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# SCIENTIFIC INFORMATION REPORT

Chemistry and Metallurgy

(28)

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Summary No. 4562

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SCIENTIFIC INFORMATION REPORT

CHEMISTRY AND METALLURGY (28)

This is a serialized report consisting of unevaluated information prepared as abstracts, summaries, and translations from recent publications of the Sino-Soviet Bloc countries. It is issued in seven series. Of these five, Biology and Medicine, Electronics and Engineering, Chemistry and Metallurgy, Physics and Mathematics, and Organization and Administration of Soviet Science, are issued monthly. The sixth series, Chinese Science, is issued twice monthly; and the seventh series, Outer Mongolia, is issued sporadically. Individual items are unclassified unless otherwise indicated.

Table of Contents

	<u>Page</u>
I. Chemistry	1
Organophosphorus Compounds	1
Plastics and Polymers	6
Rare Metals	7
Semiconductors and Dielectrics	14
Water Treatment	17
Miscellaneous	18
II. Metallurgy	22
Corrosion	22
Crystallography	26
Electron-Beam and Vacuum Processing	29
Patents	31
Powder Metallurgy	32
Treatment and Testing	35
Ultrasonic Treatment	53
Miscellaneous	55
Conferences	63

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## I. CHEMISTRY

## Organophosphorus Compounds

1. Phosphazoacyl Derivatives Prepared

"Diaroxychloro- and Triaroxyphosphazoacyls," by G. I. Derkach, Ye. S. Gubnitskaya, L. I. Samary, and V. A. Shokol; Moscow, Zhurnal Obshchey Khimii, Vol 33, No 2, Feb 63, pp 557-562

Experiments show that dialkyl esters of N-chloroiminocarboxylic acid react with diaroxychloro-, triaroxy-, and trithioaroxyphosphites and the triamides of phosphorous acid to form alkyl esters of the corresponding phosphazocarboxylic acids. The alkyl esters of N-chloroiminocarboxylic acid react with diarylchlorophosphites to form corresponding diaroxychlorophosphazoacyl compounds. On treating alkyl esters of N-chloroiminocarboxylic acid with ethylene phenylphosphites, dialkyl esters of corresponding N-phosphonyliminocarboxylic acids are formed. Hydrolysis of diaroxychlorophosphazo compounds results in the formation of corresponding diesters of acylamido-, or urethanophosphoric acids. Hydrolysis of alkyl esters of triaroxyphosphazocarboxylic acids results in the formation of urethanes and phosphates. The diaroxychlorophosphazoacyl compounds react with ammonia or amines to form diaroxyamidophosphazoacyl compounds.

2. Esters of Phosphoric Acids Prepared

"Diallyl Esters of Arylsulfonylamidophosphoric Acid," by V. I. Shevchenko, V. P. Tkach, and A. V. Kirsanov, Institute of Organic Chemistry, Academy of Sciences Ukrainian SSR; Moscow, Zhurnal Obshchey Khimii, Vol 33, No 2, Feb 63, pp 562-564

Diallyl esters of arylsulfonylamidophosphoric acid were prepared by treating four gram-moles of sodium allylate with one gram-mole of trichlorophosphazosulfonylaryls, by saponification of triallyloxyphosphazo-sulfonylaryl compounds, or by treating sodium allylate with arylsulfonyl-amidophosphoric acid dichlorides. It was found that by heating diallyl esters of arylsulfonylamidophosphoric acids in the presence of benzoyl peroxide, they polymerize to form clear, glassy resins which decompose without melting at 175-200°C.

3. USSR Patent on Organophosphorus Compounds

"Method for Preparing Esteramides of Alkyl(Aryl)- Phosphonic Acids," by K. A. Petrov, V. T. Yevtakov, K. S. Bilevich, L. I. Mizrahk, and Yu. S. Kosarev; USSR Certificate of Authorship No 145575, Filed 24 Jun 61; Moscow, Byulleten' Izobretenii, No 6, Mar 62, p 24

"A method for preparing esteramides of alkyl(aryl)-phosphonic acids from alkyl(aryl) dichlorophosphines, alcohols, and amines distinguished by the fact that for the purpose of simplifying the process and increasing the yield, the alkyl(aryl) dichlorophosphine is treated with a mixture of alcohol and base followed by treatment of the reaction mixture with the amine."

4. Rearrangement of Organophosphorus Acids Studied

"Rearrangement of Esters of Oxymethyl(Diethylphosphon)- acetic Acid," by A. N. Pudovik, I. V. Konovalova, and L. V. Debove, Kazan State University; Moscow, Zhurnal Obshchey Khimii, Vol 33, No 2, Feb 63, pp 483-486

A study was made of the addition of various diethylphosphorus acids to ethyl pyrotartrate in the presence of sodium alcoholate. It was shown that the resulting esters of oxymethyl(diethylphosphon)acetic acid undergo rearrangement to form dialkyl(alpha-carbethoxyethyl)-phosphates during the reaction, especially on being heated. The addition reaction was observed to have a small induction period.

5. Conjugation in Organophosphorus Compounds Studied

"The Phenomena of Conjugation in Systems Containing Tetrahedral Atoms II. Vinylphosphonic Acids," by M. I. Kabachnik, T. A. Mastryukova, and T. A. Melent'yeva, Institute of Elemental-Organic Compounds, Academy of Sciences USSR; Moscow, Zhurnal Obshchey Khimii, Vol 33, No 2, Feb 63, pp 382-388

The acidic properties of aryl- and vinylphosphonic acids were studied. These acids were used as a basis for studying steric conjugation in systems containing tetrahedral atoms. It was proposed that conjugation is most favored by a conformation whereby the plane of unsaturated systems connected to the phosphorus atom bisects the P=O bond. This conformation exists in divinylphosphonic and vinylphenylphosphonic acids. In diarylphosphonic acids, however, the two aromatic rings are unable to assume this conformation owing to steric hindrances. This results in a change in the influence of aryl groups on the acidic properties.

6. Preparation and Isomerization of Phosphorous Acid Esters Described

"Preparation and Isomerization of Mixed Esters of 1-Chloro-3-(beta-chloroethoxy)isopropylphosphorous Acids," by V. K. Khayrullin and T. I. Sobchuk, Institute of Organic Chemistry, Academy of Sciences USSR; Moscow, Izvestiya Akademii Nauk SSSR -- Otdeleniye Khimicheskikh Nauk, No 2, Feb 63, pp 320-327

Phosphorus trichloride was reacted with 1-chloro-3-(beta-chloroethoxy)isopropyl alcohol in a 1:1 molar ratio to give the monochloride and dichloride of 1-chloro-3-(beta-chloroethoxy)isopropylphosphorous acid. The dichloride of this acid was treated with aliphatic alcohols, phenol, and glycols. The reactions were conducted in the presence of triethylamine in absolute ether. This resulted in the preparation of mixed phosphites whose yields were somewhat low owing to redistribution of alkoxy groups at the phosphorus atom. This redistribution also took place during distillation under vacuum.

It was also observed that when these esters are heated, alkyl chlorides are split off in addition to the basic isomerization reaction. Acetyl chloride reacts with 1-chloro-3-(beta-chloroethoxy)isopropyl ester of chloromethylethyleneglycolphosphorous acid to give the corresponding chloride.

7. Reaction of Dialkylthiophosphoric Acids With Aromatic Halides

"Salts of Dialkylthiophosphoric Acids. V. Reaction of Salts of Dialkylthiophosphoric Acid With Aromatic Halogen Derivatives," by V. G. Pesin, A. M. Khaletskiy, and I. G. Vitenberg, Leningrad Chemical-Pharmaceutical Institute; Moscow, Zhurnal Obshchey Khimii, Vol 33, No 2, Feb 63, pp 388-391

In a previous work, it was shown that aromatic halides react with salts of dialkylthiophosphoric acid to form corresponding sulphides. In the present work, a study was made of the reaction between salts of diethylthiophosphoric acid with 2,4-dinitrochlorobenzene. This reaction results in the formation of corresponding sulphides and tetraethylmonopyrophosphate.

