

**C O N T E N T S**

**METALS SCIENCE. METALLURGY**

*Rybin V. V., Oryshchenko A. S., Utkin Yu. A., Odintsov N. B.* The effects of alloying and ways of making castings on mechanical properties and the structure of heat-resistant steels and alloys .....5  
*Butenko V. I., Durov D. S., Shapovalov R. G.* The influence of nonmetallic inclusions and carbides on the structure and properties of alloyed steels ..... 19  
*Filimonov G. N., Stolny V. I., Olenin M. I., Bykovsky N. G., Berezhko B. I., Sereda I. R., Kalinicheva N. V., Martynihina N. I., Novikova V. V.* Working out and mastering an energy-saving technology for producing of plates of low-alloy steels ..... 28

**FUNCTIONAL MATERIALS**

*Lopanova E. A.* Radiospectroscopic researches of process of hydration of silicates with the help of spin labels ..... 34

**WELDING. WELDING MATERIALS**

*Kashchenko D. A., Brusnitsyn Yu. D.* The influence of carbides on mechanical properties of the weld metal in argon-arc welding with low-carbon and low-alloy materials ..... 42  
*Shamin S. A., Sharapov M. G.* Improvement in the composition of charge of the rutile-type flux-cored wire with a small diameter ..... 48

**STRUCTURAL-WORKING STRENGTH AND SERVICEABILITY OF MATERIALS**

*Ivanov V. G., Kuchkin V. V., Gorynin V. I.* A study of straining and strength of boron-aluminum cylinders under hydrostatic compression ..... 54  
*Timofeev B. T., Shalygin A. S.* The assessment of change in properties of the pipeline weld joints of carbon steels during design lifetime ..... 62  
*Ananieva M. A., Zelenin Yu. V., Karzov G. P., Lanin A. A., Oshkanov N. N.* Local breaks in weakness zone of the NPP piping heterogeneous butt-welded joints ..... 70

**CORROSION PROTECTION OF METALS**

*Kuzmin Yu. L., Lashchevskiy V. O.* An influence of cathodic polarization on the corrosion mechanical strength of martensitic steel grade 07X16H4B ..... 77

**CRONICLE**

Session-symposium of experts in welding of two capitals ..... 83

**Abstracts of published articles** ..... 85

## ABSTRACTS OF PUBLISHED ARTICLES

UDC 669.14.018.44:421.774.377

**The effects of alloying and ways of making castings on mechanical properties and the structure of heat-resistant steels and alloys.** Rybin V.V., Oryshchenko A.S., Utkin Yu.A., Odintsov N.B.— Problems of Material Science, 2004, N 3(39), p. 5–19.

The effects of the casting method and the alloying system, as ways of forming the structure of castings, on mechanical properties of steel of 45X25H20C2 grade and X21H35B5C composition based alloys have been investigated.

*Key words:* heat-resistant steels and alloys, alloying system, casting method, forming the structure, cracks sensitivity, grain boundaries, thermodynamic stability.

UDC 669.111.3:669.15—194

**The influence of nonmetallic inclusions and carbides on the structure and properties of alloyed steels.** Butenko.I., Durov D.S., Shapovalov R.G. – Problems of Material Science, 2004, N 3(39), p. 19–27.

The influence of various inclusions and carbides on organization of final structures of legired steels is investigated and is shown, that the best initial composition for thermal hardening of a material are the structures of holiday, as the increased quantity dispersed carbides before thermal heating predetermines both education of large density of concentration-non-uniform sites, and high enough general saturation of a matrix by carbon and by legiring elements.

*Key words:* a pulse, structure, solution, element, carbide, dispersion, inclusion, having heated, heterogeneity, matrix, diffusion.

UDC 669.71:62—405.8

**Working out and mastering an energy-saving technology for production of plates of low-alloy steels.** Filimonov G.N., Stolny V.I., Olenin M.I., Bykovsky N.G., Berezhko B.I., Sereda I.R., Kalinicheva N.V., Martynihina N.I., Novikova V.V. – Problems of Material Science, 2004, N 3(39), p. 28–33.

An energy-saving process plan for making plates 85 mm thick of steel grade 09Г2СА-А with improved cold resistance, which includes melting, continuous casting of slabs, rolling of plates, subsequent quenching of as heated-in-rolling and as self-tempered plates, has been worked out and tried out at 5000 rolling mill. An addition of small quantities of niobium and the slab heating temperature drop in rolling makes it possible to slow down grain growth. Owing to reduction of the cooling time in water after quenching, self-tempering of plates is achieved at the expense of retained inner heat. The process plan worked out makes it possible to increase the factor of metal utilization by 20–30%, to make high-quality plates, to reduce consumption of energy carriers at the expense of ruling out the rolled plate heating for subsequent tempering.

*Key words:* low-alloy steel, making rolled plates, energy-saving process plan.

UDC 691.215.5:661.183.4

**Radiospectroscopic researches of process of hydration of silicates with the help of spin labels.** Lopan Ova E.A.— Problems of Material Science, 2004, N 3(39), p. 34–41.

