**75. F. Vode, B. Arh, J. Burja, S. Malej, F. Tehovnik**

**Calculation of heat transfer coefficients.** For accurate prediction of temperature evolution of certain reheating problem one needs beside other data also heat transfer coefficients. For temperature prediction models in metallic industry, the most often way is to measure temperature in the desired body at certain spots and instantaneously measure also temperature of the furnace wall or air or some other combined boundary condition. Since alloy thermal data are available, the only unknown parameter of model is heat transfer coefficient, assuming initial conditions and geometry of the system are known. In case of forced convection furnaces for heating aluminum alloys, convective heat transfer mechanism dominates. Supposing radiative and conductive heat transfer coefficients are constant, one can determine convective heat transfer so that the measured temperatures match calculated.

**76. M. Kán, L. Parilák, M. Adamčák**

**Possibilities of Application of High-strength Steel Tubes in Different Car Components to Reduce Weight and Emissions.** This article is concerned weight reduction in the automotive industry. Weight reduction has become a key issue in the automotive industry in recent years, and it is a trend that's set to continue as manufacturer's look to eke out every bit of extra fuel efficiency from their vehicles. This has led to rapid development in vehicle parts, but any new ideas and innovations must still retain the safety and functionality of standard parts. The challenge for designers is to develop parts which can reduce weight without affecting performance, and which will be cost-effective to manufacture in large volumes. Analysis showed that by using various grades of steel for different components, the part could meet its structural performance requirements with a 30% weight saving. We have already seen various developments with lightweight metal but the most significant advance may be the use high-strength grades of steel. These materials provide similar strength and performance to classical steel, but at a much lower weight and thickness.

**77. N. L. Chekunova-Tomacheva, I. E. Uskova**

**Use custom indicators in determining the effectiveness of mergers and acquisitions.** Using the growth in the value of the company as a criterion for the effectiveness of mergers and acquisitions do not exclude the use of a number of subsidiary indicators. The most common indicator is the P / E (price / earnings), where P - the price of ordinary shares, E - profit after tax per share. The reciprocal of the E / R shows the rate of return. Can also be used other indicators of P / R (price / revenues) - ratio of price to earnings. MVIC / EBIT - the ratio of market value of invested capital to earnings before interest and taxes or earnings before interest, taxes and depreciation and amortization - an indicator that is widely used in the community of mergers and

acquisitions. P / CF - price / cash flow, where cash flow is often a gross cash flow, ie net income plus the amount of accumulated depreciation. P / BV - price / balance value, where balance value is equal to the capital shareholders.

**78. M.A. Fedotov, G.E. Folmanis, L.V. Kovalenko**

**The obtaining of aqueous colloidal solution of selenium by laser ablation.** The laser ablation is a promising technology of preparation of selenium colloidal solutions. The resulting selenium solutions can be used in various fields. The preparation, obtained on the basis of colloidal solutions of selenium, possess biologically active properties and can be used in medicine and agricultural production. To produce colloidal solutions, high-purity selenium was used, which was irradiated by solid-state impulse laser with wave length of 1064 nm and the pulse energy of 2.50 J. Pulse duration was 12 ns and frequency was 1 Hz. It is determine that the irradiation of the target and selenium colloidal solution by laser impulses is accompanied by a change of morphology of selenium particles with size 100-500 nm.

**79. B. P. Mikhailov, V. Ya. Nikulin, A. B. Mikhailova, P. V. Silin, I. V. Borovitskaya, N. A. Krutskih, S.Ya. Alibekov**

**Structural transformations and properties of superconductors under the action of shock loads.** Superconducting parameters are highly sensitive to chemical and phase composition, grain size and morphology, density and texture, the presence of impurities at the boundaries and in the grains, the number of vacancies, number of pores and dislocations that are effective pinning centers. All these factors depend on the conditions and methods of synthesis of the superconductor, deformation and heat treatment. Recently, interest is in the use of pulsed plasma and mechanical shocks for structural transformations and enhancement of properties. The report presents the results of studies of shock effects on the structure and properties of HTSC - Bi-2223 and MgB<sub>2</sub> tapes. The possibility of increasing the critical current J<sub>c</sub> and the critical temperature T<sub>c</sub> is shown.

