

## Abstracts

*V.I.Bolshakov, L.G.Tuboltsev*

### **Directions for development of metallurgical complex of Ukraine**

The purpose of this research is the estimation of prospects for mining and metallurgical complex of Ukraine, given its current state and parameters characterizing the state of global steel industry. Based on analysis of tendencies of development in metallurgy has given directions and tasks of scientific research, and also formed proposals for development of domestic metallurgy.

*J.G.Tovarovsky, V.I.Bolshakov, A.E.Merkulov*

### **Analytical study of blast furnace processes and regimes with various conditions of burden parameters**

Multyzone mathematical model of Blast Furnace process is developed. Analytical study of Blast Furnace process basing of this model was carry out with taking into account of changing of general iron content in charge, degree of it metallization, degree of dirt fluxing with burden radial distribution variation. Internal relations of processes in the blast furnace that influence to melting regime character and final results are exposed for blast furnace more than 5000 m<sup>3</sup> volume. Obtained new scientific results can be used in practical applications.

*V.I.Bolshakov, I.G.Murav'eva, Y.S.Semenov, F.M.Shutylev*

### **Method for operative estimation of stock distribution in zones of shaft top sections based on data of profile meter**

Method for operative estimation the stock distribution on radius of shaft top, using profile meter data founded on interconnection of the ore burden distribution in the areas of shaft top section and the ratio of height courses of iron-bearing materials and coke is recommended. The method can be used for operational control of the radial distribution of the charge and the gas stream in the furnace.

*V.I.Bolshakov, V.V.Lebed, A.A.Zherebetsky*

### **Use of modern control devices for control of radial distribution of charge in the blast furnace**

The urgency of effective and operational administration by a cooling-off condition by means of rational filling sequences is shown. Examples of use of information technology controls the parameters of fusion for proved choice of a mode of a blast-furnace filling are resulted.

*A.V.Borodulin, A.L.Chayka, A.A.Sohatskiy, G.P. Kostenko, P.I.Otorvin, S.V.Nyn'*,

### **The question of increasing the efficiency of fuel additives in blast-furnace practice**

The direction of more efficient use of natural gas by heating it and the control of degree thermal dissociation methane is considered. Results of the analysis of prospects to use the natural gas in a blast–furnace practice are brought. It is shown that the inverse heat power method for calculating the blast–furnace smelting permits for output parameters of the oven and some input parameters of charge and blow to define blast–furnace blast losses, the degree of breaking–up of natural gas in tuyere region on carbon and hydrogen

*A.A.Sohatskiy, A.L.Chayka, A.G.Shevelev*

**Research of processes of thermal exchange of in the mine of high furnace and their influence on the indexes of the domain melting**

The purpose of work is establishment of conformities to law and quantitative estimation of joint development of thermal and gas processes in the mine of stove taking into account work of the cooling system. On the basis of synthesis of balance model conformities to law of influence of expense and composition of blowing are set, temperatures of ore–hearth gas and pressure of gas on the technical and economic indexes of the domain melting.

*A.S.Nesterov, A.D.Djigota, V.S.Jakushev, L.I.Garmash*

**Research of process of receipt of agglomerate with enhanceable maintenance of technogenic wastes with the use of different hard fuel**

Results over of research of process of receipt of agglomerate are brought in laboratory terms from a charge with enhanceable maintenance of technogenic wastes of ferrous metallurgy. It is shown that the receipt of standard agglomerate is possible at the use of different hard fuel and maintenance of permanent maintenance of carbon in composition a charge.

*D.N.Togobitskaya, A.I.Belkova, N.A.Gladkov, A.Y.Grinko*

**Revealing the thermodynamic ratio of components in «metal–slag» system for the purpose of the directed formation of makeup of melts in a blast–furnace well**

The purpose is to revealing reliable ratio components of "metal–slag" system on the basis of the analysis of existing approaches to studying the processes of interaction of metal and slag melts in the smelting of iron. The ambiguous interpretation of the thermodynamic ratio components of pig iron and slag in the in a blast–furnace well is shown. The criteria and technique of estimation the results of cooperative interaction of ion–exchange process of chemically uniform systems are offered.

