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USSR Report

MATERIALS SCIENCE AND METALLURGY

(FOUO 1/81)

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USSR REPORT

MATERIALS SCIENCE AND METALLURGY

(FOUO 1/81)

CONTENTS

COMPOSITE MATERIALS

COMPACTION OF REINFORCED AND 'SANDWICH-TYPE' COMPOSITE MATERIALS DESCRIBED

Kiev TVERDOFAZNOYE UPLOTNENIYE ARMIROVANNYKH METALLOV in Russian 1980
pp 2, 7-11, 115

[Annotation, introduction and table of contents from book "Solid-Phase Compaction of Reinforced Metals", by L.I. Tuchinskiy, "Naukova dumka", 116 pages]

[Text] This monograph is devoted to an analysis of the processes of compacting composite materials by means of sintering and static and dynamic hot pressing. A rheological theory is proposed for the compaction of materials with a powder matrix reinforced by parallel, orthogonal and randomly oriented fibers. The kinetic and energy mechanisms governing the formation of composite "sandwich-type" structures are described. The results of theory and experimentation are compared. The characteristics of composite material compaction are examined for various methods of manufacturing composites.

This book is intended for materials specialists engaged in the development and study of composite materials and the methods for processing them, as well as for specialists in the field of powder metallurgy. It may also be helpful to graduate students and students in the advanced classes specializing in the field of powder metallurgy and the pressure working of metals.

Introduction

One of the basic directions in the development of science in the 10th Five-Year Plan is the creation of new materials capable of satisfying the needs of rapidly growing sectors of industry.

The most promising method of accomplishing the task that has been set is the synthesis of new composite materials (CM's), the application of which will make it possible to sharply increase the strength, heat resistance, fatigue strength, hardness and shock-load resistance of many structures. It will also make it possible to regulate the thermal and electrical conductivity as well as the magnetic, nuclear and other characteristics of materials over a broad range.

There is a critical need for composite materials in space technology, power engineering, aircraft and missile construction, nuclear engineering, turbine construction, chemical engineering, shipbuilding and in other sectors of industry.

Metallic composite materials are examined in the monograph. In this work, the terms "composite material" and "composition" are used synonomously to designate materials possessing a heterogeneous structure, consisting of a metallic matrix and fibers. The matrix and the fibers are combined, but they differ in their physicochemical properties. The materials obtained possess properties not inherent in either of the components individually. Related to this class of materials can also be two-phase compositions with a matrix structure, containing disperse inclusions of roughly equiaxial form. From a technological point of view, they may be examined as a particular case of reinforced materials with randomly oriented fibers that possess a length-to-diameter ratio approximating unity.

A great contribution in establishing the science of metallic composite materials has been provided by the studies of Soviet scientists--A. T. Tumanov, Yu. N. Rabotnov, I. N. Frantsevich, K. I. Portnoy, M. Kh. Shorshorov, V. S. Ivanova, S. T. Mileyko, I. N. Fridlyander, D. M. Karpinos, A. I. Kolpashnikov, V. Ye. Panin, O. V. Roman, V. I. Belyayev, et al.

In the period of time since the first publications on metallic compositions appeared, there has been a qualitative leap in their development and a transition from the stage of laboratory experiment to industrial introduction. The mechanics of composite materials have been successfully developed. This achievement has made it possible to determine the potential practicability of composite materials and to plan methods for utilizing them in actual structures. A number of compositions have been successfully created which possess unique mechanical properties.

The main problems confronting materials specialists engaged in the synthesis of reinforced metals are manufacturing problems. Is is basically clear what sort of potential possibilities composite materials have, although for the time being it is not clear in many cases how these possibilities may be realized in practice. Problems of manufacturing reinforced materials have now been brought into the foreground. Progress in the development of the whole composite-materials problem depends upon a successful solution to these questions.

