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USSR Report

MATERIALS SCIENCE AND METALLURGY

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USSR REPORT
MATERIALS SCIENCE AND METALLURGY

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ANALYSIS AND TESTING

MANUFACTURE OF NONDESTRUCTIVE-TESTING EQUIPMENT DELAYED

Moscow SOVETSKAYA ROSSIYA in Russian 15 May 86 p 2

[Article by A. Chuba under the "Requires A Solution" rubric: "X-Ray for Metal"]

[Text] This year produced a surprise for metallurgists: USSR Gosplan required plants of the Ministry of Ferrous Metallurgy [Minchermet] to provide 100-percent quality control of its largest-tonnage product: round and square blanks.

So now what: are metallurgists obligated to shred each blank they produce into pieces? Of course not. We're talking about using modern means of quality control: above all, nondestructive testing. Metal, like a patient in an X-ray office, is "photographed" with ultrasound, electromagnetic and other types of radiation to obtain a full representation of its internal structure.

"In order to provide 100-percent quality control, special devices are needed which we are not now producing," says V. Antipin, chief of the Minchermet technical administration. "In order to check critical products at the country's metallurgical combines, it was necessary to purchase nondestructive-testing equipment from foreign countries."

How so? After all, Moscow has the Spektr Scientific-Production Association [NPO], an acknowledged leader in developing means and methods of nondestructive testing.

"Understand me, we are instrument builders," says V. Zuyev, secretary of the party committee of the Scientific-Research Institute of Introsopy, which is part of the NPO. "Industry needs automatic quality-control lines, which we don't know how to build."

Who can help the metallurgists? Those who supply them with their basic equipment: namely, the Ministry of Heavy and Transport Machine Building, say the people at Spektr NPO.

The people at Minchermet only smile skeptically when they hear that suggestion, and they produce a 12-year-old statute of the USSR Council of Ministers. It turns out that back in 1974, the Ministry of Heavy and Transport Machine Building and the Ministry of Instrument Making,

Automation Equipment and Control Systems were directed to develop means for automatic, production-line nondestructive testing for nonferrous-metallurgy enterprises. It is clearly stated who must do what when. The deadlines are not later than 1977. Several developments were carefully monitored by the government. And the result? One of them was implemented only several months ago at the Severskiy Tube Mill, while another is only now starting to be implemented at Azovstal.

Spektr NPO considers that the problem can be simplified if Minchermet specialists would develop instruments for nondestructive testing lines based on Spektr's developments. The metallurgists have Dneprochermetavtomatika Scientific-Production Association, which has taken on the development of such instruments and promises ("if we get help in solving several problems") to provide instruments for the entire sector.

The problem could possibly be solved in this way, if it involved only ferrous metallurgy. But this is not the case, and other industries besides metallurgy need testing instruments.

Thus, on one side, there is a sharp need to improve the quality of industrial products and the reliability of machines and equipment, a situation which was discussed at the last meeting of the CPSU Central Committee Politburo. On the other hand, there is a scientific reserve of means and methods, which make it possible to provide this improvement. The question is only how to tie this all into a single knot.

Surely, the State Committee for Science and Technology must be in the lead in solving this problem. The committee is now seeking ways to improve the structure of scientific-production associations and is determining the scope of tasks for engineering-technical centers and intersector scientific-technical complexes. Several of these centers and complexes have already appeared. They will be working in a centralized manner on such important directions as powder metallurgy, laser technology and reliability of machinery and mechanisms. It would seem that nondestructive research and testing methods should be included in this list.

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THE AUTOMATION OF SCIENTIFIC RESEARCH IN THE DEVELOPMENT OF NONDESTRUCTIVE-TESTING INSTRUMENTS

Sverdlovsk DEFEKTOSKOPIYA in Russian No 1, Jan 86 (manuscript received 18 Feb 86; final version 18 Sep 85) pp 17-22

[Article by A.P. Ryabtsev, A.V. Lomovitskiy, V.V. Yermakov, Ye.L. Vinogradov, and K.V. Smirnov, Siberian Physical Technical Institute imeni V.D. Kuznetsov, Tomsk State University]

[Abstract] A measuring and computing system (IVK) run by an Elektronika-60 minicomputer has been developed and used to automate the process of designing a metal detector used to protect the working parts of a KSK-100 combine. The hardware and software components of the IVK are listed and their interaction described. The data tracking system is also described. In designing a non-destructive test instrument, the two most important problems are finding the secondary field (which is a result of the interaction between the field around the test object and the object itself) and developing an algorithm for signal analysis. The FTW program was used for signal analysis, and mathematical modeling to find the secondary field. The instrument's structure had to be designed so that the boundaries of the sensitivity zone coincided precisely with the boundaries of the space within which it was necessary to test for the presence of foreign objects. The optimal geometry for the arrangement of the field sources and pickups was constructed by using the MOD 100 program to perform a numerical experiment on a mathematical model of the metal detector. Selected working models of the metal detector were used to test actual performance characteristics and to find the most effective signal processing algorithms. The experiment showed that an IVK can be used successfully to automate the design of nondestructive testing instruments. References 5: all Russian.

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CSO: 1842/168

CONTACTLESS QUASI-OPTICAL RESONANCE TESTING OF DIELECTRIC, SEMICONDUCTOR, AND METAL OBJECTS

Sverdlovsk DEFEKTOSKOPIYA in Russian No 1, Jan 86 (manuscript received 18 Feb 86) pp 35-44

[Article by G.Ye. Dunayevskiy, Siberian Physical Technical Institute imeni V.D. Kuznetsov, Tomsk State University]

[Abstract] The potential for using an open resonator (OR) in UHF testing was surveyed. The basic technique is as follows: UHF frequencies enter the open resonator through either a rectifier or a circulator. The OR is shaped like two coaxial reflectors and is first connected "to the transmission" or "to the reflection" and then to the UHF detector. The UHF signal envelope then leaves the load of the detector and enters the recording block. The object being tested is placed directly in the OR or is connected to its, thereby influencing its quality factor and resonance frequency. The deterioration of either the electric or geometric uniformity of the object alters these parameters and changes the transmission or reflection power being recorded. This technique was used to test objects with a flat surface, with good reflection, to test the parameters of sheet dielectrics, to test objects that do not cover the "spot" in the resonator field, for localized testing through an aperture in a mirror, to test small specimens, to measure ultrafine wire in an OR, to test the uniformity of a large-bore dielectric cylinder, and to study noise features in quasi-optical testing and inertia factors. The results of the survey showed that the technique has many possible applications in science and industry. References 29: 25 Russian, 4 Western (1 in Russian translation).

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UDC 620.179.14

DIFFRACTION PROBLEMS IN RADIOWAVE FLAW DETECTION

Sverdlovsk DEFEKTOSKOPIYA in Russian No 1, Jan 86 (manuscript received 18 Feb 86; final version 13 Aug 85) pp 44-54

[Article by G.N. Parvatov and A.A. Popov, Siberian Physical Technical Institute imeni V.D. Kuznetsov, Tomsk State University]

[Abstract] A general method for solving radiowave probing diffraction problems using aperture pickup emitting probes and a graphoanalytical solution for inverse problems as they apply to the comprehensive testing of sheet dielectrics was proposed. The problem was solved in detail for a planar waveguide. The problem was formulated by supposing that: a TEM wave of single amplitude was directed against the open end of the waveguide; the

sheet half-space being tested was placed in the region "z is greater than 0" and the reflected field in the waveguide was calculated as a function of the electrophysical parameters of the structure being tested while accounting for the wave diffraction at the aperture. The wave equation used was solved relative to the electrical component of the field under the following conditions: the field components at the separation boundaries are continuously tangent and the electrical field on the flanges is equal to zero. The solution was general enough for any cross-section of pickup emitting apertures. By varying the electrophysical and geometric parameters, it was possible to obtain all of the important variations of radiowave stratified dielectric testing needed for practical purposes. Given a fixed geometry for the measuring system, preconstructed amplitude and phase characteristics for the reflected fields, together with the correlations from the square waveguide solution, can be used to solve inverse problems of radiowave testing of stratified dielectrics. The "resonator" technique for the comprehensive testing of stratified dielectrics was used as an example. References 19: 18 Russian, 1 Western.

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RADIOWAVE METHOD FOR TESTING DIELECTRIC MATERIALS BASED ON MEASURING THE IMPEDANCE OF LINEAR ANTENNAS

Sverdlovsk DEFEKTOSKOPIYA in Russian No 1, Jan 86 (manuscript received 18 Feb 86) pp 54-61

[Article by A.R. Duma, V.I. Dorokhov, and A.S. Shostak, Siberian Physical Technical Institute imeni V.D. Kuznetsov, Tomsk State University.

[Abstract] The mutual impedance of two linear antennas placed in one layer of a stratified dielectric was theoretically calculated. For purposes of general application, the antennas were of different lengths and were parallel to each other and to the interfaces. Equations for the self- and mutual impedance of the antennas and for their electrical asymmetry were derived. Mutual impedance was expressed as a double integral and had to be determined in the presence of the interfaces. If the antennas were equal in length and the distance between them equal to zero, then the mutual impedance is equal to the self-impedance of one antenna. The calculations were consistent with experimental data and disclosed a number of laws governing the behavior of linear antenna impedance within this context. Testing methods based on the results of the theoretical calculations were described. The results of this study can be applied to the development of devices for measuring the humidity and permittivity of strata. References 12: 8 Russian, 4 Western.

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ADAPTIVE MULTICHANNEL SYSTEMS IN RADIATION INTROSCOPY

Sverdlovsk DEFEKTOSKOPIYA in Russian No 2, Feb 86 (manuscript received 3 Oct 84; final version 21 May 85) pp 18-23

[Article by N.Yu. Gerasenov and V.S. Melikhov, Scientific Research Institute of Electronic IntroscoPy, Tomsk]

[Abstract] The use of adaptive measuring channels to enhance the sensitivity of mosaic introscopes based on semiconductor detectors of high-energy braking radiation was discussed. Each measuring channel of a scanning bar consists of an MDPDM-structure, an input circuit, a current amplifier made from a transistor with an adaption circuit, a storage capacitor, and channel scanning elements with buffer amplifiers. These channels eliminate the static and slowly changing (relative to adaption time) components of the output signals caused by drift and radiation. As a result, mosaic introscopes built with adaptive measuring channels are capable of testing stationary, slowly moving, and moving objects, with a significant gain in contrast sensitivity in the case of slowly moving objects. These introscopes can also be easily adapted to different operating modes by modifying the algorithm for processing the videosegment and synchronization with the accelerator. Two experimental models of this type of introscope have been developed by the Scientific Research Institute of Electronic IntroscoPy. The first model contains a mosaic of $10 \times 10 = 100$ MDPDM-structures spaced 5 mm apart horizontally and 10 apart vertically. It is designed to test steel products 75 to 200 mm thick and maintain a sensitivity of 1 to 2.5% at the rated exposure dose. It has a constant adaption time of 2.5 seconds and can work with accelerators such as the B-30 betatron. The modulation mode can enhance the signal-to-noise ratio tenfold. The second model, the RAMI-2S, was designed to test extended welding seams on moving steel products with wall thicknesses of 150 to 400 mm while maintaining a sensitivity of 1%. The 72 detectors are spaced 2 mm apart in a band 144 mm wide that is mounted perpendicular to the welding seam. References 4: 3 Russian, 1 Western.

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USING THE BARKHAUSEN EFFECT TO TEST THE PARAMETERS OF LASER-HARDENED LAYERS IN FERROMAGNETIC MATERIALS

Sverdlovsk DEFEKTOSKOPIYA in Russian No 2, Feb 86 (manuscript received 5 Jun 84; final version 21 Mar 86) pp 87-89

[Article by V.L. Vengrinovich, V.P. Yakunin, S.D. Legotin, and V.N. Busko, Applied Physics Institute, Belorussian SSR Academy of Sciences]

[Abstract] The possibility of using the Barkhausen effect to distinguish among the geometric parameters of laser-hardened layers (LUS) of various types

of steel and cast iron was studied. After their surfaces were ground and coated with an absorbent coating, rectangular and round specimens were heat-treated by a 2.5-kilowatt continuous CO₂ laser operating at various power densities in multiple modes. The hardening depth of an individual LUS was up to 1.5 mm, and the hardening zone was up to 15 mm wide. The surface of the specimens was not allowed to melt. An RMShA-1 was used to measure magnetic noise. This device was equipped with a converter consisting of a bipolar magnetizing system with measuring coils of varying diameter positioned between the poles. Measurements were recorded by scanning across an LUS with the converter and constructing profile diagrams, which were compared with a metallographic analysis of the width, depth, and profile of the hardening zone. The laser heat-treatment of the specimens was varied to reflect actual differences in industrial processes. Analysis of the data showed that the signal on the "shelf" of the profile diagram has a graduated dependence on the depth of the hardening zone and, therefore, it is possible to separately measure the width and depth, as well as the nonuniformity, of laser-hardened layers. References 16: 15 Russian, 1 Western.

13050/13046
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ON THE PROBLEM OF THE THICKNESS OF THE INFORMATIONAL LAYER IN MAGNETIC NOISE STRUCTURE TESTING

Sverdlovsk DEFECTOSKOPIYA in Russian No 2, Feb 86 (manuscript received 8 Aug 84; final version 11 May 85) pp 89-93

[Article by V.L. Vengrinovich, V.P. Yakunin, S.D. Legotin, and V.N. Busko, Applied Physics Institute, Belorussian SSR Academy of Sciences]

[Abstract] The thickness of the informational layer (the layer that provides information about the properties of a material) was studied. After grinding the surfaces and coating them with an absorbent coating, disk-shaped specimens of U10 steel with a pearlite-cementite structure were hardened by passing a 2.5-kilowatt continuous CO₂ laser beam crosswise over the specimens to obtain strips of hardened layer 15 mm wide. The hardened layers had a structure of austenite, martensite, and carbide. The thickness of the hardened layers was 0.75 and 0.88 mm and was measured metallographically. Spectral density was measured by an PMSHA-1 magnetic noise analyzer equipped with a converter consisting of an attached electromagnet with a recording coil positioned between the poles. The depth of the hardened layers was altered by using electrolytic etching to remove the surface layers, and the average thickness of the layers removed and the width of the strip were measured after each etching cycle. Using the readings from the PMSHA-1, 102 profile diagrams of the magnetic noise level were constructed for all three testing phases (with remagnetization at 15 and 35 Hz). A nearly linear relationship existed between the depth of the hardened layer and the abatement of the magnetic noise, the minimum values for which coincided with the greatest thicknesses for the

hardened layers. The profile diagrams were also used to mathematically determine the width of the hardened layers. References 8: 5 Russian, 3 Western.

13050/13046
CSO: 1842/169

UDC 669.245'784'787

EQUILIBRIUM IN SYSTEM Ni-C-O

Moscow METALLY in Russian No 2, Mar-Apr 86 (manuscript received 10 Mar 86)
pp 17-22

[Article by L.V. Bochkova, L.Sh. Tsemekhman, V.P. Burylyev, L.A. Pavlinova, and L.F. Morozova, Leningrad]

[Abstract] Studies were performed in an alundum crucible placed with a charge of metal in a quartz reactor connected by a 3-way valve to a system of ampules for sampling of gas, a pressure measurement system and a vacuum pump. The system was evacuated to 133-266 Pa, then charged with argon to 13,300-16,000 Pa and placed in the furnace. Pressure changes were recorded with a mercury manometer and strip-graph recording pressure meter. Temperature was measured with a tungsten-rhenium thermocouple. The charge consisted of an Ni-C master alloy containing 0.55-2.3 mass percent carbon plus powdered nickel oxide added to yield 0.2 mass percent O in the charge. The variation in oxygen content as a function of carbon content in the nickel was found to have a minimum at both temperatures tested. Residual oxygen content increases with increasing temperature. The P_{CO}/P_{CO_2} ratio increases with increasing temperature and carbon content in the alloy. References 7: all Russian.

6508/13046
CSO: 1842/205

UDC 669.017

INFLUENCE OF COOLING RATE ON DENDRITIC LIQUATION AND QUANTITY OF EUTECTIC IN HYPOEUTECTIC ALLOYS

Moscow METALLY in Russian No 2, Mar-Apr 86 (manuscript received 23 May 84)
pp 72-75

[Article by Ye.S. Kucherenko, Dnepropetrovsk]

[Abstract] A study is made of the concentration dependence of the quantity of residual eutectic for the alloys Sn-Di and Pb-Sn in the interval of liquid phase cooling rates of $0.5 \cdot 10^1 - 7 \cdot 10^3$ K/s. Specimens with a mass of 0.1-0.3 g were placed on a thin mica sheet of a thermal analysis installation and melted; a thin thermocouple with open junction was inserted and copper disc

heating was performed. Thin inserts of paper, mica, and other substances placed on the copper heating disc were used to regulate the cooling rate. As cooling rate increases, the residual quantity of eutectic first decreases; then, at rates of $4-7 \cdot 10^2$ K/s, the decrease in the quantity of eutectic stops and subsequent increases in cooling rate over a broad range leave the quantity of eutectic unchanged. There is a concentration between the point of maximum solubility and the eutectic concentration for which the residual quantity of eutectic corresponds to the equilibrium concentration for rapid cooling. The change in ratio of quantity of phases in alloys of various concentrations upon rapid cooling is related to the decrease in the degree of dendritic liquation of the crystals of the primary solid solution, resulting in turn from the transition to isothermal crystallization of the dendritic core at the temperature of the equality of thermodynamic potentials of the solid and liquid phases. This concentration corresponds to the intersection of the line of the temperature of isothermal concentration with the eutectic horizontal line. The variation of degree of dendritic liquation as a function of cooling rate shows an initial rise, a broad smooth maximum and should show a decrease at $10^1-5 \cdot 10^2$ K/s, followed by a plateau and a second drop at cooling rates of over 16^0 K/s. References 7: all Russian.

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UDC 669.018.58

STUDY OF MAGNETIC STRUCTURE OF Fe-Mn ALLOY CONTAINING ALUMINUM

Moscow METALLY in Russian No 2, Mar-Apr 86 (manuscript received 23 May 84)
pp 179-181

[Article by V.A. Oparin, A.Ya. Nikolaich, and B.S. Yermakov, Leningrad]

[Abstract] Nuclear gamma-resonance spectroscopy is used to study the magnetic structure of the stable austenitic alloy Fe-Mn-Al containing 1% C, 28% Mn and 9% Al. Measurements were performed on an installation with a multichannel analyzer using constant accelerations. The gamma source was ^{57}Co in Pb. The gamma quanta were recorded with a scintillation detector containing a crystal of NaI (Tl) 1 mm thick). Best agreement with the experimental data was obtained by expanding the spectrum at room temperature into two components, a single line and a doublet, identified with the paramagnetic and antiferromagnetic states of the iron atoms in the alloy. The paramagnetic state is related to the manganese and carbon atoms in the near vicinity of the iron atom, the antiferromagnetic state to the manganese and aluminum atoms. At 77 K the alloy is a completely ordered antiferromagnetic alloy. Plastic deformation up to 60% does not change the magnetic structure of the alloys, though anomalous constriction of the mossbauer spectra, resulting from texture transformations, is observed with deformation of 40%. References 8: all Russian.