*D.N.Togobitsky, A.F.Hamhotko, D.A.Stepanenko*

**Linkage of viscosity and freezing point of domain slags with their mineralogical makeup**

Influence of structure and properties of the mineralogical composition of domain slag on the viscosity and crystallization temperature, is shown. The

Importance of relations  $\text{Al}_2\text{O}_3/\text{MgO}$  for an estimation the technological properties of domain slags from the point of view of their mineralogy is proved.

*A.S.Vergun, E.V.Prikhodko, V.G.Kislyakov*

**Influence of chemical composition and properties of ladle slag, formed in the process of pig-iron desulfurization by magnesium, on the contents of metallic phase**

The results of experimental of influence of model parameters and some physical-chemical properties of ladle slag, formed in the process of pig-iron desulfurization by magnesium, on the contents of metallic phase in the slag. It is shown that for maintenance minimum increase the metallic phase in the slag, he should have a maximum surface tension (320–330 mN • m), the maximum positive (–3.1 or more) physical-chemical equivalent of slag  $\Delta e$ , less negative (–1.68 or more) charge of sulfur in the slag  $Z$  (s).

*I.F.Manachin, A.F.Shevchenko*

**Estimation of influence of dispergating of the blown stream of magnesium on absorptive potential of area near furnace**

A research aim was increases of intensity of input of magnesium in liquid cast-iron at treatment of cast-iron (to 24-28 kg/of mines) at the use of one furnace and one batching system. It is shown that dispergating of magnesium is the effective factor of increase of his reactionary potential, increases of ability of fusion of cast-iron to take in magnesium Potential ability of area near furnace to take in magnesium can increase in 20 - 22 times.

*V.P.Piptjuk, I.D.Buga, S.E.Samohyalov, V.F.Polyakov, V.V.Motsny, S.N.Pavlov, J.P.Mahlaj, V.A.Kondrashkin*

**Design-layout and technological harametres for numerical exploration melt hydrodynamics at the treatment on ladle pot-furnace powerof 35 MW•A.**

Given basic parameters for numerical exploration of hydrodynamics of melt at the treatment on ladle pot-furnace (LPF) of Alternating Current by power 35 MW•A. Given the technological and design data used as initial for adapting the mathematical model and exploration the processes of hydrodynamics in the ladle with a capacity of 250 t.

*V.P.Korchenko, L.G.Tuboltsev, V.F.Polyakov, N.I.Padun, A.M.Shevchenko*

**Dynamics of pig-iron disposal impurities and oxidizing of iron in the course of oxygen-converter fusion**

The work purpose is definition of the mechanism of iron oxidizing and the basic impurity of pig-iron (carbon, silicium, manganese) on the periods oxygen-converter fusion. In work attempt to present the mechanism and real passing of process with use of formulas of the most probable structural groups

(Fe<sub>3</sub>C, FeC ; FeSi; FeMn), formal bridgings and complexes of reactions is made. It is shown, that during the first period mainly oxidized iron, silicium, manganese, and to some degree, carbon . The second period is characterised by intensive oxidizing of carbon. In the third period marked slowdown in the oxidizing of carbon and the beginning of intensive oxidizing of iron .

*S.I.Semikin, V.F.Polyakov, E.V.Semikina, T.S.Kiyashko*

**Features dust emission in the smelting of metal in the conditions of imposing on bosh of low-voltage electric potentials**

The work purpose was define how to improve the ecology of steelmaking by reducing the level of dust from the steelmaking unit. On fusion with electrical effects in laboratory and industrial conditions level decrease of dust emission in comparison with base technics is fixed. Shows the different character of dust emission during of blowing through of fusion depending on polarity of current supply to tuyere. A number of possible reasons for reducing dust emission by electrical influences is considered.

*S.I.Semikin, V.F.Polyakov, T.S.Kiyashko, E.V.Semikina,*

**Investigation of fining processes proceeding in 160-ton converters**

The purpose of work is to estimate of metal desulphurization with influence of low-voltage electric potentials to slag-metal melt efficiency when converter smelting. The comparative analysis of metal desulfurization index and residual manganese content in the metal and slag is carry out in industry smelting with electrical influence and with standard technology. Shown that increasing the specific power of electrical action gives the possibility to improve the thermodynamic conditions of desulfurization, increase of lime consumption and slag basicity, increase the residual content of manganese in the metal.