Despite the fact that the overwhelming majority of materials specialists recognize the importance of industrial research, questions regarding the manufacture of composite materials are rarely taken up in the literature, In the first place, they pertain to the theoretical aspects of the problem. Publications relating to these aspects hardly amount to a few percent of the total number of publications on composite materials. Meanwhile, it is impossible to develop optimum manufacturing methods without a theoretical analysis of the practicability of various methods of obtaining reinforced materials with specific compositions. This means that it is not possible to regulate the properties of composite materials in a controlled manner. For this reason, an analysis of the methods of obtaining composite materials, that is, research into the processes taking place during the formation of their structure, is an important and pressing task.

The primary purpose of the investigations described in this monograph involved the development of a phenomenological theory for solid-phase compaction of powder and laminar reinforced composite materials by such widely used manufacturing methods as sintering, hot pressing and smith forging. The creation of this theory is truly necessary in order to make possible the calculation of the kinetic and energy parameters of the formation processes for composite materials possessing various degrees of anisotropy and, on the basis of these calculations, the choice of conditions for obtaining composite materials and the selection of the manufacturing equipment.

The description of solid-phase methods of forming composite materials with a powder matrix is drawn from general opinions based on the rheological approach that has been used lately for the theoretical analysis of compaction of ordinary (unreinforced) materials. The description is also based on a concept that successfully combines the continuous theory of bulk viscous flow of porous bodies with the theory of metal creepage.

Since, as a rule, the compaction of powder composite materials occurs due to the shrinkage of the matrix material alone, the application of theoretical methods developed in connection with ordinary porous bodies proved to be fruitful also for reinforced composite materials.

The description of the dynamic methods of forming "sandwiches" is based upon theoretical propositions regarding the working of metals by pressure.

A theoretical analysis of the laws governing the compaction of composite materials makes it possible to understand more deeply the nature of the processes taking place, to show up the advantages and the disadvantages of each method, to decrease sharply the expenditure of time and labor in conducting experimental work and to provide scientifically based recommendations for selecting the optimum production process for obtaining composite materials.

The methods of obtaining metallic composite materials which depend upon the initial state of the matrix material may be divided into liquid-phase and solid-phase methods. The methods of deposition are divided into plating and combined methods. A block-diagram classification of these methods is given in the table.

The utilization of a matrix in a solid state--in the form of powder or foil--is characteristic for solid-phase methods. Liquid-phase methods provide for introducing the matrix into the composite material in a molten state. In the case of obtaining composite materials through a deposition method, the matrix is plated onto the fibers from salt solutions or from other compounds, from a vapor-gas phase, from a plasma, etc. The combined methods include the subsequent or parallel application of the first three methods.

In the majority of cases, the fibers are introduced in the liquid-phase state. The exception is the "in situ" liquid-phase method, during which the increase in the amount of reinforcement comes about directly as a result of fusion during controlled crystallization of the eutectic substances.

Solid-phase methods have become the most widely used methods in the manufacture of metallic compositions. They are applied both in the "pure" form as well as in conjunction with other methods. For example, plasma deposition is used as a preliminary operation, while hot pressing or dynamic compaction is employed as the final operation. We will also give primary consideration to the study of these methods.

Solid-phase methods may be divided into powder-metallurgy and pressure-working methods. This division is arbitrary and is based mainly on the difference in the initial states of the matrices. Reinforced materials whose matrix is a powder in the initial state we will call powder CM's, that is, composite materials with a powder matrix.

Materials whose matrix in the initial state is composed of thin sheets (foils) and the whole piece itself--the assembly of alternating strata of matrix and reinforcing elements laid in a given sequence--we will call "sandwich-type" compositions.

The basic manufacturing methods for forming powder and "sandwich-type" composite materials are related, nevertheless, to processes that occur during compaction. The exception is the sintering method, which is used only for powder composite materials. The mechanisms which are responsible for this compaction have their own peculiarities which demand special investigation.

The block diagram lists only those manufacturing operations that directly provide a monolithic material. They are preceded by preparatory operations which include the cleaning of the surface of the fibers, the laying of the fibers in the given direction, the assembly of pieces of matrix and fiber, the heating, etc. All of these operations require the development of special methods and equipment and the application of the corresponding means of mechanization and automation. The study and improvement of these operations is a constant problem, the analysis of which does not enter into this present investigation. For this reason we will not dwell on them but will proceed with the investigation of the processes of compaction of reinforced metallic materials.