8. New Organophosphorus Compounds Prepared

"Aryldichlorophosphazoacyls and Their Derivatives," by D. I. Derkach, V. A. Shokol, and Ye. S. Guvnitskaya, Institute of Organic Chemistry, Academy of Sciences Ukrainian SSR; Moscow Zhurnal Obshchey Khimii, Vol 33, No 2, Feb 63, pp 553-557

Aryldichlorophosphazoacyl compounds were prepared by treating an aryltetrachlorophosphorus reagent with an acid amide or with an alkyl ester of an iminocarboxylic acid. The arylldichlorophosphazoacyls react with formic acid to form acylamidoarylyphosphonic acid chlorides. Further hydrolysis with water in acetone results in the formation of free acylamidoarylyphosphonic acids.

9. Esters of Phenylphosphonic Acid Prepared

"Esters of Phenylphosphonic Acid Monoarylates," by I. N. Zhmurova, Institute of Organic Chemistry, Academy of Sciences Ukrainian SSR; Moscow, Zhurnal Obshchey Khimii, Vol 33, No 2, Feb 63, pp 549-551

An investigation showed that recently prepared phenylphosphonic acid monoarylate chlorides react with alcohols and phenols to form esters of phenylphosphonic acid monoarylates. The reaction takes place readily at room temperature and is exothermal. Pyridine or triethylamine is used to bind up the hydrogen chloride. Alcohols and phenols react with the acid chlorides of phenylphosphonic acid monoarylates to form esters of phenylphosphonic acid monoarylates.

10. Isomerization in Organophosphorus Compounds Studied

"Prototropic Isomerization of Esters of Alkenylphosphonic Acids," by B. I. Ionin and A. A. Petrov, Leningrad Technological Institute; Moscow, Zhurnal Obshchey Khimii, Vol 33, No 2, Feb 63, pp 432-437

A study was made of prototropic isomerization of the diethyl ester of allylphosphonic acid and its derivatives having methyl, phenyl, and methylchloro groups at the allyl double bond. It was shown that complete isomerization takes place only in the case of the allylphosphonic ester. Crotylphosphonic ester isomerizes by 24 percent. Cinnamylphosphonic ester does not isomerize. In the case of gamma-chlorocrotylphosphonic ester, the chlorine is substituted for an ethoxyl group without isomerization. It was concluded that there is insignificant interaction between the double bonds in the double bonds in the P=O group and the system C=C-P=O.

11. Organophosphorus Derivatives of Ethyleneimine Prepared

"Organophosphorus Derivatives of Ethyleneimine. Report No 5, Monoand Polyfunctional Monomers," by N. P. Grechkin and I. A. Muretdimov, Chemical Institute imeni A. Ye. Arbuzov and Institute of Organic Chemistry, Academy of Sciences USSR; Moscow, Izvestiya Akademii Nauk -- Otdeleniye Khimicheskikh Nauk, No 2, Feb 63, pp 302-306

Organophosphorus derivatives of ethyleneimine are useful as cytostatic agents in medicine and as monomers for the preparation of organophosphorus polymers. In the present work, several organophosphorus derivatives of ethyleneimine were synthesized to clarify the effects of various substituents on the double bond on the properties of diethyleneimides of unsaturated acids of phosphorus and polymers prepared from them. A total of 17 derivatives were prepared, including derivatives of diallylamine, allylamine, crotonic, and methacrylic acids.

12. Organophosphorus Compounds Used To Stabilize Oils

"Preparation of Tri-(alkylphenyl) Phosphites," by P. S. Mamedova; Beku, Azerbaydzhanskoye Neftyanoye Khozyaystvo, No 2, Feb 63, pp 34-35

Organophosphorus compounds have been shown to be effective additives for lubricating oils increasing their thermal stability and improving their antiwear, detergent, anticorrosive, and other properties. In the present work, results are presented on the preparation of tri-(alkylphenyl)phosphites.

Phenol was alkylated with various C<sub>2</sub>-C<sub>10</sub> alcohols in the presence of sulfuric acid. After purification, the alkylphenols were treated with phosphorus trichloride to give corresponding tri-(alkylphenyl) phosphites. A total of eight products was prepared. Preliminary tests show that these compounds improve the stability of D-11 diesel oil.

Plastics and Polymers

13. Rubidium Butadiene Polymer Prepared

"The Chemical Structure of Rubidium Divinyl Polymers,"  
by A. I. Yakubchuk and V. D. Nikitina; Leningrad,  
Zhurnal Prikladnoy Khimii, Vol 35, No 11, Nov 63,  
pp 2491-2495

Butadiene polymers were prepared in the presence of metallic rubidium and their structure was determined. The polymerization was conducted at  $-5^{\circ}\text{C}$  and at  $60^{\circ}\text{C}$ .

The total degree of unsaturation of the rubidium butadiene polymer obtained at  $-5^{\circ}\text{C}$  is 87 percent, i.e., the same as that of sodium butadiene. The percentage of 1,2 linkages in the rubidium butadiene polymers obtained at  $-5^{\circ}$  and at  $60^{\circ}\text{C}$  are 49 and 42 percent, respectively. The fragments of macromolecules detected in the rubidium butadiene polymers were obtained in the presence of other alkali metals.

14. Silicon-Containing Organophosphorous Compounds Prepared

"Synthesis of Some Triethylsilylalkylphosphonic Acids and Their Esters," by Ye. A. Chernyshev, Ye. F. Bugerenko, and A. D. Petrov, Institute of Organic Chemistry, Academy of Sciences USSR; Moscow, Doklady Akademii Nauk SSSR, Vol 148, No 4, 1 Feb 63, pp 875-877

In the present work, four new silicon-containing esters having the following formula were prepared:  $(\text{C}_2\text{H}_5)_3\text{Si}(\text{CH}_2)_n\text{PO}(\text{OC}_2\text{H}_5)_2$ , where  $n=1, 2, 3, \text{ or } 4$ .

The esters were subjected to hydrolysis by heating in 38% hydrochloric acid for 24 hours to give the resulting acids. The acids were subjected to potentiometric titration to determine the relationship between change in ionization constant and position of the triethylsilyl group in respect to the phosphorus atom.

15. Structural Changes in Polymers in Ultrasonic Field

"The Use of Ultrasound To Study the Structural Changes of Concentrated Solutions of Polymers," by I. G. Mikhaylov and N. M. Fedorova, Leningrad State University; Moscow, Akusticheskiy Zhurnal, Vol 9, No 1, Jan-Mar 63, pp 50-53

It is shown that the coefficient of absorption of ultrasonic waves is a responsive characteristic of structural changes produced in concentrated polymer solutions. The considerable change in the coefficient of absorption in the temperature interval 0-60 deg C is explained solely on the basis of a structural change of the solution under the influence of temperature.

It is suggested that the structural changes produced by intensive ultrasonic irradiation, as well as by elevated temperature, are associated with a change in the number of van der Waals points in the polymer lattice. It is shown that the structural changes within an intensive ultrasonic field are not caused by cavitation.

Rare Metals

16. Polarographic Method for Determination of Uranium

"Determination of Uranium in Ores and Minerals by the Polarographic Method," by L. N. Lyubimova and V. G. Sochevanov; Leningrad, Radiokhimiya, Vol 4, No 6, 1962, pp 701-706

A polarographic method for the determination of uranium in rocks and minerals is described. This method, using a dropping mercury cathode, makes it possible to determine uranium in ores in quantities ranging from hundredths of a percent up to 82%. Accuracy of the method was checked by wet chemical analysis and proved to be satisfactory.

The factors involved in uranium polarization (half-wave potentials, diffusion current, etc.) are discussed, and the elements and compounds which hinder the polarization process are divided into five groups according to their hindering action.

