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MAGNETIC CRYSTALS

18420191-P Moscow MOSKOVSKAYA PRAVDA in Russian 26 Jun 87 p 2

[Article by A. Presnyakov]

[Text] Alloys with amazing magnetic properties were created at the Central Scientific-Research Institute of Ferrous Metallurgy (TsNIIchermet) im. I.P. Bardin.

Rapid developments in the newest directions in the electronics, telemechanics, and electrical technologies demanded the creation of high-purity metals. These were needed primarily by the builders of scientific and technical instruments.

Ordinarily, x-ray transmission is used in the study of crystals. In this instance, however, this traditional method could not be used. The main components of magnetic alloys--iron, nickel, cobalt--are very similar in their physical properties. They disperse the x-rays almost identically. Because of that it was impossible to obtain a clear picture of each metal's atomic distribution. It was decided then to obtain a finer alloy-probing instrument--strongly penetrating particles, neutrons. The task force was lead by the well-known Soviet physicist-magnetologist, Doctor of Physico-Mathematical Sciences I.M. Puzey.

"Special apparatuses were created for conducting original experiments," says Ivan Mikhaylovich. Using neutrons for alloy "anatomizing," the investigators succeeded in increasing the accuracy of superstructure identification by a factor of 100. This allowed one to open a "window" to the magnetic crystals, to see their atomic bonds. Being armed with such a powerful method for seeing deep inside the crystals made it possible to create alloys with a priori ordered properties. Thus, the creative collective of young researchers had done a great deal to accelerate the creation of a whole series of precision alloys and to decrease the time needed for their preparation. This led to gains in time and economy of means.

Where specifically could the results of this scientific investigation be used? Here is one of the examples. In the head of the devices used for magnetic recording and reproduction of television images. The velocity of magnetic film moving along the working edge of the head attains speeds of 40 meters

per second. Because of that the device is subjected to very strong erosive effects. To increase the wear resistance of this assembly, a component was added to the alloy composition to attain quite satisfactory hardness. The technological conditions were retained without any damage to the high magnetic properties of the head. In this instance also great help was rendered by the new development of Soviet researchers.

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SERVICE LIFE EXTENDED

18420193-P Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 14 Jul 87 p 2

[Text] The service life of pipe connections in the gas and petroleum equipment was increased by a factor of four when an alloy steel used in these fittings was replaced by the scrap steel of a bearing manufacturing plant with subsequent coating with superfine powders obtained by the electro-explosions method. The high-stability composition as well as the modern technology of its preparation were developed by the specialists of high-voltage scientific-research institute (NII) at the Tomsk Polytechnical Institute, State Bearing Plant No 5, and the petroleum combine Tomskneft.

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UDC 621.746.073:669.715

DEPOSITION OF Ni-W ALLOY ON METAL-FORMING PARTS OF MOLDS

18420140 Moscow LITEYNOYE PROIZVODSTVO in Russian No 4, Apr 87 pp 26-27

[Article by V.F. Pavlenko, candidate of technical sciences]

[Abstract] Electrodeposition of a Ni-W alloy on metal-forming parts of casting molds from an electrolyte containing abundantly available low-cost oxalic acid and its derivatives was studied for effectiveness as protection of these parts against distortion as a result of excessive wear caused by corrosion, thermal and hydraulic shocks, and diffusion of melt material components. The results indicate that nickel and Ni-W alloys precipitate only from an electrolyte also containing NH_4^- ions, which with $NiSO_4$ form complexes $[Ni(NH_4)_6]\cdot[Ni(C_2O_4)_3]$ and $NH_4[Ni(NH_3)_2\cdot(C_2O_4)_2]$. The best electrolyte was found to be one with a pH = 9-10 containing 90-120 g1/1 Na_2WO_4 + 15-20 g/1 nickel salt of sulfamino acid + 20-25 g/1 $(NH_4)_2C_2O_4$. The results of subsequent tests indicate that 10 μm thick Ni-W coatings deposited with a current density of 2-5 A/dm^2 at a temperature of 35-50°C provide better protection than chemical and heat treatment of the surfaces, a thus coated mold part made of 40Cr steel having a 3-5 times longer service life than a cyanided one made of 3Cr2W8 alloy steel.

2415/13046

UDC 621.74:669.15-194

MICROALLOYING CAST CARBON STEELS WITH VANADIUM AND TITANIUM

18420140a Moscow LITEYNOYE PROIZVODSTVO in Russian No 4, Apr 87 pp 6-7

[Article by L.P. Zhitova, candidate of technical sciences, F.S. Rakovskiy, engineer, T.A. Patrina, engineer, and N.Yu. Poruchnikova, engineer]

[Abstract] The feasibility of alloying cast medium-carbon steel (0.50% C, 0.68% Mn) with both vanadium and titanium by addition of the appropriate hardener was studied, the purpose being to produce ingots with ferritic-pearlitic structure for reliable and durable parts of caterpillar tractors. The steel was smelted in a 200-kg basic induction furnace and the melt was poured fractionally into ladles. FeSi40V hardener (0.38% Si, 0.05-0.09% V, 0.010-0.021% Ti) or FeV35Si hardener (0.08% V) were added in amounts of 6-10 kg/ton, followed by aluminum as deoxidizer. Microstructural examination of cast specimens and results of mechanical tests for impact strength indicate that addition of 6-8 kg/ton FeSi40V hardener containing 0.05-0.07% V and 0.010-0.015% Ti yields the best product.

2415/13046

UDC 621.74.002.6:669.15'74-194.56

CHARACTERISTICS OF AUSTENITIC MANGANESE ECONOMY STEELS FOR WEAR-RESISTANT CASTINGS

18420140b Moscow LITEYNOYE PROIZVODSTVO in Russian No 4, Apr 87 pp 7-8

[Article by M.A. Filippov, candidate of technical sciences, M.Ye. Poptsov, candidate of technical sciences, and V.Ye. Lugovykh, engineer]

[Abstract] Reduction of the austenite-forming Mn content in wear-resistant manganese steels for economy purposes must be compensated by addition of another element such as chromium which lowers the temperature range of martensite transformation. This has been confirmed experimentally on cast steels containing 0.9-1.4% C and 10-14% Mn. They were smelted in a 50-kg induction furnace and poured fractionally into ladles. Ingots were homogenized and then forged into bars 12x12 mm^2 in cross-section, whereupon the latter were quenched in water: plain Mn steels from 1050°C and Mn-Cr steels

from 1150°C. Chromium was found to shift the martensite transformation toward lower Mn content while forming insoluble carbides, most effectively in the presence of a high carbon content. For optimum wear characteristics, accordingly, the chromium content in maganese economy steels should not exceed 1-2% Cr and the carbon content should be near the upper limit of 1.2-1.3% C. References 2: both Russian.

2415/13046

UDC 621.74.002.6:669.14

SMELTING STEEL IN ELECTRIC-ARC FURNACES BY ONE-SLAG PROCESS FOR SHAPED CASTINGS

18420140c Moscow LITEYNOYE PROIZVODSTVO in Russian No 4, Apr 87 pp 8-9

[Article by V.V. Voynov, candidate of technical sciences, Yu.M. Eydlin, candidate of technical sciences, and D.K. Butakov, doctor of technical sciences]

[Abstract] A one-slag process has been developed and is now used at the Ural Heavy Machine-Building Plant for smelting various alloys steels in electric-arc furnaces, with either complete oxidation or shorter oxidation period. Using a slag with $CaO:SiO_2 \geq 1.2$ basicity ensures a low phosphorus and sulfur content in the cast steel and a content of 10-12% FeO toward the end of the process and becoming an effective factor. The oxygen content is reduced by this process from 0.012-0.015% in the melt to 0.003-0.008% in the cast steel, just as low as after conventional smelting with two slags, while the nitrogen content and the hydrogen content are reduced to lower levels. A shorter oxidation period ensures more effective reduction of the phosphorus content. Advantages of this process over smelting with two slags are 12-18% higher productivity and 20-45 kW·h/ton lower energy consumption, better economy of ferroalloys, electrode material, refractory material, and CaF_2 and less metal waste during slag removal as well as lower labor intensity and better hygiene.

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UDC 621.74:669.14

IMPROVEMENT OF TECHNOLOGY OF SMELTING 12Cr12NiCu CAST STEEL FOR WATER-TURBINE BLADES

18420140d Moscow LITEYNOYE PROIZVODSTVO in Russian No 4, Apr 87 pp 9-10

[Article by I.A. Kuntsevich, candidate of technical sciences, V.V. Kobzistyy, engineer, Yu.V. Rozhkov, engineer, A.B. Mostovoy, doctor of technical sciences, and V.P. Fedyayev, engineer]

[Abstract] A new technology of smelting 12Cr12NiCu cast steel for water-turbine blades has been developed and is now used at the Elektrostaltyazhmash Production Association, with resmelting of alloy tailings as essential ingredient of the process. Smelting is done in a 40-ton basic electric-arc furnace requiring only a 12 MV·A transformer. One variant of this technology requires less lime and ferroalloys, only 120.6 kg/ton ferrochromium, the produced steel being more chemically homogeneous with a lower oxygen and nitrogen content. The second variant requires more ferrochromium, up to 220 kg/ton, for attainment of a sufficiently large vertical temperature gradient in the pool. Several operations such as dephosphorization and regeneration of oxidizing slag are eliminated. The technology reduces the production cost by approximately 100 rubles per ton of molten steel.

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UDC 621.745.55

ALLOYING HEAT-RESISTANT STEEL WITH NIOBIUM

18420140e Moscow LITEYNOYE PROIZVODSTVO in Russian No 4, Apr 87 pp 12-13

[Article by V.N. Ivanov, candidate of technical sciences, and A.Yu. Konov, engineer]

[Abstract] At the ZIL Production Association, heat-resistant 04Cr18Ni37Si2 steel for heat treatment equipment has been replaced with 03Cr20Ni25 steel containing niobium, this steel being suitable for parts operating under heavy load in a reducing atmosphere. Ingots of this steel up to 200 kg are produced by resmelting scrap and recovered metal, up to 80% of the charge, in large acid open electric furnaces with subsequent addition of ferroniobium to the melt before it is poured. The process has been optimized on the basis of trial runs in a 500-kg induction crucible furnace and in a 3-ton electric-arc furnace, the charges also containing FeSi45 ferrosilicon, $FeCr015N_2$ ferro-chromium, and granulated nickel. With ferroniobium hardener containing 28.0-32.5% Nb added, stable assimilation of niobium in the steel melt to the optimum level of 0.6-0.8% Nb occurs within 15-20 min. Use of the new steel reduces the production cost by 200 rubles per ton of molten steel and saves 150 tons of granulated nickel annually.

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UDC 621.74:669.15'74.194

EFFECT OF MODIFICATION ON PROPERTIES OF 110Mn13 CAST STEEL

18420140f Moscow LITEYNOYE PROIZVODSTVO in Russian No 4, Apr 87 p 14

[Article by Z.V. Byleva, engineer, N.A. Ugarova, engineer, V.F. Merkulov, engineer, and I.V. Zuyev, engineer]

[Abstract] Modification of 110Mn13 cast steel for excavator shoes with titanium, calcium, and nitrogen was studied, the purpose being to determine the feasibility of increasing its stability and impact strength at low temperatures. Ingots of this steel were produced in a 6-ton basic electric-arc furnace, conventionally with 0.1% Al as deoxidizer and specially with additional 0.08-0.15% Ti + 0.03-0.06% [N] + 0.02% Ca. The latter modification was found to improve the otherwise austenitic microstructure with precipitated $(FeMn)_3C$ carbide by making it more homogeneous without sulfide and oxysulfide inclusions based on FeS·MnS but with small clusters of Ti nitrides and oxy-nitrides, this homogeneity contributing to its stability. Its impact strength is equal to that of plain steel at room temperature, but remains 80-120 J/cm^2 higher than that of plain steel at temperatures down to -80°C.

2415/13046

OFFERED BY 'ALMAZ-87'

18420192-P Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 10 Jul 87 p 2

[TASS, Kiev 8 Jul]

[Text] Companies and foreign trade combines of Austria, GDR, Finland, FRG, CzSSR, and Japan participated in the international specialized exhibit "Superhard materials and instruments made from them"--"Almaz-87," which opened [sic] today in the Ukraine's capital. It was organized by the trade-industry chambers of the USSR and UkSSR together with the Ukrainian Academy of Sciences.

Here were shown composite materials based on diamonds and cubic boron nitride, compacting equipment, controlling-monitoring equipment, instruments and production items made from the superhard materials, and other products.

