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ABSTRACTS OF PUBLISHED ARTICLES

UDC 669.14.018.41:629.12

Creation of new economically alloyed cold-resistant steels for shipbuilding and sea technology. Gorynin I. V., Malyshevskiy V. A., Semicheva T. G., Khlusova E. I. – Problems of Materials Science, 2005, N 2(42), pp. 27–39.

Taking into account the experience of the previous works on the base of the basic principles of alloying and formation of the structure of steel in all stages of metallurgical processes, new economically alloyed cold-resistant steels are created with improved weldability having the guaranteed resistance to laminar destruction. Now their production is mastered at the Russian metallurgical plants.

Key words: new economically alloyed steels, cold resistance, the improved weldability, resistance to laminar destruction.

UDC 669.15`786–194

Development of promising fundamentally new corrosion-resistant hull steel, alloyed by nitrogen. Gorynin I. V., Rybin V. V., Malyshevskiy V. A., Kalinin G. Yu., Mushnikova S. Yu., Malakhov N. V., Yampol'skiy V. D. – Problems of Materials Science, 2005, N 2(42), pp. 40–54.

The results of developing the fundamentally new nonmagnetic hull steel are represented having yield point exceeding 690 MPa. The influence of alloying elements on mechanical and corrosive properties is investigated with establishment of their optimum concentrations. The technology of obtaining sheet rolling made of austenitic nitrogen-containing steels is developed. Steel of brand HC-5T with the yield point of 400–500 MPa and steel of brand AC with the yield point exceeding 690 MPa passed test work in metallurgical enterprises. The comparative analysis is carried out for physico-mechanical properties of steels developed in CRISM «Prometey» and corrosion-resistant steels AISI 304, AISI 316, Avesta 254SMO used in aggressive media with determination of the promising fields of application.

Key words: new hull nitrogen-containing steels, corrosion resistance, lack of magnetism.

UDC 669.14.018.295:621.785.7:629.12

Development of theory of secondary hardening during creation of high-strength hull steel. Rybin V. V., Malyshevskiy V. A., Semicheva T. G. – Problems of Materials Science, 2005, N 2(42), pp. 55–62.

On basis of basic research the model of transformations is proposed during tempering of steels characterized by secondary hardening with initial structure of dislocatory (rack) martensite. As a result of creating the principles of the alloying of low-carbon steels having secondary hardening the high-strength weldable hull steels are developed, successfully utilized for construction of deep water equipment.

Key words: high-strength weldable hull steel, theory of secondary hardening, principles of alloying, model of transformations.

UDC 669.14.018.293:621.785.7:539.56

Processes of carbide-formation and brittleness during tempering of ship steel. Semicheva T. G., Khlusova E. I., Sherokhina L. G. – Problems of Materials Science, 2005, N 2(42), pp. 69–78.

A study of brittleness of structural steels during their tempering (as development of the work of A. S. Zavyalov) with analysis of behavior of high-strength low-carbon ship steels is presented. It is established that during tempering in the range of temperatures of 400–500°C in these steels the impact energy is reduced (with manifestation of the so-called brittle tempering). A cause of brittleness during tempering of steels having secondary hardening with martensite structure is formation on the boundaries of laths and packets of the plates of cementite; for improved steels with martensite-bainite structure it is not only the embrittlement of the boundaries of laths by cementite, but also formation of regions of martensite in non-bainite areas having large quantities of plates of the cementite.

Key words: structural ship steels, brittleness during the tempering, processes of carbide formation.

UDC 621.78:669.15–194:621.039.536.2

On the role of heat working to insure a high level of the mechanical and operational properties for steel used for manufacturing of the large-dimension billets of NPP reactor vessels. Filimonov G. N., Tsukanov V. V., Grekova I. I., Morozov A. M., Nikolayev V. A., Teplukhi na I. V., Dyukov V. V. – Problems of Materials Science, 2005, N 2(42), pp. 79–92.



The special features of the heat treatment of steels used for vessels of atomic energy pressurized-water reactors and its influence on the initial mechanical properties and the operational characteristics are investigated.

Key words: new reactor steel, high level of mechanical and operational properties, special features of heat treatment.

UDC 621.039.53:539.389.3

Operation ageing of NPP equipment materials during design period of service. Karzov G. P., Timofeev B. T., Chernayenko T. A. – Problems of Materials Science, 2005, N 2(42), pp. 92–110.

The generalized data are presented regarding influence of heat ageing on mechanical properties of base metal and weld metal of the equipment components and pipelines of the first circuit of NPP with the reactors VVER and RBMK during prolonged operation. The comparison of initial properties of these materials with the analogous characteristics after 100 and 200 thousand hours of operation has showed that in the majority of the cases the changes are insignificant and the properties after 30 years of operation are not lower than the level, specified by requirements of PNAE G-7-002–86 (for the steels in application) and by PNAE G-7-010–89 (for the weld metal).