*S.I.Badyuk, A.I.Leshchenko*

**Analysis of schemes of combination of the continuous casting machines in foundry-rolling units**

The purpose of research to identify the advantages and disadvantages of known constructive schemes combining continuous casting machines (CCM) and the rolling mill for develop recommendations for their use. Reviewed and analyzed the structural features of the combined units, provide recommendations on the use of combining CCM and rolling mill in designed foundry-rolling units (FRU). It is shown, that offered schemes allow to build FRU with a minimum size and weight of equipment to minimize power consumption on the implementation of technological process.

*D.G.Palamar, V.G.Razdobrev*

**Improvement of production technology of the bar in the conditions of continuous small-section mills**

The purpose of work is to develop a method for the production of the bar, which provides compensation for the irregular distribution of temperature on length of a hot-rolled breakdown by creation of a return temperature wedge at a stock material supply in the first mill stand. The proposed method allows the production of a bar allows without complication of a master schedule and additional expenses to provide energy consumption decrease in production, and also to increase quality of ready metal products.

*L.A.Shevchenko, V.V.Zelinskaya, L.T.Zhupinskaya, L.T.Holyavchenko, S.L. Davydov*

**Cleaning strip rolling mill scale from low-temperature plasma**

The purpose of work is researching of possibility of using low temperature plasma for the descaling from the surface of strip. The technological parameters of plasma cleaning the metal surface of scale and efficiency of its use. It is shown, that plasma cleaning, in contrast to chemical, does not need in expenses on chemical materials, mixing of melts, solutions and neutralization used materials. Power intensity of plasma cleaning well lower than chemical.

*L.A.Shevchenko, V.V.Zelinskaya, L.T.Zhupinskaya*

**Using of product of regeneration of spent pickling solution for receiving ferrous powders**

The process of receiving of ferrous powder by restoration of waste regeneration process of spent pickling solution, containing 98 % and more iron oxide is investigated. As a firm reducer used technical hydrolytic lignin. Received ferrous powders correspond to the properties of ferrous powder grades (ПЖБ3) AUSS 9849–86. Established the possibility of RECEIVING of ferrous powder from secondary raw material: iron oxide – the product of regeneration of spent pickling solutions and lignin – waste hydrolytic processing of agricultural production.

*A.I.Babachenko, A.A.Kononenko, P.L.Litvinenko, A.V.Knysh, Z.A.Dementieva, A.N.Hulin, A.N.Savchenko, E.A.Shpak*

**Investigation of resistance to formation of indentation on the running surface of railway wheels different strength levels**

The purpose of work was exploration the characteristics of formation of indentation by thermal origin on railway wheels in operation. In laboratory conditions, the patterns influence the strength level and chemical composition of steel for the production of railway wheels on its firmness to formation of defects of thermal origin. It is shown, that the mechanism of indentation associated with the formation of the roll surface fragile structural component of high-carbon martensite and its subsequent spalling under operational loads.

*V.I.Spivakov, P.L.Litvinenko, E.A.Shpak*

**Investigation of structure formation in thick sheets with steel strength category X65, X70 at different cooling rates**

The purpose of this research was to investigate the influence of cooling rate on structure formation in sheets of steel such as X65, X70 in the range of their changes under the controlled rolling (CR) and the deformation thermal hardening (DTH). Established structure–phase diagram and shows the character of structure formation in thick sheets, depending on their chemical composition and cooling rates at temperatures interval of austenite transformation. The possibility of rational use and optimization of the Mo content in steels, as the most expensive element is shown.

*I.G.Uzlov, M.F.Evsjukov, K.I.Uzlov, A.V.Knysh, A.N.Hulin, Z.A.Dementeva*

**Investigation of kinetics of structure microalloyed by vanadium wheel–banded steel and its influence on the mechanical properties of products of railway transport**

By methods of dilatometric and microstructural analysis is studied the kinetics of structure formation in microalloyed by vanadium wheel–banded steels. The temperature–time boundary diffusion, intermediate bainite and shear transformations are defined. It is shown that the rate of cooling during heat treatment generates a structural state and mechanical properties of the products.