17. Extraction of Neodymium and Ytterbium With Tributylphosphate

"Stability of Neodymium and Ytterbium Nitrate Complexes," by Z. A. Sheka and Ye. Ye. Kriss; Leningrad, Radiokhimiya, Vol 4, No 6, 1962, pp720-725

Conditions for the extraction of neodymium and Ytterbium in the form of nitrate complexes are presented. Equilibrium constants, instability constants, and distribution coefficients are calculated for the various complexes formed.

Neodymium and ytterbium, when dissolved in 0.6-3.0 M nitric acid solution, can be extracted by a 1 M solution of tributylphosphate in  $\text{CCl}_4$ . Perchloric acid was used in the aqueous solution to maintain a constant ionic strength. In this process, both  $\text{MNO}_3^{+2}$  and  $\text{M}(\text{NO}_3)_2^{+1}$  complexes are formed.

It was found that the stability of lanthanide nitrate complexes increases with increasing atomic number.

18. Sorption of Uranium by Activated Carbons

"Sorption of Uranium by Activated Carbons," by P. A. Kuzin, V. P. Taushkanov, and V. S. Aleshechkin; Leningrad, Radio-khimiya, Vol 4, No 6, 1962, pp 732-737

On the basis of research on the sorption of uranium by activated carbons, grades BAU, SKT, and SKLT, from a sodium thiocyanide solution, it was shown that the capacity of these carbons to adsorb uranium decreases in the order SKLT SKT BAU.

It was established that the maximum capacity of the activated carbons occurs with a 0.22M solution of sodium thiocyanide. The selective adsorption of uranium in the presence of other ions occurs at  $\text{pH}=1-2$ , where thorium, cerium, barium, and other elements are not absorbed. At this pH, adsorption of uranium fluctuates from 107 to 254 mg/g.

19. Thermodynamic Properties of Thorium Oxychloride

"Thermodynamic Investigation of Thorium Oxychloride," by Yen Kung-Fan, Li Shao-Chung, and G. I. Novikov; Moscow, Zhurnal Neorganicheskoy Khimii, Vol 8, No 1, Jan 63, pp 89-93

The fusibility diagram for the  $\text{ThO}_2$ - $\text{ThCl}_4$  system was studied, from which it was shown that the oxychloride,  $\text{ThOCl}_2$ , exists and can be obtained by reaction of  $\text{ThO}_2$  with  $\text{ThCl}_4$ .

Heats of reaction and formation and changes in enthalpy and entropy of the components of this system were calculated. Heat of formation and absolute entropy were also calculated for compounds of the type  $\text{MeO}_2$ ,  $\text{MeOCl}_2$ , and  $\text{MeCl}_4$  for radium, uranium and neptunium.

20. Synthesis of Niobium and Tantalum Orthophosphates

"Synthesis of Normal Niobium and Tantalum Orthophosphates," by G. B. Seyfer and I. V. Tananayev, Institute of General and Inorganic Chemistry Imeni N. S. Kurnakov, Academy of Sciences USSR; Moscow, Zhurnal Neorganicheskoy Khimii, Vol 8, No 1, Jan 63, pp 63-65

The synthesis of the first derived normal orthophosphates of niobium and tantalum is described. Basically, the process consists of reacting  $\text{Nb}_2\text{O}_5 \cdot x\text{H}_2\text{O}$  and  $\text{TaCl}_5$  with excess crystalline  $\text{H}_3\text{PO}_4$  to form a white precipitate which is filtered from the solution and roasted at  $1200^\circ\text{C}$  to remove the excess phosphoric acid.

21. New Photometric Methods for the Determination of Niobium and Tantalum in Metals and Alloys

"Photometric Methods for the Determination of Niobium and Tantalum in Metals and Alloys; I. Photometric Determination of Niobium by Means of 1-(2-Pyridilazo-Resorcinol)," by S. V. Yelinson and L. I. Pobedina; Moscow, Zhurnal Analiticheskoy Khimii, Vol 28, No 2, 1963, pp 189-195

Results of an investigation of the complexes formed from niobium peroxide and 1-(2-pyridilazo-resorcinol) and a method for determining niobium in certain alloys are presented.

Niobium with hydrogen peroxide and 1-(2-Pyridilazo-resorcinol) forms a crimson complex at pH 5 which may be used for the photometric niobium determination. It was established by the method of isomolar series that niobium reacts with the resorcinol complex in the presence of hydrogen peroxide at a 1:1 ratio. The molar extinction coefficient (molar absorptivity) was found to be approximately 32,300, and the equilibrium constant of the reaction was 5.52. In addition to the effect of hydrogen peroxide on the optical density of the complex, the effects of complexon III and other masking substances were studied.

From the data of this investigation, a photometric method was developed for determining niobium in zirconium- and titanium- alloys. Accuracy of this method was in the range of 2-4% at a niobium concentration of 0.1-1%.

22. Spectrophotometric Determination of Niobium and Tantalum

"Spectrophotometric Determination of Niobium and Tantalum With the Use of 1-(2-Pyridilazo)-Resorcinol," by I. P. Alimarin and Han Hsi-i, Moscow State University imeni M. V. Lomonosov; Moscow, Zhurnal Analiticheskoy Khimii, Vol 28, No 2, 1963, pp 182-188

A study was made of the reaction between niobium and tantalum and 1-(2-Pyridilazo)-resorcinol in the presence of tartaric, citric, and oxalic acids. It was found by the isomolar series method that niobium and tantalum react with this reagent in the ratio of 1:1. Equilibrium constants for the formation of complex compounds were calculated.

From this study, a new spectrophotometric method was developed for determining niobium in the presence of tantalum, titanium, and zirconium and tantalum in the presence of niobium, titanium, and zirconium.

23. Reaction of Yttrium With Boron Pyrocatechol Violet (3,3',4-trioxy-fuchson-2'- Sulfo Acid)

"An Investigation of the Reaction of Yttrium With Boron-Pyrocatechol Violet Complex," by L. S. Serdyuk and Yu F. Filich, Dnepropetrovsk State University; Moscow Zhurnal Analiticheskoy Khimii, Vol 28, No 2, 1963, pp 166-171

A study was made of the complex formed by reacting excess boric acid with pyrocatechol violet and also of the complex formed when yttrium is reacted with the above complex. It was found that yttrium reacts in a 1:1 ratio. From this study, a photometric method was developed for determining yttrium in the presence of lanthanum and cerium with the boron-pyrocatechol complex. This method was based on the difference in the stability of boron-pyrocatechol complex and the complexes of the other three elements.

24. Extraction of Thorium and Cerium Nitrates With Tributyl Phosphate

"The Mutual Effect of Thorium and Cerium Nitrates During Simultaneous Extraction With Tributyl Phosphate," by A. V. Nikolayev and Yu. A. Afanas'yev, Corresponding Members of the Academy of Science USSR; Moscow, Doklady Akademii Nauk SSSR, Vol 147, No 6, 21 Dec 62, pp 1380-1381

The extraction of thorium and cerium nitrates in the presence of 1.5N HNO<sub>3</sub> into an equilibrium aqueous phase with tributyl phosphate was studied. It was found that the effect of the proper concentration of thorium on its distribution in the presence of cerium is considerably less than without cerium. At a constant thorium concentration, the distribution coefficient depends on the cerium concentration. This becomes significant at low thorium concentrations.

These principles are explained by the fact that cerium displaces thorium from the organic phase. An increase to an equilibrium concentration of cerium in the aqueous phase reduces the influence of thorium to almost zero.

In the final analysis, it may be concluded that cerium solvates are more stable than thorium solvates.

25. Determination of Niobium and Titanium With Phosphomolybdic Acid

"Determination of Niobium and Titanium As Ternary Complexes With Phosphomolybdic Acid," by Yu. S. Shkaravskiy, Institute of General and Inorganic Chemistry, Academy of Sciences Ukrainian SSR; Moscow, Zhurnal Analiticheskoy Khimii, Vol 18, No 2, Feb 63, pp 196-201

A study was made of phosphomolybdic, phosphotitanomolybdic, and phosphoniobomolybdic complexes and the effects of oxalate, citrate, complexon III, fluoride, phosphate, and acidity on the stability of these heterogenous complexes. It was established that a colorless phosphomolybdic reagent with MoO<sub>4</sub>:PO<sub>4</sub> = 2 at pH 1 forms yellow heterogenous complexes with titanium and niobium.