6508/13046
CSO: 1842/205

INFLUENCE OF HEAT TREATMENT ON COERCIVE FORCE OF MAGNETS OF Nd-Fe-B-TYPE ALLOYS

Moscow METALLY in Russian No 2, Mar-Apr 86 (manuscript received 30 Oct 84)
pp 182-184

[Article by A.S. Kononenko, V.V. Fedyakin, V.V. Sergeev, and A.A. Volskiy, Moscow]

[Abstract] Alloys used in this study were produced by argon-arc melting, crushed, ground, textured and sintered and the magnetic properties were measured. The influence of sintering temperature and the concentration of Nd on coercive force was determined. The influence of annealing at temperatures ranging from quite low to over 800°C on coercive force was also determined. This curve has maxima at 460 and 800°C. The coercive force of these magnets is little sensitive to sintering temperature or chemical composition of the alloys. The studies also showed that replacement of Nd with Pr results in some increase in coercive force. Introduction of Dy or Tb causes a still greater increase in coercive force. Replacing iron with 8 at.% Eo increases heat resistance of the magnetic property to 380°C, while 17 at.% Co increases this figure to 450°C. References 4: all Western.

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UDC 538.214:669.(721+76)

MAGNETIC SUSCEPTIBILITY OF Mg-Bi ALLOYS

Moscow METALLY in Russian No 2, Mar-Apr 86 (manuscript received 29 Jul 84)
pp 185-186

[Article by P.P. Kuzmenko, P.A. Suprunenko, and T.M. Tsvetkova, Kiev]

[Abstract] Results are presented from a study of the temperature and concentration variation of magnetic susceptibility of Mg-Bi Alloys in the area of existence of the solid and liquid state. Measurements of susceptibility were performed with continuous heating, with holding at each temperature point to achieve equilibrium. The magnetic susceptibility polytherms show no changes at the solidus or liquidus points in the 0-30.0 at.% Bi composition range. The results indicate preservation of Mg₃Bi₂ formations in melts with compositions other than the stoichiometric, so that the system of these Mg-Bi alloys can be considered to consist of two pseudobinary systems: Mg + Mg₃Bi₂ and Mg₃Bi₂ + (Bi + Mg) in the 0-40 and 40-50 at.% Bi areas. The results indicate stability of the compound Mg₃Bi₂ in melts with above-stoichiometric composition 0-50 at.% Bi. It is suggested that melts of these compositions have microheterogeneities. References 10: 6 Russian, 4 Western (2 in Russian translation).

6508/13046
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HOT SHORTNESS OF YTTRIUM

Moscow METALLY in Russian No 2, Mar-Apr 86 (manuscript received 6 Dec 84)
pp 211-214

[Article by A.I. Pikalov, V.V. Vorobyev, I.I. Papirov, L.A. Korniyenko,
A.A. Nikolayenko, and Ye.S. Karpov, Kharkov]

[Abstract] Fine grained yttrium was studied to determine the characteristics of its plastic deformation in the area of temperatures and deformation rates where superplastic flow might occur. It was found that the plasticity of yttrium increases with increasing temperature, reaching 80% at 650°C; however, with further heating there is a rapid drop in plasticity and at 750°C polycrystalline yttrium breaks practically without elongation. This behavior of the mechanical characteristics of polycrystalline yttrium indicates embrittlement of the metal at 750°C. Direct analysis of the composition of segregations formed along the grain boundaries of polycrystalline yttrium showed the formation of liquid phase components there containing high concentrations of impurities. The data indicate that the hot shortness of yttrium at 750°C results from the formation of liquid phases at the grain boundaries, the formation temperature of these phases being somewhat lower than the binary eutectic in the system Y-Cu. This may result from the presence of lower melting point multicomponent eutectics such as Y-Cu-Zn or Y-Cu-Zn-Pt. References 8: 5 Russian, 3 Western (1 in Russian translation).

6508/13046

CSO: 1842/205

COATINGS

UDC 669.268:548.735

SPECIFICS OF TEXTURE FORMATION IN ELECTROLYTIC CHROMIUM COATINGS

Moscow METALLY in Russian No 2, Mar-Apr 86 (manuscript received 10 Apr 84)
pp 173-175

[Article by O.B. Girin, Dnepropetrovsk]

[Abstract] A study was made of chromium coatings 30-50 μm thick precipitated from a universal electrolyte on specimens of U8 steel at a current density of 60A/dm² and electrolyte temperature of 40-70°C. The texture of the coatings was studied by direct and inverse pole figures on a diffractometer using scintillation recording of x-rays. The precipitate surface microstructure was studied on a scanning electron microscope. It was found that after the critical temperature is reached in the process of electrolysis, only α -Cr crystals are formed, producing a coating with a columnar structure and more scattered texture than is first produced. The increase in ϵ and α of the texture with increasing electrolyte temperature is apparently therefore explained by an increase in the mean grain size of the precipitate with the columnar structure. References 13: 11 Russian, 2 Western.

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UDC 669.76.87:548.735.6

STRUCTURE OF CERTAIN ELECTRODEPOSITED BISMUTH ALLOYS AND ITS CHANGE WITH ANNEALING

Moscow METALLY in Russian No 2, Mar-Apr 86 (manuscript received 11 Jul 84)
pp 176-178

[Article by V.V. Poveikin, I.M. Kovenskiy, and N.A. Yermakova, Tyumen]

[Abstract] A study is made of the structure of electrodeposited alloys of bismuth with copper, nickel and cobalt, and the influence of low-temperature annealing on this structure. Deposits about 30 μm thick were obtained from trilonate electrolytes onto mechanically polished steel plates. Phase analysis of the precipitates was performed on an x-ray diffractometer in filtered cobalt radiation. The resistivity of the precipitates was measured

with a double bridge. The supersaturated solid solution precipitates formed are metastable systems which break down very slowly at room temperature. Heating for 1 hour at 400°C converted the copper and nickel alloys to equilibrium though the diffractograms of annealed Co-Bi alloys showed reflexes of a phase not present on the constitution diagram. The reflexes are reduced by the intermetallic compound CoBi formed upon breakdown of the supersaturated solid solution of bismuth in β -Co. References 5: all Russian.

6508/13046

CS0: 1842/205

ENHANCED CRACK RESISTANCE OF RUBBER-MODIFIED EPOXY MATERIALS

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 6, Nov-Dec 85
(manuscript received 15 Mar 85) pp 963-968

[Article by A.V. Kudryavtsev, G.V. Vysotskaya, and N.D. Pukas, Strength Problems Institute, Ukrainian SSR Academy of Sciences, Kiev; High-Molecular Compounds Chemistry Institute, Ukrainian SSR Academy of Sciences, Kiev]

[Abstract] The thermodynamic compatibility of ED-20 epoxy resin with oligobutadiene (SKD) and oligobutadieneacrylonitrile (SKD) rubbers and the crack resistance of epoxy materials modified with these rubbers (EKM) were studied. To prepare the epoxy and rubber mixture, SKD-KTRA and SKN-30KTR rubbers were manually mixed into the resin, the mixture was heated through in a vacuum chamber at 333 K until all air bubbles disappeared, mechanically mixed, and cooled to 303 K in a water bath. Polyethylene-polyamine hardener was then added. The mixture was cast in molds preheated to 303 K and left to harden for 7 days. Modification with the SKD-KTRA was varied by heat treating the mixture after hardening and by inducing prior to hardening preliminary esterification (PRE) between the carboxyl and epoxy groups for 2 hours at 433 K. Thermodynamic compatibility was determined by reverse gas chromatography (OGKh) using spectra obtained on a UR-20 infrared spectrophotometer. Crack resistance was studied by statically loading double-cantilevered specimens of EKM having an initial crack. Loading was done at room temperature on a 1231U-10 universal tester. The epoxy resin and rubbers were thermally compatible up to 40 mass parts at 298 K, with an improvement in this property as the temperature increased. Crack resistance was enhanced most by an SKD-KTRA concentration of 20 mass parts and heat treatment. Crack resistance is greatly affected by the presence of an interphase surface in the EKMs. A necessary condition for enhancing crack resistance is a chemical bond between the elastic rubber inclusions and the rigid epoxy matrix, which is achieved by the modifications described earlier, of which the PRE variant was the most effective. Since the critical value for the load strength coefficient is highly sensitive to the structure of EKMs, it can be used to make optimal modifications of these materials. References 13: 8 Russian, 5 Western (1 in Russian translation).

13050/13046
CSO: 1842/156

AN EXAMPLE OF DESIGNING A COMPOSITE MATERIAL THAT IS CRACK RESISTANT WHEN
SUBJECTED TO EXTENSION (STRETCHING)

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 6, Nov-Dec 85
(manuscript received 6 Sep 85) pp 977-983

[Article by A.K. Malmeyster, Polymer Mechanics Institute, Latvian SSR Academy
of Sciences, Riga]

[Abstract] A hierarchy of mathematical models was used to determine a method
of constructing the reinforcing structure of composite materials that would
ensure the greatest possible rigidity, strength, and crack resistance. The
material was assumed to be isotropic, follow Guk's law, and have elasticity
and Poisson coefficients. Principal deformations and the values for the
components of the deformation tensor were calculated. The following defini-
tion was postulated: A material will be crack resistant when in any point in
any system of coordinates, the sum of the components of the tensor of the
deformations determining tearing and shearing will simultaneously be less
than the critical value. The data showed that 25% of the reinforcing fibers
should be distributed in the direction of extension, 25% perpendicular to
this direction, and the remaining 50% should be distributed perpendicular to
one another at a 45° angle to the principal stress (with a planar load).
This reinforcement design was applied to only one planar dimension.
References 4: all Russian.

13050/13046
CSO: 1842/156

A STRENGTH CRITERION FOR CROSS-PLY REINFORCED FIBERGLASS

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 6, Nov-Dec 85
(manuscript received 21 Mar 85) pp 1005-1011

[Article by A.A. Falenkov, A.S. Vavakin, R.M. Mansurov, L.P. Stepanov, and
N.I. Malinin, Scientific Research Institute of Mechanics, Moscow State
University imeni L.M. Lomonosov; Problems of Mechanics Institute, USSR Academy
of Sciences]

[Abstract] A strength criterion was established for KPPN (cross-ply parallel
and cross-wound) fiberglass subjected to two-dimensional stress. The material
was assumed to be homogeneous, anisotropic, and multi-ply. A detailed
description of how KPPN fiberglass is made is provided. The effect of time on
the strength of the material was not considered. KPPN fiberglass specimens
were tested on an Instron-1275. The specimens were taken from manufactured
pipe and turned in the middle to localize subsequent damage and to reduce the
amount of force required. Wall thickness in this part of the pipe varied from

2.5 to 3.5 mm. Specimens were tested for extension and compression and consisted of small pipe 121/108 mm in diameter and 100 mm high, and of rings. Load and deformation was increased at a steady rate. The test results were compared to several theoretical criteria: Malmeister's, Goldenblat and Kopnov's, Marin and Hoffman's, and Azzi and Tsay [transliteration]. Malmeister's criterion was found to be the most accurate description of the test results. References 10: all Russian.

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CSO: 1842/156

UDC 620.172:678.067

EXPERIMENTAL INVESTIGATION OF DISTINGUISHING DEFORMATION AND TENSILE FAILURE CHARACTERISTICS OF CROSS-REINFORCED WOUND COMPOSITES

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 6 Nov-Dec 85
(manuscript received 1 Apr 85) pp 1020-1024

[Article by V.N. Bulmanis, Yu.I. Gusev, A.S. Struchkov, and V.B. Antokhonov, Physical Technical Problems of the North Institute, Yakutsk Department of the Siberian Branch of the USSR Academy of Sciences, Yakutsk; Riga Branch of the All-Union Scientific Research and Planning-Design Institute of Electrical Insulating Materials and Foil Dielectrics; East Siberian Technological Institute, RSFSR Ministry of Higher and Secondary Education, Ulan-Ude]

[Abstract] The effect of the width and "degree" of interweaving the tape and of the reinforcement coefficient on the load-bearing capacity and deformation characteristics of cross-reinforced wound composites subjected to axial elongation was studied. Tubular specimens were made by spirally winding at a 45° angle tape made of VMPS6-7 2x4x2-78 glass filament impregnated with EDT-10 binder. The bore of the specimens was 44 mm, the length 300 mm, and the wall thickness 1.5 to 2 mm. The specimens varied in the number of filaments and in the reinforcement coefficient. Strain sensors were glued in various places and at various angles on the specimens, which were then tested in an Instron machine at room temperature. The elongation rate was 0.5 mm/min. Nonlinear deformation was measured by an Instron tensometer. The specimens were tested for elasticity prior to testing for tensile failure. The width and "degree" of interweaving had no effect on elasticity, whereas increasing the reinforcement coefficient led to an increase in the elasticity modulus. Making the tape narrower led to an increase in strength; increasing the "degree" of interweaving led to a decrease in strength, with the interweaving zones acting as "weak links" in the composite. Varying the reinforcement coefficient had a substantial effect on the composite's strength linked to the variation in the thickness of the layer of binding between the wound tape. References 11: 7 Russian, 4 Western.

13050/13046
CSO: 1842/156

MODERN CONCEPTIONS OF THE APPLICATION OF COMPOSITE MATERIALS IN AIRCRAFT
STRUCTURES AND ENGINES

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 6, Nov-Dec 85
(manuscript received 7 Mar 85) pp 1049-1056

[Article by A.S. Volmir, presented as a paper at the Fifth All-Union
Conference on the Mechanics of Polymer and Composite Materials, Riga, Oct 83]

[Abstract] Composite materials used in aircraft are divided into six categories depending on structural characteristics such as layering, particle content and size, type and concentration of fillers, fiber concentration, distribution, and position, and hybrid characteristics. Composite materials are not as dense as traditional materials, such as steel and duralumin, and have higher ratios of tensile strength and modulus of elasticity to density. Some composites have greater tensile strength and higher elasticity moduli. Complete substitution of metal with composites can reduce aircraft mass by more than 40%. Important areas of research are the distribution and placement of fibers; how to enhance the wear resistance of composites, which are much less durable than traditional materials; the development of hybrid composites with mechanical properties comparable to those of metals; and the development of techniques for assembling aircraft made with composites. The use of composites in aircraft engines is largely dictated by temperature. Specific examples of composite applications are provided. References 7: all Russian.

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CSO: 1842/156

UDC 678.2.001--518.5:678.067

OPTIMIZATION CRITERIA FOR THE OPTIMAL CONTROL OF INDUSTRIAL HEAT-TREATING
PROCESSES FOR PRODUCTS MADE OF COMPOSITE POLYMER MATERIALS

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 6, Nov-Dec 85
(manuscript received 27 Nov 84) pp 1066-1073

[Article by Yu.A. Afanasyev, Leningrad Mechanics Institute]

[Abstract] Certain approaches to the selection of optimization criteria as applied to the optimal control of heat-treating processes for thick-walled products were surveyed. The most commonly used quality-control indicators were listed as: the minimal energy problem, the minimal fuel consumption problem, the optimal high-speed control problem, the minimal error problem (in linear form), and criteria employing penalty functions (where a "fine" is "paid" for not fulfilling an equality). Other criteria are also used, the most important of which are cost effectiveness and its related capital recovery criteria. The correct selection of criteria is critical to the

problem of optimization. Although it is next to impossible to do, there are several approaches towards selecting a single unified criterion. These are: substituting one criterion for several, optimizing the most important of a series of criteria, and sequentially optimizing all the criteria. Current research yields several types of functions that mathematically describe the thermal cycles of the manufacture of thick-walled cylindrical products such as components free of residual thermal stress, components with precalculated stress, nonporous thick-walled products made of composite materials, and products with heat-treatment optimization criteria constrained by time or economic considerations. All of these criteria can be used in various combinations and be further modified by other conditions. Optimization criteria are selected according to the research objective and the nature of the problem and must be tailored to each specific situation. References 16: all Russian.

13050/13046
CSO: 1842/156

UDC 678.029.435+621.384.3+621.375.826

NONSTATIONARY THERMAL FIELD CREATED BY EXPOSING SURFACE OF A PRODUCT MADE FROM POLYPHENYLENEOXIDE TO LASER RADIATION WITH A WAVELENGTH OF 10.6 MICRONS

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 6, Nov-Dec 85
(manuscript received 11 Dec 84) pp 1074-1078

[Article by V.V. Korshak, L.N. Nikitin, I.G. Merinov, E.Ye. Said-Galiyev, and I.A. Ronova, Elementoorganic Compounds Institute imeni A.N. Nesmeyanov, USSR Academy of Sciences, Moscow]

[Abstract] Nonstationary thermal fields on the surface of a product made from poly-2,6-dimethyl-1,4-phenyleneoxide (PFO) exposed to quasi-pulse infrared laser radiation with a wavelength of 10.6 microns were calculated. The face of the specimen, which was a bushing 22x15 mm in cross section and 15 mm in length produced by compression compacting of 573 K, was rotated beneath a laser ray with variably controlled angular velocity. Exposure time, the time required to repeat an exposure, and the length of time between exposures were calculated. The calculations were approximated and were limited to the effects of thermal conductivity on the thermal field. Because of the way the problem was structured, the calculation of the temperature variation of the specimen was reduced to a problem involving the heating of a half-space by a pulsing thermal stream falling upon its surface. The values of the thermal field were checked by comparing the thermal degradation of the irradiated and nonirradiated material of the specimen. Thermobalances made by the Setaram company were used for this purpose. The gaseous degradation products released during dynamic heating were qualitatively identical to those released during laser degradation, and the temperature interval for this process corresponded closely to the one calculated (461 to 750 K). The data show the potential for using infrared lasers to create dynamic thermal fields. References 10: all Russian.

13050/13046
CSO: 1842/156

EFFECT OF TEMPERATURE AND COMPRESSION ON STRUCTURAL CHANGES IN MULTICOMPONENT COMPOSITE MATERIAL BASED ON A PHENOLFORMALDEHYDE BINDER

Ria MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 6, Nov-Dec 85
(manuscript received 14 Jan 84) pp 1110-1112

[Article by N.V. Skvortsova, A.N. Mishkin, L.B. Barbash, A.A. Korol, and A.N. Shcherbakov, Strength Problems Institute, Ukrainian SSR Academy of Sciences, Kiev; Central Scientific Research Institute of Construction Materials, Moscow; Institute of Materials Science Problems, Ukrainian SSR Academy of Sciences, Kiev]

[Abstract] Changes in the phase composition, structure, and properties of a multicomponent composite material based on a phenolformaldehyde binder during compression at temperatures ranging from 273 to 2273 K were studied. The specimens were cut along the grain of the fibers from slabs of laminated plastic with a filler of inserted sliver fabric containing silicic fibers in the weft and polyamide fibers in the warp. The material had a large-cell laminated structure created by the position of the fibers. The gaps between fibers were uniformly filled by a polymer matrix. Initial porosity was 12%. The specimens were 10x10x 20 mm and had a true parallelepiped shape. They were heated at 100°/min in argon. The deformation rate was 2 mm/min. Compressive strength as a function of temperature was tested on a modified ZD-100 unit made in East Germany. Compressive strength in both directions declined to minimal values as the temperature rose to 1173 K as a result of the degradation of the binder and the fibers. The property increased as the temperature rose to 1473 K due to the formation of the crystalline structure of the coke, and then dropped to minimal values again as the temperature reached 1773 K. Porosity, measured pycnometrically and stereometrically, decreased as the temperature rose to 473 K, increased as the temperature rose to 1173, decreased between 1173 K and 1373 K, and steadily increased to a maximum of 45% at a temperature of 1773 K. Optical microscopy and petrography revealed no substantial changes in the phase composition or structure of the material. References 8: all Russian.