Key words: AES, the first circuit, equipment components, pipelines, welded joints, heat ageing, prolonged operation.

UDC 669.15–194.56

Influence of metal quality and application of vacuum metallurgy on the structure and properties of austenitic solid-solution hardened steels. Vinogradova N. V., Parshin A. M., Petkova A. P., Yakovitskaya M. V. – Problems of Materials Science, 2005, N 2(42), pp. 110–119.

The influence of quality of metal and conditions of metallurgical processes on localization of defects and mechanical properties of austenitic steels and alloys is investigated. Nonstabilized austenitic corrosion-resistant steel of the type 18Cr–14Ni is developed, which possesses improved weldability and technological efficiency, increased gas density, high cleanliness regarding harmful impurities and nonmetallic inclusions, resistibility to intercrystalline corrosion in the wide temperature range (in comparison to domestic and foreign stabilized steels of the type of 18–8Ti and 18–10Nb and nonstabilized steels of the type 18–10). It is substantiated the application of low-carbon nonstabilized steel of high cleanliness of the type 01X18H14B2ЦЧВИ+ВД (with dual vacuum remelting) as the structural material for thin-walled constructions of vacuum technology and nuclear power engineering.

Key words: nonstabilized austenitic corrosion-resistant steel, thin-walled constructions, improved weldability and technological efficiency, increased gas density, resistibility to intercrystalline corrosion.

UDC 66.041.454:547.313.2

Modernization of pyrolysis furnaces of the Butovsky design for installations used for production of ethylene ЭП-300. Oryshchenko A. S., Slepnev V. N., Makarov V. N., Yavno E. I., Odintsov N. B., Udovikov S. P. – Problems of Materials Science, 2005, N 2(42), pp. 120–125.

The proposals are given for design modernization of the pyrolysis furnace of installation for production of ethylene ЭП-300. Introduction of the design changes reduces intensity of coke deposit, excludes possibility of overheating of construction elements at internal surface of the pipes, which work under conditions of maximally high temperatures, significant static loads and action of hydrocarbon medium. The requirements for the construction are formulated, with fulfillment of which it will be possible to avoid the premature destruction of the radiant coil.

Key words: installation for production of ethylene, pyrolysis furnaces of the Butovsky design, modernization proposal.

UDC 621.793.7:661.862.22

Composite detonation coatings on the basis of aluminum oxide. Blank E. D., Anisimov M. I., Oryshchenko A. S., Slepnev V. N., Galev I. M., Andreeva V. D. – Problems of Materials Science, 2005, N 2(42), pp. 126–128.



Detonation composite coatings on the basis of aluminum oxide with additions of carbides of silicon and titanium, bronze and nickel alloy are investigated. Micromechanical characteristics, wear resistance and X-ray structural state of the coatings are studied .

Key words: detonation coatings, the oxide of aluminum, microhardness, resistance to cracks, wear resistance, carbide of titanium, carbide of silicon, metal-cermets, adhesion strength.

UDC 621.791.92:621.039.536.2

Anticorrosive cladding. Accumulated experience of application and methods of improvement. Gorynin I. V., Karzov G. P., Galyatkin S. N., Mikhaleva E. I., Morozovskaya I. A. – Problems of Materials Science, 2005, N 2(42), pp. 129–143.

The accumulated experience of application of welding materials and technologies for performance of anticorrosive cladding to the internal surface of the reactor vessels of water-to-water type nuclear power plants is analyzed. The results are given for studies of the metal of the anticorrosive cladding, executed by regular welding materials. Super clean low-carbon welding materials for the cladding of anticorrosive coating are developed. The advantage of new materials lies in the fact that with retention of high technological and anticorrosive properties they ensure increased resistance to embrittlement under neutron irradiation.

Key words: reactor vessel, anticorrosive cladding, super clean welding materials, neutron irradiation, increased resistance to the embrittlement.

UDC 621.039.534.25:621.791

Technology of automatic welding of thin-walled titanium pipes with tube screens of the heat exchange equipment. Mikhaylov V. I., Polyakov V. M., Semenov V. A., Karabakhin G. Yu. – Problems of Materials Science, 2005, N 2(42), pp. 144–147.

The standard technological process is developed for welding thin-walled tubes with the tube screens for preparing the heat exchange equipment made of titanium alloys, including those of main condensers for the thermal and nuclear power plants, which provides obtaining qualitative welded joints with minimum deformation of tube screens and satisfies all presented requirements.

Key words: heat exchange equipment, titanium, welding thin-walled tubes with the tube screens, quality welded joints, minimum deformation.

UDC 621.791.04:669.35

Creation of added materials and technological processes of welding and cladding of copper alloys and different metals. Baranov A. V., Vaynerman A. E., Chumakova I. V. – Problems of Materials Science, 2005, N 2(42), pp. 148–162.