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[180-9512]

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CSO: 1842

CONSERVATION OF METALS

STROYBANK CALLS FOR CONSERVATION OF METAL

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 9, Sep 1980 pp 79-82

/Article by V. Shavlyuk, deputy chief of the Administration of the USSR Stroybank: "Putting a Stop to Excesses in the Expenditure of Metal"/

/Text/ A most important task for socialist economic management is to make efficient use of material resources, including rolled metal. The conservation of metal is very important in construction, which is one the main sectors of the economy that makes use of metal. Each year approximately 10 million tons of metal pipes and more than 20 million tons of rolled metal are expended to meet the needs for Soviet construction projects.

Scientific research that is conducted in this sector and the leading achievements of production workers show that opportunities for the economical expending of metal are far from exhausted. Flagrant squandering, unsatisfactory storage, and utilization for other than intended purposes were cited in L.I. Brezhnev's speech at the November (1979) Plenum of the CPSU Central Committee as some of the reasons why there is a shortage of metal, in spite of the enormous amounts that are produced.

Recently the planning and financial organs, scientific-research and planning and design organizations, construction projects and enterprises have been actively seeking ways to conserve metal and, without lowering the durability and exploitational properties of the buildings, to reduce the consumption of metal in construction. Standard documents have been drawn up which regulate and control the use of metal in construction; these documents include technical regulations governing the economical expenditure of basic construction materials and a standard methodology for planning the conservation of basic materials in construction. When examining the projected estimate documentation and the control measurements of construction and installation work that has been completed and studying the economic management and financial work of the planning and contract organizations, the institutions of the USSR Stroybank randomly check the correlation of the planning decisions that have been made and the construction and installation work that has been done to the requirements of the technical regulations and other standard documents that have been approved by the USSR Gosstroy and the USSR Gosplan. During the first four years of the Tenth Five-Year Plan the bank's financing institutions have randomly checked the justification for using metal in 80,000 drafts for construction projects. They found that in 10,000 of these projects standards for using metal were not observed in accordance with the standard documents that have been established. The total overexpenditure of metal came to 1,192,000 tons.

It must be noted that bank specialists cannot always thoroughly investiage all details of the draft and can only make suggestions concerning those technical solutions that are clearly in conflict with the appropriate standard documents. This is explained, by the way, by the fact that the customers and planning and contract organizations almost always accept all of the bank's suggestions that are aimed at conserving metal.

However such suggestions cannot always be realized, such as achieving a real substitution of planned metal constructions with other non-metal constructions or those that contain lesser amounts of metal. From the abovementioned 1,192,000 tons of metal that were unjustifiably called for in the plans, they managed to prevent the excessive expenditure of only 493,000 tons of metal. The remaining portion of the constructions either had already been installed or the appropriate orders for their manufacture were allocated. For such cases in order to avoid disrupting the planned introduction of capacities permission was obtained from the USSR Gosstroy and other organs. The expenditure of metal in this case was 330,000 tons. Thus, the bank's institutions annually manage to restrict the actual overexpenditure of metal, which amounts to approximately 40 percent of the disclosed amount of its irrational utilization.

As the materials of the checks that were made show, the excessive expenditure of metal is caused by its unjustified and irrational use at all stages of capital construction. Moreover, nearly 90 percent of the violations take place at the planning stage, which attests to the poor technical quality of the plans that are being drawn up and to the nonfulfillment by some ministries, departments, their planning organizations and expert organs of the instructions of the directing organs regarding the thrifty expenditure of metal in the national economy.

Analysis shows that the basic reason for the unjustified expenditure of metal showing up in the plans is primarily the continuing use of metal constructions and articles in place of reinforced concrete or other nonmetallic constructions. Such practice departs from the requirements of existing standard documents. For this reason the excessive expenditure of metal for the first four years of the Tenth Five-Year Plan came to 688,000 tons or nearly 60 percent of the overexpenditure that was disclosed. For example, in rigging the Krasnoyarsk Autotractor Trailer Plant the Giproavtoprom institute planned, and the Ministry of the Automotive Industry approved contrary to established norms, for the use of metal support constructions for the main and press and welding buildings of the enterprise, which would have required more than 28,000 tons of rolled metal. Only the interference of employees of the Krasnoyarsk office of the USSR Stroybank forced them to substitute reinforced concrete constructions for metal ones in the shell of the main building. This action made it possible to prevent the overexpenditure of 20,100 tons of rolled metal.