13050/13046
CSO: 1842/156

STRENGTH DISSIPATION IN CARBON PLASTICS DUE TO PRODUCTION FACTORS

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 6, Nov-Dec 85
(manuscript received 9 Apr 85) pp 1115-1117

[Article by A.V. Karlashov, V.M. Inyakin, G.M. Boroznets, and A.D. Gnatyuk,
Kiev Institute of Civil Aviation Engineers imeni 60th Anniversary of the USSR]

[Abstract] Plates made from LU-P-01 carbon tape were tested for short-term tensile strength. The carbon tape came from various batches, and the plates were made using 15 of the most typical production techniques. The specimens were representative of products made over a 5-year period from different batches of carbon tape and with different production techniques. All the specimens were made at the same plant in the same autoclave by operators with different levels of skill. The results were then generalized to see whether there was a relationship between strength dissipation and the arrangement of the layers of carbon tape. The mathematical model constructed for this purpose was uninformative. The data showed that the strength variation coefficient during the tensile test varied from 9% to 15%, but was not a function of the arrangement of carbon tape layers. References 2: both Russian.

13050/13046
CSO: 1842/156

AN EXPERIMENTAL INVESTIGATION OF THE STABILITY OF ROTATION SHELLS MADE FROM COMPOSITE MATERIALS WHEN SUBJECTED TO EXTERNAL PRESSURE

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 6, Nov-Dec 85
(manuscript received 15 Apr 85) pp 1120-1121

[Article by V.M. Perevozchikova and O.N. Ivanov, Moscow Chemical Machine Building Institute]

[Abstract] Five ellipsoid shells made by spiral winding from composite materials were tested for stability under external pressure. The pressure was applied by a device utilizing a thin rubber bag placed over the shell to be tested. Severe stress was applied to the narrow edge of the shells, and unrestricted stress to the wide edges, which were reinforced with bands. Loss of stability was accompanied by a pop and the formation of dimples around the ring and along the meridian. The shells recovered their shape when the load was removed. Upper and lower critical pressure values were measured and ranged from 0.010 to 0.129 and 0.05 to 0.07, respectively. These data were compared with a theoretical calculation of stability employing a semianalytical technique based on the final element and Fourier methods. The congruence of the experimental data and the theoretical calculations was satisfactory. References 3: all Russian.

13050/13046
CSO: 1842/156

VISCO-ELASTIC PROPERTIES OF GLASS-FILLED POLYMER MIXTURES CONTAINING
POLYETHYLENE

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 6, Nov-Dec 86
(manuscript received 19 Feb 85) pp 1121-1123

[Article by S.D. Petrenko, V.F. Rosovitskiy, N.A. Kvitka, and V.P. Privalko, High-Molecular Compounds Chemistry Institute, Ukrainian SSR Academy of Sciences, Kiev; Ukrainian Scientific Research and Technological Institute for the Development of Machinery and Equipment for Processing Plastics, Rubber, and Synthetic Leather, Kiev]

[Abstract] The visco-elastic properties of binary mixtures of thermo-dynamically incompatible polymers modified with fiberglass were studied. The mixtures were polyamide (PA) 66 with polyethylene (PE), PA6 with PE, and polyoxymethylene (POM) with PE. The mass fraction of the fiberglass was 30% relative to the polymer binder. The PE concentration varied from 2% to 10% relative to the polymer matrix. An automatic frequency relaxometer operating at 100 Hz was used. The temperature ranged from 20° to 260°C. The addition of 4% PE to PA66 did not change the nature of the mechanical loss tangent function, but the real part of the elasticity modulus (E') decreased. The addition of 30% fiberglass led to a 10° to 15° drop in the peak temperature in the glass point region and to lower structural uniformity. The combined addition of PE and fiberglass led to a smaller drop in the glass and to somewhat of an increase in structural uniformity. An increase in temperature was accompanied by an increase in the ratio of E' for glass-filled PA to E' for nonglass-filled PA. The introduction of fiberglass into the PA-PE mixture radically altered the composition's level of microheterogeneity by dispersing the particles of the polymer modifier. Here, an important role is played by phenomena occurring at the phase boundaries. A 4% concentration of PE in PA6 and POM resulted in increases in E' within narrower temperature ranges. The effect of adding fiberglass to PA binary mixtures can be generalized for filled polymer mixtures and depends on the nature and the concentration of the polymer modifier. References 8: all Russian.

13050/13046
CSO: 1842/156

UDC 539.4:539.2:678.067

MICROSTRUCTURE OF EPOXY MATRICES

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 1, Jan-Feb 86
(manuscript received 22 Jan 85) pp 3-8

[Article by I.S. Deyev and L.P. Kobets, Moscow]

[Abstract] A previous work assumed that the structure of an epoxy novolac matrix under long-term loading behaves as it does because its structure is

made up of microscopic blocks in which the globules are joined by chemical bonds, while the interaction of the blocks with each other is primarily a result of physical bonds. With the resultant mobility and shape variation, the microscopic blocks can orient themselves in a force field, varying the mechanism of fracture of the matrix. The purpose of this work was to check the agreement of this model with the actual structure of an epoxy matrix by electron microscope study of the transformations of its structure in various stages of loading of a plate. Ion etching produced surfaces of the fibers suitable for examination under the microscope. The major peculiarity of the epoxy matrix structure revealed by ion bombardment was microheterogeneity, clearly seen in all specimens. A second peculiarity seen in specimens tested at room temperature was high mobility and deformability of microdispersed phase particles when force was applied. A high degree of aggregation of microdispersed phase particles was observed in specimens tested at 110°C. The microplastic deformation of the epoxy matrix was found to facilitate redistribution of the heterogeneous microstress field, delaying avalanche failure of the specimen. References 7: all Russian.

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UDC 539.32:678.067

INFLUENCE OF AGGREGATION OF HARD DISPERSED FILLER ON ELASTICITY CHARACTERISTICS OF POLYMER COMPOSITE

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 1, Jan-Feb 86
(manuscript received 10 Jun 85) pp 14-22

[Article by Yu.A. Dzenis, Polymer Mechanics Institute, Latvian SSR Academy of Sciences, Riga]

[Abstract] Previous efforts to determine the effective elasticity characteristics of polymer composites with dispersed filler based on the properties of their components are briefly reviewed. Experimental data are presented for polyethylene filled with calcite, leading to a hypothesis of the aggregation of the particles of the filler which strongly influences the mechanical properties of the composite. The variation in the degree of aggregation of the filler as a function of its volumetric content and the influence of aggregation on the elastic characteristics on the composite are studied. The Monte Carlo method is used to model random structures on a computer. The effective elastic characteristics of polymers with hard aggregating fillers are calculated. Experimental and calculated values of the modulus of elasticity of filled polyethylene are compared. The results confirm the hypothesis of aggregation of fillers. One significant peculiarity of such a medium is the variable connectedness of the inclusions phase depending on the volumetric content of the inclusions. A change in the connectedness of the filler can be considered by introducing an additional parameter to the equations. A method is presented for determining the connectedness parameter based on the results of statistical modeling of the geometry of the media. References 21: 13 Russian, 8 Western.

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CSO: 1842/204

DRY FRICTION DAMPING OF DYNAMIC LOADS IN A FIBER COMPOSITE

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 1, Jan-Feb 86
(manuscript received 25 Mar 85) pp 28-37

[Article by L.V. Nikitin and A.N. Tyurekhodzhayev, Earth Physics Institute
imeni O.Yu. Shmidt, USSR Academy of Sciences, Moscow

[Abstract] When dynamic loads act on a fiber reinforced composite, much of the energy is dissipated by friction at points of separation of matrix from fiber. This article studies the propagation of waves in an elastic fiber, a rod interacting with the matrix by dry friction. The rod is considered to be of constant cross section, interacting with the surrounding matrix by Coulomb dry friction. Precise, analytic solutions are produced to a number of non-linear problems related to impact between a semiinfinite and finite fiber and the matrix. The cases of both unidirectional and reciprocal motion, as well as oscillating motion, are analyzed. The results obtained allow computation of the energy dissipated in delamination of sections of the composite under impact loading. It is shown that significantly more energy is dissipated upon dynamic loading than upon quasi-static loading.
References 5: all Russian.

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UDC 539.4:620.22-419.8

ANALYSIS OF FRACTURE OF A GRANULAR COMPOSITE IN AN UNFAVORABLE MEDIUM

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 1, Jan-Feb 86
(manuscript received 3 Jun 85) pp 44-48

[Article by D.G. Keyru, Yu.V. Osetinskiy, and A.M. Podvalnyy, Rostov
Construction Engineering Institute, Scientific Research Institute of Concrete
and Reinforced Concrete, USSR State Committee for Construction Affairs,
Moscow]

[Abstract] A review is presented of studies of the final stage in failure of a composite material, fracture itself. A well-ordered analysis of fracture is based on estimation of the stress state of the composite. This article presents the results of a study of the probability of failure of a composite material in which the unit cell is a 3-dimensional structure, a sphere in a spherical envelope. Previous works have shown that the spherical model provides the best description of the behavior of concrete in an unfavorable environment. The results of the studies of this 3-dimensional model are compared with results obtained earlier using a 2-dimensional model. Assuming that fracture of the conglomerate is caused by tensile stresses in the matrix, an expression is derived for the maximum tensile stresses. An equation is

produced for the probability of fracture of the composite. The Monte Carlo method can also be used to determine the probability of fracture. A program to perform the calculation was written to be run on a YeS-1022 computer. Comparison of data obtained by the Monte Carlo method and the analytic method indicates that both methods lead to similar qualitative and quantitative results. References 10: 9 Russian, 1 Western.

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UDC 629.76:539.3.001

USE OF LAYERED METALS IN COMPRESSED ELEMENTS

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 1, Jan-Feb 86
(manuscript received 29 Apr 85) pp 79-87

[Article by A.A. Belous and I.B. Mishulin, Central Aerohydrodynamics Institute imeni Professor N.Ye. Zhukovskiy, Moscow Oblast]

[Abstract] A study is made of the effectiveness of the use of multilayer plates with metal reinforcing layers to achieve stability of the shape of equilibrium under compressive stress in comparison to monolithic single-layer plates of the same mass made of the metal used in the load-bearing layers. Equations are presented for neutral equilibrium of plates with elastic layers. The method of calculation is described for the case when the load-bearing layers operate beyond the elasticity limit. It is shown that the use of glued metals is effective only if the load-bearing layers remain in the elastic area. References 5: 4 Russian, 1 Western.

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UDC 377.678.2.001:678.067

OPTIMIZATION PROBLEMS IN CONTROL OF TECHNOLOGICAL PROCESSES OF HEAT TREATMENT OF PRODUCTS OF COMPOSITE MATERIALS

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 1, Jan-Feb 86
(manuscript received 30 May 85) pp 103-117

[Article by Yu.A. Afanasyev and V.I. Muravyev, Leningrad Mechanics Institute]

[Abstract] A study is made of problems of heat treatment of products made of wound reinforced composite materials which are multivariate extremal problems in nonlinear programming with limitations. The method of mathematical programming and dynamic programming is discussed, and an example is presented of solution of a test problem related to the cooling rate of an orthotropic cylinder. Analysis of the speed-optimal cooling conditions thus calculated

indicates that the optimal control is always based on limitations on the control, that the limitation on the rate of change of the controlling functions such as surrounding medium temperature or product surface temperature is the major factor preventing intensification of heat treatment processes. Problems are formulated for control of the process, as well as problems of the creation of a dialogue computer system for production of estimates of the quality of the process and formation of an adaptive quality criterion. References 33: all Russian.

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UDC 539.61:678.2

GLUED COMPOSITES BASED ON ACRYLIC MONOMERS FOR PRODUCTS OF POLYVINYL CHLORIDE PLASTIC AND STUDIES OF THE KINETICS OF THEIR POLYMERIZATION

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 1, Jan-Feb 86
(manuscript received 24 Jan 85) pp 124-128

[Article by Ye.M. Morozova, Ye.L. Yergunova, A.S. Morozov, and T.S. Benderovich, Physical Chemistry Institute, USSR Academy of Sciences, Moscow; All-Union Scientific Research Institute of Medical Polymers, Moscow]

[Abstract] Results are presented from studies of the kinetics of polymerization using the gluing of tubular polyvinyl chloride parts as an example. Pipes of the smaller diameter were wet with a monomer composite and placed inside tightly fitting larger diameter pipes, then the specimens were heated for some time, the tensile stress of the glue seam was determined, and the residual monomer determined in the same specimen by the polarographic method. The data confirm the summary influence of the polymers introduced and formed on the rheology of the process of polymerization and the polymerization kinetics. References 11: 10 Russian, 1 Western (in Russian translation).

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UDC 620.17:678.2

ESTIMATE OF MECHANICAL PROPERTIES OF RIGID EPOXY BINDERS FOR COMPOSITE MATERIALS

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 1, Jan-Feb 86
(manuscript received 18 Jun 85) pp 158-160

[Article by G.A. Voloskov, V.N. Morozov, and V.V. Kovriga, Ukrainian Plastics Scientific Research Institute, Donetsk; Norplast Scientific Production Association, Moscow]

[Abstract] An attempt was made to develop a method of manufacturing specimens free of certain shortcomings related both to scattering of

experimental data and variations in technological prehistory of polymers in the specimens. Specimens were made in two stages, the first of which was pouring of a prepared composition into a special mold and curing. After curing and cooling the polymer block was removed from the mold, traces of the lubricant were removed and it was cut (second stage) into specimens of the size required by the specifications for test specimens. The method has good productivity, is technologically convenient, and permits the production of specimens for testing of the mechanical properties of epoxy polymers with distribution of residual stresses strictly constant across the width of the specimen. References 7: 3 Russian, 2 Western, 2 East European.

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HIGH-SPEED STRETCHING OF INORGANIC FIBER FABRICS

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 1, Jan-Feb 86
(manuscript received 4 Feb 85) pp 161-163

[Article by V.I. Tsyppkin, V.N. Rusak, and A.G. Ivanov, Moscow]

[Abstract] A study was made of the behavior of carbon- and glass-fiber fabric when rapidly stretched at 10^3 - $10^4 \cdot s^{-1}$. The method of estimating the load-bearing capacity of the materials was based on detonation of an explosive charge within a hollow cylindrical specimen of TS-8/3-250 glass fabric 0.2 mm thick or UUT-2 carbon-fiber fabric 0.5 mm thick at 290 ± 5 K. Results of the experiments showed that deformation of the fabrics to 3-5% occurred in the elastic area without fracture and with subsequent elastic unloading without residual deformation. Failure of the glass fiber occurred when deformation reached about 5% and that of the carbon fabric at about 4%. The glass fabric failed by a specific, local, fragment-free mechanism, the fabric losing its initial structure at final deformations of about 40-50% with the formation of local penetrating failures of meridional orientation. The carbon fabric failed with breakage of individual fibers and threads. Further increases in loading resulted in the formation of extended penetrating "brittle" cracks of various orientations, followed by catastrophic failure of the entire central area of the specimen. References 6: 4 Russian, 2 Western.

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STRESS-STRAIN STATE IN ANISOTROPIC SHELLS OF COMPOSITE MATERIALS WITH DIFFERENT MODULI

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 1, Jan-Feb 86
(manuscript received 30 Apr 85) pp 166-168

[Article by A.A. Zolochevskiy, Kharkov Polytechnical Institute imeni V.I. Lenin]

[Abstract] A new method is presented for studying the stress-strain state of anisotropic envelopes of rotation of arbitrary shape made of composite materials with different moduli. As an example, an elliptical toroidal segment loaded by internal pressure and clamped at the edges is studied. Results are significantly more accurate than previous methods which do not consider the difference in moduli. References 3: all Russian.

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REINFORCEMENT OF IRRADIATED POLYETHYLENE BY ADDITION OF SMALL QUANTITIES OF DISPERSED FILLERS

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 1, Jan-Feb 86
(manuscript received 5 Feb 85) pp 168-171

[Article by R.Ye. Ilyenko and V.P. Gordiyenko, Physical Chemistry Institute imeni L.V. Pisarzhevskiy, Ukrainian SSR Academy of sciences, Kiev]

[Abstract] An explanation is presented for the nonadditive nature of the contribution of filler and radiation to the effect of the strengthening of polyethylene containing dispersed additives in quantities such that they serve as artificial nuclei for structure formation. The influence of radiation on the change in tensile strength of polyethylene containing 0.4% Aerosil and 2.0% titanium dioxide is studied. The total strength of the irradiated polyethylene is found to be determined by the number of "penetrating" chains of the initial polymer and "penetrating" chains formed as a result of the introduction of the materials and in the process of radiation cross-linking between unloaded macromolecules in the amorphous areas of the filled material. The nonadditive nature of the contribution of the filler and radiation to the increase in strength of the radiation-modified polyethylene can be explained by an increase in the total number of "penetrating" chains, the formation of chemical bonds between the polymer and filler, and the inhibiting influence of dispersed filler particles in the process of the growth of submicroscopic cracks during failure of the composite material. References 11: all Russian.

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ROLE OF BORON MICROADDITIONS IN INTERGRANULAR CORROSION OF Cr20Ni20 STEEL IN ACIDIC MEDIA

Moscow ZASHCHITA METALLOV in Russian Vol 22, No 3, May-Jun 86 (manuscript received 28 Aug 85) pp 339-347

[Article by O.V. Kasparova, Ya.M. Kolotyркиn, V.M. Milman, N.I. Khokhlov, and N.A. Pavlenko, Physical Chemistry Scientific Research Institute imeni L.Ya. Karpov and Central Scientific Research Institute of Ferrous Metallurgy imeni I.P. Bardin]

[Abstract] An experimental study concerning intergranular corrosion in Cr20Ni20 austenitic stainless steel (19.7-20.2% Cr, 20.1-20.3% Ni) and the role of boron microadditions in this process was continued, this time high-purity (0.002% P) low-carbon (0.006-0.010% C) grade of this steel being exposed to acidic media such as 1 M HClO₄ + 0.25 M NaCl at 22°C, 0.5 M H₂SO₄ at 60°C, and 27% HNO₃ at 40°C. Strip specimens of this steel had been quenched in water after soaking at 1100°C for 1 h, then tempered at 650°C for 1-10-100 h and at 900°C for 10 h. The behavior of specimens with 0.008% B or 0.010% B was compared with that of specimens without boron. Corrosiveness was measured at potentials corresponding to the transition from active to passive state and within the overpassivation range. The distribution of boron in steel before and after action of an aggressive medium was determined on the basis of track autoradiography. Excess phases precipitating after tempering were identified on the basis of x-ray analysis by the rotation method in an RKD-57 chamber with a CrK_α -radiation source, anodic deposit having been dissolved in a 950 ml CH₃OH + 50 ml HCl + 30 g C₆H₈O₇ (citric acid) mixture at a temperature of 22°C and at a potential of 0.2 V relative to a normal hydrogen electrode. The products of steel dissolution were identified with a Perkin-Elmer spectrophotometer. Specimens for metallographic and surface examination were polished electrically with a 10:1 mixture of glacial acetic acid and chloric acid for a period of 20-30 s under a voltage of 25-30 V at a temperature of 20-25°C, then etched electrolytically with an 8.5 g C₆H₈O₇ + 8.5 g (NH₄)₂SO₄ solution in 1 l H₂O at a current density of 5 mA/cm². The results reveal a detrimental effect of boron microadditions on the resistance of this steel tempered at 650°C to intergranular corrosion within the range of the transition from active to passive state, possibly owing to faster precipitation of a Cr₂B phase than of a Cr₂₃C₆ phase in the absence of boron. The resistance is restored by tempering at 900°C, evidently owing to fast equalizing diffusion of chromium. In the overpassivation

range the effect of microboron additions is detrimental not only in steel tempered at 650°C and at 900°C but already after quenching, probably owing to segregation of boron along the grain boundaries. References 31: 11 Russian, 3 Polish, 17 Western (1 in Russian translation).