Recently, the industrial production of synthetic diamonds began to exert tremendous effect on the development of science and technology. This exhibit contributes to the deepening of the international cooperation in this field. An international conference was held during the exhibit in the course of which the Soviet and foreign specialists exchanged information on the latest achievements in the area of superhard materials.

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UDC 621.791.03-52

THE EFFECTIVE USE OF WELDING ROBOTS FOR AUTOMOBILE ASSEMBLY

18420121a Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 87 pp 4-5

[Article by Yu.A. Kartavin, engineer, Polytechnical Institute imeni A.A. Zhdanov, Gorkiy]

[Abstract] The economic benefit of using welding robots on a VAZ-2105 assembly line was calculated. The welding line contained built-in Kawasaki-Unimate robots. The calculations took into account social factors; that is, the total savings from not maintaining a human worker throughout his lifetime, including savings on the worker's needs from birth through the age of 18, for education, pensions, social needs while employed, the compensation of losses resulting from working conditions, and additional profits the worker who has been released from the given position creates in another position. The robot line in question is a flexible, self-adjusting line with 22 robots, which are maintained by 10 workers during two shifts. When the auto bodies were welded manually, there were 42 workers on two shifts. It was shown that when 1.5 workers were released per two shifts of robot line operation, the economic benefit was no more than 40,000 rubles per robot. Although the cost of welding robots is high and no reductions are foreseen for the near future, the author's analysis demonstrates that flexible, self-adjusting robot lines are most efficient when used to produce two or more models of automobile. The most important factors affecting the efficiency of robot lines are the number of workers that can be released due to the introduction of one robot, the cost of each robot in the line, and the number of models that can be assembled on the given line. References 2: both Russian.

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RESULTS OF USING A ROBOT WELDING UNIT AT THE ZHDANOVTYAZHMASH PRODUCTION ASSOCIATION

18420121b Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 87 pp 5-6

[Article by N.I. Bubenkov, engineer]

[Abstract] In 1983, the Zhdanovtyazhmash Production Association acquired an A30A robot welding unit in order to gain experience in automated welding and increase labor productivity. The unit consisted of an IPb-6 robot with a microcomputer control system, two 500 kg capacity robot arms, and equipment for gas-shielded welding and removing hazardous substances. Introducing the robot units made it possible to release three skilled workers and raise the quality of welds. The stability of the arc and the precision of the torch sometimes decreased the cathetus of the welds. However, certain technical problems, which may be characteristic of all welding operations, were encountered. In addition, up to 50 percent of all heavy machine-building products could be welded with robot assistance if the memory in the control system were expanded and circular and linear interpolation functions were added to the control system, making it possible to program welding in an interactive mode; if welding robots were installed on self-propelled gantries or other means to maneuver around the item being manufactured; and if robot lines were equipped with robot arms up to 20 tons in capacity.

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USING ELECTRON BEAM WELDING TO OBTAIN WELDED STRUCTURES FROM VT8 ALLOY

18420121c Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 87 pp 13-14

[Article by N.V. Krivko, engineer, and D.P. Shchetanov, candidate of technical sciences]

[Abstract] Various studies were done to determine how the speed of welding affected the structure of the metal in the welds. Mounted ring-shaped blanks were used to manufacture welded joints from titanium alloy. Welding was done at speeds of 7.2, 20, 50, 100, 150, 250, and 300 meters per hour with 60 kV of direct voltage on the anode. Metallographic studies showed that the metal in welds that had undergone high temperature step annealing in argon did not differ from the base metal. X-ray analysis of such welds showed that the structure of the weld and base metal were practically identical and were a mixture of α- and β-phase solid solution. It also revealed no anomalies in the chemical composition of individual grains in the metal and base metal. Studies on the microplastic deformation of welds undergoing such heat treatment revealed no differences in the amount of deformation in the welds and the

base metal. Mechanical tests showed that the fatigue limit of the weld joints was 560 MPa, which is close to that of the base metal and the tabulated data for VT8 alloy. It was concluded that high-speed welding (250+ meters per hour) is advisable when electron beam welding is employed to manufacture welded structures from VT8 titanium alloy. The main reason for the decrease in the plasticity of the metal in the welds from two-phase titanium alloys was the presence of the strong, brittle metastable α'-phase in their structure. Moreover, the plasticity of the metal in the welds can be increased by subjecting it to a special high temperature step annealing treatment. References 7: all Russian.

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DIFFUSION WELDING OF IRON-CARBON ALLOYS IN AIR

18420121d Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 87 p 16

[Article by Yu.S. Bylinkin, engineer, and E.Yu. Bylinkin, engineer, Kalinin Branch, GOSNITI [State All-Union Order of the Red Banner of Labor Scientific Research and Technological Institute for the Repair and Operation of the Machine-Tractor Fleet]

[Abstract] A well-known technique for fusion welding grey iron in a vacuum was applied to fusion welding in air. The article describes the results of a study on the possibility of welding cast iron at a vacuum pressure of $10.5\text{-}10^5$ Pa by using activating composites to coat the welded surfaces and gasket between them ahead of time. SCh20 cast iron was used for the studies. The gasket was a band of 08kp steel 50 micrometers thick. The welding was done on an SDVU-50 unit (in the vacuum) and a UDS-2 unit (in air). It was shown that it is possible to activate the iron-carbon alloy diffusion welding process during the reduction of oxides on weldable surfaces by using the carbon-bearing compounds they have been coated with. Diffusion welding in air to obtain joints of grey iron or grey iron with steel was also used. An optimal composition and consumption of the compound that coats the weldable surfaces was proposed. References 4: all Russian.

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PRESSURE WELDING OF CUPROUS SELENIDE IN THE SUPERIONIC β-PHASE

18420121e Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 87 p 18

[Article by M.A. Korzhuyev, candidate of physical and mathematical sciences, N.Kh. Abrikosov, doctor of chemical sciences, V.F. Bankina, candidate of chemical sciences, Institute of Metallurgy imeni A.A. Baykov]

[Abstract] It was demonstrated that pressure welding in which the semiconductor cuprous selenide is preheated using the superplasticity of its superionic β-phase is possible. The purpose of the studies was to use this superplasticity to preheat various specimens during the pressure welding process. Polycrystalline cuprous selenide specimens were used for the experiments. They were placed in 7 mm diameter cylindrical molds, heated to 500 K, and then compacted under pressure that exceeded the yield point for the compaction of cuprous selenide by 10-20 times. For all of the cuprous selenide specimens, the strength of the weld joints that were obtained differed little from that of the base metal. When the specimens were welded without chamfers, mutual plastic deformation and, consequently, bonding did not occur, which confirmed the theories. The mutal plastic deformation of specimens plays a key role both in the cold welding of the cuprous selenide and the welding of metals. It was concluded that pressure welding can be used to join other superionic conductors due to their high plasticity. References 4: all Russian.

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THE COLD RESISTANCE OF JOINTS WELDED FROM VS4 HIGH-STRENGTH STEEL

18420121f Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 87 pp 21-22

[Article by V.F. Musiyachenko, doctor of technical sciences, L.I. Mikhoduy, candidate of technical sciences, S.B. Kasatkin, candidate of technical sciences, G.N. Strizhius, engineer, S.D. Solodky, engineer, Electric Welding Institute imeni Ye.O. Paton]

[Abstract] The mechanical properties of VS4 steel and its weld joints and their resistance to cold are described. The data on VS4 steel is compared to the characteristics of two high-strength low-alloy steels, 12GN2MFAYu (VS1) and 14Kh2GMR, which have yield limits of more than 588 MPa and are successfully employed at temperatures as low as -60°C. The experiments demonstrated that VS4 steel can effectively inhibit moving cracks at nominal tensile stresses not exceeding 200 MPa between 1 and -4°C, which is inferior to the two other high-strength low-alloy steels. The experimental data indicate that VS4 steel has the necessary cold resistance down to temperatures of -70°C. However, at negative temperatures, VS4's resistance to cracks in

extended elements of structures is inferior to that of the other two steels, as well as to that of the metal of a weld made in carbon dioxide with PP-AN55 wire. High stress concentrators should be avoided in the manufacture of fabricated structures from VS4 steel. VS4 steel can be used successfully at temperatures as low as -30°C. Further research should be done to discover which chemical composition and manufacturing process would increase the cold resistance of VS4 sheet metal. References 5: 3 Russian, 2 Western (in Russian translation).

13050/13046

UDC 621.791.052:620.17

THE CHARACTERISTICS OF FRACTURES AND THE IMPACT STRENGTH OF THE METAL OF A WELD ALLOYED WITH YTTRIUM

18420121g Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 87 pp 25-26

[Article by A.S. Tabatchikov, candidate of technical sciences, T.I. Tabatchikova, engineer, A.V. Pryakhin, candidate of technical sciences, L.N. Barmin, doctor of technical sciences, Urals Order of the Red Banner of Labor Polytechnical Institute imeni S.M. Kirov]

[Abstract] Microalloying rare earth elements is an effective method for altering the properties of the metal in a weld. It was demonstrated that adding yttrium in the amount of 0.005 percent to a low-carbon nickel martensite weld increases its impact strength by decreasing the size of the nonmetallic inclusions and the dimensions of the facets of the intra-crystalline shear. The fractures of weld specimens fabricated with powder wire, some of which contained yttrium and some not, were studied. Ferro-yttrium in excess of 0.5 percent caused a marked increase in the carbon content of the weld metal. The impact strength of the weld containing yttrium was 140 joules per sq cm as opposed to 129 joules per sq cm in welds that did not contain yttrium. In addition, fractographic studies were performed, tough fractures were compared, brittle ruptures were studied, and the fractures in metals with an without yttrium were compared. References &: 6 Russian, 1 Western (in Russian translation).

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EFFECT OF SILICON ON STRUCTURE AND COLD RESISTANCE OF SEAM METAL BETWEEN PARTS OF LOW-ALLOY STEEL WELDED WITH HIGH-PERFORMANCE ELECTRODES COVERED BY BASIC COATING

18420139a Kiev AVTOMATICHESKAYA SVARKA in Russian No 2, Feb 87 (manuscript received 14 Jan 86, in final version 20 Jun 86) pp 1-6

[Article by I.K. Pokhodnya, academician, UkSSR Academy of Sciences, B.V. Yurlov, engineer, G.A. Shevchenko, engineer, and I.R. Yavdoshchin, candidate of technical sciences, Electric Welding Institute imeni Ye.O. Paton, UkSSR Academy of Sciences]

[Abstract] Welding of low-alloy steels with high-performance electrodes was studied for the purpose of determining the effect of deoxidation of the seam metal and of the silicon addition to it on its cold resistance and structural characteristics. Seam containing 0.07-0.09% C and 1.05-1.11% Mn, with the Si content varied over the 0.04-0.67% range, were produced by electric welding of 12 mm thick parts of 09Mn2Cu steel with a current 240-260 A at a voltage of 24-26 V. Welding at a rate of 6 m/h was done using electrodes coated with 54-56% Fe powder + Al_2O_3-SiO_2-CaO-CaF_2-TiO_2 slag forming mixture. The seams were tested for cold resistance, namely, impact strength at -60°C and deflection under impact at temperatures from +20°C to -60°C, in an "Instron" machine. Metallographical and fractographical examination of their microstructure was done under an ISM-35CF electron microscope, using a Br-CH_3OH mixture as etchant. The distributions of alloying elements (Mn,Si) and impurity elements (S,P,[O],[N]) were determined semiquantitatively in a "Link" scattering spectrometer, using for each element the ratio of the intensity of its characteristic K-series line to that of the characteristic FeK_α-line in all spectra. The results indicate that the volume fraction of lamellar ferrite decreases and the volume fraction of acicular ferrite increases with increasing Si content. The optimum Si content is about 0.3%, ensuring maximum impact strength at subzero temperatures, a higher Si content causing enlargement of the also lamellar grains of the martensite-austenite-carbide phase as well as those of the intragranular ferrite with attendant polygonization of its acicular grains. References 5: 1 Russian, 4 Western.