Frequently at the construction site or at enterprises of the construction industry the plan-required pipes, reinforcements and sections of rolled metal are replaced with others that use more metal. In the majority of cases such a substitution is caused by the unsatisfactory organization of production work and the material-technical suppply of the construction projects. For this reason at the construction undertakings that were checked the overexpenditure of metal for the first four years of this five-year plan came to 200,000 tons, or 16 percent of the unjustified use of metal that was discovered.

Thus, because of the untimely delivery of 6 and 8 mm diameter steel reinforcement there was an overexpenditure of metal at the Dnepropetrovsk House Building Combine of the UkSSR Ministry for the Construction of Heavy Industry Enterprises. In the first six months of last year alone the nondelivery by the Yenakiyevskiy, Krivoy Rog and Cherepovets metallurgical plants of the needed sizes of steel reinforcement and the subsequent use of 10 and 12 mm diameter steel the combine overexpended more than 500 tons of metal.

The construction of the Nikolayev alumina plant called for the use of metal constructions for the scaffolding of the technological pipeline made of wideshelved I-beams; but when they were not delivered the constructions were manufactured from regular I-beams, which led to an overexpenditure of 660 tons of metal and an increase in the cost of the work amounting to 169,000 rubles.

Another example. Near the largest new construction project, the Ziminskiy chemical plant (Irkutsk Oblast), the city of Sayansk is being built. All of the projects are being built out of imported constructions rated at a seismicity of 8, although there is no need to use such constructions. This not only increases the cost of the construction work but also results in an unjustified overexpenditure of metal in sizeable amounts.

In studying more than 1,500 contracts for the delivery of metal constructions by 39 plants of the USSR Ministry of Installation and Special Construction and the USSR Ministry of Power and Electrification the bank's institutions found that one in four contracts artificially inflated the weight of the metal constructions. The actual expenditure of metal as compared with the planned expenditure was 15,600 tons greater and the cost of the metal constructions was 3.5 million rubles greater. Characteristically, in addition to the cited reasons for the increase in weight of the constructions during manufacture there are reasons "made legal" by various standard documents. Thus, price list No 01-09 of wholesale prices for construction steel structures permits payment for metal constructions based on their weight being increased during manufacture apart from the one percent of the mass of the fused metal by another three percent. The above-norm expenditure of metal permitted by such "generosity" of the price list based on the contracts that were checked was 6,600 tons amounting to 900,000 rubles.

Frequently the supply plants in special amendments to the contracts even stipulate their right to manufacture metal structures from materials on hand rather than from the planned sections, which results in an increase in weight of 7 to 10 percent as opposed to the norms. The Sredne-Ural'sk Metal Structures Plant, for example, has even drawn up a "standard" contract that calls for the above-norm weight increase of structures of up to 5 percent with unconditional payment by the customer.

A characteristic example of departing from the approved plan in the section of the overexpenditure of metal is the outfitting of the Moldavian Ministry of Rural Construction with external water supply networks extending from Soroki to Floreshty to Bel'tsy. According to the plan, which was approved by the Moldavian SSR Council of Ministers, pipes with a wall thickness of 10 mm were to have been used, but actually they used 12 mm pipe for a 30 km stretch and 10.6 mm pipe for a 52.6 km stretch. This resulted in an overexpenditure of 2,500 tons of metal.