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UDC 620.194

RESISTANCE OF 07Cr13N₂Mn20, 01Cr18Ti, 01Cr25Ti NICKELLESS STEELS TO CORROSION CRACKING IN HOT SATURATED SOLUTIONS OF CHLORIDES

Moscow ZASHCHITA METALLOV in Russian Vol 22, No 3, May-Jun 86 (manuscript received 26 Oct 84) pp 348-353

[Article by S.A. Glazkova, V.A. Moroz, S.M. Kutepov, S.G. Bocharova, and L.F. Fomushkina, Scientific Research Institute of Chemical Machine-Building]

[Abstract] Three structural alloy steels of austenitic and ferritic classes (07Cr13N₂Mn20, 01Cr18Ti, 01Cr25Ti) without nickel were tested for corrosion cracking in solutions of chlorides. Laboratory tests were performed with 40% CaCl₂ (pH = 6) solution at 100°C, 35% MgCl₂ (pH = 4) solution at 120°C, and 42% MgCl₂ (pH ~ 0.6) solution at 150°C, on a 500 h time base. Industrial tests were performed with 17-19% NaCl solution and 12-14% CaCl₂ solution on a 6100 h time base. Residual stresses were measured by the "release" method and strains were measured with electrical self-compensating gages (2 mm base) which had been built at the Scientific Research Institute of Chemical Machine-Building. Specimens in the form of disks, bottom plates, branch pipes without and with welding seams were tested. A comparison with available data on corrosion cracking of standard nickel steels (08Cr22Ni6Ti, 08Cr21Ni6Mo2Ti, 12Cr18Ni10Ti) under similar conditions indicates that the tested steels are much more resistant to corrosion cracking, principally owing to the absence of nickel and also owing to a much higher rate of general corrosion (up to 0.1 mm/yr) with delocalization of stresses. They therefore are recommended for halurgical manufacturing equipment which requires welding, without heat treatment when the welding rod (argon arc) or electrode (electric arc) was of the same material but necessarily with stress relieving heat treatment when it was of a different material (other steel or tungsten). References 15: 12 Russian, 3 Western.

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TREATMENT OF CORROSION-RESISTANT CHROMIUM STEELS WITH CO₂-LASER RADIATION

Moscow ZASHCHITA METALLOV in Russian Vol 22, No 3, May-Jun 86 (manuscript received 8 Feb 85) pp 354-359

[Article by Yu.M. Lakhtin, T.V. Gulyayeva, Ya.D. Kogan, V.V. Vasil'tsov, A.N. Safonov, T.V. Tarasova, and A.F. Baskov, Moscow Highway Institute]

[Abstract] Heat treatment and chemothermal treatment of corrosion-resistant ferritic steel (08Cr13) and martensitic steels (20Cr13, 40Cr13, 95Cr18) with radiation of a continuous-wave CO₂-laser was studied, for the purpose of determining its effect on the surface profile and the case hardening as well as on structural and phase transformations and the corrosion resistance. Specimens 50 mm long and 30 x 10 mm² in cross-section were annealed at 740-800°C and coated with high-absorptivity gouache prior to laser treatment. The laser power was varied over the 1-4 kW range and the laser radiation was focused by a lens of 180 mm focal length on a spot 2 mm in diameter. The velocity at which specimens were moved under the stationary laser beam was varied over the 0.9-9 m/min range. Two modes of laser treatment were considered, with and without fusion. Plain heat treatment, for comparison, consisted of quenching (08Cr13 steel from 1000-1050°C in water, 20Cr13 steel from 950-1000°C in oil, 40Cr13 steel from 1000-1050°C in oil, 95Cr18 steel from 1020°C in oil) and tempering (20Cr13 steel and 40Cr13 steel at 200°C, 95Cr18 steel at 180-250°C). Microhardness was measured with a PMT-3 tester under a 0.98 N indenter load. Metallographic examination was made under a "Neophot-21" optical microscope. Structural and phase analysis was made with a DRON-3 x-ray diffractometer using a CrK_α -radiation source. Microplasticity was measured with a model 270 interference-type depth gage according to a procedure developed by the Machine Science Scientific Research Institute. Surface roughness was measured with a "Kalibr-252" profilograph-profilometer. Anodic polarization curves were plotted potentiodynamically at a rate of 0.5 mV/s in 3% aqueous NaCl solution at 20°C. Corrosion resistance was determined, after quenching at 1000°C and tempering at 400°C, on the basis of the corrosion current (*i*) within the passive range, the pitting potential (ϕ_p), the static potential (ϕ_s), and the passive potential range ($\Delta\phi$). The results indicate that low-carbon and medium-carbon steels harden more under laser treatment, with or without fusion, than under standard heat treatment. Laser treatment without fusion hardens high-carbon steel more than it does with fusion. Depth and width of the case increase with increasing laser power and decreasing speed of treatment, not depending on the carbon content (0.08-0.95% C) and on the chromium content (13-18% Cr). Chemothermal treatment with laser, including graphitization of the surface layer with attendant carbide formation, was found to increase the hardness of all four steels up to 13 GPa with some decrease of the microhardness and a negligible decrease of microplasticity but without any effect on the corrosion resistance. References 2: both Russian.

2415/13046

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DEPENDENCE OF CORROSION CHARACTERISTICS OF SEMIFINISHED D16 PRODUCTS ON STRUCTURE OF D16 ALUMINUM ALLOY

Moscow ZASHCHITA METALLOV in Russian Vol 22, No 3, May-Jun 86 (manuscript received 17 Jun 85) pp 367-370

[Article by V.S. Sinyavskiy and V.D. Valkov]

[Abstract] An experimental corrosion study of semifinished D16 aluminum alloy products was made, for the purpose of determining the dependence of their corrosion resistance on heat treatment, degree of recrystallization, and impurity (Fe, Si) content. Plates 2, 4, 80 mm thick and rods 18 mm in diameter were extruded from ingots at 300°C and at 400°C with recrystallized and nonrecrystallized structure, respectively. Specimens were quenched from 495°C to 20°C in water after a 2 s or 45 s furnace-to-bath transfer time. Specimens were artificially aged at 190-195°C for 4-8-12-16-24-32 h. The coarse-grain surface rim on all specimens was removed mechanically. Resistance to parting corrosion was measured in a 234 g/l NaCl + 50.5 g/l KNO₃ + 6.2 g/l HNO₃ solution. Resistance to corrosion cracking was measured in the same solution, not as indicative of this corrosion mode, with "Signal" equipment under preset loads. Electrochemical measurements were made in a 3% NaCl + 10 ml/l HCl solution. The results indicate that artificial aging first lowers the parting resistance, to a minimum within 8-12 h, and then increases it fast to a maximum, while the cracking resistance increases monotonically to a constant level within 16-24 h. Quenching after 45 s transfer time somewhat decreases the cracking resistance, but artificial aging restores it to the same level as after 2 s transfer time. Nonrecrystallized material has under all conditions a much higher cracking resistance in both principal directions and a much higher parting resistance than recrystallized material. In the earlier stage of artificial aging cracking accelerates parting, both modes of corrosion producing identical patterns of intragranular fracture observable under a scanning microscope. Reduction of the iron content from 0.15% to 0.01% and of the silicon content from 0.11% to 0.01% was found to have almost no effect on the resistance to parting corrosion. References 4: 2 Russian, 2 Western.

2415/13046

CSO: 1842/218

PITTING CORROSION OF TITANIUM IN LiCl SOLUTIONS UNDER CONDITIONS OF SPONTANEOUS DISSOLUTION

Moscow ZASHCHITA METALLOV in Russian Vol 22, No 3, May-Jun 86 (manuscript received 17 Jun 85, after revision 29 Aug 85) pp 385-389

[Article by Yu.S. Ruskol, L.I. Viter, and T.V. Shatalova, All-Union Scientific Research Institute for the Protection of Metals From Corrosion]

[Abstract] A systematic study of spontaneous pitting corrosion of VT1-0 titanium in LiCl solutions was undertaken, for the purpose of determining the dependence of the corrosion rate on the potential over the -100-(+100) mV range as well as on the LiCl concentration up to 40 wt.% and the pH of the solution at temperatures of 140°C and 160°C. Specimens in the form of 1 mm thick flag-shaped plates with a 1 x 1 cm² active surface area were cleaned with 14A10MN29 emery paper, several grades of emery paper down to 5 μm grain size being used for determining the dependence of pitting corrosion on the surface roughness. The solutions, in distilled water, were "chemically pure" for the principal part of the experiment with 40 wt.% LiCl solution and a pH = 4.6 prior to correction. Solutions of HCl or KOH were added for changing the pH. No pitting was found to occur at a potential of -100 mV or lower and +50 mV or higher. Cathodic and anodic polarization curves were plotted potentiodynamically at a rate of 0.4 V/h. These curves and 5 h tests reveal two modes of dynamic pitting corrosion, namely, proper "corrosive" pitting most intense at +20 mV (140°C) or -40 mV (160°C) and "anodic" pitting at higher potentials. Extension of tests beyond 5 h, for a study of the pitting kinetics, revealed only a small increase of the number of pits but a large increase of their size, caves appearing after 72 h in 40 wt.% LiCl solution. Local corrosion was found to become more intense with lowering of the pH, with the uncorroded surface retaining its luster and acquiring a faintly yellow oxide film, but addition of FeCl₃ solution with oxidizing Fe³⁺ ions instead of HCl solution for attainment of a pH = 0.5 did not depassivate titanium. Titanium did not corrode at all in 20 wt.% and 10 wt.% LiCl solutions at 140°C, not in 10 wt.% LiCl solution at 160°C, and only sometimes slightly in 20 wt.% LiCl solution at 160°C. The authors thank L.I. Freyman for helpful discussion. References 8: 7 Russian, 1 Western.

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CORROSION OF ALUMINUM IN SOLUTIONS OF FLUORIDES

Moscow ZASHCHITA METALLOV in Russian Vol 22, No 3, May-Jun 86 (manuscript received 18 Mar 85, after revision 7 Jun 85) pp 417-420

[Article by Yu.Ya. Lukomskiy and G.M. Priyatkin, Ivanovo Chemical Technology Institute]

[Abstract] Corrosion of aluminum in solutions of fluorides of alkali metals and passivation of aluminum at high concentration of these fluorides were studied in an experiment, its purpose being to verify formation of weakly soluble films of fluoroaluminates as the passivation mechanism. The experiment was performed with monocationic solutions (Na^+ , K^+ , NH_4^+), $\text{pH} = 5.0 \pm 0.1$, and a constant anionic support solution of $0.4 \text{ M SO}_4^{2-} + 0.1 \text{ M CH}_3\text{COO}^-$. Specimens of "chemically pure" A7M aluminum sheet, 0.5 mm thick and $50 \times 10 \text{ mm}^2$ large, were degreased and etched with $10\% \text{ KOH}$ solution at 60°C for 30 s , then cleared with $50\% \text{ HNO}_3$ solution at 25°C for 30 s . The corrosion rate was measured by the volume of evolving hydrogen, whereupon the time derivative of the corrosion rate was calculated by computer-aided differentiation of the hydrogen volume with respect to time and converted into units of current density. The potential-time curves were plotted with a KSP-4 recording potentiometer and the high-resistance voltmeter of a P-5827M potentiostat. The results confirm that up to a certain concentration the fluoride ion determines the corrosion rate and the latter increases up to a maximum, beyond which the cation determines the corrosion rate and the latter decreases. This passivation is attributable to surface films of Na_3AlF_6 , K_3AlF_6 , $(\text{NH}_4)_3\text{AlF}_6$, respectively, according to the results of phase analysis with a DRON-1 x-ray diffractometer and a copper anode. The fluoride concentration at which activation ceases and passivation begins depends on the cation, it is lowest for the strongest inhibitor Na^+ and highest for the weakest inhibitor NH_4^+ . As fluoride is added to water, the corrosion potential first shifts by approximately 0.8 V in the negative direction and this stimulates the anodic process. It then remains approximately constant at -1.1 V , while activation of aluminum proceeds, the fluoride ion equally stimulating both anodic and cathodic processes. Subsequent passivation of aluminum upon further addition of fluoride begins with a $60\text{-}120 \text{ mV}$ positive shift of the corrosion potential, which inhibits the anodic process. Both activation and passivation proceed faster at a higher temperature. References 10: 5 Russian, 1 Yugoslav, 4 Western.

2415/13046
CSO: 1842/218

STRUCTURE AND CORROSION CHARACTERISTICS OF VACUUM-DEPOSITED TITANIUM COATINGS

Moscow ZASHCHITA METALLOV in Russian Vol 22, No 3, May-Jun 86 (manuscript received 4 Jun 85) pp 426-428

[Article by V.I. Arshavskiy, V.K. Goncharov, F.F. Komarov, V.A. Lapshin, and A.I. Naumovich, Applied Physics Problems Scientific Research Institute imeni A.N. Sevchenko, Minsk]

[Abstract] Structure and corrosion characteristics of 30 μm thick titanium coatings on 1 mm thick steel plates were studied, after such coatings had been deposited by sputtering with an arc discharge under a vacuum of 10^{-4} Pa at current levels up to 200 A. Structural and phase analysis of plain coatings and condensates of the erosion products was performed by the method of x-ray diffraction with θ - 2θ sliding incidence and by continuity tests after exposure to 15% aqueous FeCl_3 solution at 22°C and at 60°C. They were found to contain principally TiO_2 (200), with TiN (200) and TiC (311) also present, near the upper surface. Their structure was characterized by porosity facilitating pitting corrosion of the steel substrate, with small caves forming after 48 h at 22°C and large caves forming after 24 h at 60°C. One batch of coatings was post-treated with the same erosive plasma, with the ionic component of the erosion products accelerated in an electric field to an energy of several hundred electron-volts. These coatings, analyzed by the same methods, were found to contain principally TiN (200), with TiN (220), (222) as well as TiO_2 (101), (220) and TiC (200), (311) and least of all TiC (111), TiO_2 (200) occupying an intermediate position. Here near the substrate surface TiN dominates, followed by TiO_2 and then TiC , while near the upper surface TiN and TiO_2 appear in approximately equal amounts with the TiC content diminished. The structure of these coatings was characterized by continuity, inhibiting corrosion of the steel substrate even at 60°C. References 6: 5 Russian, 1 Western (in Russian translation).

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EFFECTS OF MANGANESE AND SILICON ON CORROSION OF LOW-CARBON STEEL HARDENED BY HEAT TREATMENT

Moscow ZASHCHITA METALLOV in Russian Vol 22, No 3, May-Jun 86 (manuscript received 24 Apr 85, after revision 16 Jul 85) pp 428-431

[Article by V.V. Kalmykov and I.Ya. Grechnaya, Ferrous Metallurgy Institute, Dnepropetrovsk]

[Abstract] Corrosion of low-carbon steel (0.14-0.20% C) with various additions of manganese (0.66-1.68% Mn) or silicon (0.32-1.45% Si) in 1 N H_2SO_4 solution at room temperature, after hardening by heat treatment, was studied over a 72 h

period and compared with corrosion of three standard low-carbon steels for concrete reinforcement: 20MnSi (0.20% C, 1.30% Mn, 1.06% Si), 20MnSi2 (0.19% C, 1.20% Mn, 2.10% Si), 10MnSi2 (0.11% C, 1.28% Mn, 1.95% Si). The laboratory steels were smelted in an induction furnace of 150 kg capacity. They were deoxidized to the required composition by ferromanganese or ferro-silicon and alloyed by 500 g/ton of aluminum. All ingots were homogenized by annealing at 1250°C for 2 h and cooling in the furnace. The ingots were forged into bars 14 x 14 mm² in cross-section and those were again annealed at 900°C (manganese steel) or 1000°C (silicon steel) for 1 h, to ensure structural equalization. Specimens cut from these bars, 70 mm long and 10 x 2 mm² in cross-section, were hardened by quenching from 880-900°C (manganese steel) or 900-960°C (silicon steel) in water after 15 min holding and then tempered at temperatures covering the 200-700°C range with air cooling before each 25-50°C change. The commercial steels were smelted in an open hearth furnace of 600 tons capacity at the Krivoy Rog steel plant. Ingots of these steels were rolled into rods 14 mm in diameter and from the latter were cut 100 mm long cylindrical specimens 8 mm in diameter. These were quenched from 1000°C in water after 15 min holding and then tempered exactly as the specimens of the laboratory steels. The results of corrosion tests indicate that the corrosion resistance of low-carbon steels generally decreases upon addition of manganese and increases upon addition of silicon. Increasing the manganese content from 0.66% to 1.68% lowered the tempering temperature for maximum corrosion rate from 475°C to 375°C and increased that maximum corrosion rate from 24 g/m² to 38 g/m², but tempering above 500°C lowered the corrosion rate to its level after annealing or even more. Increasing the silicon content from 0.30% to 1.45% decreased the corrosion rate after tempering at 200-450°C, raised the tempering temperature for maximum corrosion rate by 75°C and decreased that maximum corrosion rate by 20%. Increasing the silicon content further from 1% to 2%, without changing the carbon content and the manganese content, decreased the corrosion rate by 36% after hot rolling and by 24% after tempering at any temperature within the given range, with a 25% lower maximum corrosion rate after tempering at a 75°C higher temperature. The corrosion resistance decreases still further when the carbon content is decreased while the silicon content is increased. References 8: 6 Russian, 2 Western.