A possible method is described for determining niobium in the presence of titanium on the basis of rapid destruction of the phosphotitanomolybdic complex with fluoride followed by the extraction of the remaining phosphoniobomolybdic complex with butanol-1.

It was also found that tantalum does not give a yellow color with the phosphomolybdic reagent and, therefore, based on this fact, the determination of niobium in the presence of tantalum may also be possible.

26. Separation of Vanadium From Aqueous Vanadate Solutions

"The Anodic Separation of Vanadium Compounds From Aqueous Vanadate Solutions," by A. S. Goncharenko; Leningrad, Zhurnal Prikladnoy Khimii, Vol 35, No 11, Nov 62, pp 2449-2454

The effect of the magnitude of the anode current density in the process of anode separation of vanadium compounds from aqueous vanadate solutions was investigated. It was shown that upon lowering the current density from 100 to 5 ma/cm<sup>2</sup>, current consumption is reduced by 15-20% for the extraction of an equal amount of vanadium at the anode. Additions of 100 g/l of a sodium chloride or sodium sulfate electrolyte also reduce current consumption. Little effect is shown if the sodium chloride concentration is increased to 150 g/l whereas with sodium sulfate the extraction of vanadium is reduced by almost 50 percent.

An over-all alkylation of electrolytes occurs during anode separation of vanadium compounds. Reducing the pH of the solution to 6-7, by adding dry calcium bisulfate, leads to an increased consumption of current in the extraction process.

27. Extraction of Molybdenum and Tungsten From Aqueous Solutions

"The Extraction of Molybdenum and Tungsten From Aqueous Solutions," by B. N. Laskorin, V. S. Ul'yanov, and R. A. Sviridova; Leningrad, Zhurnal Prikladnoy Khimii, Vol 35, No 11, Nov 62, pp 2409-2414

A study was made on the extraction of molybdenum and tungsten from aqueous solutions and solutions of trinitrooctylamine (TOA), di-(2-ethyl-hexyl)-phosphoric acid (D2EGFK), and the diisobamylester of methyl phosphonic acid (DAMF) in kerosene.

It was found in the extraction of molybdenum and tungsten from sulfuric, nitric, and hydrochloric acid solutions with TOA in kerosene that the distribution coefficients depend upon the amount of molybdenum in the organic phase. A sharp increase of the distribution coefficients at increased molybdenum concentration indicates polymerization of the molybdenum complex in the organic phase. D2EGFK was found to extract molybdenum to a lesser degree since the cation state for molybdenum is characteristically less. The same reagent does not extract tungsten.

DAMF extracts molybdenum from hydrochloric acid solution at a high hydrogen-ion concentration. From nitric acid, molybdenum is extracted to a lesser degree, and DAMF does not extract molybdenum from sulfuric acid solution.

28. Polyhalogenides Used To Separate Rubidium From Cesium

"Isotripolyhalogenides Similar in Properties to Alkali Elements and Their Use for the Purification of Rubidium Compounds From Cesium," by V. Ye. Plyushchev, S. B. Stepina, and L. I. Lepeshkova, Moscow Institute of Fine Chemical Technology; Moscow, Doklady Akademii Nauk SSSR, Vol 148, No 3, 21 Jan 63, pp 601-604

The following method is recommended for the final purification of rubidium salts from micro quantities of cesium. To an aqueous solution of rubidium iodide heated to 60-80°C, finely ground crystalline iodine is added so that the ratio of rubidium iodide: water: iodine is 5:5:1. After vigorous agitation and cooling with ice to +5°C, rubidium triiodide is crystallized. The crystals are filtered off, and a second fraction of rubidium triiodide is crystallized out at the same temperature. After three or four crystallizations, depending on the initial amount of cesium, the remaining mother liquor is evaporated to dryness at 150°C and then heated to 300-350°C to remove the iodine. The resulting rubidium iodide contains 0.01 percent cesium if the initial cesium content was 0.25-2.5 percent.

29. Separation of Radioactive Elements

"Study of Chemical Changes During Beta-Decay of Radioactive Elements When They Are Alpha-Naphthyl Derivatives," by V. D. Nefedov, S. A. Grachev, and S. Gluvka; Moscow, Zhurnal Obshchey Khimii, Vol 33, No 2, Feb 63, pp 3-339

Methods were developed for the separation and identification of alpha-naphthyl derivatives of tellurium and polonium based on paper chromatography. It was shown that utilization of chemical changes taking place during beta-decay of radioactive elements which are in the composition of alpha-naphthyl derivatives for the synthesis of organoelemental compounds of polonium containing these radicals is feasible. Previously unknown compounds of di- and tetravalent polonium were prepared for the first time.

Semiconductors and Dielectrics30. Effect of Heat Treatment on Semiconductor Polymers Studied

"On the Mechanism of Conductivity in Organic Semiconductor Polymers," by A. V. Ayrapetyanps, R. M. Voytenko, V. E. Davydov, and B. A. Krentsel', Institute of Petrochemical Synthesis and Institute of Semiconductors, Academy of Sciences USSR; Moscow, Doklady Akademii Nauk SSSR, Vol 148, No 3, 21 Jan 63, pp 605-608

A systematic study was made to determine the temperature dependence of specific resistance on thermo-e.m.f. in samples of heat-treated polyacrylonitrile fibers. Measurements of conductivity were made before and after heat treating the samples under vacuum at temperatures ranging from 520°C to 730°C. It was found that the thermo-e.m.f. of the samples increases linearly with increasing temperature at low temperatures of heat treatment, i.e., 520°C to 600°C. At room temperature, samples which were heat-treated at high temperatures (670-710°C) have a slightly negative thermo-e.m.f. value. As the temperature of measurement increased, this value drops to zero, becomes positive, and then increases somewhat.

31. Free Radical Recombination on Semiconductor Surface Studied

"Free Radical Recombination Processes on Semiconductor Surfaces and Their Role in Luminescence," by F. F. Vol'kenshteyn, A. M. Gorban', and V. A. Sokolov, Tomsk Polytechnic Institute and Institute of Physical Chemistry, Academy of Sciences USSR; Moscow, Kinetika i Kataliz, Vol 4, No 1, Jan/Feb 63, pp 24-34

The mechanism of radical recombination during luminescence was examined as a possibility in the case of light emission from luminophores under the influence of chemically active gases and during candoluminescence. The intensity of radical recombination luminescence was calculated as a function of pressure and the Fermi level. An experimental study was made of the influence of an external electrical field on the intensity of candoluminescence. The experimental results were found to agree qualitatively with developed theory.

32. Solubility of Semiconductors Determined

"Solubility Kinetics of a Glassified Germanium-Selenium System in Alkaline Solution," by Z. U. Borisova and Chin Ch'eng-Ts'ai; Moscow, Zhurnal Prikladnoy Khimii, Vol 36, No 2, Feb 63, pp 233-236

A study was made of the rate of solution of germanium-selenium alloy semiconductors in alkaline solutions. The solubility was conducted in sodium hydroxide solutions at constant temperatures of 25°, 35°, 45°, and 55°C.

The rate of solution of semiconductors having the compositions  $\text{GeSe}_3$ ,  $\text{GeSe}_4$ , and  $\text{GeSe}_6$  was found to be dependent on chemical reactions taking place at the semiconductor-solution interface. The material going into solution is chiefly  $\text{GeSe}_2$ , while excess selenium accumulates on the semiconductor surface as a crystalline coating.

