

11  
276

ISSN 0038-920X

# СТАЛЬ

[www.nkmz.com](http://www.nkmz.com)



12/2014

Москва • ООО «Интернет Инжиниринг»



**НАДЕЖНЫЕ МАШИНЫ ДЛЯ ТЯЖЕЛОЙ ИНДУСТРИИ**



## ABSTRACTS

UDC 621:669.002.5

**NKMZ Will Hold On**Sukov Gh. S. // *Stal'*. 2014. No. 12. P. 2 – 3.

In spite of complicated economical and political situation in Ukraine, NKMZ, having celebrated its 80th anniversary, keeps developing progressively. Recently fulfilled orders from metallurgical enterprises show that technical policy of our factory is based on continuous modernization of production facilities, taking into account of all special requirements and preferences of the customers and keeping of designer supervision within entire operational life of the product.

**Key words:** contractual obligations, new technical best practices, compliance with delivery period, piece-work production.

UDC 622.788

**Influence of Qualitative Characteristics of Bentonite and Concentrate upon Pelletizing of the Burgen**Timofeeva A. S., Nikitchenko T. V. // *Stal'*. 2014. No. 12. P. 4 – 6.

Pelletizing process depends not only on the parameters of the equipment operation, but in a greater or lesser degree it is determined by qualitative characteristics of burden materials themselves – concentrate, binding component, fluxing additions or hardening additives. Testing technique of iron ore burden for pelletizing ability was developed in subdepartment of Sary Oskol Technological Institute of branch establishment of National Research Technological University of «Moscow Institute of Steel and Alloys». Estimation of burden pelletizing ability was made for pellets class larger 5 mm, produced in a laboratory drum pelletizer. Pelletizing process parameters – time, velocity of circulation, the moisture content of burden were remained unchanged. Represented test report shows that burden composition and its qualitative characteristics play a primary role in the process of formation of iron ore pellets, and in particular: concentrate specific surface rise improves burden pelletizing ability; concentrate specific surface rise improves mechanical properties of raw iron ore pellets; increase of «clogging» component content in bentonite reduces burden pelletizing ability.

**Key words:** concentrate, bentonite, surface area, pelletizing ability, strength, pellets, laboratory investigations, burden.

UDC 658.512.011.56:622.788

**The System of Computer Aided Design of Circular Coolers**Endiyarov S. V., Petrushenko S. Yu., Omelchenko S. V. // *Stal'*. 2014. No. 12. P. 6 – 8.

In this article, we describe a computer aided design system for a circular cooler. The circular cooler is used to cool down hot sinter. The developed CAD system uses state-of-the-art cooling process models as well as optimization techniques. As a result, the system can help engineers to optimize circular cooler parameters as well as sintering process specifications to achieve specific goals of concrete iron ore sintering plant. The developed system can help Uralmash works to increase its competitive abilities at the market of circular coolers.

**Key words:** circular cooler of sinter, computer aided design (CAD), optimization, simulation.

UDC 539.4:66.043.1

**Three-Dimension Modeling of Thermal Stresses in the Lining of the RH Vacuum Degasser**Zabolotsky A. V., Akselrod L. M., Ovsianikov V. Gh. // *Stal'*. 2014. No. 12. P. 10 – 14.

Thermo-mechanical stress of RH-degasser lining is discussed in the article. A three-dimension non-stationary task was solved with consideration of temperature field changing, while lining preheating, the first melt and after-melt cooling. Regions of maximal thermo-mechanical stresses of the snorkel lining were fixed while calculations. These zones correspond with places of real cracks appearance. Thermal exchange between equipment surface and environment was investigated for fixing of reasons, which provide the calculated thermal stress field.

**Key words:** RH-degasser, modeling, finite element method.

UDC 669.18:061.3

**XIII International Convention of Steelmakers. Plenary Meeting**Elansky Gh. N. // *Stal'*. 2014. No. 12. P. 15 – 24.

UDC 621.745.456

**Possibilities of Iron Reduction in EAF Steel Melting and Control of the Furnace Thermal Balance**Korovin V. A., Kurilina T. D., Stepanov P. P. // *Stal'*. 2014. No. 12. P. 26 – 28.