Radiospectroscopic researches kinetics setting knitting materials are carried out at the presence of a spin label. It is shown, that during hydration the quantity of free radicals 4-hydroxy-tempo is reduced. The form of curves of a spectrum depends on time of hydration. The assumption of an opportunity of course of process of hydration Portland cement on the radical or ion-radical mechanism that can render essential influence on technology of reception of new composite materials with the given properties is stated.

*Key word:* silicates, kinetics setting, process of hydration, Portland cement, 4-hydroxy-tempo, free radicals, spin labels, radiospectroscopic researches.

UDC 621.791.75:669.111.3

**The influence of carbides on mechanical properties of the weld metal in argon-arc welding with low-carbon and low-alloy materials.** Kashchenko D.A., Brusnitsyn Yu.D. – Problems of Material Science, 2004, N 3(39), p. 42–47.

An interrelation between operating characteristics of the weld metal and carbides either formed directly in welding or introduced together with electrode coatings has been proved to exist. A part of excess oxygen in oxidation and removal of carbides from the deposited metal has been established.

*Key words:* carbides, strength, weld metal, electrode coating, flux.

UDC 621.926:621.745.4

**Improvement in the composition of charge of the rutile-type flux-cored wire with a small diameter.** Shamin S.A., Sharapov M.G. – Problems of Material Science, 2004, N 3(39), p. 48–53..

Flux-cored wire of 48ПП-8H grade has been examined from the viewpoint of quality and operating characteristics drawbacks. The ferromanganese and the aluminum contents of a charge core have been established. The improved composition of a charge core making it possible to expand operating characteristics of flux-cored wire has been developed.

*Key words:* ferromanganese, aluminum, flux-cored wire, running characteristics in welding.

UDC 621.039.5:621.791.052.4.001.42

**The assessment of change in properties of the pipeline weld joints of carbon steels during design lifetime.** Timofeev B.T., Shalygin A.S. – Problems of Material Science, 2004, N 3(39), p. 54–61.

Carbon steel grades 20, 22K and welds made of these steels by manual electric-arc welding have been investigated for an influence of thermal aging on their mechanical properties. Characteristics under study have been shown to retain high consistency within 30 years of design service life, which makes it possible to recommend pipeline users to change a frequency of inspection of the pipeline mechanical properties in the course of operation.

*Key words:* thermal aging, carbon steel, weld joint, inspection of mechanical properties, design service line.

UDC 621.039.5:621.791.052.4.002.612

**Local breaks in weakness zone of the NPP piping heterogeneous butt-welded joints.** Ananieva M. A., Zelenin Yu. V., Karzov G. P., Lanin A.A., Oshkanov N.N.– Problems of Material Science, 2004, N 3(39), p. 62–70.

The reasons for breaks of composite butt-welded joints of piping at Beloyarskaya NPP block N 3 have been studied. Inhomogeneity of the chemical composition, mechanical properties and the structure of a welded joint of 09X18H9 and 12X1MΦ steel grades has been revealed. It has been established that the reason of this are local breaks of 12X1MΦ steel resulting from dispersion hardening of the metal of a weakness zone.

It has been shown that steel susceptible to local breaks of weakness zone should not be used at operating temperatures above 450°C, and heterogeneous butt-welded joints should not be located in a zone of high compensation bending stresses in order to avoid brittle fractures.

*Key words:* NPP piping, welded joints, local breaks in weakness zone, bending stresses, heterogeneous butt-welded joints.

UDC 669.781'717—434.1:539.411

**A study of straining and strength of boron-aluminum cylinders under hydrostatic compression.** Ivanov V.G., Kuchkin V.V., Gorynin V.I.– Problems of Material Science, 2004, N 3(39), p. 70–76.

Results of hydrostatic compression tests on boron-aluminum cylinders are presented. The effects of a reinforcing scheme and geometrical sizes of the boron-aluminum cylinders, 122 mm in diameter, on their bearing capacity have been studied. Evaluation has been made of the stressed-strained state of the cylinders in the course of loading. Increase in bearing capacity of the cylinders is shown to be related to reduction in intensity of bending stresses rising through longitudinal sections.

*Key words:* boron-aluminum cylinder, reinforcing scheme, bearing capacity, reinforcing efficiency, bending stresses, elastic waves.

UDC 620.197.5:669.15—194.55

**An influence of cathodic polarization on the corrosion-mechanical strength of martensitic steel grade 07X16H4Б.** Kuzmin Yu. L., Lashchevskiy V.O. – Problems of Material Science, 2004, N 3(39), p. 77–82.

An influence of cathodic polarization on the corrosion-mechanical strength of martensitic steel grade 07X16H4Б under low-cycle loading in sea water has been studied. It has been established that a level of cathodic polarization reached at potentials in the range of  $-500$  to  $-550$  mV by a normal hydrogen electrode (or of  $-750$  to  $-800$  mV by a reference silver-chloride electrode) is high enough for complete prevention of pointed, pit, crevice and intergranular corrosion, and cathodic hydrogenation exerting a negative influence on the mechanical and corrosion properties of martensitic steel has not yet started by then.

*Key words:* cathodic polarization, corrosion-mechanical strength, martensitic steel, electrolytic protection, hydrogenation.