2415/13046

UDC (621.791.762.5:669.15-194.2):539.4.004.64

EFFECT OF CERTAIN DEFECTS ON STRENGTH OF BUTT JOINTS PRODUCED BY RESISTANCE WELDING

18420139b Moscow AVTOMATICHESKAYA SVARKA in Russian No 2, Feb 87 (manuscript received 4 Oct 85, in final version 13 Oct 86) pp 7-9

[Article by V.I. Trufyakov, corresponding member, UkSSR Academy of Sciences, V.G. Mazur, engineer, G.V. Zhemchuzhnikov, candidate of technical sciences, and B.I. Kazymov, candidate of technical sciences, Electric Welding Institute imeni Ye.O. Paton, UkSSR Academy of Sciences]

[Abstract] An experimental study of butt joints produced by resistance welding of 09Mn2VNb steel (0.11% C, 1.8% Mn, 0.24% Si, 0.06% V, 0.038% Nb, 0.020% P, 0.006% S) for gas pipelines was made, its purpose being to determine the effect of shifting of the edges and the effect of oxide films as well as the combined effect on the strength of such joints at the extreme temperatures of the Far Northern regions. Specimens in the form of 17.5 mm thick and 230 mm wide plates were welded, some with the edges shifted by up to 8 mm and others without shifting of the edges. The shift was maintained constant during welding. Joints produced under optimum conditions, namely, without shifting of the edges, were tested mechanically at a temperature of -60°C till quasi-brittle fraction occurred. Joints produced with shifting of the edges by up to 4 mm were found to be slightly weaker, but acceptable, those with more shifting of the edges were not acceptable. Oxidation during welding was intentionally induced by departure from optimum welding conditions, first without shifting of the edges. The strength of these joints at -60°C was found to have been lowered by oxide films covering areas up to 160 mm^2 large and their fracture was found to be brittle, while at room temperature their strength was adequate and their fracture was ductile. A combination of maximum allowable 4 mm shifting of the edges and 80-160 mm^2 large oxide films was found to cause the strength of joints at -60°C to drop 60-80 MPa below the 549-578 MPa strength of nondefective ones. On the basis of these data, domestically produced 09Mn2VNb steel is an acceptable replacement for imported Cr60 and Cr65 pipeline steels. References 3: all Russian.

2415/13046

UDC 621.791.75.011:(669.15-194.2:621.78)

WELDABILITY OF LOW-ALLOY STEELS HARDENED BY NORMALIZING FROM TEMPERATURE WITHIN TRANSFORMATION RANGE

18420139c Moscow AVTOMATICHESKAYA SVARKA in Russian No 2, Feb 87 (manuscript received 26 Nov 85, in final version 10 Oct 86) pp 20-23, 31

[Article by S.V. Yegorova, candidate of technical sciences, Yu.A. Sterenbogen, doctor of technical sciences, A.V. Yurchishin, engineer, A.V. Denisenko, candidate of technical sciences, N.G. Zotova, engineer, and Ye.N. Solina, engineer, Electric Welding Institute imeni Ye.O. Paton, UkSSR Academy of Sciences]

[Abstract] Four steels of a new class, ferritic-martensitic low-alloy steels hardenable by normalizing from temperatures within the transformation range, were tested for weldability after such a heat treatment. The experimental steel 09Mn2SiAlCe (0.50% Si, 0.05% Al, 0.020% Ce) and three modifications 09Mn3SiAlCe, 09Mn2SiVAlCe (0.065% V), and 09Mn2SiMoAlCe (0.235% Mo), smelted in laboratory induction and industrial electric-arc furnaces, were normalized from 740-750°C. For reference and comparison, standard 09Mn2Si steel was also produced and tested. Arc welding was done manually with ANP-2 electrodes and mechanically with Sv-08CrNi2MnMoAl wire in 1-3 passes, using AN-22 flux and an energy input of 10-24.4 kJ/cm. Both parent metal and seam were tested for tensile strength of flat and cylindrical specimens, impact strength of square bars by the Mesnager method, Vickers and Rockwell C hardness especially in the heat-affected zone, and cold cracking by the "implant" method of critical stressing for 24 h. Structural examination was done under an optical microscope, a DEOL 200-CX electron microscope with carbon replicas, and under a JEOL ISM-50A scanning electron microscope. The results indicate satisfactory weldability of all these steels, their impact strength after arc welding being comparable with that of ferritic-pearlitic steels. Their softening during welding can vary from 0 to 18%, depending on the chemical composition and welding conditions. The resistance to cold cracking within the heat-affected zone also depends on the chemical composition, 09Mn2SiAlCe steel being most resistant. References 8: 7 Russian, 1 Western.

2415/13046

UDC (621.791.72.052:669.715):620.17

JOINTS OF 1201 ALUMINUM ALLOY PRODUCED BY ELECTRON-BEAM WELDING AT LOW TEMPERATURES AND VARIOUS ACCELERATIONS OF WELD POOL

18420139d Moscow AVTOMATICHESKAYA SVARKA in Russian No 2, Feb 87 (manuscript received 14 Jan 85, in final version 22 Oct 86) pp 24-27

[Article by Ye.G. Ternovoy, engineer, A.V. Lozovskaya, candidate of technical sciences, A.A. Bondarev, candidate of technical sciences, V.F. Lapchinskiy, candidate of technical sciences, D.M. Rabkin, doctor of technical sciences, and S.V. Mnishenko, engineer, Electric Welding Institute imeni Ye.O. Paton, UkSSR Academy of Sciences]

[Abstract] Electron-beam welding of an aluminum alloy under vacuum at low temperatures was studied for the purpose of determining the effect of accelerations other than acceleration of gravity on the quality of joints produced under such conditions. Experiments were performed with an A-1084 machine including a 15 kV power supply and a 1.5 kW electron gun. Specimens of the 1201 alloy in the form of 2 mm thick and 50 mm wide strips were rigidly mounted on a table and cooled with liquid nitrogen inside a vacuum chamber with a residual absolute pressure not higher than 0.13 Pa. Welding was done with an electron beam current of 100 mA at a rate of 26-32 m/h. The weld pool was subjected to 0.01 g, $\frac{1}{6}$g, 1g, 2g, and higher accelerations, at temperatures of +20°C, -100°C, -120°C, and -183°C. Some joints were artificially aged, others were not heat treated at all. All were 100% inspected for tightness and mechanically tested for tensile strength under static load in an R-0.5 machine. The chemical composition of the seam and of the heat-affected zone were determined on the basis of spectral analysis, the distributions of phases and microdiscontinuities in them were determined in a Kvantimet-720 analyzer. The results indicate no temperature dependence and acceleration dependence of phase content in the seam and in the heat-affected zone nor of the chemical composition and the porosity of the latter. References 4: 2 Russian, 2 Western.

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UDC 621.791.754'293.052:669.296'293.056.9:669.71

USE OF ALUMINUM COATINGS AS HEAT DISSIPATORS FOR WELDING OF Zr+ 2.5% Nb ALLOY

18420139e Moscow AVTOMATICHESKAYA SVARKA in Russian No 2, Feb 87 (manuscript received 11 Dec 85) pp 28-32

[Article by M.M. Nerodenko, doctor of technical sciences, A.B. Goncharvo, candidate of technical sciences, V.F. Kirilyuk, engineer, and A.T. Zelnichenko, engineer, Electric Welding Institute imeni Ye.O. Paton, UkSSR Academy of Sciences]

[Abstract] A study of aluminum coatings deposited on Zr+ 2.5% alloy for welding of the latter was made, such coatings serving as heat dissipator and

thus regulator of the thermal cycle. Specimens of this alloy in the form of 220 mm wide and 300 mm long plates, some 7 mm thick and some 2 mm thick, were welded with an argon arc and a tungsten electrode under a gaseous shield, after having been coated on the back side by vaporization of AK aluminum wire 2 mm in diameter with an MGI-1-57 gas injecting metallizer. Coatings up to 2.7 mm thick and 200 mm wide were deposited on the 7 mm thick plates, whereupon these plates were welded at a rate of 0.28 cm/s with a current of 245 A at a voltage of 14 V so as to ensure fusion of a 3 mm deep layer. Coatings 1.2 mm thick were deposited on the 2 mm thick plates, 8.5 mm away from the edge, whereupon these plates were welded at a rate of 0.28 cm/s with a current of 100 A at a voltage of 12.5 V. Temperature cycles were recorded through W/Rh thermocouples on an N-117 oscillographs. Macrostructural examination of coated and uncoated 7 mm thick plates after welding revealed that the coatings of any thickness had narrowed the heat-affected zone by a factor of 2-3 and the seam by up to 15%, while they had shortened the heating period during which the temperature exceeded 1270 K and thus smoothed the hot spots along the seam. The thermal efficiency of the welding process was reduced appreciably, however, because of almost half as much heat absorbed by the aluminum as expended on melting the zirconium alloy and forming a seam. References 7: 5 Russian, 2 Western (in Russian translation).

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UDC 621.791.754'293.002:621.643.23

AUTOMATIC WELDING OF PIPELINES IN NUCLEAR POWER PLANTS

18420139f Moscow AVTOMATICHESKAYA SVARKA in Russian No 2, Feb 87 (manuscript received 1 Oct 84, in final version 19 May 86) pp 45-50

[Article by V.V. Shefel, engineer, Energomontazhproyekt Design-Technological Institute, Moscow]

[Abstract] Three variants of automatic argon-arc welding have been developed at the Energomontazh Design-Technological Institute for nonrotatable joints along pipelines in nuclear power plants. The first variant, applicable to thin pipes with up to 5 mm wall thickness and requiring neither spread edges nor a wider than minimal clearance between them, is pulse welding with stepwise electrode movement and with VS-2 activator flux. Small pipes up to 38 mm in diameter and up to 3 mm thick are welded automatically with subsequent flashing. The second variant, applicable to pipes with 5-16 mm wall thickness, requires U-form spreading of edges, flattening them 3-3.5 mm down, and filling the spread with wire 1.2-2 mm in diameter. Welding is done with a transversely vibrating tungsten electrode without filler wire and with VS-31 activator flux. The third variant, applicable to pipes with 16-80 mm wall thickness, requires U-form spreading of edges with one or two chamfers and flattening. Welding is done with a tungsten electrode and a filler wire transversely vibrating in synchronism, also with VS-31 activator flux. Joints between pipe segments made of 10MnCrNi2MoVN$_2$ steel were, after tempering at 620-660°C, tested mechanically for hardness, tensile strength, and flexural impact

strength of both seam and parent metal. Joints between pipe segments made of clad steel with austenitic hardfacing of edges were similarly tested, and also for static deflection of specimens with semicircular or V-notches. The chemical composition of hardfacing layers was determined for control. The optimum welding parameters have been established on the basis of the test results and the suitable welding machine for each pipe size also selected.

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ARC WELDING OF 2-4.5 mm THICK STRIPS OF 12Cr18Ni10Se SELENIUM STEEL

18420139g Moscow AVTOMATICHESKAYA SVARKA in Russian No 2, Feb 87 (manuscript received 29 Jan 86) pp 51-53

[Article by K.A. Yushchenko, doctor of technical sciences, Yu.G. Vysotskiy, engineer, and A.A. Nakonechnyy, engineer, Electric Welding Institute imeni Ye.O. Paton, UkSSR Academy of Sciences; A.F. Kolosov, engineer, and V.I. Toistev, engineer, Moscow Serp i Molot Plant]

[Abstract] Arc welding of stainless steel to improve the productivity of cold-rolling mills and reduce the metal waste was evaluated experimentally on 12Cr18Ni10Se austenitic steel containing 0.18-0.35% Se instead of Ti. Specimens of this steel containing 0.20% Se and 0.32% Se, respectively, from two different ladles were hot rolled to 2-4.5 mm thick strips. Welding was done by three methods: with an Ar arc and direct current or pulse current using a nonfusible tungsten+ yttrium electrode 4 mm in diameter, or with a He-Ar-CO_2-O_2 arc and rectified current using a fusible electrode under a multicomponent gaseous shield. SV-06Cr19Ni9Ti, Sv-08Cr20Ni9Mn7Ti, and Sv-01Cr19Ni18Mn10Mo4N_2 wires were used as filler. The results of mechanical tests and microstructural examination indicate a satisfactory weldability of this steel by any of the three methods, pores appearing in the seam already at lower welding rates as the Se content increases. This is attributable to incomplete removal of the products of pyrolysis of inclusions containing Se compounds, and it can be inhibited by use of filler wire with a high Mn content. References 3: all Russian.