Sometimes the plan incorporates solutions that are known to be unsound; a practices that leads to excessive expenditures of metal. Thus, the plan for outfitting the free discharge tunnel of the Zhinvali hydroelectric power station, which was drawn up by the Tbilisi department of the Gidroproyekt institute and tested at the USSR Ministry of Power and Electrification, the weight of the supports was increased by 2,300 tons through the use of support elements that were made of I-beams instead of the girders of reinforcing steel that were stipulated by the planning norms. The bank's proposal to prevent the overexpenditure of rolled metal was supported by the Main Administration of State Experts of the USSR State Committee for Construction Affairs. However, due to the delay in carrying out the solution of the Main Administration of State Experts by the designers and builders, the USSR State Committee for Construction Affairs after six months decided to grant an exception for the use of the planned support from I-beams in an amount of 1,617 tons. Thus they were able to save only 683 tons of metal.

It should be pointed out that the metallurgical industry does not always ensure the delivery of the product called for by state standards. For example, for the construction of the Karazhanbas to Kalamkas gas pipeline pipes with a diameter of 426 mm and a wall thickness of 4 mm (60 km), 5 mm (1 km) and 7 mm (1 km) were required. But since the smallest wall thickness that is manufactured with this diameter by the enterprises of the USSR Ministry of Ferrous Metallurgy is 7 mm, the KazNIPIneft' /Kazakh Scientific Research and Planning Institute of the Petroleum Industry/ institute when designing the technical plan for the entire length of the gas pipeline was forced to stipulate their use. This resulted in an overexpenditure of 1,250 tons of metal. A similar situation evolves in outfitting other gas pipelines.

The lack of needed sizes of rolled metal, economical assortments of metal and required grades of steel remains one of the main reasons for the non-economical expenditure of metal. Speaking at the November (1979) Plenum of the CPSU Central Committee, L.I. Brezhnev emphasized that the main trend for the further development of ferrous metallurgy is not so much the quantitative growth as the radical improvement in the quality and expanding the assortment of metal products. The accomplishment of such measures will ensure savings, in our estimation, of nearly 20 million tons of metal each year, which amounts to almost the entire amount of rolled ferrous metal, not counting pipes, needed anually for capital construction. Therefore, the problem of conserving metal is particularly urgent in the work of the planning, supply and economic organs and the design and contract organizations, which are required to make a serious turn in designs and technology toward an emphasis on thrift in using materials.

In this regard it is particularly important that the ministries and departments prior to the start of the Eleventh Five-Year Plan reexamine and adjust all design and estimate documentation on projects to be included in the five-year plan, so that they strictly adhere to existing norms. This is required by the need to eliminate in the plans all direct deviations from the existing norms for the expenditure of metal, and in some cases to improve the volume-planning and design solutions of buildings and installations.

The analysis of the work of bridge cranes at the enterprises of 18 sectors of industry has shown that 43 percent of this equipment is not being fully used. (The analysis was done by the USSR Stroybank.) Among the findings were: 15 percent of the bridge cranes are being used for no more than two-thirds of the length of the shop; loads are being displaced, the maximum mass of which is significantly less than the crane's load capacity - 14 percent; 9 percent are being used only for repairing the equipment that has been installed in the shops; and almost 5 percent are being used only several times a year.

In refusing to use bridge cranes not only is production space of the multispan building being increased by approximately 10 percent, but the height and size of the building is decreased and the weight of the metal structures that are used is reduced by 20 to 30 percent.

To more strictly regulate the expenditure of metal we need existing normative documents, which regulate the use of metal structures and materials in construction. In our opinion, the above-mentioned technical rules for the economical expenditure of basic construction materials are inadequate. They permit quite a few instances where metal structures can be used, which could be substituted by non-metallic structures, for example, rafter and sub-rafter structures in one-story multispan buildings, with a span of 24 m for the suspensions above the loading platforms, etc. In addition, several of the norms are of a recommendative nature.

The economical expenditure of metal in construction is not promoted by the USSR Gosstroy's decree of 21 March 1977, which establishes a system for substituting metal structures for reinforced concrete structures in those cases where their use is not permitted by the technical rules. In accordance with such a system the decision to use metal structures with a total weight per construction site of more than 50 tons is made by the USSR Gosstroy or the USSR State Committee for Civil Construction and Architecture (depending upon the purpose of the construction project). When the weight of the metal structures is less than 50 tons, the decision is made by the all-union and union-republic ministries-customers for the subdepartmental construction projects, and also by the state committees for construction affairs of the union republics for the construction projects of the republic ministries and departments and the executive committees of the local councils of peoples deputies. The ministries and departments make extensive use of this right. Of the total incorrectly and irrationally used metal, discovered by checks of the USSR Stroybank's institutions during 1976 through 1979, the amount of metal, for the use of which appropriate permission was obtained in the system approved by this decree, was 330,000 tons, or 25 percent of the total.

