

PROCESS METALLURGY - SECTION "B" - SUMMARIES OF LECTURES

PROCESS METALLURGY - SECTION "B"

Coke production

1. A. J. Kucková, M. Šabíková, M. Fröhlichová; *Faculty of Metallurgy Technical University of Košice, Košice, Slovakia*

The Study of Type and Maceral Constitution of the Coal Charge. At gravity charging of coke chambers equal presence of type components and macerals of all grain sizes of charge is important. Their presence in grain sizes is effected by different grindability of used coal types. The work presents research results of macerals distribution and share of type components of coal in coal charge after the collective coal grinding. Occurrence of macerals and type components in grain sizes below 0,2; 0,2 – 0,5; 0,5 – 3, and over 3 mm is evaluated. The results are confirmed by determination of mean luminous reflectance of grain sizes.

2. M. Legin-Kolar, A. Radenović; *Faculty of Metallurgy University of Zagreb, Sisak, Croatia*

Metallurgical Coke as Carburizing Material in Foundry. As carburizing materials in foundry a wide assortment of carbon materials are used: graphite, pitch coke, calcinated petroleum coke and also metallurgic coke. It is very important to know some characteristics of recarburizers as its solubility, unwashed components, mechanical properties, nitrogen content and of all structural parameters of coke. Although the direct graphite injection (size of particle to 3 mm) in melt metal is the best way in commercial carburizing, cheaper materials, but also good quality, are used. This paper investigated the properties of metallurgical cokes obtained from different feedstocks with additives (atmospheric residue and coal tar pitch) after heat treatment up to 1600 °C. The obtained results were compared to the data on commercial carburizing material used in foundry, known as "Karbina". The metallurgical coke produced with addition of coal tar pitch (because he had good values of crystallite height L_c and interlayer spacing d_{002} , and is good for thermal conversion in semi-graphitic structure at higher temperatures) was recommended as convenient carburizing material.

Sintering of fine materials

3. R. Budzik; *Faculty of Materials Processing Technology and Applied Physics Czestochowa University of Technology, Czestochowa, Poland*

The Influence of Magnetite Superconcentrates in a Sinter Mix on the Metallurgical Properties of Received Sinter. In the article the findings which were received in laboratory conditions were presented. It concerns sintering of sinter mix containing iron superconcentrates with different contents of lime and quick coke. The height of a sinter layer has reached a value 750 mm. It was found that the growth of CaO content to 17 % in mixture has caused the growth of efficiency. An increase of quick coke content to 22 % causes the growth of reduced sinter degree, however a decrease in a vertical sintering rate and the same decrease of sintering device efficiency have been observed. Those data have allowed to determine a mathematical relationship between the metallization degree of received sinter and quick coke coal content in the sinter mix.

4. R. Budzik; *Faculty of Materials Processing Technology and Applied Physics Czestochowa University of Technology, Czestochowa, Poland*

The Mechanism of the Metallization and Mineralization Process in a Magnetite Superconcentrates Mixture. A very important element of the sintering process of mixtures including magnetite superconcentrates is the shape of the silicate phase, at an extreme low SiO₂ content (maximally 1,0 %). Received sinter samples with a different content of CaO were tested to determine mineralogical composition. On the basis of received chemical constitution and mineralogical composition results, the mineralization scheme of sinter was obtained from the mixture including magnetite superconcentrates.

5. R. Budzik; *Faculty of Materials Processing Technology and Applied Physics Czestochowa University of Technology, Czestochowa, Poland*

The Behaviour of Vanadium During the Process of Extracting Pig Iron from Sintered Iron Including Titanium-Vanadium-Magnetite Superconcentrates. In laboratory conditions samples of receiving sinter from the mixture including titanium-vanadium-magnetite superconcentrates were prepared. Sinters with good metallurgical properties were received. On the basis of successful laboratory tests, in industrial conditions, sinters which were charge to industrial samples were produced. In industrial samples, it was found that vanadium is penetrating to pig iron in range from 78 to 88 %. It was also found a significant correlation between vanadium content and silicon content in pig iron.

6. S. Kripak, V. Sheremet, O. Gogenko, V. Shatokha, Y. Proydak, A. Kekukh; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Increasing of Oiled Roll Scale Utilizing Efficiency in Sinter Production. Recommendations for technology regimes of sinter production under conditions of oiled roll scale utilizing were developed. Optimal parameters of scale part at the mixture with peat and part of the scale-peat mixture at the sintering burden to ensure given pelletised burden grain-size distribution, specific process productivity increasing, perfection of sinter quality and more complete burning of scale oils were proposed.

7. G. G. Efimenko, S. E. Sulimenko, N. V. Ignatov, O. I. Mikhaliyov, V. V. Bikovets; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Hybrid Pelletized Sinter Process for Blast Furnace Burden. A new hybrid palletized sinter process had been developed by NMetAU. The process is based on principles of synergism and nonequilibrium thermodynamics as well as on creation of optimal kinetic and thermodynamic condition for oxidizing and reducing reaction through their special and time. The purpose of the present development was to develop a new iron ore agglomeration process that differs from the conventional once and thereby to improve the properties of the agglomerates. Differing from the conventional pellet-bearing sinter. The agglomerates, composed of diffusional banding structures, are constituted aggregates of irregularly shaped pellets restricted to between 5 and 10 mm in diameter.

8. L. V. Kamkina, Yu. S. Proydak, R. V. Ankudinov, A. P. Meschalkin, V. P. Kamkin; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Oiled Scale Processing Into Sinter. The content of oil vapors in outgoing gases of vacuum-chamber of sintering machines by use of oiled scale

in sintering charge was estimated. The oil vapors distribution has the extreme kind with maximum in seventh vacuum-chamber. Application of burning device on reduces the amount of oil vapors in ten times in outgoing gases of vacuum chamber.

Pig iron production

9. A. A. Grechuchin, L. V. Kamkina, Ya. V. Stovba, I. Mamuzić*; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine, * Faculty of Metallurgy University of Zagreb, Sisak, Croatia*

Three Valent Iron Reduction by Electrochemical Methods. The electrochemical reduction of three valence iron to two valence one with formation of magnetite constituent in aqueous suspension of oxide-bearing iron ore was under study. This allows authors to realize the magnetic separation of this kind of ores. The work shows the possibility of replace the high energy consuming methods (such as magnetized roast) on method electrochemical reduction of hematite to magnetite in aqueous suspension at room temperatures.

10. J. Terpák, E. Dorčák, I. Košťal, L. Pivka; *Faculty of BERG, Institute of Production Process Control, Technical University of Košice, Košice, Slovakia*

Analysis of the Blast-Furnace Wind Parameters. In this paper we will present a mathematical model of the blast-furnace theoretical combustion temperature. The developed mathematical model is dedicated for wide analyses of the theoretical temperature and the influences of adding different media. Analysed were media such as steam, oxygen, nitrogen, substitution fuels, waste gas, hot reduction gases, and powder coal. The main objectives were the results from the operational and economical viewpoints. The contribution also describes results of analyses of the blast-furnace wind parameters obtained by simulation.

11. K. Seilerová, A. Mašlejová, H. Komorová; *U. S. Steel Košice, s.r.o., Košice, Slovakia*

Verification of Capability of Blast Furnace Slag to Absorb Phosphorus and Heavy Metals From Steel Plant Sewage Water. U. S. Steel Košice (USSK) carried out tests to determine the ability of USSK blast furnace slag to absorb phosphorus and heavy metals from its main sewage water treatment plant, located in Sokolany, Slovakia Water from the sewage plant and blast furnace slag were contacted for 24 hours and 48 hours. The tests showed that the waste water experienced a reduction in P and Fe and a rise in Mn and Mg contents, as expected. Based on these results it was concluded that the use of blast furnace slag as an absorbent of phosphorus or other selected heavy metals from Sokolany waste waters is not technically feasible for USSK. The blast furnace slag could be used to remove P from waste waters provided the exposure time would be sufficiently long but it is not possible with the high water flow rates present at USSK.

12. E. Dorčák, J., Terpák, I., Košťal, I. Podlubný, L. Pivka; *BERG Faculty Technical University of Košice, Košice, Slovakia*

Monitoring of the Bottom Part of the Blast Furnace. In this paper we will present an online system for the real time monitoring of the bottom part of the blast furnace. Firstly, monitoring concerns the furnace walls and furnace bottom temperatures measurement and their graphical visualization. Secondly, monitored are the heat flows of the furnace walls and furnace bottom. In the case of two measured temperatures, the heat flow is calculated using multi-layer implicit difference scheme and in the case of only one measured temperature in a given position, the heat flow is calculated using a method based on application of fractional order derivatives. Thirdly, monitored is the theoretical temperature of the blast furnace combustion process in the area of tuyeres. Monitoring and visualization of the present or past data is being made continuously during the entire blast furnace process.

13. V. Roubiček, P. Pustejovská, J. Bílík; *Technical University of Ostrava, Ostrava, Czech Republic*

Decreasing CO₂ Emissions in Metallurgy. Modern trends in Iron metallurgy. Global carbon emissions from Iron production. New solution for iron and steelmaking in a way reduce the CO₂ emission to the level, where this might be needed in the post-Kyoto period. New blast furnace technology, which operate with very low CO₂ emissions based on drastically reduced consumption of carbon containing input materials. Inject reducing gases and oils into the furnace via the tuyeres. Injection of materials containing hydrogen permits material recycling and influences the coke consumption of the blast furnace process. Direct reduction and eliminating CO₂ emissions in Iron metallurgy. Technologies and processes with CO₂ removal. Cost optimized CO₂ reduction.

14. M. Fröhlichová, L. Fröhlich, A. Kucková; *Faculty of Metallurgy Technical University of Košice, Košice, Slovakia*

Formation of Accretions in the Blast Furnace. The paper is oriented on the accretions in the blast furnace that still change their mass, dimensions and volume. The changes of accretions are caused by incidental factors and they have close connection with dynamics of blast furnace work place. There are permanent conditions that enable perpetually formation and destruction of accretions and their changes in the blast furnace. The accretions can break and go to the lower part of the blast furnace spontaneously or by technological measures and they aggravate parameters of pig iron production, reduce productivity and enhance fuel consumption.