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UDC 621.791.4.052:539,378.3:669.295:539.376

IMPROVING PLASTIC CHARACTERISTICS OF Ti SURFACE LAYERS DURING DIFFUSION WELDING

18420139h Moscow AVTOMATICHESKAYA SVARKA in Russian No 2, Feb 87 (manuscript received 1 Nov 85, in final version 7 Apr 86) pp 57-59

[Article by V.V. Peshkov, candidate of technical sciences, Ye.S. Vorontsov, doctor of technical sciences, V.N. Rodionov, candidate of technical sciences, and V.P. Kholodov, engineer, Voronezh]

[Abstract] Diffusion welding of Ti alloys was studied, their weldability depending on the ductility of the metal and thus on the absence of brittle layers at the contact surfaces. Dissolution of brittle oxide layers with gaseous inclusions was monitored in an experiment with VT1-0 pure Ti and OT4 Ti alloy, cylindrical specimens simulating contact surfaces during diffusion welding. Oxide layers 0.6-0.8 μm thick were intentionally built up in air at temperatures of 500°C (VT1-0) and 600°C (OT4), whereupon the specimens were annealed at 650-800°C and 700-900°C, respectively. Fractograms of grooved and grooveless specimens under a flexural load reveal a "ladder" surface relief without cracks and analysis of the oxidation-dissolution process on the basis of the Fick equation indicates the optimum annealing process for cracking the brittle layers so as to restore ductility, a longer annealing period being required for the contact surface than for the free surface under a groove. References 7: all Russian.

2415/13046

UDC 622.221.2:015.3:622.271.333

INTENSIFYING THE DEVELOPMENT OF APATITE ORES IN THE ARCTIC

18420125 Moscow GORNYI ZHURNAL in Russian No 4, Apr 87 pp 3-6

[Article by V.A. Kaytmazov, chief engineer of the Apatit Production Association, G.V. Sazonov, manager of Tsentralnyy Mine, A.I. Gusev, assistant manager of Tsentralnyy Mine, and A.A. Kuleshov, professor and doctor of the technical sciences at Leningrad Mining Institute imeni G.V. Plekhanov]

[Text] Like all Soviet people, the workers at the Apatit Production Association imeni S.M. Kirov are preparing to meet the 70th anniversary of the Great October Socialist Revolution in a worthy manner. The fulfillment of the XXVII CPSU Congress resolutions, which call for increasing mineral fertilizer production to 41-43 million tons in 1990, will depend to a certain extent on the work done by the collective at the Apatit Production Association, for over 50% of the phosphorus-based fertilizer in our country is manufactured from the apatite concentrate produced here.

The Tsentralnyy Mine, which is part of the Apatit Production Association imeni S.M. Kirov, began the open-pit mining of apatite ore on Rasvumchorr plateau in 1964. Since then, 398.8 million tons of ore, with an average of P_2O_5 content of 17.53%, have been recovered. The increase in ore recovery (in thousands of tons is illustrated below:

Year	1976	1980	1985	1986
Recovery (1,000 tons)	18,137	23,066	28,200	27,578

In 1986, the mine exceeded its production capacity by 2.2 million tons. That same year, Tsentralnyy Mine mined 50.1% of all ores mined by the production association's mines. In 1986, the mine processed 22,212,000 cubic meters of mine material with an average overburden ratio of 1.3 m^3/m^3.

For the past several years, mining operations have moved an average of about 10 m deeper each year. The pit has deepened by 275 m during the mine's 20 years of operation. Although the dimensions of the pit are relatively small (3.35x1.5 km), the intensity with which the ore beds are worked has greatly increased. For example, the extraction of ore from 1 square meter of actively mined ore bed grew from 33.4 tons in 1975 to 56.3 tons in 1986.

The authors believe that the mine's outstanding achievements will be of interest to many engineers and technicians who work at open pit mines located in areas with harsh climates, because Tsentralnyy Mine is located in an area with extremely harsh climatic conditions similar to those of the Arctic, yet output increases annually and production quotas are being consistently fulfilled.

A method combining a main adit and five ore chutes is used to exploit the ore deposit. Initially, the mouths of ore chutes 1, 2, and 3 were located 1,050 m above the main adit, but they are not 780 m above the main adit. Ore chutes 4 and 5 were excavated between the main adit level and the +780 m level and put into operation in 1985. The first three ore chutes were closed because their physical condition had deteriorated.

The dimensions of the mine's transport system are unique among other open pit mines around the world: the initial depth of the ore chutes was 600 m, their diameter is 6 m, the length of the main adit is 4,650 m, and the area of the cross-section is 37 m^2.

The various levels of the pit are connected to the pithead, the ore chutes, and the spoil piles by a system of blind inclined ramps running from the pit's surface to its lowest level along its south side.

The overburden and the ore are transported from the various levels to the spoil piles and the ore chutes along temporary ramps blasted out of the rock. The width of the road bed on the ramps is 25 m, and the ruling gradient incline is 8.0%. The haulage berms on the south side are up to 30 m wide. In 1987, mining operations will be conducted on 14 benches simultaneously, and ore will be recovered on 6 benches. Production quotas will be met because excavators will work 7-8 faces simultaneously and another 3-4 faces will be held in reserve. The mine has 6.5 months' worth of prepared ore reserves, 5.4 months of which are ready for excavation, guaranteeing a steady, year round supply of ore for extraction.

Although mining conditions are worsening as mining operations move deeper, the cost of ore extraction has remained low. The fluctuations in production cost are listed below.

Year	1981	1982	1983	1984	1985	1986
Production cost, rubles/ton	1,551	1,641	1,531	1,581	1,515	1,571

Advanced engineering and organizational measures that affected every production process and engineering department in the mine has made it possible for the mine to operate smoothly, showing good technical and economic indicators.

Here are the major decisions that played key roles in the intensification of mining operations:

adoption of high-tonnage loading and transport facilities built around dump trucks with 109 ton capacities;

construction of a crushing machine with an annual output of 220,000 m^3 of crushed rock at the mine, making it possible to maintain mine roads 12 months a year;

extensive use of mobile equipment (bucket loaders and 184 and 316 kw bulldozers) to clear surfaces of snow and to maintain the approaches to the excavators and the pit roads, etc., at the mine's auxiliary operations;

the introduction of the block-and-tier method of depositing gangue onto the spoil pile to significantly improve the stability of the tall piles (up to 400 m) on the slopes of the hills around the pit's perimeter;

the considerable improvement of the reliability of the energy supply to users within the mine by installing major high-voltage cable power transmission lines (in trenches), which lead to enclosed transformer substations, along the idle side of the mine;

combining the technical transport depot with the mine to form a special service, making it possible to consolidate the repair departments of two previously separate divisions, make more effective use of repair services, and improve the management of the loading and transport facilities;

upgrading the mine's maintenance department by constructing special new facilities for servicing and repairing dump trucks with electromechanical transmissions and for repairing the electrical equipment of the mining and transport vehicles;

introducing progressive forms of organization and wage payment for self-financing brigades working in the primary production processes, with bonuses distributed according to the employee participation coefficient (KTU); establishing a time-plus-bonus system for employees in the technical transport department;

developing and introducing a planned preventive maintenance and repair program for transport equipment, enabling the mine to make better use of the technical transport equipment and to achieve consistently high indicators;

developing and introducing a system to ensure that the deep ore chutes are used properly and remain in good condition; and

introducing a well-conceived and well-arranged system for training employees and improving their skills.

The low personnel turnover rate, which is just 2.5%, is also a result of the measures that were adopted. The extensive use of experts from project planning and scientific research organizations in the solution of complicated technical problems has also been very helpful.

The primary ways of improving and restructuring production will be examined, taking each production process separately.

Loosening Mine Material

The workable ores and rocks have a Protodyakonov hardness coefficient of /f/=6÷9; /f/=10÷15, and fit into categories IV or V on the blasting scale. SBSh-250MN drilling rigs with KPV-type roller bits are used to drill the blastholes. The introduction of the KPV bits made it possible to increase rig productivity by 4% and the amount of tunneling per bit by 3.5%. One rig can drill 51-53 km of blastholes annually when the utilization coefficient of the rigs is 0.55. Because the blastholes are flooded 9 months of the year, MOS-2 units mounted on MAZ-500 vehicles are used to dry them out before charging. These units can dry 50 blastholes per shift when the water's depth is 9.5 meters. Line holes are drilled at a 60 degree angle when the drill has a mandatory orientation. The holes are drilled very rapidly. The equipment is now sufficiently reliable and completely fulfills its service life (5 years). At present, one of the mine's largest problems is acquiring new equipment; as a result, old equipment is not replaced when it is worn out.

The drilling brigades are staffed with enough employees to work four shifts. The drilling brigades switched to the cost accounting system in 1984. A brigade services a rig and works for a single job authorization. A piece-rate system with bonuses is used to pay them. In addition to bonuses for fulfilling the brigade plan, the drillers receive bonuses from the material incentive fund when they economize on roller bits. The bonus is 15% of the value of the bits that are saved. MZ-4 charging machines are used to charge the holes. When the explosive distribution point is equipped, the blasthole charging process will be fully mechanized.

Three or four major blasts are set off at the mine each month. When 538 tons of explosives are used to produce one major blast, the maximum amount of rock blasted out is 780,000 cubic meters. The quality of rock-crushing work is good.

An agreement was made with USSR Gosgortekhnadzor (USSR State Committee for Supervision of Safe Working Practice in Industry and for Mine Supervision) to decrease the radius of the danger zone from 50 to 20 m when charging the blastholes. This significantly reduced the amount of idle time for costly loading and transport equipment. The blasting system that was adopted made it possible to decrease the height of the disintegrated material, which is very important in the north because it increases the safety of loading operations.

Loading Mine Material

One type of excavator, the EKG-8I,is used to load the ore and overburden. Although the excavators are designed to have a service life of 10 years, they are used for 12-13 years because of the shortage of new excavators. The excavators undergo capital repairs twice during this period. The capital repair of one excavator costs more than 100,000 rubles. The improved quality of rock crushing and the use of dump trucks with larger capacities increased excavator productivity to an average of 1,075 cubic meters per excavator in

1986. The pace of the mine's loading operations was very smooth in 1986; the difference between first and third quarter excavator productivity was a mere 5%.

The following down-time factors were taken into account when excavator working time was determined: routine maintenance and capital repairs--18%, down time due to weather--3.3%, down time due to organizational problems--4.7%, down time related to blasting operations--5%.

All excavator brigades are staffed with enough crews for four shifts. All brigade members work for a single job authorization. The brigades have switched to the cost accounting system and the distribution of bonuses is determined by the worker participation coefficient (KTU). The piece rate system with bonuses is used to pay workers. In addition to receiving bonuses for fulfilling the plan, machine operators and their assistants get bonuses for achieving the highest labor productivity and conserving bucket teeth. The teeth are now surfaced with electroslag and strengthened to increase their durability.

Front-end bucket loaders are widely used for cleaning off platforms, removing snow from the faces of the mine, cleaning off working areas and roads after large blasts, gathering thin layers of ore from the disintegrated material after large blasts, and clearing the berms. D-9N Caterpillar bulldozers are used for cleaning up remains and scraping the floor of the faces.

As mining operations move deeper, the size of the working area decreases, and when the mine's output is stable, more powerful excavators must be introduced in order to reduce the total number of excavators working the mine. Therefore, even the partial use of EKG-10I excavators during the 12th Five-Year Plan would be wise. The Izhora Zavod imeni A.A. Zhdanov Production Association has begun to series-produce these excavators.

Transporting Mine Material

The most noticeable changes during the past several years have occurred in this production process. Ore and overburden are now transported only by dump trucks (M-120-17; BelAZ-549; ND-1200; BelAz-7519) with electromechanical transmissions. In 1986, the mine's dump trucks transported an average of 1,080,300 tons of mine material per truck. BelAZ-548 dump trucks are only used for such auxiliary operations as delivering rock to the crushing unit and crushed rock to the open pit, removing snow, and building roads. They are also used as special purpose vehicles.

BelAZ-549 dump trucks are usually used to transport ore to the ore chutes, although in 1986 the BelAZ-7519 began to be used for this purpose; the M-120-17 and ND-1200 trucks are used for hauling overburden.

The Belorussian automobile plant still has not solved the problem of cooling brake pads, and this limits the trucks' technical capabilities. For example, because the brake pads of the BelAZ-549, BelAZ-7519 (75191) overheat, they

are impossible to use fully loaded on ramps with inclines of up to 8%. Therefore, in order to fulfill its plans for transporting overburden in 1987-88, the mine will have to use its own resources to modernize the BelAZ-7519 (75191) trucks that arrive to replace the M-120-17 trucks.