Spoke about the thermodynamic of iron reduction from electric arc furnace slag, adding aluminum-containing high-alumina mixture. The calculation of the heat balance of redox reactions. Using technology with adding in an electric smelting furnace aluminum-containing high-alumina mixture in the period of melting, can translate some of the iron from the slag to the metal, the heat of reaction reduces the energy consumption, and reduces cycles of melting, increases productivity of the furnace.

**Key words:** exothermic reaction, reduction, electric arc furnace, iron, aluminum, performance, steel.

UDC 669.141.247

**Comparison of the Nitrogen Content Values in the Ladle Sample and Finished Products**Safronov A. A., Prilukov S. B., Tazetdinov V. I., Torokhov Gh. V. // *Stal'*. 2014. No. 12. P. 29 – 31.

A comparative analysis of nitrogen content in the metal of ladle samples of continuously cast billets out of pipe steel grades produced at the electric steel making facility «Zhelezny Ozon 32» commissioned in 2011 and pipes manufactured out of these billets at JSC PNTZ is given in this article. The given results are achieved by comparison of nitrogen content of 180 ladle samples with pipe samples. It is shown that the nitrogen content in the metal of ladle samples coincide completely with nitrogen content in pipe samples (considering tolerances for the method of nitrogen content analysis) on condition that flawless samples are selected in a proper manner and prepared in a way providing the achievement of reliable results.

**Key words:** Nitrogen in steel, nitrogen content analysis, ladle sample, electrical furnace steel, vacuum treatment, pipe steel grades.

UDC 621.365.23.07

**Process Control in the Ore-Smelting Furnace on the Basis of the Constant Component of Phase Voltage**Beloglazov I. I., Suslov A. P., Pedro A. A. // *Stal'*. 2014. No. 12. P. 32 – 36.

Existence nature of the valve effect in the electrode furnaces and the appearance of a constant component in the phase voltage is considered as an example of industrial furnaces. It is noted that the valve effect of the electrode in the furnace is related to the nature of electric energy conversion, in other words, the growth rate of the AC electric arc and the conditions of contact electrodes in reaction zone. Depending on degree of valve effect changing the size and behavior of the constant component of the total phase voltage, that can be used for estimation the technological process in the furnace electrode.

**Key words:** ore smelting furnace, electric arc, electrolysis, valve effect, constant voltage component.

UDC 621.771.016.3:621.785.34.019

**Peculiarities of the «Fracture» Defect Due to Sticking of Steel in Coils During Annealing**Belov V. K., Diakova M. V., Selivanov R. Gh., Mikhin A. A. // *Stal'*. 2014. No. 12. P. 37 – 40.

This article describes the topographical features of the defect of cold-rolled strips, which occurs in the process of annealing furnaces. Mechanisms of generation of defective part were defined, using advanced 3D criteria of microtopography of surface. Macro and microtopography of defect «kink» received.

**Key words:** 3D criteria, microtopography, fusibility, annealing.

UDC 669.147

**Use of Concast Rounds for Section-Rolling Production**Lube I. I., Botnikov S. A., Turbar V. P. // *Stal'*. 2014. No. 12. P. 41 – 42.

The analysis of different production flow charts for section rolling, advantages and disadvantages of section rolling out of continuous cast round and square billets have been done. The literature review of previously performed investigations related to the usage of continu-

ous cast round billet as a stock for section rolling production has been carried out.

**Key words:** continuously cast round billet, continuously cast square billet, CCM for sections, section rolling quality, total elongation ratio.

UDC 621.771.06:621.892

#### Application of Neural Networks for Description and Forecast of Energy-Power Parameters of Strips Hot Rolling

Dema R. R., Martynova U. D., Amirov R. N. // *Stal'*. 2014. No. 12. P. 43 – 47.