15. N. E. Alpaev; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Analysis of Forming of Blast Furnaces Working Lines. Research of physical and chemical properties of materials which stick on the walls of a shaft of a blast furnace with skull formation and worsen the indexes of melting is executed. It is established on the basis of analysis of chemical composition of crusts, that in one cases crusts have the stratified structure, in others the change of maintenance of separate components takes place gradually. The possible variants of forming of crusts and skull as the change of charge make up terms of work of blast furnace and different intensity of work of furnace are considered. As the principal reasons of appearance of crusts, on the role of amount of pellets in a charge and chemical composition of them, presence of area of unsteady temperatures with periodic slag near the walls of bosh and shaft, and also intensity of the blast-furnace blowing mode of operations of furnace are indicated.

16. V. M. Kovshov, V. V. Bochka, E. I. Sulimenko; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Development of Mathematical Model of Blast Furnace Melting with Application of Coke's Substitutes. It's been developed the mathematical model of blast furnace melting with application of potential coke substitutes in the load. The model above consists of four parts. The model

is being developed on the basis of statistical data, which obtained on the physical model of blowing tube zone. Model represents the material and heat balance of blast furnace melting under application of potential coke' substitutes with various types of loading, namely: from the top and with blow. This part combines of all previous parts and allows optimizing quality and quantity of potential coke' substitutes.

17. V. V. Bochka, V. M. Kovshov, E. I. Sulimenko; National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine
Evaluation of Effectiveness of Potential Coke' Substitutes Application in Blast Furnaces. By means of developed mathematical model it's been investigated the lump, gas, fluid coke' substitutes influence on the parameters and figures of blast melting technological regimes. The results of investigation revealed that effectiveness of lump coke' substitutes application, via coal, anthracite, used blast and electrical furnaces coal wastes, significantly depends on loading methods as well as material's distribution on the furnace top section. Besides it also depends on these materials behavior under thermal treatment during the movement in blast furnace. Volatile substances of coke' substitutes influence on top gas' volume and composition according to these substances content in above materials. Slag forming processes, sulfur elimination procedures are being changed only in case of coke' substitute's significant sulfur content, ash quantity and composition deviation comparing with coke applied.

18. R. Ghasemzadeh; Metallurgy Dept. Iran University of Science and Technology, Tehran, Iran
Reduction of Golgothar ore with Noncoking Coal of Shahrood. Reduction of Golgothar iron ore with noncoking coal of Shahrood has been investigated at temperatures 850, 925 and 1000 °C. Effects of time and also ore to coke ratios has been studied. It is believed that a chance of gaining higher reduction in shorter time is not undesirable.

19. P. Fečková, E. Mihok; Faculty of Metallurgy Technical University of Košice, Košice, Slovakia
Research of Coburg Family Metallurgical Activities in Slovakia. The paper is focused on research of pig iron production in blast furnaces of the Coburg family ironworks and on research of pig iron refining methods, i. e. on production of hammerable iron – steel in refining installations of the Coburg family ironworks. They included refining hearths, Comté – hearths, S – M steel plant, Bessemer converter. Further it deals with research of hammerable iron - steel treatment methods for production of iron and steel products in the Coburg family ironworks. Simultaneously, the research of working methods in foundry plants of the Coburg family ironworks is described. Hammers, rolling mills for bar products, rolling mills for sheets worked in ironworks.

Steel production

20. V. Živković; Steelworks Split, Split, Croatia
Results of Reconstruction of Steel Works in Željezara Split. The old Steel Works Split was reconstructed of electric furnace and installation of a new transformer, new secondary refining. Continuous casting mill is also reconstructed (speed 1,4 - 2,4 m/min). Capacity 190 t/year. The first results of this reconstruction are also encouraged.

21. V. F. Balakin, J. A. Dinnik, S. G. Gerasimenko, E. A. Ivlev, J. N. Nikolaenko; National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine
New Generation of Technological Equipment for Production High-Quality of Sorted Steel. New constructions of equipment have developed on principle by authors. In these kinds of equipment the mainly all loaded elements simultaneously in the contact that repeatedly promotes the level surface of contact, which considerably diminishes tearing down. A simple and comfortable interface is developed for users-designers and the function of planning is given to this interface. The results of implementation of project can be used at planning of metallurgical equipment as a complex software product, which unites a man-machine interface with collection of the programs which will realize project operations of the technological planning in industry of ferrous metallurgy and handling of metals by pressure.

22. F. Trebuňa, F. Šimčák, M. Buršák*, J. Bocko; Faculty of Mechanical Engineering Technical University of Košice, Slovakia, *Faculty of Metallurgy Technical University of Košice, Slovakia
Increasing of Reliability of Converter. The innovative activities in steel production invoke exploitation of new machines with the higher production capacity and productivity of labor. The paper deals with deformation and stress analysis of carrying parts of converter pedestal on the base of which the proposals and supporting measures were made that had the aim to increase reliability of the converter during steel production. This was achieved by lifespan prolongation of anchor and connecting bolts of converter pedestal, by change of stiffness of connected elements as well as by correction of nuts of bolted connections. The realization of structural changes decreased loading amplitudes and consequently the vibrations of pedestal. Solution was verified by numerical and experimental procedures of mechanics.

23. V. I. Pishchida, B. M. Boychenko*, M. T. Tarnavsky, A. V. Schibko, K. G. Nizyaev*; Petrovsky's Metallurgical Plant, Dnepropetrovsk, Ukraine, *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine
Notch Units Improvement of Converters. Notch Units of converters wear out as a result of erosion-corrosive attack of a moving jet, especially, converter slag and damage of refractories at cutting notch. The high level of stability of notch units of 200 - 250 meltings is provided due to use periclase-carbon of refractories with a smooth internal surface, making of a flow regime of steel on the channel without large-pulsation turbulences appreciable losses of a pressure, movement of steel on a vertical on the most part of duration of its poring in a ladle.

24. A. N. Lozhko, E. A. Vlysyuk; National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine
Simulation of the Converter's Thermal Work for Optimization of Casting and Solidification Processes for Specific Forms Ingots. This work is attempt computer simulation of casting and solidification processes for ingots, which produced by converter's process for different marks of steel. This model made in a three-dimensional statement. The results of simulation is definition of influence the technological parameters (pressure, factor of heat conductivity) on quality of ingots and definition of their optimum values for the casting and solidification processes.

25. B. M. Boychenko, K. G. Nizyaev, A. N. Stojanov, A. V. Kekuch*, V. I. Pisarenko*, S. A. Evstratenko*; National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine, *Metallurgical Plant of "Krivorozhstal", Krivoj Rog, Ukraine

Features of Application Carbon Manganese Ore in 160-t Converters of Krivoro Mining - Metallurgical Combine (Kggmk "Krivorozhstal"). In converter shop of KGGMK "Krivorozhstal" the technology with application of carbon manganese ore additives which is characterized by improvement of slag making process and increasing of the residual manganese contents in blasted metal is tested.

26. Y. O. Gitchov, V. O. Pertsevoi; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Results of Explorations to Engineering of System of Gasdynamic Cutoff of Slag at Discharge of Steel from Converters. The analysis of efficiency of systems of gasdynamic cutoff of slag is given. The engineering decision allowing determining energotechnological characteristic of a gas obturator is submitted. The exploration of gasdynamic cutoff on laboratory equipment is executed which has allowed to be determined with the design characteristics of an obturator and to confirm adequacy of engineering calculations.

27. M. Warzecha; *Politechnika Czestochowska, Czestochowa, Poland*

Gas Mixing and Chemical Homogenization of Steel in 100 t Ladle Furnace. The article presents numerical simulations of fluid flow and chemical homogenization of liquid steel in gas-stirred ladle with two asymmetric porous plugs. In this study mixing time is analyzed as a function of porous plug location. All calculations were carried out by commercial computer program FLUENT using $k-\epsilon$ turbulence model. Results show the velocity vectors of liquid steel and tracer concentration field after alloy addition. Numerical calculation were used to get the mixing time of liquid steel as a function of gas flow rate and porous plugs location.

28. O. V. Mitrofanova, L. S. Kokorev; *Moscow Engineering Physics Institute (State University), Moscow, Russia*

Simulation of Vortex Structure of the Flowing Melt for Improvement of Steel Casting Process. A new approach for prediction of behavior of complicated vortex flows and conditions for separation of slag in metallurgical steel casting systems is presented. The main point of proposed approach is to find the adequate physical model, taking into account these two aspects: the discovery of reasons and mechanisms of arising of large-scale circulation (or swirling) in the flow, and the consideration of boundary layer influence on the vorticity generation and slag separation in the liquid metals.

29. Z. Adolf, J. Šmíd*; *VŠB-Technical University of Ostrava, Ostrava, Czech Republic, *RaM- area VUHŽ Dobrá u Frýdku Místku, Czech Republic*

The Influence of the Steel Superheating and Casting Speed on the Blank Defects. There were done extensive study of the influence of the steel superheating and casting speed on the continuously cast blanks quality. It is favourable to cast steel with low superheating (20 till 30 °C) from the point of view primary structure and restriction of central segregation, higher superheating is used for improvement the surface quality and at EMS utilization. Casting speed is the parameter the most influencing blank quality even in the direct influence and even in influencing further technological parameters that influence blank quality. High speed prolongs solidification time and reduces inner quality; low speed reduces blank surface quality. For each casting machine and cast steel grade is therefore important to choose optimal casting speed.

30. B. Arh, F. Tehovnik, H. Ploštajner*; *Institute for Materials and Technology, Ljubljana, Slovenia, *Steel Štore, Štore, Slovenia*

The Influence of the Electromagnetic Stirring on Macro and Microstructure of the Continuously Casting Billets. The use of electromagnetic stirring (EMS) for continuous casting brings metallurgical benefits to cast billets. At the Steelwork Štore Steel we examined the influence of electromagnetic stirring on the solidification structure of cast billets with a size of 180 × 180 mm. EMS was applied to improve the surface and subsurface quality as well as the internal quality of macrostructures of stirred and non-stirred billets is presented.

31. T. Merder; *Politechnika Czestochowska, Czestochowa, Poland*

Modelling of Flow Behaviour in a Six-Strand Continuous Casting Tundish. Mathematical modelling have been extensively used to study the fluid flow phenomena taking place in continuous casting tundish. Presents an analysis of the hydrodynamic properties of a real industries facility - a six-strand tundish of a capacity of 30 Mg liquid steel. As a result of numerical computations carried out, spatial distribution of the velocity vectors, fields of turbulence kinetic energy, temperature of steel flowing in the tundish and characteristics called RTD (Residence Time Distribution) were get. Calculation were carried out by commercial computer program FLUENT. The geometry and nodal point grid were generated in the GAMBIT program. Results of computer simulation were verified on the industrial tundish.