As new transport equipment has been introduced, much attention has been given to constructing and maintaining vehicular roads. All of the road equipment has been concentrated in a special (bulldozer) section. The width of the traffic-bearing part of the roads has been increased to 20-25 meters, and the maximum slope is strictly regulated not to exceed 8%. The roads must meet special requirements because of the unfavorable weather conditions, which involve long winters, frequent snowstorms, and icy surfaces. Several special machines, including wheeled bulldozers, D-9N Caterpillar bulldozers, DET-250's, and BelAZ-548 dump trucks equipped with crushed rock spreaders, are used to clear the roads of snow drifts and ice. Although the total length of the mine's roads is 31 km, each year more than 60 km of roads are destroyed and built in connection with mining operation development. Powerful road equipment, the fact that the mine has its own rock crusher, and the well-organized road maintenance service all ensure that ore can be mined without interruption in almost any weather.

In addition to the introduction of powerful transport equipment, a great deal of work has been done to overhaul and modernize specialized equipment bays for servicing and repairing vehicles, to equip these bays with new types of automated repair equipment, and to improve techniques for tire maintenance, repair, and retreading. Several new stands for repairing and servicing dump trucks and tractors have been developed and introduced.

Because the dump trucks are in constant use during severe weather, the mine has a unique truck maintenance system that includes a preventive repair and maintenance program.

In 1987, an engine and major component diagnostics center will open. The diagnostics will entail the spectral analysis of oils and monitoring how the vehicles are used. The equipment for the station is now being installed and personnel are being trained.

A testing unit for recording power transmission response under various workloads has been developed in order to evaluate the condition of the electromechanical transmission and adjust it after it has been repaired by experts at the mine.

One important organizational and technical measure that made it possible to decrease down time for the dump trucks was having BelAZ-548 dump trucks modified to carry fuel, oil, and water directly into the pit to refuel the working dump trucks.

Using the time-plus-bonus system of wages and having all the crew members of each dump truck work for a single job authorization have played a progressive role in improving mine operations. The maximum bonus for brigades working

on BelAZ-549 trucks is 40% of the wage rate, and the maximum for those who work on BelAZ9-7519 (75191), M-120-17, and ND-1200 trucks is 20% of the wage rate. If the crew of drivers uses too much diesel fuel, its bonuses decrease to 20%. A significant reduction in fuel consumption has been achieved by decreasing the time the vehicles spend running idle or empty and providing material incentives to the drivers (202 tons of fuel were saved in 1986).

Transporting Ores Through Deep Ore Chutes

In order to keep the ore chutes working at the necessary receiving capacity (about 3,500 tons/hour), trucks are unloaded on three sides of the chute at the same time. At present, all ore on the main adit level is poured into one ore chute. This required increasing the maximum buffer reserve from 45,000 to 80,000 tons. Since mining began at the deposit, a great deal of experience in deep ore chute use has been accumulated and many technical problems have been solved. However, such problems as heavy wear on the hopper and transport components of the ore chute have been encountered. When the mine was in the planning stages, it was proposed that all ore chutes would remain in operation until the mine ceased to be worked. However, new ore chutes (4 and 5) were constructed after experience in operating the first three chutes was considered.

The trains on the main adit level are made up of 2VC-105 dump cars. The capacity of the trains has been increased to 2,500 tons, making it possible to remove more than 80,000 tons of ore per 24-hour period. The transport system removes material from the ore chutes more rapidly than the transport system of any other mine in the world.

Spoil Pile Formation

The gangue piles are located on the perimeter of the pit on the slopes of the hills. The gangue is dumped from the working levels of the quarry onto the block-and-tier piles in one tier up to 400 m high.

The use of heavy-duty dump trucks has made it possible to unload ore through the safety barrier directly underneath the bank. In this case, the surface of the pile is horizontal, except for a small portion that is contiguous with the safety shaft and has a reverse gradient. This method ensures the complete safety of operations. Only one bulldozer is needed to keep the approaches and the safety barrier of each pile in good condition.

Because of the harsh weather conditions, the piles are subject to constant deformation. Lengthy research done by experts at the Kola affiliate of the USSR Academy of Sciences and the Apatit Production Association produced guidelines for the use of tall piles. These guidelines were coordinated with USSR Gosgortekhnadzor in 1981. They permit snow that has been removed from the faces of the mine to be placed on the piles, but limit the snow/rock proportion to 1:6.

This piling technique has proven itself in practice over a long period of time and is clearly of considerable interest to specialists who work in open-pit

mining operations under conditions similar to those at the Apatit Production Association.

During the past several years, the organization of repair work at the pit was greatly improved by centralizing the repair divisions and placing them under the supervision of the mine's chief mechanical engineer and chief power engineer and by using portable repair units and special towing equipment for transporting trucks that have broken down from the pit to the repair shops, and so on.

As a result of the restructuring, which affected both the technical and organizational aspects of mine operation, the average annual labor productivity per mine worker was 14,277 tons in 1986. Labor productivity increased more quickly than wages.

Innovative employees and shock workers of communist labor, whose experience is being disseminated widely, played an important role in the overall rise in labor productivity. The brigades and crews of the drilling rigs, excavators, and dump trucks and the Tsentralnyy Mine collective have begun a socialist competition in order to appropriately mark the 70th anniversary of the Great October Socialist Revolution. They are supporting the initiative of the country's best labor collectives of completing their assignments for the first 2 years of the Five-Year-Plan before the 70th anniversary of the revolution arrives.

The high level of creative involvement of the workers, engineers, and technicians, the broad scope of the socialist competition, and the ideological strength of the organizational and political work of the primary party, trade union, and Komsomol organizations in the labor collectives guarantee that the socialist obligations that have been accepted will be fulfilled.

13050/13046

SCIENCE FOR MINING

18420127a Moscow GORNYY ZHURNAL in Russian No 2, Feb 87 p 3

[Editorial]

[Text] At present, the USSR Ministry of Ferrous Metallurgy Mining Institute functions as the head scientific research institute on strip mining of iron, manganese, and chromite ores and nonmetallic minerals. Studies are conducted along the following principal scientific and technical directions: technology of strip mining of ferrous metal ores, open pit transportation, rock crushing, and recultivation of land. In cooperation with other organizations, the Institute has developed an advanced cyclical-flow technology (TsPT) for strip mining of mineral raw materials. A present, TsPT complexes are in operation at eight iron ore open pits and under construction at three more. During the 11th Five-Year Plan, 384.6 million tons of mine material was produced using TsPT and in 1986--about 123 million tons.

Today, the Mining Institute is a large and solid collective of highly-skilled professionals, capable of solving serious problems of mining industry development.

A series of articles published in this issue of the journal tell about the work experience of the Institute collective, its creative activities, achievements, and difficulties.

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UDC 622.341.1.001.5:061.6

CONTRIBUTION OF USSR MINISTRY OF FERROUS METALLURGY MINING INSTITUTE INTO DEVELOPMENT OF MINING INDUSTRY IN FERROUS METALLURGY

18410127b Moscow GORNYY ZHURNAL in Russian No 2, Feb 87 pp 4-9

[Article by Candidate of Technical Sciences A.A. Kotyashev, Institute Director; boldfaced passages are italicized in the original]

[Text] The Mining Institute was creased in February 1962 on the basis of the Mining Department of the Mining and Geology Institute, Ural Affiliate, USSR Academy of Sciences; in 1965 it was subordinated to the USSR Ministry of Ferrous Metallurgy.

During the 25 years of the institute's activity, its scientific and engineering cadres have become considerably stronger, principal directions of research have been clearly defined, and strong creative connections with other scientific research and design institutes and enterprises in the industry and with scientific research organizations of other ministries and agencies and of the USSR Academy of Sciences have been established. At present, the USSR Ministry of Ferrous Metallurgy Mining Institute, which is the head institute in strip mining of iron, manganese, and chromite ores and nonmetallic minerals, conducts research work basically in the following four directions:

technology and integrated mechanization of strip mining of iron, manganese and chromite ores;

open pit transportation (automotive, railroad, conveyor, continuous, and specialized transportation);

technology and mechanization of drilling and blasting;

protection of land resources, natural objects, and structures from hazardous effect of mining and recultivation of damaged land.

The institute also conducts research on technology and mechanization of underground mining, geomechanics, economics, and organization of production in the mining industry, safety, rational utilization of underground deposits, electrical power supply, and improvement of electrical equipment in open pits, mechanization of ancillary work, and automation of production processes.

The institute completes about 50 scientific research works a year, the introduction of which saves the national economy about 6 R per 1 R of expenses. The collective of the institute conducts and implements its developments at more than 40 ferrous metallurgy enterprises in the North-West and Center of the country, in the Urals and in Kazakhstan, in the Ukraine and in Siberia.

Over the years, the institute has received 500 certificates of authorship for inventions, 75 works were exhibited at the USSR Exhibition of National Economy Achievements and 2 works were exhibited at the Leipzig fair.

The institute has conducted a set of studies **in the area of improving strip mining technology.**

Complication of hydrogeological and mining conditions due to greater depth and changing parameters of the working zone is a characteristic feature of modern iron ore pits. Shorter length of the active front of work results in reduced length of excavator units and in the increased share and more complex maneuvering of loading equipment and transport facilities, which in the end results in deteriorating of technical and economic indices of mining transportation complexes. Studies have demonstrated that under these conditions, elements of a mining system determine to a large extent the efficiency of development of deposits.

The institute has developed and is introducing basic provisions and recommendations for intensification of stripping and mining operations in deep open pits. The main ones are to improve quality of planning of mining operations by closer coordination between short- and long-term planning and the introduction of computerized stage-by-stage planning and to improve planning by implementing a rational order of mining and choosing and justifying elements of mining systems. Technology for excavation of semigranite and granite rock, using an ESh-10/60 dragline excavator, has been proposed and introduced; it involves placing the rock on the flank of a pit and their subsequent transfer outside the pit. The most important studies have been conducted on the following deposits: the Kachar iron ore deposit, the Kachkanar titanium-magnetite deposit, the chromite ore deposit at the Don GOK [mining and concentrating combine], the magnesite deposit at the Magnezit combine, and iron ore deposits at the Sarbay, Korshunovo, and Rudnogorsk deposits.

The main direction in the institute's activities in recent years has been the development of scientific foundations, predesign study, experimental-industrial testing, and wide industrial introduction of cyclical flow technology (TsPT) for mining mine material at the industry's pits.

By the end of the 11th Five-Year Plan, eight of the largest iron ore enterprises were using the TsPT on an industrial scale. The amount of mine material excavated with the use of this technology in 1981-1985 exceeded 380 million tons, which was 2.5 times higher than during the 10th Five-Year Plan. Experience in using the TsPT in large iron ore pits demonstrates that, compared to cyclical technology, the TsPT results in 1.2-1.5 times higher labor

productivity, whereas the cost of transporting mine material decreases by 25-30% and more. Taking into account high technical and economic indices and the promising character of the TsPT for mining deposits under the conditions of intensive deepening of mining operations, it is planned to expand its application by a factor of 1.6 and to increase by 1990 mining of mine material to 180-190 million tons. Besides solving problems of operating existing TsPT complexes, the institute has performed work on justification of prospects for TsPT application and testing of new complexes at the Central and Kachkanar GOKs, developed typical block diagrams of the TsPT for the period up to the year 2000 and formed sets of mining and stripping equipment on the basis of these diagrams. As early as during the 12th Five-Year Plan, it is planned to construct and put into operation new TsPT lines at the Kovdor, Novokrivorozhskiy, and Northern GOKs. Based on institute studies, a list of equipment complexes for TsPT lines with production rate of up to 8,000 tons of rock mine material per hour has been compiled, and manufacturing, shipment, and introduction of the new equipment in 1988-1990 at Krivbass [Krivoy Rog iron ore field] pits is planned. Also planned is shipment and installation of equipment for a rock and an ore TsPT line for the Kachar GOK. Requirements for the development of new models of equipment for existing TsPT lines that include a complex of automation equipment (rock mining excavators, mobile modular crushers, stackers, a complex of machines for operation at accumulating warehouses, etc.) have ben substantiated.

Leading directions of scientific and research work **in the area of open pit transportation** are:

improvement of existing and development of new automotive, railroad, conveyor, and other types of transportation equipment for deep high productivity pits; determination of optimum parameters in the area of rational utilization of equipment complexes for mine transportation;

development of scientific foundations for design and operation of pit transportation at all stages of deposit exploitation;

improvement and development of new open pit transportation schemes and justification of rational transportation systems in pits;

development of foundations of the theory of organization, planning, and management of the transportation process, using mathematical-economic modeling methods and computers.