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CORROSION OF 08Cr14MoV STEEL IN CHEMICAL DETERGENT SOLUTIONS

Moscow ZASHCHITA METALLOV in Russian Vol 22, No 3, May-Jun 86 (manuscript received 29 May 85) pp 435-438

[Article by A.A. Afanasyev, V.Ya. Yegorov, and V.A. Shishkunov]

[Abstract] A corrosion study of the 08Cr14MoV nickelless stainless steel (0.05-0.10% C, 13.0-14.8% Cr, 0.2-0.4% Mo, 0.13-0.15% V, 0.20-0.45% Si, 0.80-1.20% Mn, 0.02-0.04% Ce, - 0.035% P, - 0.0.2% S) was made, this steel

being used for heat exchangers and washed with various chemical detergents. Accordingly, 30 x 30 mm² large and 1 mm thick square plates of this steel were treated with seven detergents: 1. 0.82 M HCl (pH = 0.41, 30°C, 4 h); 2. 0.31 M H₂SO₄ (pH = 0.05, 60°C, 4 h); 3. 0.30 M sulfamic acid (pH = 0.73, 60°C, 5 h); 4. 0.22 M oxalic acid (pH = 1.13, 98°C, 6 h); 5. 0.18 M phthalic acid (pH = 1.85, 98°C, 5 h); 6. ammonium citrate (pH = 3.25, 98°C, 5 h); 7. 0.06 M Trilon B+ (pH = 3, 98°C, 8 h). Tests were performed in a teflon cell with continuous stirring to maintain a V/S = 50 l/m² ratio of fluid volume to surface area. A common corrosion inhibitor, Captax, was added in an amount of 0.012 mole/l. Corrosion was measured by the weighing method, corrosion products were determined from the results of atomic absorption spectroscopy, and the composition of the steel surface layer was determined from the results of Auger spectroscopy. Anodic polarization curves were plotted potentiostatically and potential-time curves were plotted, to indicate the electrochemical behavior of the steel in those solutions. The data reveal that the corrosion resistance of this steel is low in acidic solutions but increases as the pH increases, general corrosion taking place in all these solutions. Passivation of the steel in the less acidic solutions is attributable to protective surface films of Cr₂O₃ and CrO₂ oxides. While the ratio c_{Cr}/c_{Fe} wt.% of Cr concentration to Fe concentration in the corrosion products passing into the detergent solution reached 0.17, the ratio c_{Cr}/c_{Fe} atom.% in the steel surface layer decreased depthwise to 0.20-0.24 at a depth of 20-40 nm and remained so farther down. On the basis of these results, the 08Cr14MoV steel becomes activated in detergent solutions 1-4 with attendant strong corrosion and remains passive in detergent solutions 5-7 with minimum attendant corrosion. References 3: all Russian.

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ANODIZING OF BERYLLIUM

Moscow ZASHCHITA METALLOV in Russian Vol 22, No 3, May-Jun 86 (manuscript received 5 May 85) pp 447-450

[Article by R.M. Altovskiy and M.I. Irazbayev]

[Abstract] Anodizing beryllium with chromic acid has so far produced high-quality coatings not thicker than 40 μm. The feasibility of producing thicker high-quality coatings, for more severe service conditions, was therefore studied in an experiment with specimens of 99.7% pure beryllium and other anodizing electrolytes. Cylindrical specimens 5 mm in diameter and 10 mm long were cut from hot pressed or extruded blanks. They were anodized with 10% (NH₄)₂MoO₄ solution at 40°C, with 10% Na₂CrO₄ solution at 20°C, and with 10% H₂CrO₄ solution at 10°C, a pH = 5 being attained by addition of CrO₃ and Mo, Cr isotopes being used as tracers. The cathode was made of 1Cr18Ni10Ti stainless steel and the current density was varied over the 5-20 A/dm² range.

Specimens were weighed analytically before and after anodization as well as after removal of the anodic layer by etching with 10% aqueous H_2CrO_4 solution at 90-95°C for 25-30 min. The thickness of coatings was measured under an MIS-11 Linnick dual microscope and their porosity was measured by the conventional method. An analysis of the experimental data and interpretation of the general law of film growth kinetics according to the equation $d^n = k\tau$ (d - film thickness, τ - time, k and n depending on metal and electrolyte) indicate that $(NH_4)_2MoO_4$ is most efficient, with a 0.845 maximum weight ratio of forming film to reacting metal at 15 A/dm², and can produce coatings even thicker than 100 μm within 1 h. While Na_2CrO_4 is somewhat less efficient (0.834 at 10 A/dm²), H_2CrO_4 is least efficient (0.681 at 10 A/dm²). Preferential diffusion of beryllium through the oxide layer causes the anodic film to grow on the side of the oxide-electrolyte interface, and at an almost constant rate (n = 1.2 in $(NH_4)_2MoO_4$). Presence of chlorides and sulfates in small amounts does not significantly affect the quality of these coatings but lowers the anodizer efficiency, in large amounts destabilizes the anodization process and results in friable coatings. The coating thickness and porosity depend on the current density and the temperature as well as on the pH of the electrolyte and the impurity content in it. References 12: 8 Russian, 4 Western (1 in Russian translation).

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FERROUS METALS

FERROUS METALLURGY: A CHANGE IN PRIORITIES

Moscow EKONOMICHESKAYA GAZETA in Russian No 19, May 86 p 6

[Article by S. V. Kolpakov, Minister of Ferrous Metallurgy]

[Text] The product line of the domestic metals industry is practically equal to that of other highly industrially developed countries.

Why then do machine builders and other metal consumers continue to direct valid criticism toward metallurgists?

The sector's enterprises produce 3900 hot-rolled and 2000 cold-roll-formed and molded high-precision shapes and 2800 grades of steel. The total number of different grades, shapes and sizes is about 15 million annually.

However, the sector still does not fully satisfy the demands for shipments of metal products with higher quality characteristics or for shipments of certain high-efficiency shapes. Above all, this relates to thin-walled roll-formed and several precision shapes, rolled products with corrosion-proof coatings, metal with excellent surface finish for cold upsetting, steels with improved machinability and several other types of metal products.

The average strength of ferrous metals must be improved to meet the requirements for technical progress in machine building and the industrialization of construction. In our view, there has been a change in priorities. There is no need to talk about metal shortage. The country is the world leader in metal output. The USSR produces over 20 percent of the world output of metal. What we're talking about is the shortage of specific types of metal products which have specific consumer properties. Another thing is clear. Too much metal is used in situations where other materials, such as plastics, could be very efficiently used.

The Political Report of the CPSU Central Committee to the 27th party congress noted that: "The output of fundamentally new and improved structural and other progressive materials will accelerate the growth of electronics, machine building, construction and other economic sectors,"

Clearly this does not relieve our responsibility for the quantity of metal products, as specified by the plans. I must note that in the past year, a

series of major measures were carried out to stabilize the sector's performance. The material-technical supply of enterprises was improved, basic equipment was repaired and the demands on workers were raised. As a result, the plans for the third and fourth quarters were basically fulfilled. The sector workers have confidently begun the 12th Five-Year Plan.

Over and above the plan for the 1st quarter of 1986, the sector produced 616,000 tons of cast iron, 794,000 tons of steel, 337,000 tons of finished rolled products, 35,000 tons of steel pipe and over a million tons of commercial iron ore. The entire increase in production was obtained through higher labor productivity. The task for this indicator was overfulfilled by 2.3 percent.

Progressive Shifts

We face clear tasks: achieve stable operation of all enterprises, unconditionally fulfill the production plans, significantly raise the technical level of the sector overall and on this basis improve the supply of metal to the national economy.

The basic directions of the country's economic and social development have clearly determined that there must be noticeable progressive shifts in the production structure, quality and product line. Accelerated equipment-replacement in ferrous metallurgy will make it possible to ensure faster output rates of the most efficient types of rolled products.

Overall for the five-year plan, we must achieve a growth of finished-rolled-products and steel output while stabilizing the output of cast iron by expanding the use of metal scrap. All types of resources must be conserved in this effort, particularly coke and iron ore, which require large capital investments and large labor expenditures.

A broad program of equipment replacement and renewal has been developed for the sector. A distinguishing feature of this program is its firm orientation toward implementing the achievements of scientific-technical progress. A sector growth strategy has been determined; it provides for a transition from increasing the production volumes to sharply improving the quality of metals.

A core problem is the replacement of steel-making equipment. One of the primary measures is to replace open-hearth furnaces with oxygen converters at the following combines: Magnitogorsk, Kuznetsk and Zaporozhstal. Open-hearth furnaces totalling 15 million tons-per-year capacity are to be taken out of service. This is five times higher than in the 11th Five-Year Plan.

By the end of the five-year plan, the volume of continuously cast steel will double. Vacuum treatment of steel will increase 10-fold.

The change of priorities is also reflected in a thorough restructuring of investment policy. During the 12th Five-Year Plan, the sector is to direct over 50 percent of the capital investments to reconstruction and equipment replacement of existing enterprises, while for Chelyabinsk Oblast, this will be around 80 percent. Over 25 percent of the funds allocated to the

USSR Ministry of Ferrous Metallurgy [Minchermet] will be used for equipment replacement and development of pipe- and metalware-production enterprises and final-processing shops.

Internal reserves are to be brought into action to the maximum extent. More construction is to be done by the enterprises themselves.

Reconstruction and equipment replacement are being carried out energetically and with initiative at the Cherepovets, Novo-Lipetsk and Chelyabinsk Combines. Worthy of approval is the work of collectives at such small plants as Amurstal, Svobodnyy Sokol, Sarkanays Metalurgs, Guryev and Lysva, where people are not sitting idly or waiting for capital investments to be allocated. Rather, they are using first of all their available resources and are finding economic solutions.

Reconstruction and equipment-replacement at enterprises naturally leads to an increase in quality and to an expansion of the metal product line. The draft 12th Five-Year Plan calls for output of cold-rolled sheet to be raised to 12.5 million tons; output of low-alloy-steel rolled products, to about 21.5 million tons, and output of rolled products with hardening heat treatment, to 15.5 million tons. Production of oilfield pipe, gas pipe, other types of pipe with corrosion-proof coatings and metalware is increasing and quality is improving. At least 500 new rolled shapes are to be produced.

Production is to be organized of new types of economical products: aluminized plate and sheet-metal, thin-walled roll-formed shapes, very thin strip for picture tubes, glassy metal alloys, high-strength automotive sheet steel, wire rope, fasteners etc.

It has been calculated that by 1990, due to the leading growth of efficient types of metal products and to improvements in the product line, the sector should ensure metal savings equal to 60 percent of the growth of metal-product output for the entire five-year plan.

Special attention should be given to: 1) the efficient use of the available production potential; 2) the search for reserves for reducing the metal content of rolled products, tubes, and metalware and 3) improving strength characteristics. Meanwhile, it must be directly stated that we are making poor use of the present possibilities.

The task of the day is to ensure quality through stable technology. For this, we need integrated automation of independent sections, lines and shops. We have now concentrated this work at leading enterprises in the sector; later, we will multiply these developments after they are completed and tested.

Proposals of Metallurgists

The realization of the program for equipment replacement in the ferrous metals industry and for improving product quality requires first of all that the sector have the necessary equipment. And we hope that machine builders will make an important contribution to solving this problem.

The metals industry needs reliable equipment for ladle refining of steel, 100-ton arc furnaces which can produce 350,000-500,000 tons per year, high-production machines for continuous merchant-blank casting and ready-to-use scrap recycling equipment. We are waiting on machine builders to produce modern, high-production finishing equipment which is superior to foreign analogs.

Modernization of existing shops, especially in the case of rolling and tube shops, requires the manufacture of compact modern equipment which can fit into the existing buildings. Reliable integrated systems are needed for automating the steel-making and rolling processes. Also needed are means of nondestructive testing on the production line.

Machine builders play an important role not only as manufacturers of equipment, but also as consumers of metal. Analysis shows that about two-thirds of the high metal content of the country's gross national product is due to inefficient use of structural materials and to the high specific metal content of machines and equipment. The metal-use coefficient has remained practically the same, while the output of efficient types of metal products has increased 2.5-4 times over the past 15 years.

Unfortunately, a number of proposals by USSR Minchermet to improve the structure of ferrous-metals output and to organize the output of new, efficient types of products have not been supported by the main metal consumers. For example, in 1985, most of the enterprises of the Ministry of Heavy and Transport Machine Building, the USSR Ministry of Power and Electrification, the USSR Ministry of Installation and Special Construction Work and many territorial administrations of the USSR Gosnab have refused to use metal products with higher strength characteristics. The Novo-Lipetsk and Western Siberian Metallurgical Combines, which have the ability to increase their output of higher-quality rolled products, have not received a single positive response from potential customers.

The wasteful attitude toward metal is troubling. Often, perfectly good metal is scrapped due to poor layout, while sometimes even finished parts and assemblies are scrapped. Even assembled machinery units are scrapped. There are many cases where enterprises mix scrap of carbon and alloy steels, nonferrous metals and other impurities.

The value of close cooperation between the metallurgical industry and machine building is now immeasurably rising. And, in our view, sector science has a leading role. Metallurgical scientists must anticipate the needs of machine builders. In turn, machinery designers must do the same with regard to our sector.

In recent years, we have fulfilled a number of important developments which have already been or will be used in the 12th Five-Year Plan. These include a technology for manufacturing gas-pipeline pipes for northern service, plasma metallurgy, domestically developed direct-reduction processes and many others.

But, scientific-technical problems are not always resolved at the proper level or within the required period. There are large gaps in developments and, I would say, strategic mistakes have been made, which have led to delays in certain problems of converter and electric steel production, in scrap preparation and in the coke-chemical and refractory industries.

Now we are earnestly working to improve the organizational structure of sector science and its institutes. At the same time, we are making greater demands on specific people to make real contributions to science and production.

It would be impossible not to mention the great role of the enterprises themselves and their managers in accelerating scientific-technical progress. Examples of this are the Novo-Lipetsk, Cherepovets and Western Siberian Combines, which are working directly with science to implement a number of new technologies and types of equipment at their enterprises. We encourage these contacts in every way possible.

Under present conditions, the role and significance of economic services is especially increasing. In March, at a special meeting of the Collegium of USSR Minchermet with enterprise directors, problems of the fundamental restructuring of economic work were discussed. Every week, a sector commission on economic work solves the most urgent problems of management activity at enterprises.

Concern for the Working Person

The process of deep transformation taking place in the sector concerns not only engineering and economics. A central place in all our undertakings is concern for the working person and activization of the human factor.

At the Novo-Lipetsk and Chelyabinsk Metallurgical Combines and at the Southern Mining-Enrichment Combine, where concern for people is of paramount importance in all production-management activity, the problems of personnel turnover have been basically resolved and working-time losses have been reduced to the maximum extent. This has provided a significant growth of labor productivity.

So far, there are only a few such examples in our sector. Not all enterprises have fully taken up the problem of socio-cultural and residential construction. In 1985, the Western Siberian and Nizhniy Tagil Combines did not fulfill their plans for implementing kindergartens, while the Khartsyzsk and Vyksa Metallurgical Plants did not put health-care facilities into service. At the Tavricheskiy Mining-Enrichment Combine, the plan for implementing investments for housing construction was only 21 percent fulfilled last year. We consider this situation unacceptable, and we are strongly critical of managers who permit such--mildly speaking--oversights.

The renewal of production presupposes a new attitude toward things, a breaking of old thought patterns and a rejection of stagnant attitudes.

We must confess that several of our managers, including experienced and honored people, cannot restructure their work and are limiting themselves to half-measures, although they speak in full support of the prescribed course. In the sector, much work was done with party organizations to strengthen management personnel at enterprises, in particular at the Oskol Electrometallurgical Combine, Azovstal Combine in Zhdanov, Zaporozhstal Combine, the Dneprospetsstal Plant, the Southern Pipe Plant in Nikopol and a number of others. At many of these enterprises, we immediately noted positive trends.

This work is continuing. For each lagging section today, we must select energetic, skilled specialists with initiative, who are able to mobilize labor collectives and provide new approaches to solving production problems and to realizing the equipment-replacement program in ferrous metallurgy.

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FERROUS METALLURGY DEVELOPMENT DISCUSSED BY A DEPUTY MINISTER

Moscow TEKHNIKA I NAUKA in Russian No 5, May 86 pp 2-5

[Interview with Anatoliy Aleksandrovich Kogadeyev, chairman of the Central Board of Scientific and Technical Society of Ferrous Metallurgy, deputy minister of ferrous metallurgy of the USSR: "Ferrous Metallurgy Today and Tomorrow"; date and place not specified]

[Text] [Question] Anatoliy Aleksandrovich, about a year ago at the June plenum of the Central Committee of the CPSU, the operations of ferrous metallurgy were subjected to biting criticism. It seemed that with the situation that prevailed it would be impossible to cope with those, frankly, huge tasks specified for metallurgists in the Main Guidelines of Economic and Social Development of the USSR in 1986-90 and up to 2000. What are the reserves and levers that you have succeeded in utilizing to move forward? Will you please tell the readers of our magazine about this?

[Answer] This is not an easy question to answer. Professionals know that "swerving" a heavy and huge industry such as ferrous metallurgy onto a new track is much more difficult than just replacing a machine tool with a different model, even if it is more expensive and perfect. "Accelerating the retooling of the industry"--this is how it is stated in the Main Guidelines adopted at the 27th Congress of the CPSU. What does this mean? First of all, we have to replace open-hearth furnaces (which are mainly used today for steel smelting) with converters and electric furnaces. This is a gigantic enterprise both in terms of costs and labor involved, but it is necessary: these furnaces are obsolete; they fail to yield the necessary outputs and required quality of metal. Under the 12th Five-Year Plan, new oxygen-converter plants are to be introduced to replace open-hearth furnaces at major enterprises, such as Magnitogorsk and Kuznetsk Metal Works, and to replace open-hearth furnace production with electric steel smelters at Krasnyy Oktyabr and Sarkanays Metallurgs plants.

Take, for example, steel casting. How can one reduce the metal waste in substandard billet heads that will be cut off and improve the working conditions when pouring the metal into ordinary molds? The optimal solution today is to introduce continuous steel casting. Although a large number of continuous billet casting machines [MNLZ] are already operational, their number is far short of what is required for a radical change of the situation. Under the 12th Five-Year Plan, MNLZ will be introduced

at the oxygen-converter workshop of the Dnepropetrovsk Metal Works imeni Dzerzhinskiy and the Rustavi Metal Works. These are just a few examples.

Under the 12th Five-Year Plan we of course will only perform the priority operations in technological retooling of steel smelting and will continue these efforts during the 13th and 14th Five-Year Plan periods.

[Question] Will you tell us what such technological retooling of steel smelting will yield?

[Answer] Above all, this will raise the yield of standard quality metal, producing significant savings of fuel and ferroalloys. The productivity will be increased substantially, the working conditions will be improved drastically and the ecological problems at the sites where metal works are located will be resolved.

The reconstruction and retooling will take place not only in steel melting but also in other metallurgical processes. This is indispensable for accomplishing the task set by the Main Guidelines--raising by 1990 the output of rolled metal to 116-119 million tons without increasing the output of cast iron and with a significant reduction in the consumption of coke.

[Question] Without increasing the output of cast iron--does that mean that in the blast furnace production and its tooling no basic changes are planned?

[Answer] That is not so. Blast furnaces will also be reconstructed. But we intend to do this during furnace overhauls. Many aspects of mechanization and automation of blast furnace production will then be resolved; some of the furnaces will be equipped with new charging assemblies--those without cones. This is all to be funded from overhaul budgets, i.e., with a maximum degree of savings.

[Question] Talking about savings, we all know how urgent it is to save coke. What is being done to solve this problem?