32. M. N. Vinichenko, N. I. Vinichenko; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

New Technology of Production – New Quality of Mold Powder for Liquid Steel. New production technology of Mold Powder for liquid steel in a mold and a tundish Continuous Casting, in a mold, in a ladle through oxidizing pyrolysis of mixture components and organic waste is developed. New production technology of Mold Powder gives new improved quality of such features as thermal-insulating ability, lubrication and surface proof, dust-making ability thanks to three interconnected factors: using pyrolysis carbon of organic waste as carboniferous component of Mold Powder; perfect mixture of carboniferous and mineral components; granulating powder in production process. Using Mold Powder of a pyrolysis type, for example, in a tundish of Continuous Casting, lets cast in one series 11 - 12 thousand tones of liquid steel with extra-low consumption (0,04 - 0,05 kg/t). With this, temperature wavering of liquid steel in casting process is not higher the 5 °C. Surface of ingots is described with far fewer numbers of defects then produced with mixed powder.

33. Z. Adolf, P. Suchánek, T. Gumulec; *VŠB-Technical University of Ostrava, Ostrava, Czech Republic*

Theoretical and Experimental Study of the Influence of the Mg in Deoxidisation Al on the Non-Metallic Inclusions Formation in Steel. There were done thermodynamic analyse of the formation of the inclusions on the spinel base in liquid steel. 106/04/0029. Inclusions of type $MgO \cdot Al_2O_3$ rise at the deoxidisation of the steel by aluminium containing magnesium. Magnesium increases aluminium deoxidisation ability because rising MgO decreases Al_2O_3 activity. Al_2O_3 and $MgO \cdot Al_2O_3$ inclusions are solid, hardly float from the steel and can clog the CCM nozzles. There was verified experimentally that in system Al-Mg-Ca-O-Fe (under steel deoxidisation by aluminium and following calcium modification) rise inclusions, whose nucleus is formed by the solid spinel and around the nucleus precipitate liquid cover formed by calcium aluminates.

34. J. Bažan, K. Stránský*; *VŠB-Technical University of Ostrava, Ostrava, Czech Republic, *VUT Brno, Brno, Czech Republic*

Steel Reoxidation during its Filtration. There were done experiments with steel filtration by various ceramic filters in the frame of grant

project GACR No. 106/06/0393. Experiments proved that oxide inclusions originating in filter during solidification are less thermodynamically stable than non-metal inclusions in steel before its filtration. It may be assumed that these inclusions originate in steel by reoxidation. Course of reoxidation phenomena is supported by fall of metal temperature (accompanying fall of oxygen solubility), by oxygen transfer from atmosphere to the stream of filtered steel and by successive oxidation of Ca, Al, Si, Mn and Fe. It was found existence of direct proportion for intensity of steel reoxidation during filtration and this leads to the strong fall of filtration effectivity.

35. J. Kijac; *Faculty of Metallurgy Technical University of Košice, Slovakia*

Study of the Metallurgical Aspects of Steel Micro-Alloying by Titan. Present paper is oriented particularly to the thermodynamic aspects of deoxygenation by titan in process of production of micro alloyed low carbon steel in two plants (oxygen converter 1-OC1 and 2-OC2) with the different effect of micro-alloy exploitation. Analysis of the effect of the metallurgical factors on the titan smelting loss in micro-alloyed steel production points at the need to master the metal preparation for the alloying and especially has got the decisive effect upon the oxidizing ability and rate of the slag phase availability. When comparing the micro-alloying matter yield among the individual production units, disclosed have been better results obtained in plant OC2. Confirmed has been the effect of the slag amount (average amount of 7,3 t at OC1 and 5,83 t at OC2) and its quality during the steel tapping as one among the most significant factors affecting the alloying process and which also represent its oxidizing potential.

36. V. V. Tiagnij, G. P. Stovpchenko*, G. N. Polsky, Yu. N. Gristchenko*, L. V. Chuprina, V. M. Kimstach*; *Niznedneprovsky Pipe Work, Niznedneprovsk, Ukraine, *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Optimization of Wheel Steel Deoxidation. Using thermodynamics calculations and statistical analysis of effects of ladle treatment technological factors (active oxygen content in steel, scheme of deoxidation and vacuum treatments, aluminum and calcium losses) on wheel steel quality (mechanical properties, morphology of the non-metal inclusion etc.) allow us to set possibilities of non-metal inclusion control. Economical technology of wheel steel deoxidation was developed and mastered, which reduce of aluminium and calcium alloys expense as well as gases and non-metal inclusion content in wheels steel. Composition and distribution of the non-metal inclusion for providing of high metallurgical quality of ingots and mechanical properties of wheels was studied.

37. V. Grozdanić; *Faculty of Metallurgy University of Zagreb, Sisak, Croatia*

Three-Dimensional Mathematical Model of the Solidification of Large Steel Ingots. Three-dimensional mathematical model of the solidification of low-carbon steel ingot in a chilled mould has been formulated and investigated in the paper. The model is based on theoretical knowledge and it is supplemented with experience data. In the mathematical model the thermo physical data are incorporated which are temperature dependent, what gives nonlinearity to the model. The model is solved by means of the explicit finite difference method - the method of enthalpy. The solidification algorithm has been solved with computer SPERRY 1106 in program language ASCII FORTRAN. The time of solidification, the optimum stripping time, the thickness of the solid skin in any direction, and the potential prints of possible defects in ingot may be obtained on the basis of the model.

38. M. Balcar, R. Železný, L. Martínek, P. Fila, J. Bažan*; *ŽĎAS, a.s., Czech Republic, *VŠB-Technical University of Ostrava, Czech Republic*

Modelling of Solidification Process and Chemical Heterogeneity of 26NiCrMoV115 Steel Ingot. Steel making at ŽĎAS, a. s. using the secondary metallurgy elements enables to produce liquid metal with high parameters of metallurgical cleanliness. During the casting and subsequent solidification of forging ingots, steel crystallization takes place. Directional material solidification, grain size, chemical heterogeneity and discontinuities existence can affect the final product properties negatively. Comparison of the resulting chemical composition acc. to the numerical calculation with heterogeneity of the real ingot has proven the possibility of application of MAGMA software in modelling the ingot casting and solidification conditions for 26NiCrMoV115 structural steel open-die forgings. The paper has been solved within the EUREKA program of the E13192 ENSTEEL project, registration number 1P04EO169, in financial support of the Ministry of Education, Youth and Sports of the Czech Republic.

39. B. Arh, F. Tehovnik, B. Arzenšek, J. Triplat*, M. Klinar*; *Institute of Metals and Technology, Ljubljana, Slovenia, *Acroni, d.o.o., Jesenice, Slovenia*

Chromium Loss In EAF During Stainless Steel Manufacture. Stainless steels are characterized by chromium content in excess of 10 % Cr. Austenitic stainless steels containing between 16 % and 24 % Cr. Chromium is a chemically active expensive element of stainless steel. The analysis of chromium behavior reveals that more than 97 % of chromium losses occur in the EAF. In present work a control of EAF at steel plant Acroni Jesenice will be presented.

40. B. Piekarski; *Institute of Faculty of Materials Engineering Technical University of Szczecin, Poland*

Properties of Stabilised Ni-Cr Cast Steel Exposed to the Effect of Carburising Atmosphere and Thermal Fatigue. In this paper results investigation of an effect of niobium and/ or titanium as well as silicon on the resistance of 0,3%C-30%Ni-18%Cr cast steel to the carburising effect and thermal shocks at a temperature of 900 °C under the carburising atmosphere of carbon potential equal to 0,9% are shown. Eight test alloys were manufactured in which the content of niobium was changing in a range of 0,0 - 1,75%, that of titanium in a range of 0,03 - 1,00%, and of silicon in a range of 1,34 - 2,48% (wt. - %). Quantitative relationships were plotted to describe the effect of stabilizing elements on an increase of specimen weight and volume content of carbide phases in the external layers of specimens. Also the susceptibility to crack formation and mechanical properties after carburising process is shown. It has been proved that, with exception of the resistance to carburising effect, the examined elements deteriorate the cast steel properties.

41. A. M. Golovachov, V. V. Zukov*, V. M. Juravel*, G. P. Stovpchenko, L. B. Medovar*, B. B. Fedorovskyy*; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine, *Paton Electric Welding Institute, Kiev, Ukraine*

Composite High Speed Steel In As Cast Conditions. A lot of attempts were made to replace monolithic high speed steel round shaped billets by composite billets for manufacturing tools with the same level of properties and lower cost. For example, during last years were positively tested various type of tools manufactured from the rolled and forged billets made from so known "Liquid Sandwich Ingots" of high speed steel

of M1 type with after teeming by 4140 steel. On the basis of these results were proposed to test for the same goal the Electroslag Surfacing by Liquid Metal (so known ESS LM technology) that successfully used for composite rolling mill rolls manufacturing. At the pilot ESS LM furnace were made few trials with manufacturing bi-metallic composite billets M1 over 4140 with overall dimensions $\varnothing 110 \times 1000$ mm.

42. M. Torkar, V. Uršič*; *Institute of Metals and Technology, Ljubljana, Slovenia, *TERMIT d.d., Moravče, Slovenia*

The Application of Waste Silica Cyclone Powder for the Protective Coating of Steel Billets The role of a protective coating is to diminish the oxidation of a steel surface during the reheating process for hot rolling. The protective coating consists of several components, and the effect of the coating is based on the formation of the α modification of Al_2O_3 , amorphous SiO_2 and $FeO \cdot Al_2O_3$, which all exhibit low permeability to oxygen at temperatures up to 1200 °C. The silica sand powder from the cyclone is a waste product in the separation of silica sand. Tests confirmed that waste cyclone powder could replace the silica flour as one of the ingredients in the protective coating. Here we present results of the efficiency of the protective coating after the advanced application of waste cyclone powder on AISI 1059 and AISI 6150 steels. The application of the coating reduced the oxidation and decarburisation of the steel surface during the reheating for hot rolling.