In this work mathematical approaches for forecasting of power parameters of process of hot rolling are presented and analysed. The method of neuronetwork modeling of process which allows to lower an error of the forecast significantly is offered. The received neural models for current forecasting on cages No. 7 – 12 cages of fair group will allow to investigate analytically optimum from the point of view of energy efficiency a rolling mode, at a variation of key parameters. Comparative approaches are given in work for regression and neuronetwork models.

**Key words:** hot rolling, energy efficiency, neuronetwork model, work roll, lubricant.

UDC 621.774.352

#### A New Method of Expansion of Hot-Formed Pipes on a Short Arbour

Bogatov A. A., Pavlov D. A., Lipniagov S. V., Suvorov V. N., Pavlova E. A. // *Stal'*. 2014. No. 12. P. 49 – 51.

A new method of rolling of hot-rolled tube on automatic mill «tandem» consisting of two lengthwise rolling mills (a lengthwise rolling mill № 1 and № 2) is proposed. Method allows to achieve the rough tube preovalisation before rollers of a lengthwise rolling mill. The rough tube preovalisation provides uniform groove filling and a decrease of nonuniform pipe wall thickness. The rough tube preovalisation will allow to increase elongation ratio from 1,5 to 2,0 on the lengthwise rolling mill № 1 and to decrease the elongation ratio on the piercing mill. That will allow to decrease the risk of a rolling skin formation of on external tube surface.

**Key words:** tube rolling-off; stub mandrel; automatic mill «tandem»; finite-element simulation; coefficient of rough tube ovalisation.

UDC 621.778.079

#### Application of Titan Dioxide in Lubrication for Dry Drawing

Arrighetti G., Garoli G., Bellina F., Bisoffi E. // *Stal'*. 2014. No. 12. P. 52 – 56.

Titanium dioxide is under observation in many countries for suspected health risks to operators, and it is expected that its use will be severely limited, if not completely banned, in the coming years. A new line of lubricants for wiredrawing – 100 % free from titanium dioxide – has been studied and developed. This paper examines and compares the new lubricants' capabilities versus the products currently in use, in relation to wear of tungsten carbide dies and wire quality. New types of dies have been realized in order to obtain better lubrication, increase wear resistance, and improve suitability for recycling and re-use of the hard metals.

**Key words:** die wear, wire drawing lubricant, titanium dioxide, carcinogen.

UDC 621.746.27

#### Highly Efficient Facilities for Producing Concast Billets

Sukov Gh. S., Sus Yu. V., Plugatar V. S. // *Stal'*. 2014. No. 12. P. 57 – 61. NKMZ PAO has supplied 2 units of 6-strand billet casters to EMZ PAO, Enakievo. As the result of arrangements realized for caster equipment revamp, the actual output capacity of 2 888 000 tpy for two units under nominal designed capacity of 2 000 000 tpy for two complexes has been achieved. Vertical 2-strand slab caster supplied by NKMZ PAO to NLMK JSC, Lipetsk was designed with regard of installation into existing foundation. Upon that, the caster also allows producing the slabs from electrical steel. The following systems are implemented in above-said caster: – soft reduction; dynamic cooling of the ingot; control system for metal level in the mold; control system for thermal field distribution in the mold; control system for billet drawing force. All above-mentioned systems are integrated into the main control system of the caster and allow operation in automatic mode.

UDC 621.771.01.001.57

#### Simulation of the Leveling Process in Plate-Leveling Machines with Removal of the Defect Waviness of Rolled Stock

Barabash A. V., Gavrilchenko E. Yu., Gribkov E. P., Markov O. E. // *Stal'*. 2014. No. 12. P. 62 – 66.

The paper considers the method of determining the parameters of the sheets leveling, a distinguishing feature of which is the inclusion of a working roll bending and its impact on the correction of the defect waviness. The method is based on the joint use of an engineering model levelling the curvature of sheets and descriptions of regression resulting from the implementation of the finite element model changes waviness. Experimental studies have confirmed the adequacy of the proposed method and the possibility of its use in automatic control systems levelers.