It is apparently time to abolish the right to depart from existing norms regardless of the weight of structures for a given construction project and to tighten both the norms themselves and the responsibility for their observation. For now the only measure in regard to the contract and design organizations, which violate the established procedure for conserving metal in construction, is financial influence in the form of deductions from the cost of construction and installation and planning work that is performed with a departure from the norms. But with the forthcoming change over to estimates for finished product in planning and construction, when the time gap between the committed violation and payment for the work will be significantly increased, the inevitability of the action of such a sanction and its effectiveness will be weakened. Deducting the cost of already completed work cannot have a substantial influence on preventing the violations that are being committed.

In accordance with the decree of the CPSU Central Committee and the USSR Council of Ministers concerning the improvement of the economic mechanism, the construction undertakings are being shifted to the comprehensive supply of materials through the territorial organs of the USSR Gossnab according to orders of the construction-installation organizations. In connection with this it is thought expedient to devise sanctions that relate to the material incentive funds of the enterprises-suppliers and other organizations, responsible for violating the conditions of delivery and the overexpenditure of metal that is connected with exceeding the parameters of the metal structures that are used in comparison with what was required by the plans.

In determining the expertise of the design and estimate documentation it is advisable that the expert organs at all levels in mandatory manner reflect the results of analyzing the soundness and effectiveness of using metal as the most important indicator of the technical level of the plans and whether they correspond to present-day requirements.

Reducing the use of metal in the construction projects that are being erected is a most important national economic task. It needs to be comprehensively solved at all stages - planning, designing and construction. Great importance is attached to improving the work of the metallurgical industry, the goal of which is to meet the growing needs of the construction undertakings for metal. There is no doubt that this goal cannot be met by just increasing the production of metal. It is necessary to mobilize all reserves and to eliminate all irrational use of metal and to discourage the flagrant squandering and careless storage of metal.

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NONFERROUS METALLURGY

COST EFFECTIVENESS OF IMPROVING PRODUCTION IN NONFERROUS METALLURGY

Moscow EFFEKTIVNOST' SOVERSHENSTVOVANIYA PROIZVODSTVA V TSVETNOY METALLURGII in Russian 1980 signed to press 5 Dec 79 pp 3-6

[Table of contents and introduction from book by Vladimir Nikolayevich Leksin, Nikolay Vasil'yevich Krupkin and Leonid Grigor'yevich Mel'nik, Izdatel'stvo "Metallurgiya," 1,000 copies, 216 pages]

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Introduction

The task "assure comprehensive improvement of effectiveness of social production, improve product quality and strengthen the national economy,"[1] assigned by the 25th Congress of the CPSU, is being carried out both in the national economy and in all of its links, primarily by means of systematic improvement of industrial production. This task is also top priority for nonferrous metallurgy, in spite of the fact that it is, in terms of the level of effectiveness, one of the leading sectors of the national economy in the mining-processing system.

The gradual movement of the sector into regions of Siberia, Central Asia, Far East and the Arctic, the need to process increasingly complicated raw materials, the implementation of comprehensive programs of scientific-technical transformations in the sector (including those of a social nature) confront the sector with a number of difficult technical-economic problems, the solution of which comprises the specific content of the concept "improvement of sector production." This is an exceptionally broad concept under modern conditions and is manifested in the most diverse forms, but there is no doubt that the effort to improve production efficiency and product quality is a unifying experience.