**80. Vedyakov I. I., Gurov S. V., Konina S. M., Odesskiy P. D., Egorova A.A.**

**New construction steel in standards and norms.** In recent years there have been significant changes in the chemical composition of the steel, significantly decreased the carbon content, especially harmful impurities, primarily in the case of high strength steels with  $\sigma_y \geq 390$  N/mm<sup>2</sup>. These changes are associated with a radical improvement of production technology of hardening of steel under consideration, that occurred in the steel industry over the last 20 years. Well-known the basic concept of improving the quality of the considered steels is enhanced dispersity of the composition of the rolled metal, combined with increasing purity of the metal in harmful impurities and gases. New standard “Rolled products for structural metal constructions. General specifications” GOST 27772-2015, and the standards on tubes and I-beams with parallel flange edges take into account the latest achievements of metallurgy in the production of metal with finely dispersed structure and high purity by harmful impurities and nonmetallic inclusions. Increased physical-mechanical properties of rolled products and pipes for construction metal structures considered in the drafting of new building design standards SP 16.13330.2017.

**81. N. A. Kazakova, A. L. Gendon, N. V. Sedova, E. A. Khlevnaya**

**Estimation of factors and projected growth of the metallurgical branch of russia under unstable market conditions.** The results of the performed analysis of the development indexes of the Russian metallurgical industry, the production dynamics and export tendencies of the largest exporters were represented. The estimation of the specific factors of price formation in the market of steel products of the Russian Federation, the record of the growth of prices for ore and coal in the world, together with the analysis of the main financial values of the activity of the largest metallurgical companies allowed calculating the projected indexes basing upon their activity for 2017-2018. On the base of these projected indexes of the companies' activity and worldwide trends of demand for steel products, the estimations of the products demand were given taking into account the determining factors of the branch development.

**82. C. Y. Shi, J. C. He**

**Analysis of influencing factors of the blocking layer based on electromagnetic induction-controlled automated steel-teeming system.** RThe steel-teeming time, directly affected by the output parameters of power supply, is one of the most important technical indicators for the electromagnetic steel-teeming system. The location and thickness of the blocking layer in the molten steel channel directly affect the steel-teeming time. This paper establishes numerical simulation model and uses high temperature off-line test to prove the accuracy of numerical simulation. Result shows: As the tonnage increase of ladle, the position and thickness of blocking layer are basically unchanged; As the length of molten steel channel extends, the position of blocking layer shift upper and thicker; As the diameter of molten steel channel extends, the blocking layer is lower and thinner slight; Comparing the molten steel channel in “horn” shape with cylindrical shape, the blocking layer of former is upper and thicker than the latter.

**83. M. Kramarz, W. Kramarz**

**Management the flow of components between cooperating organizations.** This paper discusses the strategy of strengthening the resilience through production postponement and building network relations with subcontractors and participants of distribution channels. Two variants of this strategy were considered and their limitations were indicated. Due to the aim of the research, attention was focused on the material decoupling point of the supply chain: assemble-to-order. The research procedure consists of the following stages: the identification and the analysis of disruptions (diary method, statistical analysis), the identification of material decoupling points, the identification of factors which determine network relations and the development of a construct of the cooperation climate and the analysis of the sensitivity of the supply chains to changes in the cooperation climate (simulation modelling in the system dynamics technique).

**84. A. Nechausov, I. Mamuzić, N. Kuchuk**

**Synthesis of the air pollution level control system on the basis of hyperconvergent infrastructures.** The basic influencing on character of dispersion and distribution of harmful substances factors in atmosphere are allocated. A multifactorial mathematical model has been developed for constructing fields of concentration of pollutants, which is based on two types of distribution the normal and S<sub>L</sub>-distribution of Johnson. The geoinformation technology (GIT) structure components are determined. A program for determining the stability class of the atmosphere has been developed. A model of the process under investigation on a cartographic basis was developed with the presentation of the results in the form of a concentration isotype. The structure of the database of the parameters of sources and characteristics of sources of air pollution which is part of the serving hyperconvergent infrastructure has been developed.