*E.G.Demina, S.A.Zdorovets, V.I.Sukhomlin, J.Z.Chehuta*

**Influence of regimes of deformation the bullion of the axial steel on increase of impact elasticity of railway axes**

Influence of regimes of deformation of bullion of axial steel on bloomer on structure of the normalised axes is investigated. It is shown, that for axes produced on skilled rolling schedule, the increase in density of dendritic structure at 40,0 %, reduction of size of the valid grain by 20,0 % and increase of level of impact elasticity at 30 % is characteristic.

*M.F.Evsjukov, P.D.Grushko, G.V.Galenko*

**About spheroidizing the secondary cement carbide in white irons**

The work purpose is studying the influence of heat treatment on structure formation in white pig irons. Described the kinetics of origin and secondary cementite growth in austenite after crystallization and its kinetics spheroidization after separate heating. It is shown that the cooling process after crystallization from supersaturated by carbon austenite at the eutectic carbides originating the lamellar secondary cementite and grows deeper austenite branches with a laminar growth mechanism, and secondary cementite spheroidization occurs during annealing.

*D.A.Stepanenko*

**Role of viscosity of slag in the process of interaction in the metal–slag–gas system**

Results of works about influence of metallurgical slag viscosity on the diffusion processes occurring in system metal–slag–gas–refractory, various additives on the basis of which were obtained depending on nitrogen and hydrogen permeability of slag on their viscosity have been analysed. Shows the defining role of viscosity of metallurgical slags in the processes of their interaction in system metal–slag–gas–refractory, various additives.

*V.S.Luchkin, L.G.Tuboltsev, V.P.Korchenko, V.F.Polyakov, S.I.Semikin, N.I.Padun, A.M.Shevchenko*

**Structure of liquid iron and free carbon in Fe–alloys**

On the basis of literature and experimental data the possibility of transforming the structure of liquid iron in the melting process is analyzed. Shown that the structure of liquid iron is consists of different types of particles and interparticle spaces. Existence in a liquid of particles with distant order that allows to explain the mechanism of behaviour of iron, structural groups and accompanied elements in the oxygen–converter melting.

*A.M.Nesterenko, V.L.Pljuta, E.G.Demina, O.J.Svistelnik*

**Structure formation in ekonomo alloyed chrome – manganese alloys for manufacturing of of details of the replaceable metallurgical equipment**

Found that, in cast chromo–manganese alloys of Fe–Mn–Cr–C transitive class (carbon content no more 2,2%) at certain combination of Mn and Cr is possible formation of crystals of highly hard carbide  $Me_7S_3$ . It is shown that ekonomoalloyed chromo–manganese alloys of Fe–Mn–Cr–C with eutectic on the basis of carbide  $Me_7S_3$ , are characterized by high levels of shock–abrasive wearing quality and can be used for the manufacture of rubber–metal element inserts lining the mining and metallurgical equipment.

*A.S.Kozachek, E.V.Prikhodko*

**Estimation of influence of the basic alloying elements on properties of medium–carbon steel**

The new approach and estimation technique of influence of concrete alloying element in complex with the basic composition on mechanical properties of steels is offered. Equations describing the mechanical properties of medium–carbon steels, taking into account the tempering temperature are received. It is shown that this technique can be applied to account for the influence of manganese, chromium, silicon and nickel, in any ratio of components.

*S.V.Bobyry, M.F.Evsjukov, A.M.Nesterenko*

**Investigation of the transformation eutectic cementite in manganese iron type 200Г5Х2ТЛ**

The features of transformation of eutectic cementite in the manganese–iron type 200Г5Х2ТЛ at cooling. Established that carbon diffusion in cementite occurs on small distances comparable with the distances of diffusion in the perlite (0,05 – 0,5 mm). Shown that the formation of dispersed carbides in the process of transformation of eutectic cementite defines increasing shock–abrasive wear resistance of pig iron.

*O.G.Sidorenko, L.G.Tuboltsev, I.P.Fedorova, A.P.Suhoy, Z.A.Dementeva*

**The nature of extreme speed up of the phase transformation, developing at warming the overcooled high–temperature phases**

The purpose of work was to define the nature of effect of extreme increase the rate of decay of the overcooled austenite detected by researching the structure of reinforcing bar, the hardening by heat treatment with intermittent hardening method. Established that the nature of the extreme speed up the phase transformations associated with development of transformation front.