[Answer] The problem of coke is crucial for steady operation of ferrous metallurgy: This involves both saving it in blast furnaces and reducing the consumption of baking coals in the production of coke, as well as substituting other types of fuel in nonmetallurgical production for metallurgy-quality coke. In order to save coke, such well-tested techniques will be also used as raising the iron concentration in the concentrate and pellets and the basically new techniques of spraying coal dust into the blast furnace and using hot reducing gases and coke gas. Technological retooling of coke production will also be stepped up. For example, we plan to rebuild 28 coke batteries, which will involve their reconstruction. New processes are being introduced--selective crushing, partial bricketing, tamping and thermal pretreatment of coal charge. This will help solve not only industrial but economic problems as well.

Returning to the growth of the output of metal products without increasing the output of cast iron, I would like to mention another task: the need of utilizing additional resources of scrap metal. In order to increase the proportions of scrap metal in the metal charge, we must improve its preparation, which means equipping the scrap metal processing plants with modern facilities and installations separating nonferrous metals, plastics and other materials. This task must be accomplished immediately.

This would call for more initiative on the part of the scientific and engineering community. We know a lot of examples where the members of scientific and technical societies [NTO] take active part in other ferrous metallurgy subindustries. For example, specialists from Uralgiproruda and Uralmekhanobr institutes are working jointly with members of the staff of Soyuzruda, Uralruda, Uralmash and Kachkanar mining and ore concentration combined works [GOK] to develop a project for reconstructing the pelletizing mill at Kachkanar GOK--installing instead of the old machines with a pelletizing area of 108 square meters new and improved designs with an area of 216 square meters (with a respective productivity increase). This will make it possible to scrap earlier plans for building a new agglomeration plant, reducing the cost of construction and installation work by 20 million rubles. The annual output of the pellets at the same time will be increased by 2 million metric tons without increasing the number of personnel involved.

I would also like to mention suggestions for reconstructing the billet storage and main production line of the rolling mill 550 at Dneprospetsstal factory that has been developed by the staff of Chernetmekhanizatsiya Scientific-Production Association. Their proposal involves installing in the existing building, instead of obsolete and worn "trio" rolling mill, a new mill with reinforced stands furnished with devices for automatic billet turnover (eliminating the hard manual work), mechanized (keyboard-controlled) resetting and adjusting of rollers, which will reduce the time of roller resetting of all stands by nine times. Other progressive solutions will be introduced, some of them for the first time in the world. The result will be a 15 percent increase in the rolling mill productivity at a cost of a mere 250,000 rubles.

I feel obliged to mention also the reconstruction of rolling mill 2000 at Novolipetsk Metal Works. It has provided an increased output by 200,000 metric tons with a unit cost half that for a new construction. And that was accompanied also by an improved quality of rolled metal.

[Question] You have mentioned the rolled metal quality. We know that our country produces more steel than anybody else in the world, and yet there is a shortage of metal. This is probably associated, above all, with product quality?

[Answer] Certainly, but not only with that. We experience a shortage of metal because of the insufficiently high quality of metal products, their limited assortment, as well as because of unthrifty use of metal in

metal-consuming industries. This means that a set of measures should be undertaken to ensure that the objective that has been set--reducing the metal-intensiveness of the national economy by half by the year 2000--be achieved. As to the metallurgists, they have to master as many as 500 new economical rolled metal shapes!

Again here, the role of the scientific and engineering community is great. The all-Union scientific and technical conferences, seminars, reviews and contests--do you know what they produce? Economists have calculated that the effect from the introduction of the recommendations suggested by scientific and technical meetings and conferences held by the Central Board of NTO in 1984 alone amounted to more than 22 million rubles! A large number of valuable proposals are advanced by specialists at these forums and accepted.

For example, according to the recommendations of the All-Union Conference on Improvement of the Production of Cold-Shaped Pipes, the plan has been adopted for reconstructing 20 cold pipe roll mills, replacing two-high stands with "tandem" stands at Nikopol South Pipe Factory and Pervouralsk New Pipe Factory.

As a result of the contest imeni I. P. Bardin held in 1984, a project on the creation and introduction of an industrial process for steel melting in oxygen converters with a cyclic variation of oxygen consumption has been cited as one of the best projects. At Karaganda Metal Works, the savings from one year of use of this process amounted to 700,000 rubles. The process has stabilized, the indicators of slag formation have improved, the amounts of ejections and losses have been reduced, the stability of plant lining has been improved and the dephosphorization without the use of fluor has been upgraded. This efficient and reliable production process can be expanded with confidence to all Soviet converter workshops.

A large number of examples of when the recommendations and projects awarded prizes at NTO contests were introduced into industry can be given. Not always, however, do our efforts produce the desired results. The industry is still not meeting its planned targets for introduction of new technology. The reasons are various. For example, because of a shortage of capacity the production of electrically welded pipes for thermal electric heaters at Novosibirsk Metal Works and Moscow Pipe Works have not been organized; due to delays in the introduction and mastering of equipment, the production of high-resistant drilling pipes with welded joint tips at Azerbaydzhan Pipe Rolling Plant has not been started; the same is true of Sinarskiy Pipe Factory, which failed to receive the necessary billets from Orsk-Khalilovo Metal Works. Lysva Metal Works is not producing 0.22-0.36 mm chrome-plated foil, because Karaganda Metal Works is late with delivering the black plate it needs for this purpose. The Zaporozhstal Combined Metal Works has not started production of steel cold-rolled diffusion-chromized sheet, because of the design flaws in the equipment! The same reasons--design flaws in the equipment--have prevented the timely launch of the production of railroad rails with high-frequency current heating for tempering at Azovstal Metal Works.

You see that there is still a large number of negative examples and shortcomings. This shows that the New Technology Commission of the central board of our NTO, as well as new technology commissions in some of the oblast boards of the NTO, are still not monitoring sufficiently the introduction of new technologies and fail to render the necessary assistance to enterprises in timely spotting and elimination of the sources of plant fulfillment failures.

The critical remarks concerning the operation of the ferrous metallurgy industry offered at the June (1985) Plenum of the Central Committee of the CPSU require more active participation of NTO in the advancement of scientific and technological progress in this industry. The 10th plenary session of NTO of ferrous metallurgy, in defining the tasks facing the scientific and engineering community of metallurgists, recommended, above all, a broad promulgation of the knowhow of leading enterprises--such as Cherepovets Metal Works--in reconstructing and modernizing equipment.

Finally, we should make a special mention of the role of our specialized scientific-research institutes. We must raise the standards and productivity of research and development in the industry, strengthen the research and development units at the factories and achieve a real integration of science and production.

[Question] Anatoliy Aleksandrovich, do you think that metallurgical science today is still not "working" hard enough to meet the needs of the industry?

[Answer] The accomplishment of Soviet metal science are well known. The projects developed at our design and research institutes have built up a high prestige of Soviet metallurgy all around the world and led our metallurgy to the leading positions. The ideas of Soviet scientists have been embodied in a large number of production processes and design solutions in our country and abroad. Yet, not infrequently, some of the scientific research, design and production process development organizations still fail to pay due attention to promoting conditions for creativity. A part of the blame for this lies on NTO organizations. It is especially important today, therefore, to expand the advanced experience of the best primary units of NTO, especially creating groups of engineering support to production improvements.

The engineering support is now given not only to individual workers but to workers' collectives--production teams. If earlier the workers had to come to experts for assistance in doing the calculations, designs and preparing application materials and drawings, the engineering support groups now volunteer in suggesting to the production personnel the use of certain equipment and new technologies, which frequently changes the nature of the work performed by the workers drastically. Special attention is given to improving the weak components in the production chain, which yields impressive end-results for the entire working collective.

At Nikopol South Pipe Plant, for example, the group of engineers has helped the team of steel workers of cast tool workshop to introduce a new steel melting process and fulfill the socialist commitment they had undertaken in honor of the 27th Congress of the CPSU. By reducing the time of metal charging and deoxidation, they produced above the planned target more than 70 metric tons of cast rolled tools and also improved working conditions.

[Question] Can you tell us how widespread in the industry this movement of the scientific and engineering community is?

[Answer] Very widespread. Now, about 8500 teams are working together with engineering support, and this program is being expanded.

The presidium of VTsSPS [All-Union Central Board of Trade Unions] has cited the positive work of the NTO boards and the trade union committees of Kosogorsk Metal Works imeni Dzerzhinskiy and the Tsentrodommarent trust on engineering support to the fulfillment of plans and socialist commitments by production teams.

One is particularly encouraged by the fact that young workers are attracted to this effort.

Mikhail Gorbachev, meeting at the Central Committee of the CPSU with the veterans of the Stakhanov Movement, emphasized that we need to spare no effort to open broad opportunities for technological creativity of young people. In ferrous metallurgy, the young members of NTO are actively enlisted to participate in the volunteer creative associations, scientific-technical conferences, meetings, reviews and contests and receive training in seminars. At the central board of NTO in 1985, we have created a special section for work with young people.

[Question] Anatoliy Aleksandrovich, what else would you like to note as regards the social aspects of the work of ferrous metallurgy and its NTO?

[Answer] The application of the Law of Work Collectives. This law places in the hands of the community considerable rights and power and makes it obligatory for us to utilize them to accelerate scientific and technological progress and to broadly introduce into industry the accomplishments of science, the new technologies, the modern production processes and scientific organization of work and management.

Proceeding from this law and carrying it into effect, the NTO boards of ferrous metallurgy should now direct their efforts to psychological readjustment of the cadre, a better and more efficient organization of work, improved management in all components of metal industry, so as to bring into action all of our reserves and successfully achieve the grandiose goals set by the 27th Congress of the Party before the nation's industry, including ferrous metallurgy.

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INFLUENCE OF MOLD MATERIAL ON STEEL QUALITY

Moscow METALLY in Russian No 2, Mar-Apr 86 (manuscript received 2 Jan 84)
pp 90-92

[Article by A.Ya. Oleksiyenko, V.M. Borevskiy, V.A. Voronov, N.A. Stetsenko,
and N.N. Dranyuk, Zaporozhye]

[Abstract] A study was made of the influence of mold material on the quality of high alloy steel type 08-12H18N10T by pouring the steel into grey cast iron molds alloyed with aluminum (aluminum cast iron), grey cast iron with plate graphite (grey cast iron) and high strength cast iron with spheroidal graphite modified with magnesium (magnesium cast iron). New molds were used to avoid the influence of other extraneous factors on steel quality. An experimental mold consisting of two parts made of grey cast iron and two made of magnesium cast iron was used to clarify the mechanism of the influence of mold material on steel quality. The rate of rejection due to cracks and other defects was 1.43, 3.38 and 0.33% for grey, magnesium and aluminum cast iron, respectively. References 4: 3 Russian, 1 Western (in Russian translation).

6508/13046
CSO: 1842/205

NONFERROUS METALS AND ALLOYS; BRAZES AND SOLDERS

UDC 621.74.002.6:669.715.48.018.28

THE FLUIDITY AND MOLD FILLABILITY OF SECONDARY SILUMINS

Moscow LITEYNOYE PROIZVODSTVO in Russian No 1, Jan 86 p 11

[Article by candidates of technical sciences V.A. Kozhanov, L.P. Seleznev, and Yu.B. Bychkov, and engineer V.A. Zhuravleva]

[Abstract] The effect of various concentrations of zinc and copper on aluminum alloys was studied. Before testing their casting properties, the alloys were melted and held at 720°C in a graphite crucible. Fluidity was determined using a bar-shaped tester heated to 250°C. A permanent tester was used to measure mold fillability given a static head for a column of molten metal 10 to 120 mm high. Two cylindrical metal rods were placed vertically in tangential contact with each other in the tester, which was preheated to 150°C. Mold fillability was then evaluated according to how the casting menisci behaved. Copper in concentrations up to 4% did not affect fluidity, but did increase mold fillability by 30%. When this concentration was increased to 10%, fluidity increased 14% and mold fillability 11%. Zinc (up to 2.5%) did not affect either property. References 5: 4 Russian, 1 Western.

13050/13046

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UDC 621.74.043:669.715

IMPROVING THE PROPERTIES OF AL4 ALLOY SMELTED FROM CHARGES CONTAINING SECONDARY SILUMINS

Moscow LITEYNOYE PROIZVODSTVO in Russian No 1, Jan 86 pp 12-13

[Article by candidates of technical sciences A.M. Galushko and B.M. Nemenenok and engineers Yu.V. Markarov and M.I. Strizhenkov]

[Abstract] The use of various combinations of universal liquid flux, carbon trichloride, sulfur, and strontium to refine and modify AL4 alloys smelted from charges containing secondary silumins was studied. Fluidity was measured on a spiral tester at a pouring temperature of 720°C. Volume shrinkage was assessed on a spherical tester. The corrosion rate was determined from the specimens' decrease in mass when immersed for 2 hours in

a 3% solution of NaCl with 0.1% H₂O₂. The alloy's microstructure was determined from microsections taken from the thick part of specimens. Fluxing the melt with 0.8% flux containing 0.2% carbon trichloride refined the melt and had a positive effect on the formation of the concentrated shrinkage cavity and on the gas content, corrosion rate, and fluidity of the alloy. Modification of the melt with powdered sulfur and flux improved the alloy's plastic properties, decreased its porosity, and increased its corrosion resistance and fluidity. This modification also resulted in the lowest gas content. Alloys modified with a combination of sulfur and strontium had better mechanical properties than the other alloys studied and had the best overall combination of properties. In view of the scarcity of strontium, it was recommended that the melts be modified with a combination of flux and sulfur. The effect of modification and pouring temperature on mold fillability was also studied. An increase in the pouring temperature and modification with a combination of sulfur, flux, and strontium had a positive effect on mold fillability. References 3: all Russian.

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UDC 669.295.3.34

THERMODYNAMICS OF MAGNESIUM-THERMIC REDUCTION OF TITANIUM TETRACHLORIDE

Moscow METALLY in Russian No 2, Mar-Apr 86 (manuscript received 20 Jul 84)
pp 44-49

[Article by V.F. Baybuz, V.Yu. Zitserman, S.I. Gorbov, Yu.N. Olkhov, and V.V. Golikov, Moscow]

[Abstract] An algorithm for machine computation of equilibria in complex heterogeneous systems based on the variation principles of chemical thermodynamics, seeking the global maximum of the Gibbs potential in a multivariate space of concentrations, was utilized to analyze the thermodynamics of reactions in the system Mg-Ti-Cl over a broad range of temperatures, pressures and relationships of initial reagent contents. The influence of temperature, pressure and excess of reducing agent on the yield of metallic titanium was determined. It was found that the high temperature process is suitable where there is a significant excess of reducing agent and at pressures of 5 to 7 MPa. The adiabatic temperatures of the reducing agent were calculated with the self-supporting process in the system as a function of the enthalpy of the initial products, excess of reducing agent and pressure. References 11: 7 Russian, 4 Western.

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CSO: 1842/205

IMPURITIES IN IRIDIUM AS A FUNCTION OF TEMPERATURE AND PRESSURE UNDER
EQUILIBRIUM CONDITIONS

Moscow METALLY in Russian No 2, Mar-Apr 86 (manuscript received 6 Nov 84)
pp 50-53

[Article by N.A. Vatolin, G.K. Moiseyev, P.A. Matyukhin, A.I. Timofeyev,
and A.V. Yermakov, Sverdlovsk]

[Abstract] Equilibrium states of systems consisting of contaminated iridium plus argon were studied in the 2000-4000 K temperature interval at pressures of $9.8 \cdot 10^{-2}$, $1.3 \cdot 10^{-2}$, $1.3 \cdot 10^{-4}$, $1.3 \cdot 10^{-6}$ and $1.3 \cdot 10^{-8}$ MPa. Equilibrium states were computed on a type YeS-1040 computer, considering solid: C, Si, Al, Ga, Ca, W, Zr, Fe, Mn, Ni, Zn, Pd, Rh, Ir, SiC, Al_4C_3 , WC, ZrC, Fe_3C , Fe_5Si_3 , $FeSi_2$, $FeSi$, Fe_3Si , ZrSi, $FeAl_2$, $FeAl_3$, $FeAl$, W_2C , $CaAl_4$, CaC_2 ; gaseous: Ar, C, C_2 , C_3 , C_4 , C_5 , Si, Si_2 , Si_3 , SiC, SiC_2 , Si_2C , Si_2C_2 , Si_3C , Al, Al_2 , AlC, AlC_2 , Al_2C_2 , Ga, Ca, Ca_2 , W, Zr, Fe, Ni, Zn, Mn, Pd, Pd_2 , Rh, Pt, Ir. It was found that as temperature increases and pressure decreases the concentration of impurities in the iridium decreases with the exception of W. The refining process is selective: Ga, Ca, Mn and Zn are first evaporated followed by Fe, Si, Al, Ni and Pd. Little loss of Rh, Pt, Zr and C is observed and W actually accumulates. Low pressures and temperatures slightly above the melting point are suggested. A comparison of calculated and experimental data at 2800 K shows that the experimental degree of purification agrees with the calculated degree quantitatively in many cases. References 6: 4 Russian, 2 Western.

6508/13046
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UDC 669.017:539.32

ELASTIC PROPERTIES OF ZINC, CADMIUM, BISMUTH, THALLIUM, TIN, LEAD AND THEIR
BINARY ALLOYS WITH INDIUM

Moscow METALLY in Russian No 2, Mar-Apr 86 (manuscript received 11 Jul 83)
pp 133-135

[Article by A.M. Magomedov, Makhachkala]

[Abstract] A study was made of the elastic properties of the pure metals Zn-00, Cd-00, Bi-00, Tl-00, Pb-00, Sn-00 and their binary alloys with indium. Elasticity moduli were determined by measuring the propagation velocity of longitudinal and transverse sound waves in the specimens and their density. The relative error in determining elasticity modulus was not over 1%. The concentration variation of elasticity constants for the indium alloys are nonlinear, with negative deviation from the additive line. References 3: all Russian.

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MECHANISM OF COLD DEFORMATION OF Ti-Nb ALLOYS

Moscow METALLY in Russian No 2, Mar-Apr 86 (manuscript received 5 Jul 84)
pp 136-140

[Article by G.N. Kadykova, Moscow]

[Abstract] X-ray structural studies were performed on titanium alloys containing 25-65% Nb at intervals of 5% which were made under a vacuum, deformed hot to produce 3.5 mm plates, hardened from 750°C in water and cold rolled to foil 0.02 mm thick. Textures were also studied. The distribution of intensity around the major ring of the {110} pole figure was determined and electron microscope studies were performed. The process of twinning was found to be highly developed, with the usual system for a body-centered cubic structure. Twinning leads to a strengthening of the {111} and <211> orientations with an increase in the degree of compression of rolling. Both martensite conversion and twinning are highly developed during cold plastic deformation as a result of the instability of the initial β phase. References 11: 8 Russian, 3 Western.