Non - ferrous metals

43. M. Šuler*, L. Kosec*, I. Anžel, M. Bizjak*, B. Kosec*, A. C. Kneissl***, J. E. Amengual*******; **Faculty of Natural Sciences and Engineering University of Ljubljana, Ljubljana, Slovenia, **Faculty of Mechanical Engineering, Maribor, University of Maribor, Slovenia, ***Montanuniversitaet, Leoben, Austria, ****Universitat Politecnica de Catalunya, Barcelona, Spain*

Synthesis of Rapidly Solidified Ribbons of Copper Alloys. In the present work, the synthesis of rapidly solidified ribbons of copper alloys is presented. Binary copper alloys, with a maximum iron content of 4,41 mass. % and similar alloys with a maximum copper content of 0,014 mass. % were produced by rapid-solidification on a rotating wheel (melt spinning). In both groups of alloys, highly supersaturated solid solutions were achieved. Rapidly quenched ribbons were examined both prior to and after heat treatment using optical and scanning electron microscopy in order to determine microstructural characteristics along the thickness of the ribbons. Thickness of the ribbons and the concentration of alloyed elements had the highest effect on microstructural changes after heat treatment. Analysis by X-ray diffraction and transmission electron microscopy were carried out to evaluate the resulting crystallography and changes in the face centered cubic cell which were controlled by the concentration of the alloyed elements. To evaluate the decomposition of supersaturated solid solutions during heat treatment, which is controlled mostly by the concentration of copper in the alloy, in-situ electric resistivity measurements were also carried out.

44. V. Hotea, E. Pop, G. Iepare; *North University of Baia Mare, Baia Mare, Romania*

The Second Order Interaction Coefficient of Oxygen at Infinite Dilution in Liquid Copper. The work presents the study of some thermodynamic properties of the CaO system, which represent the base of several technological processes in the pyrometallurgy of copper. The research have been determined several thermodynamic measurements activity and a activity coefficients of oxygen in liquid copper-oxygen function on the temperature and oxygen concentration influence of them. The experimental results have been compared to various thermodynamic models reference to metallurgical melting for alloys and discovery of some structural information on the melting in the studied system.

45. M. Achimovičová, P. Baláž, J. Briančin*; *Institute of Geotechnics Slovak Academy of Sciences, Košice, Slovakia, *Institute of Materials Research Slovak Academy of Sciences, Košice, Slovakia*

The Influence of Mechanical Activation of Chalcopyrite on the Selective Leaching of Copper by Sulphuric Acid. In this paper chalcopyrite, $CuFeS_2$, has been selective leached by H_2SO_4 as leaching agent (170 g/dm^3) in procedure of hydrometallurgical production of copper. Mechanical activation of the chalcopyrite resulted in mechanochemical surface oxidation as well as in the mineral surface and bulk disordering. Furthermore, the formation of agglomerates during grinding was also occurred. Surface changes of the samples using infrared spectroscopy and scanning electron microscopy methods were investigated before and after leaching. The leaching rate, specific surface area, structural disorder as well as copper extraction increased with the mechanical activation of mineral.

46. M. Bizjak, L. Kosec, B. Kosec, I. Anžel*; *Faculty of Natural Sciences and Engineering University of Ljubljana, Slovenia, *Faculty of Mechanical Engineering University of Maribor, Slovenia*

The Characterization of Phase Transformations in Rapidly Solidified Al-Fe and Cu-Fe Alloys through Measurements of the Electrical Resistance and DSC. For the characterization of the phase transformations in the alloys during the heat treatment the various methods of the thermal analyses are available. During the heat treatment the phase transformations of the rapidly solidified alloys of Al-Fe and Cu-Fe were successfully detected by the simultaneous measurements of the electrical resistance, and were compared by the DSC method. By determination of the temperature regions of the phase transitions or temperatures, where the dynamics of the changes is maximal, the samples were heat treated and analysed by the scanning and transmission electron microscopy respectively.

47. M. Barto, I. Vasková; *Faculty of Metallurgy Technical University of Košice, Košice, Slovakia*

Decreasing of Hydrogen Content in Aluminium. The porosity of aluminium castings is characteristic defect caused by hydrogen. The porosity is caused by the blowholes of hydrogen, that are created by influence of hydrogen solubility decrease that is related to temperature. The primary capacity of hydrogen is decreased by the falling temperature of aluminium in consolidating furnaces. In the vacuum hydrogen is removed from the melt by the influence of intermediate pressure decrease. The process can be accelerated by melt stirring or by increase of surface area of melt. The next possibility of hydrogen content decrease is the melt bubbling with inert gas. The mechanism consist of the hydrogen diffusion to the bubbling gas and its transport from melt by the inert gas bubbles.

48. E. S. Coroteev, V. S. Ignatiev; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Lead Chloride Dust Recovery by Pyrometallurgical Method. Ukrspav Ltd. introduced technology of lead chloride dust recovery by pyrometallurgical (fire) method in a drum furnace. Technology assumes preliminary dust preparation absence. Due to the assurance of the fusion preset parameters, suitable lead output is 93 - 95 %, while dust ejection does not exceed 6 %. This technology permits to complete secondary lead low-waste recycling establishment and chlorine withdrawal out of production at the plant.

49. **A. M. Znaiko, V. S. Ignatiev**; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Carbide-Thermal a Way of Reception Lead-Calcium of Alloys. Physico-chemical laws carbide-thermal of a way of reception of alloys Pb-Ca grounded on stirring of calcium carbide in fluid lead under chloric flux are investigated. The yield of calcium in an alloy makes 50 % of carbide and provides reception of an alloy with the contents of calcium up to 6 %. The way is recommended for replacement of the accepted technology of doping of lead with metal calcium.

50. **D. K. Borikar, S. S. Umare, S. G. Viswanath***; *Department of Chemistry Visvesvaraya National Institute of Technology, Nagpur, India, *Department of Chemistry Laxminarayan Institute of Technology Nagpur University, Nagpur, India*

Electrowinning of Nickel from Ammonical Sulphate Bath and Effect of Acetone on Morphology of Nickel Deposit and its Correlation with Kinetic Parameters. The electrodeposition of nickel from nickel sulphate bath was studied in ammonia medium. The electrolytic conditions for nickel deposition were optimized at room temperature. The effect of acetone on current efficiency, morphology, stability and particle size of deposited nickel powder was studied. The effect of organic additive Tribenzyl ammonium chloride (TBAC) on the morphology of nickel powder was also studied. The kinetics of electrodeposition was studied and the results were utilized in developing mathematical model. During electrodeposition the current efficiency was found to increase with increase in acetone concentration up to 15% V/V in bath solution.

Foundry metallurgy

51. **N. P. Koteshev, A. A. Zhegur**; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Improvement of Construction of Externale for Founding Cast-Iron Rollers with the Castings Calibers. Felling with the bleached castings calibers are used in the clean cages middle sort, shallow sort and tube-rolling figures. Rise of wear proof of working a layer of calibers felling is achieved on account of receipt of bleached layer on the shaped type of calibers. At the equal conditions, the depth of formation of cementite on ledges of calibers in smooth-casting to felling turns out in 2 - 4 time more than in cavities of calibers, and in felling with the castings brooks this distinction diminishes. This is conditioned to those, that in case of curvature of surface of heat-dissipation the change of direction of vector of thermal stream on type of calibers takes place felling. Reduction of thickness of wall of external with 180 mm about 55 mm at founding rollers by the diameter 310 - 320 mm and long the barrels 500 - mm results 600 in the increase of consolidation duration on 28 - 30 %.

52. **I. Budić, D. Novoselović**; *Faculty of Mechanical Engineering University of Osijek, Slavonski Brod, Croatia*

The Influence of Technological Parameters on Occurrence of Residual Stresses in Iron Castings. The paper establishes the present day state of knowledge on parameters influencing residual stresses in iron castings, based on writings on this subject. Furthermore, testing examined the influence of parameters, such as mold humidity, mold stiffness; pouring temperature and carbon equivalent (CE) on residual stresses. Tests have been carried out on standard grating test piece made of grey cast iron, poured in sand molds. The obtained measurements have been drawn in diagrams and the influence of each single parameter has been evaluated.

53. **J. Tušek, B. Taljat***; *Faculty of Mechanical Engineering University of Ljubljana, Ljubljana, Slovenia, *Steel d.o.o., Ljubljana, Slovenia*

How to Extend the Life of Die-Casting Tools. The paper explores some possibilities of extending the life of die-casting tools for non-ferrous metals, particularly aluminium, magnesium, and their alloys. In the first part of the paper is shown theoretical background of the problem. The major part treats the tools: tool life, tool manufacture, tool certificate, tool operation and repair of tools by welding. Welding is the only technology fit for repair of tools and thus to extend their service life. In the paper is shown some welding processes, which are suitable for repair welding of tools.

54. **Č. Donik, A. Kocijan, M. Jenko**; *Institute of Metals and Technology, Ljubljana, Slovenia*

The Electrochemical Characteristics of Grey Cast Iron Studied in Alkaline Solution. Aqueous based cleaning systems are used widely for industrial cleaning. They are effective and often have environmental and worker safety advantages over cleaning system based on organic solvents. In aqueous cleaning systems, however, conditions can exist the increase the possibility of corrosion. In addition to general overall corrosion, localised corrosion can occur. Because of the inclusion of bicarbonate and carbonate salts into some cleaning compositions, it is of particular interest to study of the effect of these salts on localised corrosion. In the present work, electrochemical characteristics of grey cast iron were studied in commercial alkaline cleaning agent Upon. The influence of chloride, temperature and pitting inhibitors was also studied.

55. **S. Bockus, A. Dobrovolskis***; *Kaunas University of Technology, Kaunas, Lithuania, *Join-Stock Company "Kauno ketaus liejykla", Kaunas, Lithuania*

Effect of Melting Techniques on Ductile Iron Castings Properties. The study was designed to investigate the effects of the charge, melting conditions, nodularizing and inoculation on the ductile iron castings properties. Results showed that the temperature and holding time of the melt in an induction furnace and the intensity of spheroidizing effect on the carbon and residual magnesium contents in the ductile iron castings. The same grade of ductile iron may be obtained using different chemical compositions. The castings of ductile iron will be ferritic as-cast only when large amount of pig iron in the charge and in addition some-steps inoculating treatment are used.

56. **V. Yu. Seliverstov, Yu. V. Dotsenko**; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Use of Gas Dynamic Influence on the Solidifiable Metal of Ingots and Casts. The experimental findings confirm financial viability of working off the technological process of gas dynamic influence technical and on fusion in a form for casts. Developed and can be used different variants of serve of gas and construction of devices for his input. Physical and mathematical models of the metal hardening process in the sprue device system for gas input were developed. To adapt the model, data of experimental investigations of the process of form heating. The comparative analysis of physics and technological behaviors, and calculation of an amount of gas-making matters is reduced on the basis of lime carbonate and limiting hydrocarbons.