**Key words:** thick plate, leveling, stress-strain state, mathematical modeling, quality, leveler.

UDC 621.785.616.22.002.5

#### Roller Quenching Machines of the Design of the Company «NKMZ»

Tiunov V. N., Gritsenko S. A., Ostapenko A. L., Beigelzimer E. E., Kozlenko D. A. // *Stal'*. 2014. No. 12. P. 67 – 71.

Roller quenching machines manufactured by PJSC «NKMZ» make it possible to provide high quality of plates quenching regarding cooling rate, microstructure and flatness. It is confirmed by experimental researches and experience of their operation at «HSW-Huta Stali» (Poland) and JSC «Severstal» (Russia). High technical capabilities of the above roller quenching machines have been realized by means of Automatic control system of quenching process based on mathematical model and engineering support of Research and production company «Donix».

**Key words:** mathematical model, cooling rate, flatness, martensite-bainite structure.

UDC 621.771.07.001.76

#### New Technological Possibilities of Producing Rolling Rolls of the Brand «NKMZ»

Shreider A. V., Dardesov A. A., Motov S. N. // *Stal'*. 2014. No. 12. P. 72 – 73.

**Key words:** high-silicon steel, hardened case, double-frequency hardening, differentiated heat treatment.

UDC 621.785.369

#### Modifications in the Macro- and Microstructure of Multiphase Low Carbon Steel Grades under the Impact of Formation-Thermal Treatment

Mischenko V. Gh., Sheiko S. P. // *Stal'*. 2014. No. 12. P. 74 – 76.

In this paper we analyze the effect of rolling parameters on the nature of structural phase transitions and mechanical properties of steel. It is shown that an appropriate combination of temperature, the degree and rate of deformation, provides a fine-grained structure of austenite with a highly polygonal substructure. It is found that for low-carbon steel rational mode of cooling and coiling after rolling characterized by the following parameters.

**Key words:** low carbon steel, strain-heat treatment, mechanical properties, structural and phase transformations.

UDC 669.14.018.294.2:621.771.262

#### Research into the Operational Reliability of Railway Rails Rolled under Various Techniques

Kolbasnikov N. Gh., Vargasov N. R., Zotov O. Gh., Lukianov A. A., Belozherov V. L. // *Stal'*. 2014. No. 12. P. 76 – 83.

Based on experimental studies of the complex mechanical properties and microstructure, as well as simulation of rails rolling modes made from different steel manufacturers are shown the main technological approaches to obtain rails with high operational reliability. Found that, under the current production technology of domestic steel rails the adjustment of the chemical composition, temperature-deformation modes of rolling and cooling speed rate of the rails is suitable for reducing the negative free ferrite influence on rails durability.

**Key words:** rail, microplasticity, microstructure, stress.

UDC 620.194.4

#### Analysis of Influence of Structural-Mechanical Factors upon the Corrosion Susceptibility of Tubing Strings under the Conditions of Carbonic Acid Well Corrosion

Skoblo T. S., Marchenko A. Yu. // *Stal'*. 2014. No. 12. P. 84 – 88.

The paper discusses the influence of structural factors degradation steel tubing used in the gas industry, the intensity of damage to their corrosion. On the example of carbon dioxide corrosion under stress, which exposed tubing in operation, analyzed degradation mechanisms have become under the simultaneous action of tensile stresses and corrosive environment.

**Key words:** corrosion damage; tubing; diffusion of carbon; carbonic-acid corrosion; pittings; degradation of structure; non-metallic inclusions.

UDC 669.14.018.58.001.76

**Amorphous Electrical Steel Grades on the Modern Level of Development**  
Molotilov B. V., Galkin M. P., Kornienkov B. A. // *Stal'*. 2014. No. 12. P. 90 – 92.

The article describes the modern metallurgical methods of producing amorphous electrical steel having high magnetic properties (electromagnetic loss, induction and others.). The efficiency of using these steels to construct power electronics products and electronics is shown. The expediency of the compound in one enterprise production technology of amorphous electrical steel and technology applications of these steels in high performance electrical units is shown.