6508/13046
CSO: 1842/205

UDC 669.71'1+669.71'24+669.71'26]:536.413.2/.3

TEMPERATURE COEFFICIENT OF LINEAR EXPANSION OF ALUMINIDES OF IRON, NICKEL AND CHROMIUM

Moscow METALLY in Russian No 2, Mar-Apr 86 (manuscript received 26 Jan 84)
pp 168-169

[Article by Ye.G. Ivanov, Moscow]

[Abstract] A study is made of the temperature variation of the coefficient of linear expansion of a number of Fe-Al, Ni-Al and Cr-Al alloys. The temperature coefficients of linear expansion were determined on a model D_{α} -1500 RHP dilatometer at 20-700°C with a heating rate of 10°C/min and cooling rate of 50°C/min. No phase conversions were observed except for the alloys containing over 60 mass percent aluminum, in which phase conversions occurred at 700°C. The minimum value of temperature coefficient of linear expansion is that of alloys corresponding in structure to the compounds FeAl, NiAl, and Cr_4Al_9 . References 8: 6 Russian, 2 Western (1 in Russian translation).

6508/13046
CSO: 1842/205

ABSORPTION OF HYDROGEN BY POROUS TITANIUM AT HIGH TEMPERATURES

Moscow METALLY in Russian No 2, Mar-Apr 86 (manuscript received 19 Mar 84)
pp 220-222

[Article by L.A. Kupriyanova and A.A. Mazayev, Leningrad]

[Abstract] The absorption of hydrogen by porous titanium was studied at temperatures of 573-1373 K and pressures of 0.007-0.066 MPa in specimens of titanium with 22-80% open porosity. The kinetics of absorption of hydrogen were studied on an installation allowing saturation of the specimens with hydrogen at high temperatures and degassing of the specimens. The rate of absorption of the hydrogen as a function of porosity was found to follow a parabolic rule. The rate of absorption depended on hydrogen pressure according to the equation $W = 6.17 \cdot 10^{-6} P_{H_2}^{0.8}$, $g \cdot g^{-1} \cdot s^{-1}$. References 10: 5 Russian, 5 Western.

6508/13046

CSO: 1842/205

USING THE MAGNETOOPTICAL ACTIVITY TECHNIQUE FOR THE CONTACTLESS MEASUREMENT
OF CARRIER CONCENTRATION IN GaAs

Sverdlovsk DEFEKTOSKOPIYA in Russian No 1, Jan 86 (manuscript received
25 Dec 84) pp 90-92

[Article by Ye.K. Galanov]

[Abstract] The magneto-optical activity of n-GaAs was studied on a UPI-10 polarimeter. The GaAs specimens were alloyed with tellurium and were cultivated using the Chokhralskiy technique to obtain various concentrations of free carriers. Hall's technique was used to measure these concentrations. A linear relationship exists between magneto-optical rotation and the concentration of free carriers at certain concentrations. The theoretical and experimental functions of the magneto-optical constant versus the uniformity of carrier distribution coincided. Using the graphs derived during the experiment, it was possible to determine the concentration of free carriers in n-GaAs semiconductor specimens. References 8: 7 Russian, 1 Western.

13050/13046
CSO: 1842/168

PREPARATION

NEW EQUIPMENT APPROVED FOR AMORPHOUS-METAL PRODUCTION

Leningrad LENINGRADSKAYA PRAVDA in Russian 3 Apr 86 p 2

[Article by Yu. Vorobyevskiy, correspondent of Leningrad Department, TASS:
"Refrigerator for Boiling Metal"]

[Text] Within imperceptible parts of an instant, the molten metal poured in a vacuum cools by 1500 degrees. Its atoms do not have time to take "their places" in the crystal lattice. This is how a new class of metals--metals with an amorphous internal structure--are produced.

The Kristall-702 installation, developed by the All-Union Institute of High-Frequency Current, is designed to produce these metals. Yesterday, tests of the installation were successfully completed, and it has been recommended for industrial production.

The use of amorphous metals ensures truly revolutionary changes in many industrial sectors. Already, a very thin ribbon has been produced (a 100-gram coil is 2.5 km long) which has a very high resistivity. This guarantees a four-fifths reduction in the electrical losses for electrical instruments. Granulated amorphous metals can also be manufactured. The cutting tools pressed from these granules have the same strength and corrosion resistance as tools containing tungsten, chrome and other alloying metals.

12595

CSO: 1842/210

ORGANIZATION OF POWDER METALLURGY RESEARCH DISCUSSED

Moscow IZVESTIYA in Russian 19 May 86 p 2

[Interview with Professor Oleg Vladislavovich Roman, doctor of technical sciences, general director of the Powder-Metallurgy Scientific-Production Association, by M. Shimanskiy, IZVESTIYA correspondent; Minsk, date not specified: "Barriers of Instructions Separate Partners in Solving Powder-Metallurgy Problems"]

[Text] The country's first powder-metallurgy scientific-production association is now operating in Belorussia. How much will new organizational forms promote the faster practical implementation of scientific developments? What must be done so that the new sector of science and technology could more actively solve such an important problem as metal conservation? An IZVESTIYA correspondent will discuss these matters with Professor O. Roman, doctor of technical sciences, general director of the association.

[Question] Oleg Vladislavovich, interest in powder metallurgy is increasing not daily, but by the hour. What's the reason for this?

[Answer] The powders are being used to develop, to literally construct, materials with specific properties. Therefore, without powder metallurgy [P/M], new equipment would be practically unthinkable. The second advantage of the method is resource conservation: not just materials, but also time and working effort. For every thousand tons of parts produced from powders, labor productivity is several times higher than for parts produced by metal-cutting processes. Every thousand tons of P/M parts produced frees up 190 workers and 80 metal-cutting machine tools. Two thousand tons of rolled products or castings are conserved. There is almost no production scrap, for 95-98 percent of the material is used.

[Question] Today we are talking about powder metallurgy as a new sector of science and engineering. How did it become established in the republic?

[Answer] Our association includes a plant built in Molodechno, the Scientific-Research Institute of Powder Metallurgy and two special design-technology bureaus with experimental production facilities. The association reports to the BSSR Council of Ministers. This determined both

the significance of the work, and the possibility of going directly to USSR Gosplan or Gossnab and the republics. We can solve important problems directly with the managers of the respective sectors. And, of course, we have wonderful capabilities of solving large-scale intersector problems, while at the same time providing P/M parts for the region.

[Question] Oleg Vladislavovich, the Political Report of the CPSU Central Committee to the 27th party congress emphasized the need to raise the work efficiency of scientific-research establishments and the need for new forms of interaction between science and production.

[Answer] The congress again confirmed the special significance of developing intersector scientific-technical complexes. Our association is part of the Powder Metallurgy Intersector Scientific-Technical Complex. We participate in realizing five integrated programs of the USSR State Committee on Science and Technology and four republic programs. The association is the lead organization in two programs entitled "Powder Metallurgy": one a republic program, the other a program of USSR Ministry of Higher and Secondary Specialized Education.

In order to satisfy the demands of Belorussian industry for P/M products, we conclude economic agreements with enterprises, study the demand patterns for our parts from plants and, if necessary, conduct research. We do full production preparation, up to setting up parts for output.

During the 11th Five-Year Plan, 137 finished developments were implemented at more than 100 of the country's enterprises. The length of the "research-implementation" cycle was reduced on average to 1.9 years.

At the Borisov Automotive-Tractor Electrical-Equipment Plant, a new technology was implemented for producing starter commutators for internal-combustion engines. The plant annually saves 700 tons of commutator-copper shapes. And here's an example from another sector. Thermal electric power plants use atomizers for fuel-oil burners in boilers. We proposed to make these parts from a powder compound. These P/M parts now last for 4500-5000 hours, rather than 600-800 hours.

[Question] Tell us about your plans for the 12th Five-Year Plan.

[Answer] They can be described by one word: intensification. We plan to increase the capacity of the Molodechno plant through equipment replacement and production automation and mechanization. Overall, the association will produce over 38,000 tons of P/M parts during the present five-year plan. These parts will save tens of thousands of tons of rolled products and will free up over 500 workers. The development of new materials and technologies will provide the economy with savings of over 100 million R.

I especially want to talk about the application of protective coatings. A powder layer restores the original dimensions to a part and protects it from wear. Repair of worn parts is now a considerable concern for any plant.

Sections and shops for applying protective coatings are being established directly in enterprises. Today in Belorussia, there are already 25 of these, and 5-6 are to be added each year in the present five-year plan. This work is going well in the republic's Ministry of Light Industry, where a special program was adopted to establish such sections at sector enterprises.

[Question] The first steps of your association and the work under new conditions have probably posed their own problems. What are the primary reasons for these and how can they be solved?

[Answer] Our problems are linked with the acceleration of the implementation of scientific developments into production. Here is a specific and, unfortunately, unpleasant situation. Thirty presses are idle at the Molodechno plant. They are deficient, and all our efforts to "bring them to life" have not helped. The presses were produced at the Pinsk Forging-Machinery Plant of the Ministry of the Machine Tool and Tool Building Industry [Minstankoprom]. These Pinsk rejects have been very costly to us: because of them, we cannot produce complex precision parts; namely, the kind needed by our customers. The USSR State Committee for Science and Technology, USSR Gosplan, the USSR People's Control Committee and, finally, Minstankoprom--which, in our opinion, must solve the problem--know of the situation. Reports have been written and deadlines set, but the presses still don't work.

Now, about implementation. On an initiative of the Ye. O. Paton Institute, engineering centers are being established around the country. This is a very good idea: to bring scientific development up to the level of industrial technology. We have posed this task and pose it from the moment our work is even on the laboratory level. But, two partners are obligated to solve the task: we, as the scientific institution, and the enterprise. And, the enterprise must be vitally interested in this matter. There are beautiful examples of such cooperation, in particular with the Ministry of Nonferrous Metallurgy, on request from whom we developed efficient bimetals. And at the same time, all our efforts to find an application for these materials in Belorussia have failed.

An intersector organization has difficulty in finding contacts, since sector institutes until now are interested in implementing only their own developments.

There also needs to be improvement in the system of material-technical supply for scientific institutions. The practice of placing orders a year in advance is not acceptable for us, especially with the present task of sharply accelerating the results of scientific-research developments.

What's the solution here? Scientific organizations must have the right, even if three or four times a year, to turn to supply organizations for quick solution of a problem. Possibly, scientific organizations should be permitted to conclude direct agreements with the enterprises which manufacture needed equipment and instruments. Perhaps, some fund materials from other enterprises, organizations or scientific-research institutes could be obtained. At present, this is categorically prohibited. And the

result? Our association, say, urgently needs several kilograms of stainless steel. A neighboring organization has some and they are willing to help. They can't. This steel is fund material. It can only be ordered for the next year, and has to be ordered by March of the present year. But no one will accept an order from us for several kilograms.

Several organizational problems of the operation of our association should be discussed. Actually, for several years, the NPO has been a republic intersector material-science complex. Its departments perform the role of engineering centers. And here, we encounter flaws in the mechanism of planning the association's work. The association is now working by three financing systems: Science, Scientific Service and Production. This year, we combined the scientific-research institute and one special design-technology bureau into a single scientific-research and design-technology institute. One positive result was that the gap between research and experimental-design work was organizationally eliminated. But, workers at institute subdivisions still had different pay rates.

Until now all plan indicators for science, scientific service and production have been given to the association separately. As before, there are "white" and "black" workers, working on solving the same task: to bring scientific developments and ideas to fruition. But the work of some workers is planned according to Science, for others, according to Scientific Service, and for yet others, according to Production. Different systems of planning, different systems of reporting and different wages specified not by the nature of the work, but by the scale of job titles. There's no way to stem the paper flow which is really flooding the association. How much is one balance report worth! All of this interferes with the real work.

Quite recently, in an interview by IZVESTIYA, K.V. Frolov, vice president of the USSR Academy of Sciences, emphasized that the fundamental and research nature of complexes should not be lost. I fully agree with this. We are basing our goal--to develop basically new technological processes, equipment for them and testing instruments--namely on the foundation of fundamental research. In this five-year plan, these processes will not only be developed, but will find industrial applications. This will take place first, of course, at the Molodechno plant, and then at other enterprises.

12595

CSO: 1842/210

TREATMENTS

UDC 621.746.62Δ669.7.018

THE INTERRELATIONSHIP OF SHRINKAGE PHENOMENA DURING THE SOLIDIFICATION OF LIGHT ALLOYS

Moscow LITEYNOYE PROIZVODSTVO in Russian No 1, Jan 86 pp 7-9

[Article by candidate of technical sciences L.V. Nikulin and engineers A.A. Pushkarev, deceased, and V.Ye. Novitskiy]

[Abstract] The interrelationships between solidification rate and pressure, shrinkage, and shrinkage defects were studied. Al-Mg, Mg-Al, Al-Cu, and Mg-Cd binary alloys were tested. Free linear contraction using a base length of 100 mm and mechanically uninhibited contraction during solidification under pressure and hindered contraction using a base length of 50 mm were determined. The tendency towards zonal macrostress was tested using ring specimens with off-center holes. First-order residual stress in the solid solution was determined on a URS-50IM unit using x-ray crystallography. The number of hot cracks was determined during solidification at atmospheric and high pressures. The correlation between solidification rate and pressure had a greater influence on shrinkage than the composition of the alloys. A strong association between shrinkage and casting defects was established. A faster solidification rate, while not changing the nature of the relationships, did result in higher values for the shrinkages, stresses, and defects. Under pressure, the values for contraction under pressure and hindered contraction decrease, and compression stress arises at the center of the specimens, resulting in the formation of cracks in the outer layers of the specimen. Higher absolute differences between the different types of shrinkage are associated with higher incidences of casting flaws. References 3: all Russian.

13050/13046

CSO: 1842/148

DIFFUSION WELDING OF FERRITE METAL UNITS

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 86 pp 3-5

[Article by engineer O.Yu. Zhevaley, candidate of technical sciences N.M. Kotina, doctor of technical sciences G.V. Konyushkov, Saratov Polytechnical Institute, and Candidate of Technical Sciences R.A. Musin, Perm Polytechnical Institute]

[Abstract] Diffusion vacuum welding of ferrites, magnetic oxide ceramics with complex chemical composition and crystalline structure, to metals requires more careful selection and rigid observation of technological parameters than welding of ordinary ceramics. This article discusses the specifics of diffusion vacuum welding of ferrites. In contrast to welding of structural ceramics, the factor of the effect of heat and vacuum is significant in terms of possible changes of the magnetic and electrical properties of the ferrites. Ferrosinels are more subject to this effect than ferrogarnets. As the dimensions of specimens increase, the resistance to temperature stresses decreases more rapidly than in other ceramics, meaning that these materials are more sensitive to fluctuations in heating and cooling rates during welding. Large specimens must be heated and cooled at not over $0.08-0.12 \text{ K}\cdot\text{s}^{-1}$. Automatic programmed temperature regulators must therefore be used. Conditions must be changed with a change in the size of the pieces being welded. the optimal relationship of thickness of the ferrite, copper interlayer and stress compensator should be 10:1:3 to 10:1:5 in welded units in the shape of plates with contact areas of $100-700 \text{ mm}^2$. References 8: all Russian.

6508/13046

CSO: 1842/202

INFLUENCE OF DIFFUSION WELDING PROCESS ON PROPERTIES OF TsTS-19 PIEZOCERAMIC AND ITS JOINTS WITH ALLOY AMg6

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 86 pp 5-7

[Article by candidate of technical sciences V.A. Bachin, doctor of technical sciences N.F. Kazakov, deceased, Moscow Aviation Technological Institute imeni K.E. Tsiolkovskiy, candidate of technical sciences V.G. Novikov and engineer A.I. Yekimov, Plant-Higher Technical School, Krasnoyarsk Polytechnical Institute]

[Abstract] A study is made of the influence of diffusion welding conditions on properties of TsTS-19 lead titanate-zirconate piezoceramic and the transition zone in joints of this material with aluminum alloy AMg6. The piezoceramic is most sensitive to changes in stoichiometry resulting from the volatility of lead at over 1200 K when crushed into a powder. Sublimation of lead becomes significant at temperatures over 1073 K. The compact piezoceramic is less sensitive to changes in stoichiometry under these conditions. If holding time is kept to 60 minutes or less in a vacuum of $1.33 \cdot 10^{-2}$ MPa, temperatures of up to 1100 K are permissible. During welding, selective interaction of magnesium with the components of the ceramic occurs by reduction of oxygen compounds of lead, titanium and zirconium. The interaction occurs mainly by diffusion of magnesium over the intergrain boundaries of the ceramic. References 3: all Russian.

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DIFFUSION WELDING OF METAL CERAMIC HARD ALLOYS IN AIR UNDER FLUX

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 86 pp 7-8

[Article by doctor of technical sciences V.F. Potapkin and engineer L.V. Maiorov, Kramatorsk Industrial Institute]

[Abstract] A technology has been developed for diffusion welding of metal ceramic hard alloys in the tungsten carbide-cobalt system in air under flux. The welding is performed at a temperature sufficient to produce the liquid phase, about 1593 K. Studies have shown that the welding point of hard alloys is 1673-1773 K, depending on the content of cobalt. If its content is slight, alloys must be welded at 1743-1773 K, leading to an increase in ductility. Welded parts have not lost their shape under these conditions, even with 25-30% cobalt. However, stronger joints are produced in these alloys at 1673-1703 K, since grain size of the carbide phase is kept smaller. A boron oxide-based flux is most suitable for the process. Usage tests of rolling mill rolls produced by this method showed that the rolls retained good usage properties throughout the entire range of working loads characteristic for cold

rolling mills for copper and copper-zinc strips 0.4-1.5 mm thick. Bending of 0.2 mm over a roll length of 400 mm was noted under the influence of the rolling force. References 3: all Russian.

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UDC 621.791.364:69.3:621.762

PRESSURE SOLDERING OF CERAMIC TO METAL USING COPPER SOLDER

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 86 pp 8-10

Article by engineer M.A. Pavlova and candidate of technical sciences
I.I. Metelkin]

[Abstract] Results are presented from studies of the process of the interaction of nonmetallic ceramic with metal during soldering under pressure using copper as the solder. Good overall adhesion and the necessary usage properties of the metal ceramic joints, such as vacuum tightness, thermomechanical strength and reliability can be achieved by assuring good contact at the phase boundaries with subsequent activation of the process of interaction. Joints with nickel were found to be stronger than those with Kovar under all conditions. The strength of soldered joints of dielectrics containing 100% Al_2O_3 is 50 to 60% of the strength of joints with ceramic VK94-1, which contains 94% Al_2O_3 . In ceramic molybdenum systems, only holding over 20 minutes can achieve a long-term strength of 150-190 MPa. Overheating cannot be allowed during soldering of molybdenum pseudoalloys, since the solder penetrates into the pseudoalloy, greatly reducing the strength of the joint. Joints can withstand heating to 950°C many times without losing vacuum tightness, and also resist long-term heating to 650°C in hydrogen, cyclical exposure to temperatures of +150°C and -60°C in air, as well as operation under tropical humidity conditions. References 4: all Russian.