*V.I.Bolshakov, I.B.Listopadov*

**Investigation of work combined breaking device feeding the pilger mill machine**

The purpose is the investigation of features of pneumatic braking device as a part of hydro–pneumatic braking system, the mobile mass feeding pilger mill machine. It is developed the mathematical model, and the results of investigation of air brake high–speed characteristics and braking efficiency are brought. It is shown that air braking the most effectively at the rolling of heavy assortment funnels with the minimum turns of rolls. At the rolling of easy assortment funnels the air braking notable results for improvement of quality of work of the feeding machine.

*V.V.Verenev, N.I.Podobedov, S.V.Matsko, O.V.Simenenko, V.A.Jatsenko*

**Modelling the interaction of cages of fair group of the broad–strip mill through the strip with compliance of line drive**

The nature of the transition processes in the continuous group of cages of the broad–strip mill when at modelling when consider in modeling the elastic torsional oscillations in the lines of the drive rolls and a compliant s cage system. Found that when small discontinuous increase in the thickness of the strip at the entrance to the in a cage during the rolling tension in front of the cage by 0.2 seconds decreases to zero and then looping occurs, with the thickness of the tension before and behind the cage increases, accordingly, 2 and 1,5 times.



*V.V.Korennoj*

**Comparative analysis the dynamics of various schemes of the main sheet mill trains**

Results of analysis of dynamics of the main finishing mill trains of the broad-strip mill hot rolling under its various schemes and the composition of the equipment are brought. The scheme of a line of a traction mechanism of finishing stands with the engine of an alternating current and the extended intermediate shaft, providing a minimum level of dynamic loads by coefficient of dynamism in the range of  $1,5 \leq K_d \leq 2,0$ , is offered to realisation direct-drive, which will increase the reliability of work of a line of a traction mechanism of a rolling cage in general.

*B.N.Maymur, V.I.Petrenko, I.G.Murav'eva, S.V.Vashchenko*

**Methodology of selection the methods and means of increasing the effectiveness of roller presses**

Analyzed the influence of various factors on the efficiency of the roller press. Developed and presented in the form of block diagram methodology for selection of rational ways to improve productivity of press. It is shown that the realisation of developed algorithm in the form of software product will allow at the constructing of presses to consider all possibilities to increase of productivity of the unit for each kind briqueted charge.

*K.V.Bajul*

**Analysis of operating conditions, wear and structural features roll briquet presses**

The work purpose is the assaying and generalisation of the information on service conditions, wear and constructive features of roll briquet presses. The estimation of the factors, influencing on wear and duration of the work of roll briquet presses is executed. The embodiment influence of rolls on their operational characteristics is observed. Defined the base for creation of calculating and analytical apparatus predicting tyres wear, which will allow the design on extrusion press equipment stage to establish the admissible degree of wear of the working surface of the tyres and to develop technical solutions and recommendations on the extension of resource exploitation.

*L.G.Tuboltsev, G.N.Golubyh, S.P.Sushchev, V.V.Blinnikov*

**Probability estimation of risk of origin emergency situations and incidents in blast-furnace production**

The purpose of work is the estimation of risk of origin the incidents and emergency situation at equipment operation in a blast-furnace production of the metallurgical enterprise. In work incidents and the emergencies arising in the course of a domain fusion are identified, theoretical and empirical laws of distribution of incidents and time of their liquidation on the basis of the assaying of statistical data are compared. It is shown, that process of origin the

incident. It is shown, that process of origin the s and emergencies submits to distribution from Poisson's law, and time of their liquidation – to the indicative law. The received results allow, for definition of probability of origin the incidents in a blast–furnace practice, to apply the theory of mass service.

*V.M.Kuzmichiv, O.N.Perkov*

**Estimation of base level the quality index of the rolled wheels centres**

The analysis of working conditions of locomotive wheels centres and loads which they have in operation is carried out. standard quality indexes of metal of rolled railroad wheels and cast locomotive centres are compared. The required level of quality index of rolled metal centers to ensure their reliability is previously estimated.

*V.I.Bolshakov*

**In memory of Sergey Mihajlovich Zhuchkov**

Presented data about scientific and scientifically–organizational activity Doctor of Science (Tech.), the professor, the deputy director for scientific work of Iron & Steel Institute National Academy of Science of Ukraine (2001–2009) S.M.Zhuchkov – noted scientist in the field of the theory and technology of metal forming.