57. **A. Mikhalev, T. Mikhaylovskaya, V. Khrichikov**; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Mathematical Model of Consolidation Metal in a Casting Form. For the sake of the high-quality founding production without conducting

of series models experiments construction of virtual casting imitator is offered. A virtual casting imitator describes the process of consolidation metal in a casting form taking into account the process of transfer heat and natural convection in a molten metal. System of differential equalizations has been decided with use method of finite elements. Mathematical model adequately represents the real physical process. Thus, a virtual casting imitator correctly forecasts quality of founding.

58. S. Senčič, B. Kosec*, F. Unkić;** *KOVA d.o.o., Celje, Slovenia, *Faculty of Natural Sciences and Engineering University of Ljubljana, Ljubljana, Slovenia, **Faculty of Metallurgy University of Zagreb, Sisak, Croatia*

Foundry Waste Management. Waste management in foundries is gaining higher ecological and economical importance. In our work, the waste management on the case study of Slovenian foundry FENIKS d.o.o. will be researched. From the sustainable development point of view is waste management most suitable since it assures material utilization of waste, reduces consumption of natural renewable or non-renewable resources and makes efficient production capacity utilization possible. Properly treated ecologically safe waste with suitable physical characteristic, long term existence is a substitute for natural materials. Sand, dust, slag and other mineral waste from foundries is increasingly being used as material in other industries.

59. L. Mariusz; *Faculty of Foundry Engineering University of Mining and Metallurgy, Cracow, Poland*

An Experimentally Verified Theoretical Model of the Mechanical Reclamation Treatment of Used Sands in a Centrifugal Reclamation Unit. In the paper a theoretical model of the mechanical reclamation treatment of used sands in a centrifugal reclamation unit is presented. The formula for calculation of the single sand grain trajectory on the surface of the disc in a centrifugal reclamation is given. The calculated path of the sand grain moving on the disc surface enabled determination the work of friction force acting on the single sand grain. In the paper the high speed camera recordings of the sand grains movement on the disc surface in wide range of testing conditions are presented.

60. L. Mariusz; *Faculty of Foundry Engineering University of Mining and Metallurgy, Cracow, Poland*

The Influence of a Single or a Multiple Mechanical Reclamation Treatment of Different Intensity on the Wear Effect of Silica Sand Grains. In the paper the results of investigations the influence of mechanical reclamation treatment on the wear effect of silica grains was discussed. The wear effect of silica sand is usually joined with many foundry processes during new sand preparation. The significant effect of silica grains destruction by means of crushing, abrasion attrition is caused by most of mechanical reclamation treatment which lead to higher sand consumption. In the paper the test were carried out aimed on recognition of manner and intensity of reclamation treatment exerted on silica sand grains during mechanical reclamation processes realized in a centrifugal reclamation unit.

61. Z. Zovko Brodarac, P. Mrvar*, J. Medved*, P. Fajfar*; *Faculty of Metallurgy University of Zagreb, Sisak, Croatia, *Faculty of Natural Science and Engineering University of Ljubljana, Ljubljana, Slovenia*

Local Squeezing Casting Influence on the Compactness of AlSi10Mg Alloy Castings. The aim of the local squeezing casting process examination has been to eliminate the hot spot i.e. the place of potential formation of shrinkage porosity. The influence of variation of process parameters on the density i.e. soundness (compactness) of AlSi10Mg alloy castings has been obtained by the local squeezing process with the pin during gravity casting in the special permanent mould. Local squeezing parameters have been determined on the basis of preliminary investigations of AlSi10Mg alloy: temperature intervals and relevant temperature of singular phases precipitation and the microstructure development at different cooling rates. The temperature interval of performing the local squeezing casting process have been established in which the density values approaching to the theoretic ones have been determined.

Refractories

62. B. M. Boychenko, V. I. Pishchida*, M. T. Velichko, M. T. Tarnavsky*; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine, * Petrovsky's Metallurgical Plant, Dnepropetrovsk, Ukraine*

To Mechanism of Mgo-C Refractories Wear in Converter. Special researches of thin structure periclase-carbon of refractories on the phenolic sheaf, working in cone parts of converters, have allowed finding out under slag skin: secondary periclase and carbon, micropores on a place of burnt out binder and reacted, recrystallization of the last with softening grains. The received data are the basis for perfecting technique of a converter process and manufacture of refractories.

63. B. M. Boychenko, V. I. Pishchida*; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine, * Petrovsky's Metallurgical Plant, Dnepropetrovsk, Ukraine*

Research of the Conditions Service of Periclase-Carbon Refractories in Converters LD. Samples of refractories are selected from zones of contact of refractories with aggressive phases after service during 2000 meltings in a cone part of the converter, its slag zone and from steel letting out hole. Researches of phase structure are carried out on x-ray diffractometer "Dron-2" in molybdenum K_{α} -radiation, fixing of diffraction diagrams is carried out in an interval of corners $2\theta = 5 - 70^{\circ}$. The route in direction to «not changed a refractories -slag zone» in area of the converter pins is investigated with the help of a microprobe "MS-46" of "Cameca" firm. Petrographically researches of samples have executed at increase up to 500X in reflected light on a microscope "Epignost 21". Results of researches have allowed describing physical - chemical and analytical models of process of destruction periclase-carbon refractories in investigated zones of converters.

64. J. Bažan, L. Socha; *VŠB-Technical University of Ostrava, Czech Republic*

Evaluation of Corrosion of Refractory Materials by Molten Steel. Works were oriented on the study of corrosion phenomena of refractory materials, especially on interface refractory material – molten steel. Evaluation procedure was designed and experiments were done, which had to simulate in laboratory the conditions reached in plant. Results obtained in this manner make possible to evaluate influence of steel corrosion effects on refractory material. Assessment of metallographic cleanness of steel before and after contact with refractory material and assessment of rate of its corrosion, erosion and possibility of non-metal inclusion trapping on the refractory material walls were also parts of evaluation. Evaluation of individual parts of refractory material corrosion process can give insight into its very probable behaviour under operational conditions.

65. V. G. Porokhnjavyj, B. M. Bojchenko; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Service Lining in a Ladle. Conditions of service refractory and various variants combined lining of ladles are analyzed, and also the basic tendencies of its development are determined. Using law cement lining is preferable. However high cost of account materials and increased requirements to manufacturing techniques constrain its mass introduction at the metallurgical enterprises. Therefore the variant most widespread today is combined lining on a basis to form up refractory containing oxide MgO and Al₂O₃ with additives of carbon.

Production of ferroalloys

66. A. V. Lysakov, Y. V. Sadovnik; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Production of Low-Carbon Ferrochromium with Use of Converters with a Bottom Blast Supply. The technology which provides silicothermic process of low-carbon ferrochromium production in the converter with a bottom blast supply is tested in pilot scale. Optimal temperature and slag regime of process are developed. General use of chrome at the converter at a level of 95 - 96 % is reached. Hot metal has dense structure, and the carbon content does not exceeds 0,10 %.

67. I. Osipenko, O. Naumov, G. Fomenko, A. Belyi; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Micro Silica Dry Gas Cleaning of Production of Ferrosilicon, as Replacement to the Ground Silica in Compositions of Casting Rengen Phase. The expounded results of researches of silica dust of dry gas cleaning of production of ferrosilicon are expounded. Certain basic physical and chemical properties of dust of dry gas cleaning of production of ferrosilicon of the Stahanovsky factory of ferro-alloys. It goes out from the results of researches, that particle-size chemical and near to the ground silica. In obedience to the rengenphase analysis, silica part of dust is mainly represented high temperature silica. The presence of ions of calcium and magnesium (mineralizers) at the proper heat treatment will provide transition of quartz in a tridymite, not in a cristobalite, that owns a considerable by volume effect that can entail defects of coverage in the processes of exploitation. The analysis of previous tests rotined possibility of replacement of traditional basis (ground sand) in composition against the oxide crust on departure, of production of ferrosilicon (micro silica).

68. A. I. Mikhalyov, K. U. Novikova, V. A. Korjavin; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Fuzzy Identification of Smelting Process of FeSi. As the algorithms of fuzzy logical conclusion algorithms are chosen as Mamdani and Sugeno, comparative description is done. And as the explored of smelting parameter of FeSi maintenance of coke is chosen in a stove (correlation between C/SiO gas). That in a stove there was insufficient maintenance of coke in periods (4 - 12; 15; 19 - 22; 54 - 57; 59 - 63) was the result of the explored algorithms, surplus maintenance of coke in periods (1 - 3; 13 - 14; 16 - 24; 46 - 51; 58; 64 - 75), and the state-slaggy prevailed in a period (25 - 45).

69. L. V. Kamkina, G. P. Stovpchenko, A. Yu. Projdak, I. V. Golub; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Ferrotitanium Production from Ilmenite Concentrate by Way Aluminothermics Reduction. The thermodynamic analysis of ferrotitanium receiving conditions from ilmenite concentrate with use of wastes of machine-building and metallurgy was executed. On the base of experimental data the optimal ratio of various technogenous wastes for conditional ferroalloys receiving was found.

70. W. A. Grinshpunt, L. V. Kamkina; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Kinetic Investigation of Chromite Reduction in a High-Carbon Ferrochromium Alloy Bath. Kinetic measurements on the reduction of chromite ore from a lime-silicate slag by carbon dissolved in a high-carbon ferrochromium alloy bath were conducted at temperatures between 1500 and 1650 °C. The reaction kinetics were followed by periodic sampling and chemical analysis of the reduced products. The effect of adding powdered graphite to the refining slag was assessed by the extent of reduction obtained and carbon pick-up in the alloy. The results showed that for chromium oxide saturated slags, the rate of oxidation of carbon is independent of the oxide content. Carbon diffusion from the bulk alloy to the alloy/slag interface is envisaged to be rate controlling in the initial instance. Later, the reaction appears to exhibit mixed control kinetics. However, when powered graphite is added to the slag surface, less dissolved carbon participates in the reduction process.