In the concept "improvement of sector production" the authors include the entire complex of measures that are included and reflected in the composition of the plans "Technical development and organization of production," "Development of quotas and standards," "Capital construction," "Labor and cadres," "Social development of labor force" and others, prescribed by the Typical methodology of the development of the five-year plan of an industrial association (combine) of an enterprise. The ever-increasing cost of implementing these measures and in many cases the national economic (extrasectorial) importance of their adoption, the diversity of solutions and many other factors necessitate serious economic substantiations during determination of the national economic cost effectiveness of the improvement of sector production.

Unfortunately, the existing methodology works in this field and typical procedures can be used in by no means all cases for practical calculation purposes, since not all the information necessary for calculations is available, by no means not all of the indices are quantitatively defined for specific conditions, and there are

[1]"Materialy XXV S"yezda KPSS" [Materials of the 25th Congress of the CPSU], Moscow, Politizdat, 1976, p 167.

no unequivocal answers for the solution of many specific problems of improvement of sector production in nonferrous metallurgy.

An attempt is made in this work to connect recent progress in economic theory with experience in the calculation of cost effectiveness for the methodologically most complex, and at the same time most urgent trends of improvement of sector production in nonferrous metallurgy. Aspects of the assessment of the cost effectiveness of new technology in the light of the latest methodological premises, efficient utilization of natural resources, reduction of economic loss inflicted on the environment by industrial pollution, and energy technology consolidation, are set forth in a systematic sequence. The very list of these trends illustrates the diversity of ways to improve sector production and the methodological heterogeneity of their economic assessment.

Because the literature contains different interpretations of the fundamental concepts of the theory of the effectiveness of social production -- the theoretical foundation of the problems examined herein, the work is prefaced with a brief generalizing chapter, containing the most important concepts of this theory, necessary for the ensuing presentation.

Chapter 1 was written by V. N. Leksin and N. V. Krupkin, Chapter 2 by N. V. Krupkin, Chapter 3 by V. N. Leksin, Chapter 4 by V. N. Leksin and L. G. Mel'nik and Chapter 5 by N. V. Krupkin. V. N. Leksin did the general editing of the book.

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POWDER METALLURGY

ARTICLES ON POWDER METALLURGY

Minsk POROSHKOVAYA METALLURGIYA in Russian No 3, 1979 signed to press 22 Jan 79
pp 143-145

[Table of contents from collection edited by O. V. Roman, Izdatel'stvo "Vysheyshaya shkola", 600 copies, 145 pages]

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RARE METALS

RARE METALS AND ALLOYS. PHYSICOCHEMICAL ANALYSIS AND PHYSICAL METALLURGY

Moscow REDKIYE METALLY I SPLAVY. FIZIKO-KHIMICHESKIY ANALIZ I METALLOVDENIYE in Russian 1980 signed to press 30 Nov 79 pp 3, 254-255

[Foreword and table of contents from book by Ye. M. Savitskiy and G. S. Burkhanov, Izdatel'stvo "Nauka", 1,950 copies, 255 pages]

[Text] The authors were prompted to write this bock by two circumstances: the ever increasing importance of rare metals and alloys in scientific progress and the dearth of literature on the physicochemical aspect of the analysis and development of alloys of rare metals and technology of their production and utilization. Meanwhile, as experience has shown, this approach to the problem of rare metals and alloys is most productive. Therefore the authors laid out the plan of the book, assembled the material and interpreted it from physicochemical viewpoints.

The fundamental principles and laws of physicochemical analysis, formulated by N. S. Kurnakov and developed by his school, are presented in the book. Theoretical and experimental techniques of physicochemical analysis and their development at the present time are examined.

In view of the physicochemical orientation of this monograph considerable attention is devoted to aspects of the interaction of rare metals with another metal and with other elements of the periodic table (metals and nonmetals) and interaction of the structure and properties in accordance with the position of the rare metals in the periodic table. Data are presented on the structure and properties of alloys based on rare and refractory metals that enjoy considerable technical application. The fruitfulness of the physicochemical approach for scientific substantiation and selection of the optimum technological processes for the production and processing of products of rare metals and alloys is demonstrated.

The authors welcome the readers' comments on the content of the monograph and will try to consider them in future work.

The authors gratefully acknowledge M. I. Beloborodov and I. V. Vlasov for their assistance in the preparation of the manuscript.