The procedure of complex evaluation is developed for the technological strength of copper basis alloys, which takes into account their properties over a wide range of temperatures, the presence of lack of plasticity in the temperature range of 250–700°C, effective solidification range of alloys, the minimum value of relative elongation at elevated temperatures.

Key words: alloys on copper basis, technological strength, method of estimation, welding materials, welding technique, technology of cladding.

UDC 621.039.531:539.4

Prognostication of long-term stress-rupture strength of austenitic materials under neutron irradiation. Margolin B. Z., Gulenko A. G., Kursevich I. P., Buchatskiy A. A. – Problems of Materials Science, 2005, N 2(42), pp. 163–186.

The physico-mechanical model is presented, which makes it possible to forecast destruction of materials subjected to neutron irradiation in creep conditions. Model is based on the description of damages in the form of grain-boundary pores. The equations of origin and increase in the pores, proposed earlier, are developed in the case of neutron irradiation of material. The indicial equations are formulated, which describe the ductile plastic deformation of material taking into account the development of pores. The criterion of the plastic stability of a unit cell is used as the criterion of destruction. The predictions of stress-rupture strength and plasticity of austenitic materials in the initial state and in the irradiated state with different intensity of neutron flux are made on the basis of the model. Calculated results are compared with existing experimental data.



Key words: physico-mechanical model, stress-rupture strength and plasticity, origin and an increase in the pores, microplastic collapse, fluence, flux.

UDC 669.15–194:621.039.536.2:621.791.92:539.56

Characteristics of anticorrosive cladding for calculating resistance to brittle failure of reactor vessel material. Margolin B. Z., Shvetsova V. A., Prokoshev O. Yu., Kursevich I. P., Smirnov V. I., Minkin A. I. – Problems of Materials Science, 2005, N 2(42), pp. 186–213.

Experimental results are presented on investigation of standard mechanical properties and fracture toughness for anticorrosive cladding in the unirradiated and irradiated conditions. For the first time, fracture toughness data are obtained for cladding irradiated to a fluence of $F = (2,3–3,0) \cdot 10^{20}$ neutrons/sm².

An approach is proposed that determines requirements to fracture toughness of cladding such that when satisfying these requirements, initiation of the brittle fracture from cladding to the base metal does not happen. The dependencies and parameters for cladding necessary for calculation of reactor pressure vessel strength on the brittle fracture resistance criterion are determined.

Key words: reactor vessel, anticorrosive cladding, irradiation, standard mechanical properties, fracture toughness.

UDC 669.14.018.29

Structural aspects of fitness for work and reliability of structural materials. Vinogradova N. V., Parshin A. M., Petkova A. P., Yakovitskaya M. V. – Problems of Materials Science, 2005, N 2(42), pp. 213–220.

The determining influence is shown for structural transformations, which take place at different stages of decomposition of solid solutions, to the operating characteristics of structural materials and processes of degradation of metal in the construction. The way is proposed for increasing in service life and reliability of operation of structural materials, related to application of vacuum metallurgy during usage of super clean batch materials and microalloying by rare-earth elements.

Key words: structural materials, operating characteristics, structural transformations, increase in the resource, vacuum metallurgy, super clean batch materials, rare-earth elements.

UDC 620.179.1

Establishment and development of test laboratories complex in CRISM “Prometey”. Nikolaev G. I. – Problems of Materials Science, 2005, N 2(42), pp. 221–227.

Presented is a historical digest of establishment and development of test laboratories in CRISM “Prometey”, basic directions of their activities, stages of development of complex research system of materials composition, structure and properties, peculiarities of nondestructive test application.

Key words: test laboratories complex, directions of activities, development stages, historical aspect.

UDC 621.039.578:629.78

Participation by CRISM “Prometey” in creation of the first space nuclear power plants. Materials science support of project “Topaz”. Gribov N. N., Sinyakov I. N., Povyshev I. A. – Problems of Materials Science, 2005, N 2(42), pp. 227–232.

The participation by CRISM “Prometey» is described in creation and construction of the first space nuclear power plants of transport designation. The successes of the scientific school of CRISM “Prometey” in this area of engineering activity are inseparably related to the scientific foundation, which bases were placed by the first director of our institute — by the outstanding scientist and by organizer of the branch science, *Mr. Andrey S. Zavyalov*. Using classical materials science approaches, the fundamental scientific and applied works of predecessors, the engineers and scientists of the Institute knew how to develop the existing ideas in the field of the physical metallurgical science of reactor steels and alloys, which made it possible to come to the new frontiers in creation of highly technological materials with specified combination of properties for contemporary space technology. The complicate complex of works executed by the Institute for scientific and technical support and materials science procurement of the national project “Topaz” contributed to the successful fulfillment of the RF Government set task in the area of the Russian space reactor engineering, which was the important contribution of Russian scientist-materialogists to the technological mastery of space.



Key words: space nuclear power plants of transport designation, highly technological materials with the specified combination of properties, RF national project "Topaz", scientific and technical support and the materials science procurement.