Thermal energetics

71. J. A. Sova, V. B. Veselovsky, I. Mamuzić*, V. O. Syasev; *Dnepropetrovsk National University, Dnepropetrovsk, Ukraine, *Faculty of Metallurgy University of Zagreb, Sisak, Croatia*

Mathematical Modeling of Intensive Thermal Processes of Heating of Ingots. In new technological processes apply the equation of heat conductivity to the description of temperature fields at high-intensity thermal influences at laser processing materials and calculation of thermal modes of ingots. Mathematical models of high-intensity heat exchange constructed for compound system of bodies which are described by system of the hyperbolic equations of heat conductivity. Results of numerical parametrical researches of heating of ingots are resulted depending on duration and a kind of thermal influence.

72. S. Fedorov, M. Gubinsky, G. Shevchenko; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

The Influence of the Compact Chamber Construction on Regenerative Burners Work Effectiveness. The experimental researches of the influence construction chamber of the compact regenerator on parameters of it work have been made. The link between coefficient of hydraulic resistance and regenerator efficiency has been determined. The getting results will be able to use for choose the alternative construction chambers.

73. V. Pererva, M. Gubinskiy, A. Samsonenko; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

The Research of Energy Consumption during Production of Profiled Iron at the Shielded Mills. The estimation of the possibility of energy saving in rolling production in the "furnace-mill" section when the heat saving shields has been installed above the inker plate has been investigated. The results of the numerical studies of the process of billet heating in the furnace, temperature and profiled iron regimes demonstrate

that installation of the safe heat shields will improve the roll billet temperature on 20 - 48 °C, and will decrease electric consumption on 6,5 %. Decrease of the heating temperature in the heating furnaces on 40 - 50 °C will cause a fuel saving on 3 - 7 %.

74. A. Lozhko, E. Sorokina; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

An Acoustic-Pulsation-Based Intensification of Heat Transfer. The technical-and-economic furnace exploitation indices are considerably influenced by the system of heat utilization. In the situation of total output decrease works are forced to exploit furnaces at the partial loading, sometimes even at the idle running for the sake of steam production. The furnace exploitation in this regime is known to cause the increase of the heat portion, taken away together with waste flue gases. The losses can be partially compensated at the expense of heat exchange efficiency development in the recuperator or heat-exchanger. One of the well-known methods, characterized by high efficiency and low expenditures is the intensification of the heat exchange process by the means of pulsation method.

75. A. V. Subir; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Numerical Simulation Of Heat-Transfer In A Chamber Heated By Regenerative. The numerical simulation of lined chamber heating by regenerative burners was carried out. The problems of turbulent gaseous flow, radiant-convective heat-transfer and transient heat-conduction of chamber's wall were solved jointly. The variants of burner's arrangement in the lower part of the chamber and on its profile planes were studied. The advantage of lower arrangement of regenerative burners was shown.

76. Y. O. Gitchov, G. O. Tkachenko*; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine, *The Ukrainian State Chemical-Technological University, Dnepropetrovsk, Ukraine*

Results of Exploration of Efficiency of Pulsation Incineration of Fuel at Drying and Heating-Up of Steel-Teeming Ladles. The mathematical model of pulsation incineration of natural gas with reference to processes of drying and heating-up of steel-teeming ladles designed. The engineering decisions allowing predicting effect of pulsations are received. The results of plant explorations confirming efficiency of pulsation incineration of fuel are given.

77. Y. O. Gitchov, D. S. Adamenko; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Results of Exploration of Pulsation-Acoustical Incineration of Fuel in Furnaces of Steam Boilers. The results of theoretical and experimental-industrial explorations of pulsation-acoustical incineration of fuel in furnaces of steam boilers are given. On a base of theoretical explorations the preferable frequencies of acoustical actions are determined. The adequacy of results of theoretical explorations to real process of incineration of fuel in a field of acoustical pulsations is confirmed by explorations on a working steam boiler in boiler-house of the industrial enterprise.

78. S. N. Foris, O. G. Fedorov; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

The Economy of Natural Gas in Metallurgical Lime Production. The aim of investigations was to find the possibility of natural gas replacement by in shaft limekiln furnaces. The mathematical model of the furnace that based on equations of material, heat balances and heat transfer of separate zones of furnace: lime-heating zone, calcining zone, cooling zone was using for investigations. The results of shaft limekiln furnace figures calculation in case of partial natural gas substitution by blast-furnace gas has shown, that it is possible to use mixture of natural and blast furnace gas with content of blast furnace gas not higher than 70 - 75 % by capacity.

79. J. Tušek, M. Šraj; *Faculty of Mechanical Engineering University of Ljubljana, Ljubljana, Slovenia*

Oxy-Hydrogen-Flame for Cutting of Steels. The paper deals with oxy-hydrogen-flame cutting of a steel plate. The first part deals with calculation of the combustion efficiency of a oxy-hydrogen flame. Then follows a description of a device for supply of hydrogen-oxygen mixture. The main part of the paper is focused on oxy-hydrogen cutting. Advantages of oxy-hydrogen cutting are indicated too. The main conclusions shown that the cutted surface is very smooth, the heat affected zone is very narrow and the cutting speed is relatively higher.

80. A. Jaklič, F. Vode, B. Brezovec, J. Triplat*, F. Perko*; *Institute of Metals and Technology, Ljubljana, Slovenia, *Acroni d.o.o., Jesenice, Slovenia*

Simulation of Slab Cooling During the Transport from a Continuous Caster to a Hot-Processing Plant. In the production process at the Acroni d.o.o. steelworks the slabs are cast on a continuous caster and then transported to the hot-processing plant, where they are reheated and rolled into plates or strips. The transport of slabs is carried out by covered wagons. In the paper a simulation of slab cooling during the transport from the continuous caster to the entrance of the reheating furnace is presented. The simulation is performed for different isolations of wagon covers. The initial temperature field for the simulation is the temperature field at the end of the continuous casting process. The 3D finite-difference method is used for the calculation of heat conduction inside the slabs. Different boundary conditions that appear during the transport are described. The results were compared with optical pyrometer measurements.

81. A. Jaklič, F. Vode, B. Brezovec, *T. Marolt; *Institute of Metals and Technology, Ljubljana, Slovenia, *Štore Steel, Štore, Slovenia*

Monitoring the Reheating Process in an OFU Furnace. Štore Steel billets are reheated for additional rolling processes in an OFU furnace. The monitoring of the reheating process is important for successful furnace control. The real-time simulation model calculates the non-measurable temperature fields of all the billets in the furnace. The simulation model results and the measurement data are stored in a MySQL database. The GUI is developed in LabVIEW. The database is accessed using a GUI and presents the simulation-model results in a user-friendly way. The user can select a billet charged in the furnace and gets its real-time and past information in graphs and tables. The data can be monitored over the GUI from any computer in the steelworks that is connected to the network and has the correct installation.

Environmental aspects

82. J. Šipalo-Žuljević; *Zagreb, Croatia*

The Preparation of OH-Deficient Ferric Hydroxide Sorbents. The OH-deficient $\text{Fe}(\text{OH})_{3-n}^{n+}$ was developed to be applied in: ionic, colloid and precipitate flotations as well as for the usage of waste-water treatment from metallurgical facilities. The sorbents were prepared by specific partial neutralisation of FeCl_3 solution and characterized by pH immediately after base addition and pH after subsequent ageing. The sorbents

are composed of Fe-OH complexes (incl. bi-nuclear ones) and of precolloidal particles. The systems were characterized by Tyndallometrically observed coagulation and the portion of Fe-OH species was calculated from the equilibrium constants.

83. A. S. Grek, M. V. Gubinsky; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

The Two-Stage Process of Complex Biomass Wastes Utilization with the Aim of Fuel Gas Receiving. The way of two-stage complex utilization of the fine-dispersed biomass wastes with heating in a hot air flow and further thermal decomposition in a dance layer in vapors atmosphere has been designed. The products of such process are mixture of pyrolysis gas with an air and carbon residue. The pilot unit has been built. The experimental and numeric studies of such processes as heating and thermal decomposition of biomass were done.

84. Y. O. Gitchov; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Results of Exploration and Basic Technical Solutions at System Engineering of Technological use of a Converter Waste Gas. The results of theoretical, laboratory, experimental and trial explorations on use of a converter waste gas for reduction of iron-ore raw materials, burning of a limestone and heating of scrap metal are given. The results of exploration have allowed to receive the basic technical solutions on a recuperation chemical and thermal energy of a converter waste gas and to return it in a converter process with solid charge constituents.

85. V. S. Ignatiev, V. V. Filuk, G. A. Polyakov; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Exploration Cyclonic Swimming Trunks of Red Slimes. The technology of salvaging of red slimes of aluminous production with application of cyclone installation is developed and tested in the production conditions. Are carried out explorations of an opportunity of smelting-down of red slimes with the additive of lime and hard coal and reduction of iron oxides in a cyclone smelting room at factor of surplus of air close to 1, with the subsequent final reduction of iron from a melt in a forehearth mixing ladle. Melting allows providing partial reduction of iron oxides in a cyclone at a level of 30 % and final reduction in a forehearth mixing ladle at a level of 97 - 98 % at productivity on a melt 2 - 3 t/h.

86. U. Nefedov, S. Kravets, A. Gusev, V. Fedorinchik, V. Pechida; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Development of a Physico-Chemical Model for the Process of Regenerating Secondary Metallurgical Raw Materials during Cyclone Smelting. On the basis of theoretical and practical studies a physico/physico-chemical model has been developed of the process for desulfurising thin films of molten oxides in various industrial wastes. A mathematical model of the process for desulfurising an oxide cyclone smelting was based on the calculation relationships that determine the thermodynamic and kinetic character of the process of desulfurising of the sulfur dissolved in the slag by the gaseous oxygen, as well as on the physical mechanisms that describe the characteristic features of the formation of the flowing molten films and their parameters (thickness, flow rate, duration of the desulfurisation reaction in the smelting cyclone). Values were determined of the effective mass-transfer coefficient for the sulfur dissolved in the slag during the oxidizing cyclone smelting. It was found that the completeness degree of the process of desulfurising industrial wastes of various chemical compositions during cyclone smelting does not depend on the initial sulfur content in the slag.

87. U. Nefedov, S. Kravets, V. Fedorinchik, A. Gusev, V. Pechida; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

A Study of the Process of Liquid-Phase Reduction of Low-Iron Slags while Employing the Cyclone Smelting Technology. A technology has been studied for iron reduction in charge materials based on blast furnace and oxygen converter slimes. The theoretical analysis was based on a reduction process scheme adapted to the mechanism of subsequent contact reduction in accordance with the classical thermodynamic algorithm. In such case, as a reducing agent, the own carbon (C_1 ; C_2 ; C_3) was used, that is contained in the blast furnace top and oxygen converter iron-containing dust, whose non-stoichiometric quantity varies within the 12 % - 16 % range. With the purpose of studying the influence of the gaseous phase composition (while smelting highly dispersed raw materials in a cyclone) on the reduction process calculations were performed of the composition and theoretical temperature of the gaseous medium at different oxygen enrichment values of the blast. A blast schedule was selected for the cyclone smelting with an oxidizer surplus coefficient $\lambda \leq 1,0$ and theoretical temperature $t^\circ \approx 2100$ °C.