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REACTOR MATERIALS

PROPERTIES OF MATERIALS IN RADIATION FLUXES

Kiev PROCHNOST' I PLASTICHNOST' MATERIALOV V RADIATSIONNYKH POTOKAKH in Russian 1979 signed to press 12 Dec 79 pp 3-4, 283-284

[Foreword and table of contents from book "Strength and Ductility of Materials in Radiation Fluxes", by Georgiy Stepanovich Pisarenko and Vladimir Nikolayevich Kiselevskiy, Izdatel'stvo "Naukova dumka", 1400 copies, 284 pages]

[Text] The development of atomic power engineering causes the necessity to develop scientific foundations of strength calculations for the structural elements in the active zones of nuclear reactors and, primarily, the heat-liberating elements which determine the reliability and efficiency of reactors as a whole. Use of material reserves with the capability to be resistant to loads under complex conditions of thermal and radiation actions is possible only in the presence of scientifically based norms of designing elements of the corresponding structures.

Modern technology of treating heat-liberating elements provides for complex research into the physical and mechanical properties of fuel composites and shell materials as well as testing of both the elements and assemblies of heat-liberating elements (for example, shells, ceramic fuel inserts, rods, pellets, etc.) and the designs as a whole in the form of properly heat-liberating elements and their installation /131/.

During the 1955-1975 period, radiation materials science put together an independent science having perceptible successes in solving theoretical and applied problems in the physics of radiation damage, development of new materials possessing a complex of physical and mechanical properties. The obtained results make it possible to solve problems of using individual types of materials in specific conditions of operation.

In the creation of these and other designs the stress-strain state and maximum support capacity of their elements in a given stage of developing the physics of strength should be calculated on the basis of solid state mechanics which, for radiation damaged and deformed solids, can be found in the stage of nucleation.

Material equations of state, constructed on the basis of continuum mechanics, applicable to the applied aspects can be formulated by means of correlating test results under conditions very close to actual. Investigation directly in radiation fluxes for the purpose of obtaining initial information on the behavior of irradiated materials in different modes of thermomechanical action has been associated with significant method difficulties which impede obtaining the corresponding equations of state.

In connection with this, in establishing the sizes and shapes of heat-liberating elements, there exists a known uncertainty which does not guarantee any optimality of the initial models and prototypes and they must be subjected to further complex study. The absence of scientifically founded norms of strength requires introduction of large coefficients of strength reserve into the calculations involving, as a rule, lowering of the neutron-physical characteristics of reactors, increasing construction costs and, as a consequence, decreasing the technical economic indicators of atomic apparatus and power units as a whole. Therefore, investigations of the properties of irradiated materials from the position of solid state mechanics are conducted for the purpose of determining not only the characteristics of strength and ductility, but also the principles of change in resistance to deformation and failure in relation to the modes of irradiation, form of the stress state, character of the applied load, temperature and other factors. Conducting research in this environment requires using special programs which differ from the generally accepted programs of radiation materials science.

In this work an attempt was undertaken to solve the principal questions of the method of interreactor research of mechanical properties of structural materials and correlate data on the effect of radiation irradiation on the different characteristics of their resistance to deformation and failure for the purpose of establishing in reasonable limits a bounded number of independent variables in the equations of state under irradiation conditions. A phenomenologic model of creep in irradiated steels and criteria of their maximum support capacity in a complex stress state are presented.

Development methods and research results, presented in this monograph, were produced by a collective of associates at the Institute of Strength Problems, UkSSR Academy of Sciences, under the direction and with participation of the authors. In particular the data examined in paragraph 3 of the first chapter and paragraph 1 of the second chapter were produced by the active participation of D. V. Polevyy and O. N. Yudin, paragraph 3 of the first chapter and paragraph 2 of the second chapter--V. K. Lukashev and G. P. Khristov, paragraph 4 of the first chapter and paragraph 4 of the second chapter--Yu. D. Skripnik, paragraph 5 of the second chapter--S. S. Tishchenko, and paragraph 2 of the fifth chapter--B. D. Kosov and O. N. Yudin. The authors express deep recognition to them.

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