**85. B. Kosec, M. Vodlan, B. Karpe, I. Kopač, I. Budak, A. Pavlič, T. Puškar, H. Taubmann, A. Nagode**

**Thermal characteristics of selected dental materials.** Today almost all producers of dental materials in their certificates of quality of material give its chemical composition, mechanical properties, process ability in aesthetic characteristics while informations about thermal properties are not available. Within the work measurements of the thermal properties of selected, in daily dental practice used, dental materials which were produced in the laboratories of Slovenian firms and high education institutions have been carried out. Measurements were carried out at room temperature, and in a temperature range between 0°C and 50°C, in accordance with standard ISO 22007-2. A complex study was preformed and evaluation of functioning of the Hot Disk TPS 2200 device, modern and high-quality instrument for the thermal properties determination, was carried out.

**86. A. Pacana, A. Gazda, N. Życzynski**

**Monitoring the process of anodising of pistons using the control chart.** The process of anodising of aluminium pistons has been analysed. The analysis has been conducted with the use of a control chart, which is one of the traditional quality management tools. Its purpose is consistent and effective elimination of faults by means of identification of their actual causes and applying appropriate preventive measures. It has been determined that even the most complex control chart, the  $\bar{X}$  and R chart, can indicate problems within the anodising process and contribute to its improvement.

**87. I. Vitez**

**Modeling of industrial soil pollution.** There are two kinds of of industrial soil pollution. The first one is direct injection of toxic or radioactive liquids into soil inside plans area for example as a result of spillage. The second one is atmospheric preipitations containing such pollution inside ouer large area. The main attention in the present work is paid to residual pollution created as a result of sorption of pollutant by rigid frame and ways to over come these negative phenomena.



## 88. N. Živković

**Ecological systems under influence of industrial activity.** Beside of usual ordinary differential integral and finite mathematical models of specific factors convective-diffusive models are used in the present work. At the present time equilibrium states of ecological system are changed due to human activity especially industrial activity of metallurgical plants and power generation system. A specific asymptotic approach analysis of ecological system behavior near the behavior near the equilibrium state is developed in the present work.

## 89. V. D. Sekerin, M. N. Dudin, V. I. Gayduk, S. V. Bank, A. E. Gorokhova

**Managing iron and steel enterprises: study of innovative methods of industrial engineering (logistics approach).** Specifics of the logistics approach in managing an iron and steel enterprise is reviewed. Attention is focused on the logistics management issues; the areas of their solution are defined. The article proposes an economic mechanism for managing the logistics activities of iron and steel enterprises, including a set of consistent, mutually agreed management activities and measures that encompasses the cycle of assessing, analyzing and optimizing logistics activities and aims at achieving the performance goals. The mechanism is based on a system of methods, models and techniques and provides for the adjustment and control of deviations, thereby ensuring timely response to the deteriorating parameters of managing the logistics activities of an iron and steel enterprise.

## 90. Iu.V. Brazaluk, O.G. Goman, O.O. Kochubey, I. Mamuzic, M.V. Poliakov, D.V. Yevdokymov

**Space metallurgy: modern aims.** At the present stage of development, the space metallurgy remains rather field of theoretical science dealing with investigations of microgravity influence on metallurgical processes. The nearest aim of the considered science is to develop a technology of transformation of waste metal constructions into the new necessary metal products. Such approach is extremely important from the economical point of view, because every kilogram transported from the Earth to an orbit costs very high. It's a pity, but International Space Station and similar space objects cannot be considered as a platform for the described activity. Therefore, beside of development of an space metallurgical technology for metal product processing, an orbital platform for its realization must be prepared.

## 91. Iu.V. Brazaluk, A.V. Davydova, O.I. Gubin, O.O. Kochubey, I. Samardžić, D.V. Yevdokymov

**Mathematical modelling and numerical simulation of welding processes in outer space.** Basic physical phenomena in welding process in outer space are completely similar to the same phenomena in usual terrestrial conditions, however quantitative parameters of the process can sufficiently differ. To formulate a mathematical model of the process, let us assume that we have two metallic bodies (generally of different metals) clasped close one to other. Let there is intensive heat source on the interface boundary. Thus, the temperature fields in bodies are described by non-linear heat conduction equations, heat source on the interface is prescribed or obtained from the solution of electrodynamic problems, if an electrical welding is used. Thermal radiation into surrounding vacuum and possible melted metal evaporation into surrounding vacuum is taken into account in the prescribed boundary conditions. Several numerical calculations are carried out to illustrate the considered problem.