88. M. Holtzer, J. Dańko, R. Dańko; *Faculty of Foundry Engineering University of Mining and Metallurgy, Cracow, Poland*

Possibilities of Formation of Dioxins and Furans in Metallurgical Processes as well as Methods of their Reduction. Formation of dioxins (PCDD) and furans (PCDF) is associating the human activity for at least 100 years. These compounds were recognized as carcinogens of I group, i.e. as the strongest toxic compounds, stimulating the development of cancer by people. It can be accepted that the PCDD/PCDF may be created in each thermal process, if there are in the combustion area an organic substance and chlorine. Ones of such processes are metallurgical processes. In the article there are discussed the sources of PCDD/PCDF in metallurgical industry as well as the methods of the reduction of their emission into the environment. These methods can be divided into primary and secondary ones.

89. J. Mráček, Z. Ertl, Z. Adolf; *REAL Leasing, Ltd. Kladno, Czech Republic, *VŠB-Technical University of Ostrava, Ostrava, Czech Republic*

Model of the Effective Scrap Materials Processing of the Metallurgical Production. Paper summary is in elaboration of the sanitation system project model of the historical originated dump of the scrap materials from the ironmaking and steelmaking. There were assembled a sanitation alternatives for the concrete dump with metallurgical origin, their advantages were reviewed and risks of the resolution were identified. Each alternative comprehends economic (value) factors of the resolution and out economic factors of the resolutions (effect on the environment, sanitation time, method of the scrap removing etc.) including failure risks too. Integration of thereby arose knowledge complex leads in the design of the optimal alternative resolution. Presented model represent methodically usable direction of the difficult environment problems resolution.

Smelting reduction

90. V. P. Ivaschenko, Y. S. Paniotov, A. K. Tarakanov, V. S. Mameshin; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Main Principles of Development and Realization of Smelting Reduction Process. Smelting reduction process (SPR) is necessary for developing, as a continuously working energy metallurgical complex effectively working on cheap and accessible raw material with full recycling of smoke gases heat in the technological and power purposes. SPR is a continuously working the unit, therefore pig-iron from it should be processed

at once in steel (in a stream) in the steel-smelting unit of continuous actions and to be casting on continuous casting machine, or to act in the warmed buffer capacity from which delivery of pig-iron in steel-smelting units of periodic actions (the converter, the electric furnace) is made. The buffer capacity can simultaneously be the unit for additional refinement (for example, desulphurization) pig-iron and heating-up.

91. A. K. Tarakanov, V. P. Ivashchenko, S. V. Bobrovitskij; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Optimization of the Smelting Reduction Process Flowsheet. In conditions of Ukraine and Western Europe, for example, there is profitable to limit at an optimal level a degree of afterburning of gases in working space of smelting reduction aggregates, using the off-gas for generation of electric power in steam-gaseous cycle. But it requires higher investments in the power part of the project. In the report the technological limitations of bath smelting processes that have been developed on a pilot scale (Romelt, Hismelt, DIOS, Ausiron) are analyzed. There is shown also the example of choosing of the smelting process, which is optimal for the conditions of the Integrated Mining and Metallurgical Works "Krivovorzhstal" and which is oriented on the processing of accumulated in storage ponds in quantity more than 7 million ton mixes of metallurgical slugs and oiled millscale.

Welding

92. K. A. Yushchenko, V. S. Savchenko, A. A. Nakonechny, A. A. Rabinovych*, B. A. Gryaznov, A. P. Gopkalo**, Yu. S. Nalimov**;** *E. O. Paton Electric Welding Institute, National Academy of Science of Ukraine, Kiev, Ukraine; *R'P Company "Zarya-Machproect", Nikolaev, Ukraine; ** Pisarenko Institute for Problems of Strength, National Academy of Science of Ukraine, Kiev, Ukraine*
Fusion Welding Repair of GT Blades of EP-539LM Nickel Alloy. The plasma-arc cladding method allows repair of the airfoil tips of the blades. The developed plasma-arc welding technology provides formation of a defect-free repaired zone with corrosion properties close to those of the base metal of blades. The level of basic mechanical properties ($\sigma_{0.2}$, σ_r , δ) is 0.7 and the level of long-time strength is 0,75 of those of the base metal. As proved by fatigue tests, the repair conducted causes no decrease in fatigue properties of the blades.

93. B. Bajcer, M. Hrženjak*, K. Pompe*, B. Jež*; *Gorenje Tiki d.o.o., Ljubljana Slovenia, *TKC d.o.o., Ljubljana, Slovenia*
Improvement of Energy and Materials Efficiencies by Introducing Multiple-Wire Welding. Part I. The paper deals with a study and comparison between welding with several wires in different shielding atmospheres and single-wire welding. The first part treats the equipment for multiple-wire electrode welding and a comparison between single-wire welding and multiple-wire welding. The second part deals with the melting rate as a basis for determining the productivity of welding processes, and the third one with the energy efficiency as a criterion of cost-effectiveness of welding. The fourth part states some results obtained regarding strength of submerged arc welded joints produced with a single wire electrode and those produced with a multiple-wire electrode. Finally some conclusions are drawn.

94. J. Tušek, B. Taljat, B. Bajcar*, M. Hrženjak**;** *Faculty of Mechanical Engineering University of Ljubljana, Ljubljana, Slovenia, *Gorenje Tiki d.o.o., Ljubljana, Slovenia, **TKC d.o.o., Ljubljana, Slovenia*
Analysis of Lack of Fusion in the Welds on the Water Heaters. The paper treats a weld discontinuity called lack of fusion, in the welds, which is the most often cause of leakage of the water heater. The heater was produced by MAG welding using two wires (twin arc welding). The paper states some reasons for the occurrence of the lack of fusion, i.e. the arc blow effect, an inappropriate gun position, an uncontrolled movement of the weld pool, a too-low energy input, an improper joint preparation. The defect is illustrated in a macrograph of the weld welded on the water heater with twin wires in a shielding gas. Welding with twin wires is schematic representation of making circumferential weld joint assembly between end and shell of the water heater. At the end of the paper some practical conclusions are drawn.

Inorganic materials

95. V. I. Korsun, V. L. Galuta*; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine, *National Mining Academy of Ukraine, Dnepropetrovsk, Ukraine*
Minerals Magnetic Concentration Process Modeling by the Particles Method. High-gradient magnetic separation technological process modeling by the particles method is described in the work. Computing experiments results executed by the modern software products are given. Natural experiments results are well coordinated with them.

96. R. Petrik, K. Kyseľová, Z. Hajduová*; *Faculty of Metallurgy Technical University of Košice, Slovakia, *Faculty of Aeronautics Technical University of Košice, Košice, Slovakia*
Application of Natural SiO₂ - Al₂O₃ - CaO - MgO - Fe₂O₃ Based Minerals in Selected Metallurgical Processes for Energy Saving During Melting. Contribution deals with application of natural and similar synthetic SiO₂ - Al₂O₃ - CaO - MgO - Fe₂O₃ based materials. Natural minerals are polycomponent systems which during their spontaneous creation underwent natural thermal processes. During the production of similar synthetic materials energetically highly demanding processes take place (diffusion in solid state, or partial melting-down of the component with lowest melting temperature and subsequent dissolution of other components).

97. K. Kyseľová; M. Zacharov*; *Faculty of Metallurgy Technical University of Košice, Košice, Slovakia, *BERG Faculty Technical University of Košice, Košice, Slovakia*
Assessment of the Possibilities of Unconventional Raw Material Use – Biotitic Granodiorite in Metallurgical Processes. The assessment of usability of the unconventional raw material resources – biotitic granodiorite of slovak provenance – Polômka locality in some pyrometallurgical processes was oriented on its mineralogical and chemical composition and especially the selected physical-chemical properties important for metallurgical processes (melting temperature and viscosity). From obtained experimental results (e.g. softening temperature 1250 °C, melting temperature 1340 °C), the idea of their potential implementation in some metallurgical processes seems well-founded.

98. M. Zacharov, K. Kyseľová*, M. Havlík*; *BERG Faculty Technical University of Košice, Košice, Slovakia, *Faculty of Metallurgy Technical University of Košice, Košice, Slovakia*
Viscosity as One of the Properties Influencing the Usability of Basalts in Metallurgy. The contribution deals with the assessment of the

possibility to use basalts in metallurgy according to their experimentally determined viscosity values. Viscosity values are one of the factors influencing the reaction rate, the rate of separation of individual melting products and thus also the metal losses in slag. Obtained data about viscosity of studied basalts objectively imply their perspective use, namely for systematic improvement of the metal quality and as a basis for slagging additives and casting powders.

Miscellaneous

99. D. B. Bozhenko, G. A. Polyakov, M. I. Tarasev, A. V. Rabinovich; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*
Direct Alloy Building became Wolframium with Application Artificial Scheelite. The way of a direct alloy building is developed and tested in industrial conditions became by wolframium with application of an artificial scheelite. The estimation of an opportunity and expediency of restriction of a flow diagram of extraction of wolframium from waste with reception of one of its most important minerals wolframate calcium with the subsequent direct alloy building it of a steel without manufacture ferrotungsten. Quality of the metal succeeded on skilled technology with application of a scheelite is satisfactory on a macrostructure, hardness, to impurity with nonmetallics and replies requirements of the normative documentation.

100. V. I. Golovko, O. N. Kukushkin, N. V. Mihailovsky, L. A. Golovko*; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine, *Iron and Steel Institute of Ukraine National Academy of Science*
Application of Microwave Engineering for Information Guaranteeing to Metallurgy. It is grounded, worked up and brought the complex of scientific and technical decisions for guaranteeing control of technological parameters of metallurgical processes by radio-locating systems by way replacement radio-isotope engineering on environmentally friendly funds.