In order to improve efficiency of transportation during modernization of existing and construction of new pits, the institute has developed scientific foundations of, and methodology for, selecting the type of pit transport and substantiated the need to switch from one type of transportation to another. It has developed and transferred to design institutes technological schemes of transportation systems for working deep levels at the Sarbay, Pervomaysk, Poltava, Olenegorsk, Ingulets, and other iron ore pits. Basic principles of formation of transportation systems at iron ore pits have been established, and methods for optimizing parameters of the systems have been developed, taking into account different mining conditions in the process of exploitation of deposits.

The institute has prepared scientific justification of the feasibility of developing electrically-powered automotive transportation with motor-wheels. In cooperation with the Belorussian automotive plant, the institute developed a series of types of pit motor vehicles and technical and economic specifications for development of dump trucks with the load-carrying capacity of 75, 110, 180, 230, and 280 tons; these specifications were implemented in BelAZ-549, BelAZ-7519, and BelAZ-7521 dump trucks.

Based on a complex of industrial experiments, scientifically justified productivity standards for high load-carrying capacity dump trucks and standards for fuel and lubricant consumption have been developed and introduced at mining enterprises; these standards take into account the specific character of deep pits. Also developed and introduced were road surface designs that ensure reliable operation of dump trucks with up to 180 tons load-carrying capacity and methods for industrial construction of automotive pit roads.

A large volume of research has been done on a most urgent and complex problem of modern railroad pit transportation: ensuring its operation at 50-60% slopes. Theoretical and experimental studies on developing new braking equipment and experimental-industrial testing thereof at the Sokolovo-Sarbay GOK and Bakal RU [ore mining administration] has made it possible to accomplish industrial implementation of railroad transportation technology operating at 60% slopes, whereas an exit trench with a 50% slope, built at the Lebedin GOK, has made it possible, along with deep introduction of the railroad transportation into a pit, to reduce the scope of basic mining work by 25%.

Due to the increasing depth of quarries, higher volumes of shipments and more complicated mining conditions, special attention is paid to expanding the area of application of electrically-powered railroad transportation and improving the rolling stock. In cooperation with the Kaliningrad railcar building plant, an experimental lot of dumpcars with the load-carrying capacity of 145 tons was developed. Problems of wider utilization of railroad tracks with steep slopes, further electrification of pit railroad transportation and development of new towing units and dumpcars form the basis of research on railroad transportation during the 12th Five-Year Plan as well.

The institute has delineated rational areas of application of various types of conveyors (belt, cable-belt, multidrive, wheel-belt, and apron) and conveyor trains. Based on works by the institute, the Sverdlovsk technical rubber products plant developed high-strength conveyor belts MK-400 and TA-300, widely used at mining enterprises. The institute has also developed and widely introduced devices for maintenance of conveyor paths (turning over and cleaning of belts, removing spillovers, etc.).

Scientific research in the **rock crushing area** is conducted in the following directions: improvement of the existing and development of new technology for drilling of blast holes; improvement of existing and search for new methods for crushing rock using blasts; testing and industrial implementation of efficient VV [explosives] and SV [blasting suppleis] and schemes of and

equipment for integrated mechanization of blasting at the industry is pits; investigation of the seismic effect of mass-scale blasts in pits and mines on buildings, structures, and mine workings; investigation, development, and creation of efficient methods and technical means for nonblast crushing of rock and ores.

Based on scientific research conducted in cooperation with NIPIgormash [Scientific Research and Planning-Design Institute of Mining and Concentrating Machine Building], Gipromashobogaschcheniye [possibly State Institute for Designing Concentrating Machinery], VNIPIrudmash [All-Union Scientific Research and Design-Technological Institute for Ore Mining Machine Building], SKB [special design bureau] GSO [not further identified] and other organizations, new types of drilling rigs for roller-bit, percussion-rotary and flame-jet drilling were developed, as well as new types of highly-durable drill and cone drill bits. As a result of development, industrial testing, series production, and introduction of SBSh-250MN, SBsh-320, and other drilling rigs, pits have been retooled with new types of drilling rigs. At present, over 90% of mine material in ferrous metallurgy pits is drilled with the help of roller-bit drilling rigs developed in accordance with specifications of the USSR Ministry of Ferrous Metallurgy Mining Institute. In order to shape slopes of pit flanks and benches, the institute has developed specifications for a drilling rig for drilling blast holes up to 160 mm in diameter, up to 60 m deep, and with an up to 45° slope. Due to higher rotary drive capacity, higher rates of lifting-lowering operations, automation of drilling and complete mechanization of ancillary processes, SBSh-250-20 and SBSh-250-32 drilling rigs provide up to 30% higher drilling productivity. Assignments and initial specifications for development of new cone drill bits for the mining industry were developed; these bits are widely used in all pits of the industry. At present, the institute is conducting basic research on replacing a scarce tungsten-containing hard alloy for the reinforcement of cone drill bits with a no-tungsten titanium-containing alloy and experimental work on improving durability of cone drill bits. Replacement of the tungsten-containing alloy with the titanium-containing one makes it possible to save up to 17% of hard alloy per chisel.

The main direction in research in the blast work area is investigation of parameters of mass blasts and methods for blasting that ensure intensive crushing to specifications with maximum utilization of blast energy. In doing this, main attention is paid to hard-to-blast rock, which is the most difficult to crush. Experimental and pilot industrial studies of the basic mechanisms of break-up and crushing effects of a blast in solid media have been completed. Efficient methods for blasting hard-to-blast tough rock bodies that have large-block structure have been completed and technology of multirow short-delay rock blasting has been developed; this technology makes it possible to attain a required degree of mine material crushing with minimum material and labor expenditures. Application of this technology at the Kachkanar GOK resulted in multifold reduction of the yield of oversized material; the content of fractions under 500 mm in mine material was 90-95%; shift productivity of EKG-81 excavators increased by 20-30%. A complex of studies on failures of hole charges during mass blasting in ferrous metallurgy pits has been conducted, causes and statistical relationships for the existing technology

of multirow short-delay blasting have been established and, based on these data, the institute has developed a method for calculating reliability of blasting networks and systems and an interindustry manual on prevention and elimination of failures and a manual on organization and performance of mass blasting of hole charges in strip mining.

Research in the area of explosives and mechanization of blasting was aimed at studying efficiency of new explosives, blasting supplies, schemes of and equipment for integrated mechanization of blasting, determining the rational sphere of their application, assimilating them and introducing them in the industry pits. The institute participated in the development, testing, and wide implementation of new VV (granulites, grain granulites, igdanites, water-filled VV, etc.), and SV (detonating fuses, pyrotechnic relays, relay detonators, shaped charges, etc.), particularly a new waterproof detonating fuse DShE-12. Feasibility of improving the existing assortment of VV for pits and of application of high-density water-filled and the simplest VV (igdanites, granulites, etc.) was established. In accordance with the institute's technical specifications, new main-circuit and hole detonating cords, a detonating strip, mechanically strong detonating blasting cartridges, pyrotechnic relays, and other SV were developed and tested. Ministry pits were issued suggestions on the use of locally made VV and recommendations on development of more efficient technical means for manufacturing water-filled VV and igdanites. Based on a set of studies by Yuzhgiproruda [Southern State Institute for the designing of Ore Mining Enterprises], implementation of three projects of mechanized facilities for receiving, storage, unpacking, and loading of charging machines with VV that eliminate manual labor in these operations and improve sanitary and hygienic labor conditions was begun. Implementation of institute's works on utilization of soft containers for transportation of VV has made it possible to completely mechanize loading and unloading at base VM [explosives] warehouses, increase the labor productivity of blast workers by a factor of 1.4-1.6, and eliminate direct contact of workers with hazardous trinitrotoluene-containing substances.

Research of mine seismics involved improvement of methods for calculating seismically-safe and efficient blast-hole drilling methods that ensure safety of mine workings, buildings, and facilities in pits and mines in the Urals, Siberia, Kazakhstan, and other regions of the country. To this end, theoretical and experimental studies were conducted that made it possible to determine mechanisms of propagation of seismic-blast waves in various geological conditions of iron ore deposits. Results of these studies make it possible to provide enterprises in the Urals, Kazakhstan, North-West, and other regions of the country with reliable methods for seismically-safe blasting.

In the area of new methods for crushing rock, research, experimental work, and testing of experimental prototypes of equipment for blastless crushing, such as units for crushing oversize pieces, using commercial frequency currents and hydropneumatic hammers, and electrothermal weakening of an iron ore mass, were conducted.

The Mining Institute was one of the first organizations in the ferrous metallurgy mining industry to begin research in the **area of recultivation of**

land damaged by mining. One of the cardinal aspects of the problem is land protection and utilization. Based on factual data, condition of land resources of enterprises of the industry was analyzed in great detail. Procedural instructions on recultivation planning were developed and a forecast of land utilization was given, including recultivation working during the 12th Five-Year Plan. Methodology of choosing directions of recultivation and standard flow charts for recultivation operations were used in developing projects for land recultivation in iron ore pits in Kazakhstan, Urals, Siberia, and the Center of the country.

The institute performs considerable amount of studies on **rational utilization of reserves of raw iron ore and ore quality control** at mining enterprises of VPO [All-Union production association] Soyuzruda, Soyuzmetallurgprom, and Soyuzmetiz. Studies on rational utilization of reserves of raw iron ore are aimed at developing methodology for calculating the optimum level of ore losses and its depletion during mining, improving methodology for accounting for, and planning of, these indices and developing suggestions for their reduction. A considerable number of scientific studies were aimed at solving the problem of preparing raw ore for concentration. For deep pits, the most promising method for controlling quality of ore sent for concentration is to create individual averaging-grading complexes, equipped with automated systems for ore quality control. An automated system for quality control of raw iron ore, developed by the institute in cooperation with specialized organizations and put into industrial operation at five GOKs, is widely used in the industry. A radioisotope method for quality control of chromite ore has been developed and introduced. This year, development of a system for control and management of quality of raw materials in manufacturing of magnesia electrotechnical powder at the Bogdanovich refractory plant has begun.

In the **area of stability of flanks in pits and dumps,** studies have been conducted and continue to be conducted in three directions: studying and forecasting physical and technical conditions for development of iron ore deposits; studying stability of flanks and benches in iron ore pits; developing technology and procedures for filling high dumps on a sloped foundation and ensuring their stability. These studies cover all large iron ore pits in the Urals, Kazakhstan, Siberia, and North-West. In recent years, the studies have also begun at Krivbass pits. Results of the studies and methods for ensuring stability of flanks in deep pits are widely used by design institutes and enterprises of the industry in placing pit flanks into the maximum allowable position and in arranging bench slopes. During the preceding 5 years alone, initial data for design and placement of flanks and benches in the maximum allowable position were provided for 12 deep GOK pits, and bench sloping technology was introduced. At large pits, such as the Sokolovo, Sarbay, Korshunovo, Olenegorsk, etc., this made it possible to reduce the scope of stripping by 12-15%, compared to the project, while maintaining the planned volume of ore mining. Institute work on technology of, and procedures for, filling of automotive dumps has been widely introduced in the industry, which made it possible to drastically (by a factor of 6 to 7) reduce the volume of blast-hole drilling in dumps and reduce allocation of land for dumps by a factor of 2-2.5, by doubling and at some enterprises tripling and quadrupling dump height.

In the process of solving problems of improving open-pit mining technology, the institute pays special attention to research and development in the **area of developing equipment and technical facilities for mechanization of main and ancillary production processes.** For TsPT complexes, self-propelled crushers SDA-1000 and SDA-3 were developed and tested in accordance with institutes' elaborations, and the SDA-1000 crusher is now in series production. Studies on developing standard TsPT flow charts for various mining engineering conditions and different pit productivity culminated in developing a type-and-size series of basic and ancillary equipment, accepted for designing TsPT complexes at iron ore pits.

Along with establishing specifications for new types of basic equipment, work on mechanization of ancillary processes has been conducted. Track repairing machines PRM-3 and PRM-4, developed in cooperation with machine building organizations and plants, provide high level of mechanization of track work in pits and are widely used. Use of these machines made it possible to increase the level of labor mechanization of track work during the 11th Five-Year Plan from 27 to 44% and increase the labor productivity of track workers by 14-17%. Using the institute's work, Uralgiproruda [Ural State Institute for Design of Ore Mining Enterprises] is developing a project for pit rail length bases, using the flow-line method for repairing railroad rail lengths, which makes it possible to reduce labor consumption in track repair by 30-40%.

The USSR Ministry of Ferrous Metallurgy has approved and released to Minelektrotekhprom [USSR Ministry of the Electrical Equipment Industry] application cards and technical and economic specifications, developed by the institute, for development and production of mobile integrated transformer substations for pits, with primary voltage of 6 and 10 kV, adjustable capacitor units for pits and mines and 110/10/6 kV mobile step-down and distribution substations. Mobile switching units with vacuum switches for power users in pits, high-voltage switching equipment, and a number of other electrical devices, developed on the basis of the institute's work, are now in series production.