**Key words:** amorphous magnetic materials, amorphous electrotechnical steels, power electronic products based on amorphous materials, amorphous alloys in an electronic engineering.

UDC 658.8.012.12:339.564

**Russian Exports of Ferrous Metals: Problems and Outlook**

Bobylev V. Gh. // *Stal'*. 2014. No. 12. P. 93 – 96.

**Key words:** world market, region, country, advanced economies, emerging market developing economies, steel statistical, export, apparent, pig iron, flat products, ingot and semis, finished steel products, future development, population, strategy selection.

UDC 699.184.163

**Melting Dust As Toxic Substance and Valuable Construction Raw Material**  
Butorina I. V., Fedotova E. S. // *Stal'*. 2014. No. 12. P. 97 – 99.

The characteristics of the melting dust formed in steelmaking units and at shimmering of molten ferrous metals such as specific formation, chemical and particulate composition are given. It is shown that melting dust is the most dangerous component comprising dust emissions of metallurgical enterprises. Organization of its efficient capture will make the complicated ecological situation in the metallurgical centers significantly healthier, and it will be cost effective because collected dusts can be considered as a marketable product as a superfine iron oxide pigment for coloring concrete and other building materials.

**Key words:** steelmaking units, smelter dust, specific yield, chemical and particulate composition, fugitive emissions, dust suppression, pigment recovery, economic effect.

## ЧЛЕНЫ СЕКЦИЙ РЕДАКЦИОННОЙ КОЛЛЕГИИ

### Доменное производство:

Шатлов В. А. (редактор раздела), Александров Л. И.,  
Брагин Ю. С., Евстюгин С. Н., Лазуткин А. Е., Сперкач И. Е.,  
Чернусов П. И., Юсфин Ю. С.

### Сталеплавильное производство:

Паршин В. М. (редактор раздела),  
Еланский Г. Н., Зинченко С. Д., Зинько Б. Ф., Марукович Е. И.,  
Носоченко О. В., Смирнов Л. А., Соколов В. В.

### Электрометаллургия:

Косырев К. Л. (редактор раздела), Буцкий Е. В., Галкин М. П.,  
Смирнов А. Н., Стомахин А. Я.

### Ферросплавы:

Серов Г. В. (редактор раздела), Гладких В. А., Дашевский В. Я.,  
Жучков В. И., Ишутин В. И., Куцин В. С., Павлов А. В.

### Прокатное производство:

Юсупов В. С. (редактор раздела),  
Бринза В. В., Парамонов В. А., Тулунов О. Н.,  
Хлопонин В. Н., Целиков Н. А., Юнин Г. Н.

### Производство труб:

Коликов А. П. (редактор раздела),  
Клачков А. А., Кондратов Л. А., Романцев Б. А.

### Метизное производство:

Яранцев Б. М. (редактор раздела), Кузнецов Н. А.,  
Манушин В. А., Ориничев В. И., Салехова Г. А.

### Металлургическое оборудование:

Чиченев Н. А. (редактор раздела), Горбатюк С. М.,  
Жильцов А. П., Корчунов А. Г., Савельев А. Н.

### Металловедение и термическая обработка:

Филиппов Г. А. (редактор раздела), Капуткина Л. М.,  
Одесский П. Д., Тишаев С. И., Шур Е. А., Эфрон Л. И.

### Новые металлические материалы и процессы:

Молотилов Б. В. (редактор раздела),  
Лазуткин С. Е., Лясоцкий И. В., Свистунова Т. В.

### Экономика, управление и организация производства:

Бродов А. А. (редактор раздела),  
Иванов И. Н., Караваев Е. П.,  
Макаров Л. П., Юзов О. В.

### Экология и ресурсосбережение:

Каленский И. В. (редактор раздела), Валавин В. С.,  
Колдаева И. Л., Клейменова Э. В., Клименко С. В.,  
Максимов Б. Н., Шушан Ф. Б.