### 33. Electrical Conductivity of Polymeric Dielectrics Study

"The Compensating Effect in Electrical Conductivity of Crystalline Polymeric Dielectrics," by B. I. Sazhin and N. G. Podosenoza, State Scientific-Research Institute for Polymerized Plastics and Experimental Plant of the State Committee of the Council of Ministers USSR on Chemistry; Moscow, Doklady Akademii Nauk SSSR, Vol 148, No 3, 21 Jan 63, pp 6-9

In many chemical and physical processes, rate variations are related to changes in both activation energy and pre-exponential factors. In condensed bodies, changes in activation energy and pre-exponential factor often affect the rate of the process in opposite directions. This compensating effect was observed while studying electrical conductivity in polymers having conjugated double bonds, which normally have hole type conductivity.

In the present work, this compensating effect was observed in typical polymeric dielectrics for which an ionic mechanism for conductivity was proposed. A study was made of the effect of crystallization of technically pure polyethyleneterephthalate, polytrifluorochloroethylene, and pentaplast (a polymer of 3,3-dimethylchloroxycyclobutane) on electrical conductivity as measured by the residual current.

### 34. Microquantitative Analysis of Impurities in Selenium

"Determination of Impurities in Selenium," by N. P. Strel'nikova, G. G. Lystsova, and G. S. Dolgorukova, Horil'sk Mining and Metallurgy Combine imeni A. P. Zavenyagin; Moscow, Zavodskaya Laboratoriya, Vol 28, No 11, Nov 62, pp 1319-21

For separating microquantities of Cu, Ni, Co, and Pb from selenium, extraction of their carbonates with carbon tetrachloride or precipitation on a cation resin is recommended. After separation from selenium, the above metals can be determined by various known methods. Arsenic in selenium can be oxidized to the chloride, distilled, and determined colorimetrically with ammonium molybdate. Analyses using both extraction and ion-exchange methods were in good agreement, with the exception of nickel.

35. Yugoslav Industrial Production of Silicon Mastered

"Industrial Production of Silicon Mastered"; Belgrade, Privredni pregled, 14 Feb 63, p 2

"At the request of the Elektrobosna Enterprise in Jajce and after completion of the theoretical analyses, the scientific associates of the Institute for Chemical, Technological, and Metallurgical Research (Institut za hemijska, tehnoloska i metalurska istrazivanja) have mastered industrial production of silicon," announced Engr Aleksandar Dediđer, director of the institute. In the recently set up small-scale experiemntal plant at Jajce, the first quantities of this element are being produced, while the zone refining and extraction of monocrystals are done at the institute in Belgrade, it was reported. Together with the study of the first technological solutions, the institute is working on the procedure for obtaining highly pure silicon. This material is currently one of the most important raw materials necessary for the domestic radio industry. Yugoslav enterprises which produce transistor receivers annually consume an average of 200 kilograms of this material. Since silicon is imported at 2,500 dollars per kilogram, the institute's effort is very significant.

While analyzing the sulfuric acid process at the "Zorka" factory in Sabac, institute associates concluded that there was a loss sulfur dioxide. Checks showed that most of the loss took place in the conductor pipes. Recommendations were made to the factory which would improve production of sulfur dioxide. It is expected that "Zorka" will implement the recommendations since it would save millions of dinars.

The institute is also studying an original industrial process for the "Zorka" factory in Sabac which would enable the latter to produce Freon [halogenated hydrocarbons used as refigerants] from waste raw materials.

In the interest of studying the possibilities of developing and planning industrial processes (other than processing industries) in Yugoslavia, with particular emphasis on the possibilities of domestic machine building, the institute set up special sections for planning technological processes and a center for chemical engineering. The section for planning technological processes is supposed to enable the transfer of laboratory experiences and theoretical knowledge on actual processes into industrial production. The center for chemical engineering is working on developing production processes and equipment to implement the basic operations of such processes. For these purposes, the center is supplied with two large testing halls and reliable equipment which can be of great use in scientific work.

C-O-N-F-I-D-E-N-T-I-A-L

The institute in 1963 also organized a special section for petroleum technology, petroleum derivatives, and petroleum chemistry, according to Engineer Dediđer. The assignment of this section is primarily to study possibilities of using natural gas and refinery gases for production of plastics, synthetic fibers, and various intermediates.

In conclusion, Engr Aleksandar Dediđer, the institute director, said that "the potential of the institute is very great, but enterprises frequently misunderstand the work of the institute with respect to assignments of interest to industry. If the institute had its own operating resources and could come before economic organizations with completed results of its individual research efforts, it presumably would have greater success in interesting the latter to adopt such results. This would also make the work of the institute more effective. Nevertheless, cooperation of individual economic organizations with the institute is more successful from day to day."

Water Treatment

36. Chlorinated Lime Cartridges Used To Purify Well Water

"Experiment on Chlorination of Water in Wells With the Aid of Dosing Cartridges," by V. A. Gofmekler and V. V. Gerashchenko, Central Institute for the Advanced Training of Physicians and Sanitary-Epidemiological Station, Moscow; Moscow, Gigiena i Sanitariya, No 3, Mar 63, pp 97-98

A study was made of the effectiveness of using cartridges containing chlorinated lime to purify well water. The cartridges contained about 700 grams of chlorinated lime and were placed in the well about 50 centimeters below the surface of the water.

The results of chemical and bacteriological tests made on the water were satisfactory. After 2 days, the residual chlorine concentration was 0.1 milligram per liter, and the Coli titer exceeded 111. Negative results were obtained, however, at another well, where it is believed that the residual chlorine was absorbed by iron, whose concentration was found to decrease from 6.4 to 1.5-2.0 milligrams per liter.

37. Water Purification With Gamma-Irradiation

"The Effectiveness of Disinfection of Water With Gamma Irradiation," by G. I. Sidorenko, Moscow Medical Institute; Moscow, Gigiena i Sanitariya, No 3, Mar 63, pp 14-16

The feasibility of using gamma rays for water sterilization was investigated. Water from natural sources was irradiated with doses ranging from 10,000 to 3 million roentgens. Total sterilization of water required not less than 1.2-1.5 million roentgens. During the irradiation, mineralization and nitrification processes were found to be accelerated considerably.

38. Ways Found To Rid Waters of Industrial Waste

"So That the Rivers Will Be Clean," by V. Shepilevich; Leningrad, Leningradskaya Pravda, 13 Feb 63, p 4

The Leningrad laboratory of the All-Union Scientific-Research Institute of Fuel Utilization is studying ways of purifying industrial sewage. Doctor of Technical Sciences B. Ivanov, Candidate of Chemical Sciences N. Sharonova, and junior scientific worker Yu. Kozak studied the flow of waters during the gassification of shale at the combine in Kokhtla-Yarve which are dumped into the Gulf of Finland. They found that these waters contained phenols which are harmful to fish, but are also a valuable raw material for the synthesis of high-quality tanning agents used in the leather industry. At the suggestion of the workers of the laboratory, a plant for the dephenolization of the sewage was constructed at the combine -- the sewage is now nearly free of phenols, which go to the production of tanning agents.

Laboratory personnel proposed an original method for treating the sewage of the Oldtinsk chemical combine by burning the organic matter in it. An industrial installation planned for this will go into operation this year.

Miscellaneous

39. Plasma Stream Used To Convert Hydrocarbons

"Conversion of Methane to Acetylene in an Argon Plasma Stream," by G. V. Gulyayev, G. I. Kozlov, L. S. Polak, L. N. Khitrin, and G. N. Khudyakov, Institute of Petro-Chemical Synthesis, Academy of Sciences USSR, and Energy Institute imeni G. M. Krzhizhanov; Moscow, Doklady Akademii Nauk SSSR, Vol 148, No 3, 21 Jan 63, pp 641-643

Experiments were conducted on the conversion of methane to acetylene in an argon plasma stream to clarify the possibility of lowering the specific energy output and reaching high degrees of conversion. The plasma stream

was obtained with a 15-kilovolt plasmotron having an argon stabilized discharge. The arc was struck between a tungsten cathode and a water-cooled copper anode. The argon plasma flowed to the atmosphere through a 3-millimeter diameter nozzle to the anode. The methane was introduced to the plasma stream at a 90° angle through a special opening in the nozzle wall. The reaction products were analyzed chromatographically.