Pit ventilation and ventilation-irrigation units, built on the basis of aircraft engines and high capacity electrical motors, are in the stage of industrial implementation. The Perm mining machine-building plant has made 130 of these units, and 30 of them have already been delivered to Ministry pits. For design organizations, Instructions on designing systems for artificial ventilation of the Ministry's pits have been developed and implemented; the Instructions make it possible, using a computer, to model and form a rational ventilation system for various stages of pit operation, taking into account mining and climate factors. Based on the Instructions, Giproruda [State Institute for Design of Ore Mining Enterprises] is designing ventilation systems for pits of Olenegorsk and Kovdor GOKs.

A large portion of scientific and production activities of the institute is devoted to **research and development, aimed at improving technology of underground mining** in the Ural-Kazakhstan region. Studies on improving efficiency of existing iron ore mines are related to investigation of the most

rational and progressive mining systems and optimum parameters of production processes of underground ore mining and to forecasting the technical progress and identifying reserves for further increase in labor productivity. Experience in application of single-stage versions of systems with caving in Ural mines has demonstrated that they reduce the specific volume of preparation and cutting by 20-30%, simplify block design, increase productivity of face workers by 20-25%, and create the safest production conditions. A longwall mining system with ore breaking onto contracted medium has been introduced, and mining systems with vibrational ore removal, which increased labor productivity of delivery in Ural mines by a factor of 1.3-1.5, have been improved. Mechanisms of the variation of technical and economic indices of the underground mining method as a function of mining depth and methods for determining rational placement of concentration levels are used by Uralgiproruda in designing stripping and working of lower levels of iron ore deposits in the Tagil-Kushva region. Based on institute work, Uralgiproruda has prepared and is implementing a project for stripping and exploitation of deep levels at the Severopeschanskaya mine under shock-hazardous conditions.

New technology for development of iron ore deposits, using rock pressure energy, has been developed; it is protected by certificates of authorship and has made it possible to improve the quality of mined ore by 3-4% and thus achieve national economy savings during the 11th Five-Year Plan in the amount of 5.38 million R.

New versions of technology for ore mining under water-bearing rock have been developed; they too are protected by certificates of authorship. In these versions, differentiated compositions of filling mixtures, combined filling, and partial caving were used for the first time in the domestic practice. This made it possible during the 11th Five-Year Plan to reduce consumption of cement by 10% and of granulated blast-furnace slag by 20% and at the Sokolovo underground mine alone to save about 42,000 tons of cement and 248,000 tons of granulated slag.

In cooperation with machine-building institutes and plants and based on the institute's specifications, loading-delivering machines, self-propelled drilling units, a complex for locomotive haulage with continuous ore loading and unloading, a complex for butt ore removal, and a number of experimental prototypes of other machines have been developed and are being tested.

Based on the theory of formation of stresses in a rock mass and methods for their determination, developed by the institute, a choice of methods for controlling rock pressure at iron ore mines in the Urals and Kazakhstan was substantiated. Implementation of work on flow charts for mining that eliminate rock bursts in complex geological conditions of the deposits of the Urals, Kazakhstan, and Siberia that are prone to rock bursts and of methods for controlled self-caving in mines of the Ural-Kazakhstan region has made it possible to reduce ore losses and depletion by 3-10%, increase ore extraction, and realize actual savings of direct costs in the amount of 13 million R over 15 years.

Based on the institute's work on controlling rock displacement, the possibility of involving in mining over 150 million tons of iron ore that had been put in dead storage in protective pillars of Urals and Kazakhstan mines was substantiated. About 6 million tons of reserves that had been put earlier in dead storage have been already worked, and it is planned to work over 6 million tons during the 12th Five-Year Plan.

In recent years, special attention has been paid to trying out on an industrial scale and introduction in the especially complex mine-geological conditions of the Don GOK mines of a system of measures that ensure efficient mining of chromite ores, reducing losses thereof in mining, and bringing mine capacity to the design level. A mining system for the first phase of exploitation of a chromite ore deposit in the Molodyozhnaya mine of the Don GOK has been chosen and substantiated. Based on technological specifications developed by the institute, a mining system with filling of mined space is being developed for the second phase; applications of the system will make it possible to reduce expenditures for mining 1 ton of ore by 0.3-0.4 R. Studies on controlling rock pressure at the Sokolovo underground mine and at the Don GOK mines is expanding.

An optimum stable form of workings and a new support have been developed, which has made it possible to considerably reduce concrete and metal consumption in mines of the Nizhniy Tagil metallurgical combine, Magnezit combine, Sokolovo-Sarbay GOK, and Atasuy RU.

The final stage of all technological studies is technical and economic assessment of adopted technical decisions. Therefore, the institute conducts the necessary volume of research in the **area of production economics and organization** along the following principal directions: improvement of planning and intraproduction unit self-financing; analysis of the production economics and financial activities of enterprises and forecasting of the development of the mining industry; improvement of production organization and management; application of mathematical methods and computer technology. In order to improve analysis of the production and economics of mining enterprises of the USSR Ministry of Ferrous Metallurgy, methodological recommendations were developed on determining labor productivity in pits, taking into account mine-wide shops, and on comparing labor productivity in domestic and foreign pits. Data obtained in using these recommendations made it possible to substantiate a list of immediate tasks for further improvement of production efficiency. As far as improvement of organization and management in intrapit processes, instructions on accounting for utilization of drilling rigs, excavators, locomotives, and dump trucks have been developed and approved and are being adhered to by all enterprises. At Ministry mining enterprises, rules for organization of the work of main production shops of GOKs on the basis of weekly and daily schedules, developed by the institute, are in effect. Over 10 GOKs have accepted for implementation the institute's proposals on improving management structures and setting standards for the number of engineering and technical personnel and office personnel.

Considerable work has been performed on substantiating and developing of standard-setting and methodological documents. Industry materials on setting

standards for productivity of industrial automotive transport and diesel fuel consumption were made effective in accordance with appropriate directive documents of the Ministry. Putting in effect of consumption standards, of calculations of demand for cone drill bits, and proposals for their distribution has made it possible in the last 3 years to cut the unit consumption norm for drill bits per 1,000 m^3 of mine material by 10%. At present, voluminous work on substantiating standards for production reserves and developing new standards for mine transport equipment depreciation is coming to an end.

Based on earlier research, proposals are being developed for converting GOKs to low-waste technology by utilization of overburden rock and concentration waste. The institute has developed the technical and economic justification of measures for better utilization of secondary resources and standards for collection, processing, and utilization of overburden rock and concentration waste during the 12th Five-Year Plan for 12 Ural and 3 Kazakhstan enterprises. Besides additional profits from selling secondary resources, the mining enterprises will be able to reduce the area of land for storing rock in dumps. Recently, the institute has been widely using computer technology and office equipment.

A number of studies have been conducted on developing methods for preproject assessment of iron ore deposits and software for automated control systems for GOKs, including development and computerized mining-geometric analysis of the mathematical model of a deposit. Algorithms and computer programs have been developed for long-term and current planning of the volumes of stripping and mining work that ensures production of the required quantities of iron ore concentrate of a specified quality. For modern iron ore pits, with their great depths, huge volumes of mine material transportation and the use of several types of transportation, algorithms, and programs for managing mine material delivery from deep levels of a pit have been compiled. Computerized systems for long-term planning of mining have been successfully tried out at the Korshunovo and Sokolovo-Sarbay GOKs.

A specialized information center for the mining industry has been created and functions at the institute. Information service is provided to 30 collective subscribers at the institute, 29 executives of the Ministry, and 38 mining enterprises and organizations in the industry. During the 12th Five-Year Plan, the main attention will be paid to the development of an information retrieval system "Strip Mining of Ferrous Metal Ores."

Exploitation of deposits during the 12th Five-Year Plan will be accompanied by further deterioration and complication of mining conditions: average weighted depth of iron ore pits will increase by 12-15% and will be close to 240 m; over two-thirds of rock mass will be mined at depths over 200 m; at a number of large iron ore pits (Kachkanar, Kovdor, Kostomuksha, etc.), rock and ore hardness will increase by 10-15%, whereas the volume of mine material, mined with the use of combined types of transportation, will increase by 20-25%. The negative effect of these factors will be reflected in technical and economic indices of mining enterprises.

Further improvement of efficiency of mining deposits of mineral resources requires that the mining science solve a number of complex problems of implementation of new scientific ideas, which will make it possible to compensate for increased labor and financial expenditures in the mining industry.

During the 12th Five-Year Plan, scientific and production activities of the institute will be aimed at justification, development, and implementation of the main directions of the scientific and technical progress and at improving the technical level of exploitation of deposits, in order to meet the industry demand for metallurgical raw materials and the required quality.

In order to provide scientific support for solving the problem, research directions have been clarified, and the institute structure has been improved. Scientific research will be conducted along the following principal directions:

development and implementation of suggestions on modernization and retooling of industry pits, in order to reach the world level in strip mining equipment and technology and improve utilization of production capacity of mining enterprises;

search for new technical solutions, development, and implementation of a complex of measures for improving mine material transportation systems in large iron ore pits and expanding the area of use of conveyor and electrically-powered railroad transport by using, developing, and introducing promising means of transportation and rolling stock;

research on improving efficiency of the technology of drilling and blast crushing of rock under cramped conditions at deep levels in iron ore pits, based on significant improvement of the level of mechanization and on the use of VV and SV with improved properties;

justification and implementation of suggestions on rational utilization of fixed production assets and identification of priority directions for capital investment for expansion and modernization of ore mining during the 12th and 13th Five-Year Plans;

improvement, development, and implementation of highly efficient equipment and technology for underground mining of ores on ferrous metals in the Urals and Kazakhstan.

Along all of the above scientific directions, it is planned to solve problems of saving labor, material, and energy resources, converting to a low-waste technology, environmental protection, and recultivation of land damaged by mining.

In 1987, the laboratory and experimental base of the institute will be complemented by a computer center which is being developed on a shared basis in cooperation with the Mathematics and Mechanics Institute of the Ural Scientific Center, AS USSR. The center is equipped with modern computer complexes. Commissioning of the computer center will make it possible to

broaden the use of mathematical-economic modeling and improve the validity of technical and technological solutions in conducting theoretical and investigative research. At present, the experimental base of the institute is represented by the experimental production shop (EPM) and a blast chamber, designed for modeling the blasting process and testing new VV and SV. The EPM capacity is low, and its equipment, machine tools, and instrumentation should be replaced because of their wear and obsolescence. The scientific research and experimental production base does not fully meet current requirements and does not make it possible to reduce the cycle from research to production implementation of new technology.

In order to improve the validity of technical decisions and the quality and results of development work, the institute has, with the help of the Ministry, to retool its scientific laboratories with modern instruments, equipment, and experimental production units. One should solve the problem of construction of a modern laboratory and experimental building and of assigning a specialized design and planning department (or bureau), a plant for manufacturing experimental production prototypes of new equipment, and base mining enterprises to mining institutes of the industry.

Large-scale production implementation of results of scientific studies can only be accomplished via a project (new flow charts for mining, new equpment, changing slope angles of pit flanks, etc.). In the first place, a project should utilize the most efficient technological developments, because in the long run the technical level of mining depends on how well the designers take into account the scientific and technical progress in the world equipment and technology. However, at present, when assessing the activity of scientific research institutes, savings that are realized as a result of implementation of their work, even at the working drawings stage, are not taken into account. As a result, subject plans of scientific research institutes include a limited number of works for design institutes, because the number of works that will not generate savings is limited in NII [scientific research institute] plans to 15-30%, whereas their activity in a current year is basically assessed according to just one criterion--return per 1 R of expenses. The end result is that scientific research institutes are forced to conduct a large number of small works for enterprises that mainly solve routine problems, whereas design institutes incorporate obsolete equipment and technology in new projects. Therefore, one should develop new organizational and standard documentation, which must clearly define procedures for planning, performance, and implementation of new technical solutions by NII in close coordination with long-term plans of design organizations and mining enterprises of the industry and regulate relations between scientific research, design, and production organizations in development, manufacturing, and introduction of new equipment and technology.

At present, enterprises develop their plans for introduction of new technology without properly taking into account institutes' proposals on introduction of completed NIR [scientific research work], i.e., institutes and enterprises have separate plans for introduction of new technology.