101. A. I. Michaliyov, N. V. Lysa, V. A. Gladkih, V. F. Lisenko, B. F. Lysiy; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Optimization and Prediction of Characteristics in Metallurgical Processes with Adaptive Synergetic and Hybrid Models. The problem of optimum composition (to the measure of minimum cost) the parts of multicomponent ferro-alloy charge in the preset chemical boundaries is considered. The algorithm for solving the problem with the parameters of process set as intervals and described by the membership functions is proposed. Evaluation of technological parameters of manganese ferro-alloys smelting process with the different types of expert estimation is conducted. The problem of prediction the dynamic of technological processes with the use of multimodel and fuzzy-neuro net is considered. The algorithms that use multimodel approach for prediction of the nonlinear processes are improved.

102. K. G. Nizyaev, B. M. Boychenko, A. N. Stoyanov, V. V. Kernitskiy, A. N. Buturlim, A. A. Chernenko; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Thermal Definition of a Charge at Recovery of Calcium and Magnesium in Bulk of Molten Metal. With the purpose of definition of the power expedient thermodynamic scheme of processes of electro-thermal recovery of earth metals the cost analysis of an energy on passing of chemical reactions is made, including formation of complex oxides of Mg_2SiO_4 , Ca_2SiO_4 , $CaAl_2O_4$, $Ca_3Al_2O_6$, $MgAl_2O_4$, $Ca_3Al_2O_6$, $CaAl_2O_4$. Demonstrated during a deoxidation process under the scheme with binding of resultants of reaction in complex oxides, the temperature lowering at the a beginning of chemical reactions constitutes 5 - 35 %, and thermal of a blend is reduced thus in 2 - 2,5 times. The analyses of a received results has shown, that from thermodynamic and power points of view the silicon reduction of calcium and magnesium is more preferable than a message with formation of Ca_2SiO_4 and aluminothermal recovery with education of $Ca_3Al_2O_6$. By results of researches the structures of mixes for obtaining of vaporous magnesium and calcium in bulk of molten metal are designed.

103. M. Martinkovič, M. Kusý, P. Grgač; *Faculty of Materials Science and Technology, Slovak University of technology, Trnava, Slovakia*
V-Cr High Alloyed Iron Based Tool Alloy Prepared by Rapid Solidification Process. V-Cr iron based alloy of ledeburite type exploits the gas atomization as a mean leading to an enhancement of technical parameters. Microstructure analysis of the rapidly solidified powder (presence of 5 main variants of solidification microstructures, carbide phase V_4C_3), HIP-ed compacts (ferrite resp. martensite, austenite, M_7C_3 , V_4C_3 , possibly V_6C_5) and bulks after quenching from various quenching temperatures (ferrite resp. martensite and V_4C_3) was made. For exact description of microstructure dependence on technological parameters the methods of quantitative analysis were used.

104. K. G. Nizyaev, B. M. Boychenko, A. N. Stoyanov, V. V. Kernitskiy; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Estimation of a Submergence of Electric Arc Capability Discharge in a Volume of Molten Metal. The existence of electric discharge in bulk of liquid is known for a long time and is widely applied at underwater electric arc welding. In this case electric arc exists in a gas cavity, which is generated for account of continuous evaporation of ambient water. At submergence of an electric arc in a volume of an iron-carbon melt to provide presence of a gas cavity it is possible for account a special construction of the submersible unit of application and presence in a material isolating welding rods from ambient metal of gas-making materials. It is shown, that at handling an iron-carbon melt by magnesium reduced under bed of molten metal in a zone of an electric arc, the velocity of its recovery on 2 - 3 order exceeds a velocity of consumption on a response of desulphuration, deoxidation and dissolution reactions. The indispensable gas permeability of a reduced mix thus is easily reached by present methods of a molding of spent blocks.

105. V. I. Kuzmenko, V. Yu. Dobronogova, A. V. Bojko*; *Donbass State Technical University, Alchevsk, Ukraine, *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Application Features of Belts and their Joints on Belt Conveyors at Iron and Steel Enterprises. Operation reliability analyses of belt conveyors at iron and steel enterprises showed that up to 70 % of all emergency downtime and labor-intensiveness of their maintenance is connected with destruction and remaking of junctions and that 5 - 7 % of all belt's consumption is used for butt-joint, and service life of junctions is 2 - 2,5 times less then belt's one. In this work the technological violations occurring during joining process are studied which are committed

while producing vulcanizing junctions, as well as implications and methods of their eliminations. The results of experimental works on strength properties of junctions produced with using non-glue technology are given.

106. V. Marušić, I. Budić, T. Šarić; *Faculty of Mechanical Engineering University of Osijek, Slavonski Brod, Croatia*

Research into Causes of Scrap Occurrence in Thread Cutting on Die Casted Aluminum on Steel Cases of Engine Components. This paper deals with causes for scrap building, wear and break of cutters during thread cutting of steel cases casted in aluminum die castings of car engine supports. "Annealing" at 720 °C was performed in laboratory electric chamber furnace of the raw cases, so as to simulate heat treatment to which the cases have been exposed during aluminum die casting of supports. Hardness control of raw, annealed and in support casted cases was carried out. The probable cause for excessive wear and also for breakage of the cutter and consequently to scrap occurrence should be found in the fact that internal diameter of the cases often lies under specified minimal thread cutting values.

107. O. O. Kochubey, I. Mamuzić*, M. V. Polyakov, D. M. Serbichenko, D. V. Yevdokymov; *Dnepropetrovsk National University, Dnepropetrovsk, Ukraine, *Faculty of Metallurgy University of Zagreb, Sisak, Croatia*

Mathematical Modeling of Drop Solidification. Drop solidification is widespread as in environment, as in different technologies. The solidification of drop starts from the outer boundary and at the very initial time period enough thin solid layers is formed on the outer drop boundary. After that the solidification process progresses as an ordinary phase transition process, as a rule, with spherical symmetry. However most of phase transitions lead to sharp density change. As a rule, density of solid phase is more, than liquid one, but the created surface solid layer resists to any radial load and saves the shape of drop, thus a hole is formed in the center of the drop. Otherwise, for example, for water, ice density is less than water density and, as a result, sufficient residual stresses take place after drop solidification. Solution of correspondent problem for spherical drop is presented.

108. Yu. V. Brazaluk, O. O. Kochubey, D. Tkalčić*, M. V. Polyakov, D. V. Yevdokymov; *Dnepropetrovsk National University, Dnepropetrovsk, Ukraine, *Tube Rolling Mill Sisak, Sisak, Croatia*

Interaction of Bubbles in Bubbling Process. Motion calculation of set of bubbles is one of the most difficult problems of modern hydrodynamics, because of very complex and changeable shape of flow domains. An algorithm of such problem solution is proposed in the present work. It is based on splitting with respect to physical processes, in particular, viscous and in viscid effects is separated in the model. Viscous force is assumed quasi-stationary and determined by well-known empirical formula for ball drag. Dynamic effects and interaction forces are calculated in ideal fluid flow theory; in particular, dynamic effects are determined by apparent additional mass theory. The proposed approach is illustrated by several calculation examples of the bubbling.

109. Y. S. Paniotov, V. S. Mameshin; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Modelling of the Liquid Blowing By the Horizontal Gas Jet. Modeling of the liquid blowing by gas through horizontal located nozzle is carried out. The parameters of a jet and a zone of the blowing on a pulse of a jet are investigated and received on an impulse of a jet. It is shown, that extent of a gas jet in a liquid depends on a way of blasting supply a little. On the basis of results of modeling it is offered to consider a horizontal gas jet in a liquid as a linear source of gas.

110. J. V. Romanko; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Research of Hydraulic Resistance of Compact Regenerators with Various Nozzles. Experimental researches by definition of hydraulic resistance of compact regenerators with nozzles of various types have been lead. Hydraulic resistance of the ball, honeycomb and combined nozzles were defined. Honeycomb blocks were used both pure, and polluted.

111. V. E. Hrichikov, V. Yu. Seliverstov, V. F. Mazorchuk, O. S. Naumov*, G. V. Fomenko*; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine, *Ukrainian State Chemical-Technological University, Dnepropetrovsk, Ukraine*

Application of the Second Materials for the Forms of Incomes of the Massive Casts and Ingots. For diminishing of non-productive losses of metal apply the different special ways of diminishing of expense of metal on an income and, in particular, mixtures with low heat-retaining ability. Explored physical and chemical properties of ash-taking away of Prydneprovskoy warmly power-station. It is set that by volume mass of ash-taking away in made light and close-settled, state is 948 kg/m³ and 1105 kg/m³ accordingly, closeness certain by the method of Le-Shatel'e, - 2345 kg/m³. The last testifies to the presence in composition the ash of several of heavy metals. The analysis of chemical composition of ash-taking away rotined that she on ~ 94 % represented by oxides SiO₂, Al₂O₃, Fe₂O₃, CaO and MgO. In composition ash silica is represented free SiO₂ and also structurally tied-up SiO₂ in composition of mullyt. Possibility of the partial or complete use of ash-taking away is set as the heat-resistant component of moulding compositions for the incomes of the massive casts and ignots.

112. Yu. A. Nefiodov, L. I. Anelok, K. D. Ilchenko, Ye. V. Kriukov; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Temperature Correlations of Heat and Physico-Chemical Properties of Oceanic Concretions. Physico-chemical and thermo-physical properties of oceanic concretions (PMC) have been studied using the sample heat balance method and by thermo-graphic weighting while determining the temperature relationships of reduction of weight the heat consumption, the specific heat capacity, the thermal conduction coefficient of concretions within the 20 - 1100 °C temperature range. It has been found that in their physical-chemical and thermo-physical characteristics PMCs substantially differ from the conventional types of manganese-containing raw materials. At the temperatures of 100 - 800 °C the specific heat capacity of concretions drastically exceeds the heat capacity of manganese concentrates (by 1,5 - 2,8 times up to 400 °C and by 1,05 - 1,9 times above 400 °C) and the process dewatering PMC comes to an end at temperature above 800 °C.

113. I. A. Vinnik, L. V. Kamkina; *National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine*

Utilization of Nykel Products of Elektroerosion Treatment of Details of Machine-Building Assortment By Metallurgical Methods. Physical and chemical descriptions of wastes of elektroerosion treatment of the details, made from alloyed steel are considered, containing nickel, chrome, molybdenum, is considered. The products of erosion contain toxic connections, that require development of technologies of their use. It is shown that such processing can be carried out in the conditions of renewal of wastes by a carbon. An appearing metal on composition is near to compositions of complex ligatures. It is shown that the cast-iron modified by the recovered metallic phase gains improved casting characteristic.