Increasing the nozzle diameter to 4.5 millimeters resulted in higher acetylene yields and permitted a lower energy output. This result indicates the possibility of further decreases in specific output by way of improving apparatus construction with resultant lower product losses.

Further investigations on the possibility of using a plasma stream to carry out endothermal chemical processes are being conducted in the following areas: conversion of methane to acetylene in a 200-kilovolt plasmatron using argon, hydrogen, and certain other gases as the carrier gas; conversion of propane to butane, and conversion of propane-butane fractions in a plasma stream.

#### 40. Arsenic-Organic Compounds Prepared

"Concerning Alpha-Alkylallyl and Alpha-Alkylcrotyl Esters of Phenylarsenous Acid," by Gil'm Kanzy and R. K. Zaripov, Kazan Chemical-Technological Institute; Ivanovo, Izvestiya Vysshikh Uchebnykh Zavedeniy -- Khimiya i Khimicheskaya Tekhnologiya, Vol 5, No 6, 1962, pp 1938-1941

A study was made of the reaction between phenyldichloroarsine and secondary unsaturated alcohols in the presence of pyridine or diethylaniline. The resulting alpha-alkylallyl and alpha-alkylcrotyl esters of phenylarsenous acid were prepared and studied for the first time. It was shown that acetic and benzoic acid chlorides react with alpha-alkyl-allyl esters of phenylarsenous acid to form alkenoxyphenylarsenous acid chlorides and the corresponding acetates of benzoates.

41. New Insecticides and Herbicides Synthesized

"Derivatives of 2,2'-Diphenic Acid II. Substituted Monoamides and Monoaryl Esters of 2,2'-Diphenic Acid, Their Insecticidal and Herbicidal Activity," by L. P. Kulev, R. N. Gireva, and G. M. Stepnova; Moscow, Zhurnal Obschey Khimii, Vol 33, No 2, Feb 63, pp 411-412

Previously prepared substituted monoamides of 2,2'-diphenic acid exhibited rather high herbicidal and insecticidal activity. For the purpose of finding new biologically active formulations, an additional 21 compounds of this series were synthesized in the present work. The substituted monoamides and acid esters were obtained from diphenic anhydride and the corresponding amide or phenol.

The new compounds are crystalline substances, insoluble in water and soluble in organic solvents. Determination of the insecticidal and herbicidal activities of the compounds shows that the sodium salt of 2-thiazolamide and 4-cresylic ester have the highest insecticidal activity. The former acts as an intestinal poison, and the latter, as a contact poison. The sodium salt of 2,2'-diphenic acid monomethylamide has high herbicidal activity.

42. Energy Transfere in Luminophores Studied

"Study of the Processes of Energy Transfer by the Methods of Luminescence and Radiation Chemistry," by V. A. Krongauz and I. N. Vasil'yev, Physico-chemical Institute imeni L. Ya. Karpov; Moscow, Kinetika i Kataliz, Vol 4, No 1, Jan/Feb 63, pp 67-75

A study was made of the radiolysis and luminescence in three component solutions of toluene, benzoyl peroxide, and a luminophore such as p-ter-phenyl or 2,5-diphenyloxazol. It was shown that the shielding action of the luminophore toward sensitized radiation decomposition of the peroxide and extinction of photo- and radio-luminescence in the luminophore by the peroxide may be explained on the basis of competing energy transfer from the solids to both acceptors and from the luminophore to the peroxide. Transfere of energy from toluene to benzoyl peroxide and to the luminophore occurs by "remote control," although the main role is played by diffused molecules. Energy transfer from the luminophore to benzoyl peroxide apparently takes place by a diffusion mechanism by forming an intermediate complex of an excited luminophore molecule with a peroxide molecule.

43. New Glass Has High Resistance to Heat and Corrosion

"Insoluble Glass"; Moscow, Izvestiya, No 38 (14201), 14 Feb 63,  
p 4

:Ordinary glass is soluble in water. The most accurate analytical balances show that in a glass of tea, you may drink about one thousandth party of a gram of glass.

"However, if to the ordinary glass a small amount of salts of rare earth elements such as lanthanum, zirconium, or lithium are added while the glass is still in the molten state, the solubility of the resulting glass is decreased by almost 100 times. It also becomes extremely stable to solubility in sulfuric acid. In other words, ordinary glass acquires the properties of laboratory glass. It may be heated to 400°C and then quickly cooled. It does not crack.

"Such high thermal and chemical stability against acids and alkalies makes articles of this glass serious competitors to quartz, whose production is difficult and expensive and requires special raw materials and large amounts of energy. Raw material for the new laboratory glass is very economical.

44. Factory Produces Cylinders Capable of Withstanding Ultrahigh Pressure

"For Large-Scale Chemistry"; Leningrad, Leningradskaya Pravda, 9 Feb 63, p 4

"The factory 'Bol'shevik' is filling orders for large-scale chemistry. These are cylinders for various chemical agents, designed for ultrahigh pressure. For example, the last four cylinders which were prepared in January were designed for 1,800 atmospheres.

"The other day, two such cylinders were shipped to the city of Kuybyshev."

II. METALLURGY

Corrosion

45. Corrosion of Welded Nickel in Alkaline Media

"Welded Compounds of Nickel for Service in Alkaline Media,"  
by O. N. Ivanova; Kiev, Avtomicheskaya Svarka, No 1, Jan 63,  
pp 91-92

In addition to the harmful effects which result from the presence of oxygen, hydrogen, and sulfur in nickel welds, the presence of manganese can also be detrimental in certain cases. For instance, nickel crucibles welded with an argon-arc with an NMTs-5 filler wire were used to melt sodium peroxide at 600°C. These crucibles broke along the weld within one hour. Crucibles were then welded with a filler wire having the same composition as the crucible itself. These crucibles were found to have very good corrosion stability in the alkaline media and did not break during the melting of sodium peroxide.

46. Corrosion Studies of Welds of Titanium and its Alloys

"Corrosion of Welded Joints of Titanium and Its Alloys in Inorganic Chloride Solutions," by L. N. Yagupol'skaya and S. M. Gurevich, Institute of Electric Welding imeni Ye. O. Paton, Academy of Sciences Ukrainian SSR; Kiev, Avtomaticeskaya Svarka, No 1, Jan 63, pp 44-47

The corrosion properties of welded joints of titanium grade VT1-1 and alloys OT-4 and OT-4-2 in concentrated boiling solutions of  $MgCl_2$ ,  $CaCl_2$ , and  $NH_4Cl$  in both the stressed and unstressed conditions were investigated. Test welds were made by the argon-arc and submerged-arc method.

Corrosion studies in the unstressed state showed that these welds suffered little or no corrosive attack in this condition. In the stressed condition, corrosive attack takes place depending upon the temperature of chloride solution and degree of stress; however, cracking occurs only in the base metal.

It was established that welded joints of these materials are stable to corrosive attack in a 52-53% solution of magnesium chloride at 162°C, in a 50-51% solution of calcium chloride at 130°C and also in a boiling 46-47% solution of ammonium chloride.

47. Intergranular Corrosion Studies of Austenitic-Ferritic Steels

"Investigation of Intergranular Corrosion in the Heat-Affected Zones of Welded Joints of Steel Kh28AN," by N. I. Kakhovskiy, V. G. Fartushnyy, K. A. Yushchenko, and D. V. Diðbulidze, Institute of Electric Welding imeni Ye. O. Paton, Academy of Sciences Ukrainian SSR; Kiev, Avtomaticheskaya Svarka, No 12, Dec 62, pp 1-8

The corrosion resistance of welded stainless steel was investigated. Samples of steel Kh28AN (EI-657, GOST 5632-61) were welded by the inert-gas shield and submerged-arc methods and given various heat treatments. A study of the phase transformation after quenching and after heat treatment revealed the processes occurring in the heat-affected zone.