It is necessary that enterprises and institutes share equal responsibility for production implementation of results of NIR, and this can only be accomplished by developing a joint coordinated plan for introduction of scientific and technical achievements. In order to do this, one should develop and put in effect rules for developing a joint plan for the introduction of new technology and results of scientific research.

The system for assessment of NII activity by a comparative economic efficiency ratio, which is in effect now, does not take into account the specific character of operation of institutes in individual subindustries and does not encourage performance of work for design institutes, nor performance of large investigative research work and a number of other works on an industry scale. Probably, an integral index should be used for assessment of institutes' activities, which, besides economic effect, would also take into account the technical level of development work, patentability of subjects and licenses sold, the scope of investigative research work, the scope of work on all-union and industry scientific and technical programs, etc.

Solving these problems will facilitate acceleration of scientific and technical progress in the industry, an increase in the results and quality of NII development work, the achieving of a unified technical policy, and reduction of the "research-development-introduction" cycle in the production of new equipment and technology.

At present, the collective of the institute is conducting serious organizational restructuring of its scientific research activity and training and retraining of personnel for solving the huge and crucial tasks set for ferrous metallurgy in the 12th Five-Year Plan by the 27th CPSU Congress.

The collective of the USSR Ministry of Ferrous Metallurgy Mining Institute will do everything it can to make an adequate contribution to the acceleration of the scientific and technical progress of the mining industry during the 12th Five-Year Plan.

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ACCELERATION AND THE CAMPAIGN FOR QUALITY

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[Text] The campaign for quality is reaching new horizons: beginning on 1 January 1987, the state product acceptance system was introduced at 1,500 of our nation's enterprises. The USSR Council of Ministers has developed a list that includes enterprises and associations that manufacture computers and machine tools, power engineering equipment and automobiles, agricultural equipment, consumer goods, and, in some cases, the basic accessories for these products. The state product acceptance system will be administered by new USSR State Standards Committee agencies, which will take extra departmental responsibility for product quality.

One of the most important and crucial measures aimed at drastically improving technical sophistication and product quality is being implemented.

The XXVII CPSU Congress determined that quality is an immediate and important resource for intensifying the national economy.

The policy of accelerating scientific and technical progress requires the creation of new generations of such modern technology as high-speed computers, flexible production systems, industrial robots, and high-precision instruments.

Solving the problem of technical sophistication and product quality will favorably affect all sectors of the economy, ensure the accelerated growth of the national income, encourage foreign trade ties, and, eventually, promote better living standards for the Soviet people.

At a CPSU Central Committee meeting in November 1986, M.S. Gorbachev stated that low quality and poor, unconscientious work are the most dangerous ways of squandering social labor, material and technical resources, and our national wealth in general.

The decree "Measures for the Radical Improvement of Product Quality," issued by the CPSU Central Committee and the USSR Council of Ministers, is creating

new opportunities. This decree focuses on the product development stage, for it is at this stage that the quality characteristics of a future product are engendered.

It provides for a number of measures aimed at improving the development stage. The efficient information system that is being created in our country provides the design and production engineers who develop products with essential information about the latest scientific and technical achievements in our country and abroad. Automated design, modeling, and artistic conceptualization systems will be used to develop industrial and consumer goods that will undergo comprehensive testing at the prototype stage.

Work is under way to improve the standards and technology that product developers have to work with, and state standards are being altered in order to free design engineers from rigid regulations and to decrease the amount of documentation in the design process. Only the start and finish of the development process will be regulated by standards, and the other stages will be completely dependent on design engineers' initiatives [1].

Product engineers shall assume full responsibility for the quality of the goods they design. Developments that do not meet the highest international standards shall not be put into production. As scientific research, project design, and project engineering organizations develop or radically modernize machines, equipment, and industrial processes, they shall take full responsibility for meeting long-term requirements for technical sophistication and quality; chief design engineers should be personally accountable for meeting these requirements.

Contract discipline is being strengthened. The customer has been granted the right to unilaterally break a contract with a supplier who repeatedly delivers substandard goods. The supplier's ministry must ensure that the goods provided for by the contract are delivered, and the supplier that is at fault shall be punished in accordance with existing laws.

The campaign to improve quality should become an everyday aspect of labor collective activities. Every employee including the enterprise manager shall bear direct responsibility for drastically improving quality. Henceforth, indicators that reflect technical sophistication and product quality shall be determining factors in the formation of enterprises' material incentive funds.

Responsibility for losses resulting from the manufacture of poor quality goods has been increased. Managers of enterprises and associations have been given the right to lower the skill rating (class, category) of employees who are responsible for such losses for a period of up to 3 months. The employee's skill rating will be restored when he attains the standards established for the initial awarding of the rating.

Considerable attention is being devoted to using the human factor, which is a powerful lever. A planned, continual improvement of the skills of workers and specialists will take place in all areas and at all levels of the economy. Special-purpose courses, advanced experience schools, clubs, and seminars will be used for this purpose.

In 1987, workers, engineers, and technicians in industry will take a compulsory training course on quality [2].

Quality groups, which are being organized in production sections and shops and at enterprises, associations, and organizations, are urged to accumulate creative ideas and initiative [3]. The members of such groups include the most skilled and competent employees who have initiative, organizational ability, and an innovative approach. The primary tasks of quality groups are to analyze and reveal shortcomings that affect product quality (bottlenecks in production, to study pertinent information and advanced knowledge and achievements, and to develop proposals to improve the organization of production and product quality.

Quality groups have the right to demand that administrative and public organizations give effective consideration to proposals and participate in their implementation.

Directors of enterprises and enterprise divisions shall bear full responsibility for providing an atmosphere in which quality groups can work creatively and for training employees that become group members. Special bonuses and premiums above and beyond the enterprise's existing material incentive system may be established for quality group members who promote the improvement of quality and production efficiency.

The quality control system is being strengthened. Quality control departments (OTK) have been given an improved status: their managers are being granted the same rights as deputy general directors of production associations or deputy plant directors for quality. Quality control departments are being equipped with modern process-control equipment, and they are being staffed by skilled employees who have high principles and expectations. The wages paid to quality control personnel are increasing, and their material incentives will not depend on the results of economic operations.

Henceforth, all State Standards Committee activities shall be subordinate to the task of ensuring that product quality meets the highest international standards. Existing state standards are being modified to bring product quality in line with that of the best products in the world. This will make it possible, as early as during the 12th Five-Year Plan, to increase the reliability of newly-acquired technology by a factor of 1.5 to 2, reduce the metal content of machinery by 12-18%, and decrease energy consumption by 7-12%.

The standards for general specifications for groups of similar products are playing an increasingly important role. The long-term indicators, which will be phased in, and the staggered deadlines for plan-based implementation that are contained in these general specifications will improve manufactured goods.

Comprehensive standardization programs (PKS) are being developed for particularly important or sophisticated goods, such as power engineering equipment, industrial robots, flexible production systems, and so on. The documentation for these comprehensive standardization programs becomes

effective according to specified deadlines and ensures a close correlation at all stages between the quality of the finished product, its components, and the raw materials and resources used in its manufacture.

The USSR State Standards Committee is coordinating the ministries' and departments' efforts to achieve the highest quality and reliability indicators within the planned time period, and is concentrating particularly hard on the timely development and introduction of "Quality" programs at all levels, on certification programs and on the standardization of weights and measures throughout the economy.

The 14 November 1986 CPSU Central Committee meeting was devoted to issues related to the introduction of the state product acceptance system at the associations and enterprises of the industrial ministries. The results of the meeting were discussed at the 20 November 1986 meeting of the CPSU Central Committee Politburo.

A Statute [4] was approved stipulating that state product acceptance agencies at enterprises will exert extra departmental control over the quality of the manufacturing process and will accept products in accordance with the instructions of the USSR State Standards Committee. State product acceptance employees are responsible for evaluating product quality correctly, ensuring that products meet standards, technical specifications, design documentation, standardized models, and delivery and contractual conditions (that pertain to product quality requirements). The state product acceptance system's quality control work will be done in the following areas: control over technical documentation, product manufacture, product acceptance, and the reliability of accepted goods, and customer service.

Manufacturing quality control is organized to reflect both the structure and nature of production and technical documentation requirements. Manufacturing quality control includes the continual control over product manufacture and on-the-spot control over various aspects of the overall production process that need attention. Continual control over quality is exerted directly in production shops and sections and at work stations. It includes actively observing the production process and performing groups of, or individual, industrial operations; quickly discovering deviations from established norms for the industrial process; and preventing defects in goods from appearing at the final product acceptance stage.

On-the-spot controlling of the quality of the overall production process encompasses checking all aspects of the enterprise's activities that are related to the manufacture of the given product, except those that are covered by the List of Required Control and Acceptance activities. Specifically, this aspect of the quality control process includes ensuring that industrial processes are followed; checking technical documentation, work stations, incoming materials, the storage conditions of materials and semifinished and finished purchased goods, production standards, the operation of the central laboratories; seeing that regulations for storing finished products are adhered to, etc. On-the-spot control of the production process can be incorporated as part of the plan or outside the plan's framework (initiative-based). The latter type of control is carried out at the direction of the

director of state product acceptance (state acceptance group), or upon the initiative of any product acceptance specialist.

The state product acceptance system is giving much attention to the correct implementation of procedures for controlling an enterprise's incoming materials in order to monitor the quality of purchased products, raw materials, and semifinished products that will be used to complete or manufacture the output. Defects in products and materials that are purchased elsewhere are being recorded. The state product acceptance system will immediately report any complaints about purchased products or materials to the state product acceptance agency of the supplier enterprise, or, in the absence of such an agency, to the territorial agencies of the USSR State Standards Committee. In all such instances, the appropriate agencies must promptly take steps to eliminate the shortcomings in the given products and report what action has been taken to the state product acceptance agency of the customer enterprise.

The most important aspect of the state product acceptance system's work is the acceptance of finished goods. This work is done in compliance with GOST 26964-86 "Regulations for the State Acceptance of Goods. Basic Statutes."

Goods are considered to have been given final acceptance if they have passed all of the acceptance tests in the order called for by the technical documentation and by the List of Required Control and Acceptance, and if the test results have been confirmed by periodic tests.

The goods are returned to the quality control department if they do not comply with the technical documentation or if other problems are revealed. Scrapping of goods during the acceptance process is not permitted.

The director of state acceptance shall, in writing, inform the enterprise director, the Main State Product Acceptance Administration of the USSR State Standards Committee, and the manufacturing ministry of any suspension in the acceptance and shipment of goods (notification regarding the resumption of the acceptance and shipment of goods shall be made in the same manner).

Any disagreement that arises between the enterprise and the state product acceptance agency regarding a technical question related to quality control and product acceptance shall be resolved by the appropriate authorities of the USSR State Standards Committee and the ministry (or department).

The Statute on the Organization of State Product Acceptance Activities also closely regulates matters pertaining to control over the reliability of goods being accepted, customer service, standardization work at the enterprise, the condition and use of measuring equipment, adherence to metrological regulations, as well as a number of other areas that determine the activities of the state product acceptance system.

The enterprise's existing technical standards documentation is analyzed to ensure that it strictly complies with the requirements of state standards.

The key factor in the acceptance of finished goods is that they meet the requirements of the normative and technical documentation. Large-sized goods undergo individual, "piece by piece" quality control, and mass-produced and series-produced goods undergo statistical quality control.

When a defective batch of goods is returned for modification, all resulting losses shall be assumed by the enterprise.

Management, specialists, and enterprise party and social organizations are urged to eliminate bottlenecks in production. Effective sanctions are to be applied to subcontractors who do substandard work. This approach will increase the effectiveness of the state product acceptance system and, in the final analysis, ensure quality control throughout the nation's industries.

The introduction of the state product acceptance system does not relieve enterprises and their quality control departments of responsibility for quality. Goods will only be presented to the state product acceptance agency after they have been accepted by the enterprise's quality control department. The manner in which the state product acceptance system interacts with the quality control departments is determined locally, depending on the type of production and the characteristics of product testing.

The experimental introduction of the state product acceptance system has demonstrated that even outstanding enterprises initially encountered difficulties, some of them major.

Labor collectives should correctly evaluate the work of the state product acceptance system and strictly adhere to standards, technical specifications, and other documentation.

When production workers receive reports from the state product acceptance agency stating that their goods are defective, they must waste no time in correcting the situation.

Creative, cooperative interaction between labor collectives and state product acceptance authorities guarantees that the goals that party and government have set for introducing the state product acceptance system and all measures aimed at the radical improvement of product quality will be met successfully.

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