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ULTRASONIC SOLDERING OF TsTS-19 PIEZOCERAMIC WITH LOW-TEMPERATURE SOLDER

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 86 pp 10-11

[Article by candidate of technical sciences D.I. Kotelnikov, engineer Yu.G. Zadorozhnyy and engineer Z.S. Loginova, Chernigov Branch, Kiev Order of Lenin Polytechnical Institute imeni the 50th Anniversary of the Great October Socialist Revolution]

[Abstract] A study is presented of changes in the mechanical strength of joints in TsTS-19 piezoceramic obtained by ultrasonic soldering with various low-temperature solders as a function of soldering time and surface roughness of the parts being soldered. Low temperature solders used included wood's alloy, tin, POS61 solder, lead, a eutectic containing 10% Zn and 90% Sn, and zinc. Mechanical strength of the joints was tested by static bending using a 3-point method and tensile testing. Ultrasonic soldering with zinc was found to achieve equal strength of soldered joints and is recommended for commercial manufacture of piezoceramic transducers. References 3: all Russian.

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ANALYSIS OF RESIDUAL STRESSES IN UNCOMPENSATED METAL-CERAMIC WELDED JOINTS

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 86 pp 11-13

[Article by candidate of technical sciences R.A. Musin, engineer Ya.V. Lyamin, Perm Polytechnical Institute, and candidate of physical-mathematical sciences V.N. Ivanov, Continuum Mechanics Institute, Ural Scientific Center, USSR Academy of Sciences]

[Abstract] A study is made of the use of the method of finite elements to calculate a simplified model of metal ceramic welded joints, based on the assumptions that the deformation state is planar, the metal layer operates within the limits of elasticity on the stress-strain diagram, and that there is no external pressure. Only the final state of the joint is analyzed, and the initial state is considered stress-free. The distribution of residual stresses is found to be complex, and zones are present where stresses are locally high. These zones are usually located near the place where the welding plane reaches the free surface and/or the locations where fractures begin. Stresses acting in a local volume with maximum values are most dangerous. The approach to investigation of the stress-strain state of uncompensated metal-ceramic welded joints used in this article allows investigation of the distribution of stresses in edge zones for the first time. The method can serve as a basis for computation and analysis of stress

fields in joints, taking ductility and various technological factors into account. References 12: all Russian.

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INFLUENCE OF ALLOYING ELEMENT CARBIDES ON PROPERTIES OF WELDED SEAMS OF NP-2 NICKEL

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 86 pp 18-19

[Article by engineer V.N. Puchkov, candidate of technical sciences B.D. Lebedev, Dneprodzerzhinsk Industrial Institute imeni M.I. Arsenichev, and candidate of technical sciences V.V. Karatysh, Perm Polytechnical Institute]

[Abstract] Results are presented from studies of the influence of titanium, zirconium, vanadium, niobium, chromium and molybdenum carbides on the tendency of seams of NP-2 nickel toward formation of pores and hot cracks, as well as on the corrosion resistance of the seams. The influence of the carbides on pore-formation tendency was studied by remelting experimental alloys in a chamber with a controlled atmosphere. Three ingots were produced in an arc furnace for each composition tested. The hot crack formation tendency criterion used was the critical rate of deformation of the seam metal. Corrosion resistance was evaluated by calculation of the corrosion rate and determination of mass loss of specimens. It was found that titanium and zirconium carbides have the most favorable influence when their content in the welded materials is 4 to 6%. Powder wires were developed for welding and surfacing of nickel which permit the production of welded joints with good mechanical properties. The seam metal contains less than 1% of the alloying elements and is resistant to fluoride, chloride and alkaline media. References 6: all Russian.

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INFLUENCE OF WELDING ON PROPERTIES OF VSt3sp + 08KH22N6T BIMETAL

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 86 pp 20-21

[Article by candidate of technical sciences V.A. Borisenko, candidate of technical sciences O.A. Denyachenko, engineer V.Ye. Kozhevnikov and engineer V.I. Sannikov]

[Abstract] Results are presented from studies of the influence of the welding heat cycle on the properties of the bimetal VSt3sp + 08KH22N6T (EP53) obtained by explosive welding. Imitation of welding pipes was achieved by filling a

V-shaped notch in the cladding layer, 3-3.5 mm deep. Two welding methods were used: with a type E-08KH20N9G2B electrode and argon arc welding with type Sv-01KH19N9 wire. It was found that application of the cladding layer did not result in a decrease in mechanical strength or deterioration of structural state of the welded zone, nor did it influence the nature of fracture in short-cycle fatigue testing.

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INFLUENCE OF HEAT TREATMENT ON RESIDUAL STRESSES AND PROPERTIES OF ELECTRIC-SLAG WELDED JOINTS OF 08KH18N10T STEEL

Moscow METALLY in Russian No 2, Mar-Apr 86 (manuscript received 30 Oct 84)
pp 112-116

[Article by A.A. Astafyev, L.I. Lepekhina, N.M. Batiyeva, M.Ya. Khalikov, N.A. Viktorov, and S.N. Blozhko, Moscow]

[Abstract] A study is made of the distribution of residual stresses in two welded joints of 08KH18N10T steel 100 mm thick made by electric slag welding with Sv-04KH19M11M3 wire 3 mm in diameter by the usual welding method and under forced welding conditions with elevated current and higher welding speed. Both joints were welded with two electrode wires. Two maxima were found on the curve of residual stress as a function of distance from the seam axis for both joints: one on the seam axis, another in the heat-affected zone at 15-25 mm from the melting line. The level of stresses immediately after welding was 1.5-2 times as great as the yield point of the seam metal and the base metal. Austenitization at 1050°C with cooling in air causes redistribution of stresses in the joint, but leaves them higher than the yield point. Stabilization at 800°C with cooling in air after austenitization, though it causes an additional drop in residual stresses, leaves them higher than the yield point. Stabilization also may cause formation of the σ -phase, which increases brittleness. Tempering of products at 480°C is promising. References 10: 9 Russian, 1 Western.

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CSO: 1842/205

EXTRACTIVE METALLURGY AND MINING

FLOTATION-REAGENT OUTPUT INSUFFICIENT

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 17 May 86 p 2

[Article by O. Bogadanov, honored scientist and engineer, professor of the Mekhanobr Institute [All-Union Scientific-Research and Project Institute of Mechanical Processing of Mineral Resources], and V. Ryaboy, doctor of technical sciences, under "How To Accelerate Implementation?" rubric: "Small, But Valuable"]

[Text] When one or another enrichment mill shuts down, we in the Mekhanobr Institute and people throughout the USSR Ministry of Nonferrous Metallurgy are well aware of it: it happens when the meager supply of flotation reagents is depleted. For over two months last year, the Ak-Tyuz Enrichment Mill of the Kirghiz Mining-Metallurgical Combine was shut down. The suppliers had to send a truck to Orgsintez in Volgograd Oblast.

One look at a map, and you will see that it's a long distance. So that the trip would not be in vain, the chemical plant, as a courtesy, gave out a little of the chemicals, and immediately, the mill doubled its extraction of scarce metals. But, you can't send a truck out every time you need a reagent: there are about 450 reagents used in nonferrous metallurgy...

But what else can be done, if over 95 percent of all nonferrous-, rare-, and precious-metal ores now are dressed by the flotation process? The Union Ministry of the Petroleum Refining and Petrochemical Industry [Minneftekhimprom]; the Ministry of Timber, Pulp and Paper, and Wood Processing Industry; the Ministry of the Chemical Industry [Minkhimprom] and the Ministry of Mineral Fertilizer Production are far from fully supplying the needs of USSR Ministry of Nonferrous Metallurgy [Mintsvetmet]. In addition, the assortment and quality of flotation reagents at times are very poor.

In place of good-quality, full-strength product, these ministries in a number of cases supply the sector with wastes of variable content from various processes. Clearly, this results in poorer technological indicators, reduced metal yield and poorer metal quality.

Flotation reagents are a "delicatessen" product: the quantities required are tens--at most, hundreds--of tons per year. In short, these are very low-tonnage chemical products. And, although the most important decisions are made according to it, the magic of astronomical figures has a much greater influence on manufacturers.

V. Listov, Minister of the Chemical Industry, informed P. Lomako, USSR Minister of Ferrous Metallurgy, that dichlorocarboxylic acids will not be produced in the 12th Five-Year Plan. This news was a signal of disaster for the mill workers at the Tyrnyauz Tungsten-Molybdenum Combine.

This decision should have met with firm resistance in the republic Gosplan and Gossnab. The managers of the departments involved and leading specialists are well aware that the chemical, petrochemical and other enterprises year after year are failing to fulfill their obligations for flotation-reagent production. The output of some flotation reagents was to have started back in the 10th and 11th Five-Year Plans, but has not yet begun.

But, it seems, this did not disturb G. Merkulov, deputy chairman of USSR Gossnab. Here is what he wrote to L. Yefremov, first deputy chairman of the USSR State Committee on Science and Technology [GKNT]: "USSR Gossnab considers it unfeasible to organize the production of low-tonnage flotation reagents at Minkhimprom enterprises, because this ministry is already overloaded with problems in providing many types of extremely important chemical products for the national economy. Taking into account the importance of this problem to nonferrous metallurgy and the need to solve it as soon as possible, low-tonnage flotation reagents should be produced at USSR Mintsvetmet enterprises. Minkhimprom should be assigned the task of developing the technology and the corresponding project designs."

After reading this, one wonders: are metallurgists to take care of such matters? Maybe they should convert over completely to producing chemicals, and assign metal-winning to... Minkhimprom? This is a sad joke, especially after GKNT informed us that the program for seven extremely important reagents was postponed until 1987-1989, although it was originally planned for the beginning of the 11th Five-Year Plan. There's no assurance that the new deadline will not be pushed back even further: the chemical industry does not have a good experimental base, where they could "break in" the production of new, high-efficiency chemicals proposed by scientists.

No one seems to have any desire to work on the problem: at GKNT representative meetings, Minkhimprom, Minneftekhimprom and other ministries sometimes call in specialists who are practically incapable of bearing responsibility for the fulfillment and solution of current and future problems.

But even if Minkhimprom is pressured into organizing the production of some new product, it will be bounced around from association to association. Take these same dichlorocarboxylic acids; they are the most important reagent for dressing tungsten ores. Production of these acids was first assigned to Soyuzanilprom, from which the order was kicked over to Soyuzkhlor, ending with the previously cited letter by V. Listov. The same fate befell higher aeration flotation reagents: they were transferred from Soyuzanilprom to Soyuzorgsintez, but no one there took the matter seriously.

But how to get someone interested, and whom? Minkhimprom established a laboratory at the NIIKhimpolimer Scientific-Research Institute to produce experimental batches and organize production of flotation reagents. The laboratory, reporting to Soyuzanilprom, is working successfully, but the association management is carefully making sure that the plan does not include work outside its speciality area. Thus, the original idea, which was well thought-out and presented, loses its value to a great degree, since only a few of the proposals of "outside" organizations are realized, and they are shunted back to the very end of a long list.

A very applicable approach to flotation reagents is: small, but valuable. Without them, it's impossible to begin the output of new products, and the national economy annually loses at least 30,000 tons of copper, zinc, lead, molybdenum, tungsten and other nonferrous metals, as well as about 40,000 tons of fluorite, barite and other valuable minerals.

New flotation reagents have been developed through great effort; these reagents are highly efficient, inexpensive and are entirely satisfactory to the ore dressers. But, the greatest difficulties lie in the path of implementing them into mass production. This isn't the way to do things! Obviously, at one of Minkhimprom's plants, it would be feasible to organize a shop to produce low-tonnage flotation reagents (for the needs of all consumers) with a flexible production circuit and the ability to rapidly switch over to different products.

Naturally, one can't get by without the crucial role of USSR Gosplan. This must be done with specially assigned specialists, responsible for planning and coordinating the work on such products in various ministries. The sooner they take on this task, the greater will be the gain for the national economy.

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CSO: 1842/210

MISCELLANEOUS

IMPROVEMENTS IN CAPITAL CONSTRUCTION OUTLINED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 24 May 86 p 2

[Interview with S. Bashilov, Minister of Construction of Heavy Industry Enterprises, with SOTSIALISTICHESKAYA INDUSTRIYA correspondent A. Valentinov; date and place not given: "Beginning a Long-Term Construction Project"]

[Text] The 27th party congress designated the fundamental improvement of capital construction by all departments and organizations as one of the most important tasks. How will the All-Union Ministry of Construction of Heavy Industry Enterprises [Mintyazhstroy] fundamentally improve the efficiency of construction work? This question began an interview conducted by our correspondent A. Valentinov with S. Bashilov, USSR Minister of the Construction of Heavy Industry Enterprises.

[Answer] The tasks set forth by the congress were taken up by the construction industry, as they were by all Soviet people, with great inspiration. Now we must sharply restructure our work, in order to eliminate slow construction rates. Because of this slowness, enormous assets are frozen and scientific-technical progress is retarded. What are the ways to eliminate these shortcomings?

A statute was adopted soon after the congress by the CPSU Central Committee and the USSR Council of Ministers. It includes additional measures to improve capital construction and makes it possible to avoid many negative phenomena which have hindered work for years. And, shaping the 12th Five-Year Plan, we, along with customer ministries, are determining the work volumes in accordance with construction-time norms. At the same time, we are proposing to mothball a number of construction projects and we are attempting to make a truly vigorous construction front.

Together with the USSR Ministry of Ferrous Metallurgy, we are preparing to conduct an experiment, the goal of which is to reduce the length of the investment process by combining project-design and construction. This experiment will be conducted in the construction of a 2500 wide rolling mill at the Novolipetsk Metallurgical Combine and a 350 rolling mill at the Oskol Electrometallurgical Combine. This work is not going smoothly yet,

and unforeseen difficulties have to be overcome. But we are hoping for successful results.

However, not everything depends on us alone. In planning contracted work, from our point of view, the number of indicators approved by higher agencies must be sharply reduced. Measures must be taken to improve the system of wages and incentives. Organizations must be gradually converted to being self-supporting.

[Question] Sergey Vasilyevich, a good start is a pledge of success. What practical ways has the ministry selected to more quickly realize the priority program of the first year of the five-year plan?

[Answer] It must be said that the priority program for this year is extremely crowded. Judge for yourself: over 240 facilities and production installations have to be built. These include the No. 5 blast furnace (the world's largest) at the Cherepovets Metallurgical Combine and installations for producing over 2 million tons of rolled products, 362,000 tons of steel and 2.75 million tons of iron. Also included are new capacities in nonferrous metallurgy.

Enterprises of the machine-building complex will be further expanded, with top priority given to those linked with the output of the Don Combine, as well as the Krasnoyarsk Heavy Excavator Plant. A large number of enterprises in light industry and for USSR Gosagroprom are to be put into service.

However, as in previous years, over two-thirds of the projects are to be completed in the fourth quarter. And this by no means guarantees the fulfillment of the priority program. That's why the ministry collegium approved the initiative of the labor collectives and organizations of the Ukraine and Kazakhstan Mintyazhstroy, of Glavsreduralstroy [Main Construction Administration of the Central Urals] and of the Tsentroyazhstroy, Kursktyazhstroy and other All-Union Associations. These organizations have decided to move up the completion dates for the construction of 70 priority facilities and production installations.

The technological preparedness of these facilities makes it possible to hasten their startup. The matter is now up to the supply organization of USSR Gosnab, which must deliver equipment, cables, conductor products and other materials ahead of schedule. But, the situation with deliveries is cause for alarm.

Equipment is being supplied unacceptably slowly for the sheet-metal shop at the Karaganda Metallurgical Combine and the rail-quenching heat-treatment system at the Azovstal Plant. The delivery deadlines have passed for equipment for the Ivdelskaya and Kurskaya priority compressor stations on main gas pipelines, as well as for the ammonia-production system at the Azot Production Association in Kemerovo.

The 27th party congress gave special attention to problems of future socio-cultural development and to solving the housing problem. And we planned to complete 40 percent of the housing units and children's institutions planned for this year in the first half. The success of this

effort will depend on the coordinated performance of all construction participants and their timeliness in solving specific tasks.

[Question] The country's Basic Directions of Economic and Social Development set forth the tasks of systematically industrializing construction work and transforming it into a unified process of erecting facilities from factory-prefabricated elements. Is the sector ready for this new turn?

[Answer] Unfortunately, I must say that the ministry does not yet have the necessary base to fully provide for construction needs . . . new progressive structures and materials. However, in recent years, a number of large, unique enterprises producing new progressive products have been established in the sector. These products are highly prefabricated and do not require additional labor expenditures at the construction sites.

Presently, at our experimental production facilities, new technological processes and equipment are being developed. These include cassette-conveyor lines, automatic concrete-handling systems, automation of cement mixers and equipment for formless construction of reinforced-concrete articles. The technology for erecting structures from unit-cast concrete is being converted to an industrial base.

[Question] Sergey Vasilyevich, what about the other side of construction industrialization; namely, mechanization?

[Answer] Presently, our repair-mechanical plants are producing 70 different types of construction machines and means of small-scale mechanization. During the 12th Five-Year Plan, another 36 types of specialized construction equipment will be added to this. By raising the level of mechanization, improving the use of construction machines and raising the number of shifts during which they are in operation, more than a 30 percent increase in labor productivity will be achieved.

[Question] A fundamental improvement in work quality is one of the central problems of the socio-economic policy. How will you solve this at the ministry's construction sites?

[Answer] We have developed a target program. It defines measures to improve the management of construction quality. Organizationally, this program is augmented by the establishment of quality-inspection services, both in the central apparatus and in the central administrations, combines and individual large trusts.

There are also fundamental new engineering and technical solutions, which make it possible to raise the quality not only of individual types of work, but also of the entire structure, be it industrial or residential. At the same time, there are aspects of the quality-improvement problem which the construction workers themselves are powerless to solve. We're talking about the supply of high-quality industrial and traditional finishing materials. In most cases, these do not yet meet modern aesthetic requirements.

[Question] Sergey Vasilyevich, at the 27th CPSU Congress, much attention was given to personnel policy. What is the ministry undertaking to improve personnel work and to provide better professional preparation?

[Answer] Of all the problems which we have discussed today, this is the most difficult. There is a chronic shortage of workers. Alas, there is little hope of filling out collectives through organizational sources. Thus, one path remains: to interest people with good wages, good housing, good working conditions and recreation. Therefore, during the present five-year plan, we are sharply increasing the construction of housing, small-family dormitories and residential cooperatives. Many more cultural, medical, sports and auxiliary facilities will be built than in previous years.

The educational network will be expanded for preparing workers on the job. Greater numbers of qualified workers will be prepared in construction trade schools. Over the five-year plan, we plan to prepare and send to construction sites 180,000 people--55,000 more than in the previous five-year plan.

As you can see, we have enough problems. But, we are making every effort to solve them during this sharp turnaround which the country has started.

12595

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A HIGH-SPEED ALGORITHM FOR DIGITAL INFORMATION

Sverdlovsk DEFECTOSKOPIYA in Russian No 1, Jan 86 (manuscript received 25 Aug 83; final version 5 Mar 85) pp 89-90

[Article by A.I. Greyser, Atomkottlomash Scientific Production Association, Rostov-on-Don]

[Abstract] The "sliding average" algorithm was modified to reduce the amount of time required to compute it on an Elektronika-60 computer. Its effectiveness in solving for the S quantity during radiometric product testing was then evaluated through mathematical modeling. The proposed algorithm was less accurate than the optimal algorithm by an order of 10% and can be used wherever this variance is permissible. References 1: Russian.

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