Mechanical tests, along with corrosion studies of the welded joints, showed that a post-anneal at 800-850°C reduces the tendency toward intergranular corrosion in the transition zone as it stabilizes the austenite and ferrite phases.

48. Long-time Strength of Steel in Liquid Sodium Containing Oxygen

"The Long-Time Strenght of Steel in Liquid Sodium Containing Oxygen," by V. I. Nikitin, Central Boiler and Turbine Institute imeni I. I. Polzunov; Sverdlovsk, Fizika Metallov i Metallovedeniye, Vol 13, No 4, Oct 62, pp 613-617

One of the important problems associated with the use of sodium as a heat-carrier is the permissible oxygen content. Investigations on the corrosion of steel in liquid sodium have led to the conclusion that the concentration of oxygen in the liquid metal should not exceed 0.005%.

In this work, the author investigated the long-time strength and creep properties of an austenitic chrome-nickel steel containing 2.3% tungsten and 1.2% niobium. Thin-wall tubes of this steel were used for the three series of tests on long-time strength.

The first series were tested without sodium. The second series were tested in sodium containing 0.01% oxygen; and the third, in sodium containing 1% oxygen.

Results of tests on the long-time strength showed that sodium containing 0.01% oxygen causes no premature fracture of the steel in comparison with tests made without liquid sodium, whereas the steel tubes containing liquid sodium with 0.25% oxygen had a reduced long-time tensile strength. Similar tests conducted to study the creep rate of the steel in liquid sodium revealed that the rate of creep is accelerated only in liquid sodium containing 0.25% oxygen.

## C-O-N-F-I-D-E-N-T-I-A-L

Analysis of the microstructure of the samples after fracture showed that the extent of intergranular cracking increases with increased oxygen content in the liquid sodium.

It was believed that the effect of the liquid-metal media on the metal in the stressed state occurs as a result of one or the combination of the following three processes: adsorption, corrosion, and diffusion. The corrosion action of the liquid metal on the solid metal results from one or a combination of several other processes: (1) dissolution of the solid metal in the liquid; (2) intergranular penetration of the liquid metal into the solid metal; (3) formation of solid solutions and compounds between the solid and liquid metal; (4) interaction of the solid metal with impurities in the liquid metal; (5) thermal mass transfer; and (6) isothermal mass transfer.

In this particular study, only adsorption and corrosion processes are possible as diffusion cannot take place due to the difference in atomic size of iron and sodium. Little or nothing is known about the mutual force of the various effects of this active media on stressed metal. However, it was concluded that an oxygen content of 0.01% in the liquid sodium is permissible. If this amount is exceeded, premature fracture of the steel will result.

### 49. Oxidation Nb-Zr Alloys

"An Investigation of the Oxidation Process of Nb-Zr Alloys,"  
by D. A. Prokoshkin, Ye. V. Vasil'yeva, and V. Ya. Yanushkevich;  
Moscow, Izvestiya Akademii Nauk, Otdeleniye Tekhnicheskikh Nauk,  
Metallurgiya i Gornoye Delo, No 1, Jan/Feb 63, pp 186-190

The kinetics of oxidation of Nb-Zr alloys containing 0.25-50% Zr at 1,000, 1,100, and 1,200°C with various stabilizers were studied. It was established in alloys containing 0.25-15% Zr that the zirconium decreases the resistance to oxidation of niobium. With a zirconium content of greater than 15%, the oxidation rate decreases. Metallographic and X-ray analysis of the oxides formed on the alloys showed that the oxidation rate is determined by structural changes in the oxide layer, particularly by the formation of the compound  $6ZrO_2 \cdot Nb_2O_5$  with an orthorhombic crystal structure and also by the formation of suboxide layers.

50. Protective Effect of Tungsten in the Oxidation of Titanium

"Effect of Tungsten on the Oxidation of Titanium," by D. I. Layner and Ye. N. Slesareva, State Scientific and Planning Institute for the Processing of Nonferrous Metals; Sverdlovsk, Fizika Metallov i Metallovedeniye, Vol 14, No 3, Sep 62, pp 400-405

A discussion by the authors on the effect of tungsten in the oxidation of titanium based on their own experimental works is presented.

The structure of titanium alloyed with tungsten and the diffusion processes of both tungsten and oxygen in titanium are discussed, in conjunction with the tungsten and oxygen content and temperatures. Basically, according to the authors, the protective action of tungsten in retarding the oxidation of titanium is the formation of a  $WO_3$  layer under a layer of  $TiO_2$  which greatly reduces the diffusion of oxygen into the base metal.

Titanium alloys containing 0, 1, 1.24, 5, and 14.45% tungsten were oxidized in air and steam at temperatures 800-1,000°C for varying intervals of time. Hardness measurements were made and microstructures examined; however, in the discussion of the results, no indication is given as to the optimum tungsten content, and no conclusions are drawn for temperature and oxygen-content limitations.

51. Stress Concentrations in Molybdenum Disulfide Layers

"The Effect of Stress on the Stability of Silicide Layers in Molybdenum," by V. Ye. Ivanov, Ye. P. Nechiporenko, A. D. Osipov, and V. I. Zniy; Sverdlovsk, Fizika Metallov i Metallovedeniye, Vol 14, No 4, Oct 62, pp 574-577

Silicide layers on molybdenum form a highly oxidation-resistant coating which withstands high temperatures in steady-state heat flow. However, in unsteady-state heat flow (cyclic heating), cracks are noted to form as a result of concentrated stresses caused by the large difference in the coefficients of thermal expansion for silicon and molybdenum.

A study was conducted by the authors on the effect of temperature on the stability of molybdenum disilicide layers and the maximum stresses which disilicide layers of varying thickness could withstand.

Mathematical relationships, testing procedure, and graphical representation of their results are given in the text.

Crystallgraphy52. Creep Studies of Ferrosilicon

"The Effect of Substructure on the Creep of Single Crystals of Ferrosilicon," by V. M. Rozenberg and A. V. Shalimova, Institute of Metallography and Metal Physics, Central Scientific-Research Institute of Ferrous Metallurgy imeni I. P. Bardin; Moscow, Doklady Akademii Nauk SSSR, Vol 148, No 1, 1 Jan 63, pp 82-83

Results of a study of deformation and annealing, leading to the formation of a substructure in the subsequent creep of single crystals of ferrosilicon (3.2% Si), are presented.

Single crystals of ferrosilicon (20x3x0.3 mm) were obtained by electrolytic etching, and the resulting crystals vacuum annealed at 1350°C for 3 hours. Prior to annealing, the crystals were deformed by bending into a circle with a 25-mm radius around the (010) axis. The selection of this particular axis was made because it creates two intersecting systems of slip: (011), [111] and (110), [111]. The specimens were tested in three conditions: (1) annealed at 1350°C, (2) annealed at 1350°C and deformed, and (3) annealed at 1350°C, deformed, and annealed at 800°C. Creep testing of the crystals was conducted in a vacuum at 700°C for (one hour at a constant load one g/mm<sup>2</sup>).

Plotted curves showed that the creep rate of the deformed and annealed specimens (condition 3) is less than the others. This factor was due to the polygonization of the crystals in this condition.

It was concluded that the creep rate of single crystals with a certain degree of deformation is practically independent of the initial substructure being only a function of the testing temperature and load.

53. Dislocation Loops in a Hardened Cu-Al Alloy

"Examination of Dislocation Loops in a Hardened Cu-Al Alloy With an Electron Microscope." by L. S. Bushnev, G. G. Minayeva, and V. Ye Panin, Diberion Physical and Technical Institute; Sverdlovsk, Fizika Metallov i Metallovedenie, Vol 14, No 3, Sep 62, pp 470-472

An investigation of ordering processes during the annealing of hardened solid solutions of Cu-Al alloy showed that in the case of very high quenching temperatures (800-900° C), secondary processes take place in the alloy, in addition to ordering, which lead to anomalies in the properties of the alloy. In the present work, it was also shown that there is an existing effect caused by the segregation of excess vacancies with subsequent formation of dislocation loops. These dislocation loops were very stable and disappeared only by annealing at very high temperatures. The concentration, shape, and size of the loops depend upon the material and the quenching conditions, and their formation is accompanied by changes in the properties of the material.