## 92. O.O. Kochubey, Iu.V. Brazaluk, A.V. Davydova, M. Kostelac, R.O. Shulha, D.V. Yevdokymov

**Hydrodynamic Interaction of Particles in the Melt in Microgravity Conditions.** The object of the present work is numerical simulation of hydrodynamic interaction of disperse phase objects in the melt due to Stokes flow, possible their clustering and coalescences, what can effect on quality of the metal. Boundary element method and Lagrangian computational approach are used as tools of numerical simulation. The considered problem is illustrated by several examples of numerical calculations.

## 93. O.O. Kochubey, Iu.V. Brazaluk, O.G. Goman, I. Mamuzic, M.V. Poliakov, D.V. Yevdokymov

**New Approach to Space Debris Problem.** The authors of the present work have developed an idea to collect space debris with following processing them into elements of new space constructions or working bodies of rocket engines. Really, costs of materials, transported from the Earth to space in constructions or equipment are extremely high. Space debris includes the same materials and equipment, which are similar to necessary one. Transport systems for collection of space debris can be designed and manufactured at the present stage of development. However, metallurgical technologies for reprocessing of space debris are at the very beginning. Possible particular technological processes for space debris handling are discussed in the present reports.

## 94. A.V. Siasiev, O.O. Kochubey, I. Mamuzić, R.O. Topchii

**Mathematical Model of the Process of Crystallization of the Rod.** The main result is the following: an approximate analytical method and algorithm to solve the problem of thermo-viscosity for growing bodies in the presence of phase transfer, taking into account the heat exchange with the environment is developed; the law of motion of the boundary of phases division, the temperature field and stress-deformed state are determined by the decisions of the so-called associated problem of thermo-viscosity on the basis of the developed method; approximate analytical solutions that allow to simulate different technological processes are obtained.

## 95. O.I. Gubin, O.O. Kochubey, O.A. Kovalenko, A.Yu. Kruhlyi, G. Šimunović

**Numerical investigation of the temperature field of the coating-base system in plasma jet processing.** The model takes into account the temperature dependence of thermophysical characteristics of the materials, the heat loss from the surface by the radiation and smelting of the metal coating. To solve the problem the difference method with smoothing coefficients was used. On the basis of this method the calculations of the temperature field in the sample with a steel base and a tungsten or molybdenum coating are performed. The calculations of motion law of the front of the phase transition in the coating during the pulsed action of the plasma jet are performed too. The analysis of results was carried out. The results of the work can be used to investigate the thermal processes in bodies with coatings in plasma jet processing as well as in the choice of regime parameters of the process.

## 96. O.I. Gubin, O.O. Kochubey, O.A. Kovalenko, I. Mamuzić, V. V. Shcherban

**Numerical investigation of temperature field of a pipe in the application process of ion-plasma coating on its inner surface.** For numerical solution of the problem the locally-one-dimensional difference scheme was built. On the basis of the scheme the calculations of the temperature field of the pipe were performed. A detailed analysis of the calculation results was carried out and the regime parameters of the coating process were selected which provide the recommended thermal regime of the pipe in the process. The results of the work can be used to investigate the thermal processes in the application process of the ion-plasma coating on the inner surface of the pipe taking into account the influence of various parameters of the technological process.

## 97. V. V. Biliaieva, V.V. Dzhepa, O.O. Kochubey, I. Mamuzić

**Numerical simulation pollutants transfer in industrial rooms after accidents.** The numerical models proposed can be used to predict air pollution in industrial rooms for different type of ejections (accident spillage, short time ejections, etc) permitting to take into account both the equipment situation in the room and in- and out openings of ventilation. The numerical models permit to calculate the process of toxic gas neutralization from steady and mobile sprinklers. Numerical integration of model equations is carried out using implicit change-triangle difference schemes, A.A. Samarski's method and Libmann's method. The results of numerical experiments carried out to investigate the processes of air pollution in industrial rooms for the different type of accidents and different ways of toxic gas concentration reduction are presented.

## 98. A. Pacana, K. Czerwińska, L. Bednářová

**Discrepancies analysis of casts of diesel engine piston.** The essential material requirement for pistons concerns its parameters at different piston working temperatures at different ambient temperatures. The study employed penetrating tests in quality control of diesel engines used in passenger cars. The aim of the research was to determine the sources of casts discrepancies detected in penetrating test, using traditional quality management tools. Ultimately, the conducted analysis was aimed to reduce the number of non-compliant products or their total elimination.