Copper containing 14.3 atomic % Al was made into thin foil with a thickness ranging from 1,000 to 2,000 Å. These four samples were held at 900°C for one hour, quenched to room temperature, and given one-hour anneals at various temperatures (100, 200, and 300°).

Examination of the annealed samples with the electron microscope showed that after one hour at 100°, the quenched effects were still evident. After a one-hour anneal at 200°, a large number of dislocation loops measuring 300-500Å were observed. After a one-hour anneal at 300°, the number of loops became considerably less, but their size approached 800-1,000Å. It was noted that only hardening effects in the form of dislocation loops were observed. No tetrahedral defects, which are characteristic for alloys with low stacking-fault energy, were observed. The reason for the absence of tetrahedral defects is at present unknown.

According to the authors, dislocation loops exist even at 800°C, and from their point of view the processes of ordering and disordering are still not understood.

54. Investigation of Stacking Faults in Cobalt Alloys

"Stacking Faults and Segregation in Cobalt-Based Alloys," by Yu. A. Skakov and Yu. O. Mezhenyy, Moscow Institute of Steel and Alloys; Sverdlovsk, Fizika Metallov i Metallovedeniye, Vol 15, No 2, Feb 63, pp 280-284

Stacking faults in cobalt-based alloys with face-centered cubic lattices (Kh<sup>4</sup>ONKHM-type alloys) were investigated. A comparison of the shifts of peaks and centroids (the centroid of the area formed by the intensity curve and abscissa) of X-ray lines (111) and (200) after deformation and annealing led to the conclusion that the process of cold deformation in alloys forms stacking faults, and with subsequent annealing, segregation of impurity atoms are formed in the areas of hexagonal close-packing.

The effect of heat treatment and alloy composition on the concentration of defects was discussed, and it was concluded that the strengthening of cobalt-based alloys by heat treatment is associated with the formation of segregations near the stacking faults.

55. Scattering of X-Rays by Dislocations

"The Theory of Scattering of X-Rays by Crystals Containing Dislocations. The case of Randomly Dispersed Edge and Screw Dislocations in a Crystal," by M. A. Krivoglaz and K. P. Ryaboshapka, Institute of Metal Physics, Academy of Sciences Ukrainian SSR; Sverdlovsk, Fizika Metallov i Metallovedeniye, Vol 15, No 1, Jan 63, pp 18-31

An examination is made of the scattering of X-rays by crystals containing rectangular screw and edge dislocations. It was assumed that there is no correlation in the grouping of dislocations and that their diffraction lines are situated along directions characteristic for the given structure. It was also pointed out that slip at a given point creates dislocations in the vicinity of and away from the point of slip.

The case was investigated where the average distance between dislocations is considerably less than the size of the crystal. It was found that dislocations cause a widening of the lines in the diffraction pattern. The width of the lines is proportional to  $\tan\theta$ , where  $\theta$  is the scattering angle and depends not only on the length, but also on the direction, of the corresponding diffraction vector.

The above statements were derived as a result of an extensive mathematical treatment on the theory of dislocations. Crystals containing a single dislocation or multitude of dislocations were considered. Edge and screw dislocations were given separate treatment.

Electron-Beam and Vacuum Processing56. Effect of Vacuum Melting on the High-Temperature Properties of Iron Alloys

"Effect of Vacuum Melting on the High-Temperature Properties of Iron Alloys," by I. L. Mirkin, T. I. Volkova, and M. S. Blanter, Moscow, Struktura i Svoystva Novykh Zharoprochnykh Materialov, Book No 105, 1962, pp 125-134 (from Referativnyy Zhurnal, Otdel'nyy Vypusk -- 48. Mashinostroitel'nyye Materialy, Konstruktsii i Raschet Detaley Mashin, No 3, Mar 1963, p 13, Abstract No 3.48. 90)

A series of iron-base alloys were examined to determine the effect of vacuum melting ( $1 \times 10^{-4}$  --  $5 \times 10^{-5}$  mm Hg). It is established that steels of complex composition melted in a vacuum have increased resistance to creep and an increased relaxation stability. The long-time strength of complex alloy steels is somewhat higher with vacuum melting and casting; however, the ductility is lower. It is established that the best results are obtained in a case when the use of a vacuum is accompanied by a certain modification of the chemical and phase composition of the steel which is impossible with melting in air.

57. Electron-Beam Welding of Chromium

"Electron Welding of Chromium," by S. M. Gurevich and G. K. Kharchenko, Institute of Electric Welding imeni Ye. O. Paton, Academy of Sciences Ukrainian SSR; Kiev, Avtomaticheskaya Svarka, No 12, Dec 62, pp 56-59

Comparative studies were made on the quality of welds of commercially pure chromium. Welded chromium samples were made by three methods: electron-beam, inert-gas shield (manual), and electric-arc welding with a nonconsumable tungsten electrode in a controlled atmosphere.

In all cases, best results were obtained by the electron-beam method. Welds by this method possessed the best mechanical properties, microstructures, and ductile-to-brittle transition temperature. It was noted that the base metal had increased ductility after electron-beam welding as a result of decreased content of gas impurities.

58. Elimination of the Arc-Discharge During Electron-Beam Melting

"A Device for the Automatic Cut-off of the Anode Current of the Electron-Beam Gun During Development of an Arc Discharge," by A. B. Koval', Institute of Electric Welding Imeni Ye. O. Paton, Academy of Sciences Ukrainian SSR; Kiev, Avtomaticheskaya Svarka, No 1, Jan 63, pp 84-86

One of the problems encountered in the electron-beam melting of metals is the appearance of an arc discharge caused by intensive ionization of gases during their ejection from the melting chamber, which in turn causes a short circuit in the thyatron rectifier.

A device has been developed for eliminating this arc-discharge at the Institute of Electric Welding. Schematic diagrams of the circuit of this new device and a discussion of its operation are given in the text.

59. Purification of Cadmium by Vacuum Distillation

"Purification of Commercially Pure Cadmium by Vacuum Distillation With the Use of a Preheated Condensing Plate," by B. N. Aleksandrov and I. G. D'yakov; Sverdlovsk, Fizika Metallov i Metallovedeniye, Vol 14, No 4, Oct 62, pp 569-573

The vacuum distillation method of obtaining a superpure grade of cadmium (99.99994%) is described. The optimum conditions for this process were obtained by running a number of tests at varying vaporization temperatures and temperature gradients of the condensing plate. These tests showed that at vaporization temperature 450°C and a condensing plate gradient of 255°-280°C, the best results were obtained. The purity of the cadmium was as good as or better than pure cadmium produced by electrolysis plus zone refining.

60. Vacuum Condensation of Uranium and Thorium

"Vaporization of Substances in A Vacuum on a Thin Organic Film" by A. I. Baranov, V. A. Blinov, G. P. Lepnev, and Yu. A. Selitskiy; Moscow, Pribery i Tekhnika Eksperimenta, No 5, Sep/Oct 62, pp 173-174

A method is described for the vacuum vaporization and condensation of metals with melting points above 1000°C onto thin organic films which can be easily removed from the condensing plate. The problem of heat transfer from the condensing plate was solved by using metals or alloys with high thermal conductivity to take heat away from the condensing plate.

The described process has been successfully used to obtain uniform semitransparent layers of chromium and iron with thicknesses of 100 micro-g/cm<sup>2</sup>.

To obtain layers of uranium or thorium, which have melting points above that of the tantalum heater, tetra fluorides of these elements were used. Layers of uranium and thorium with a thickness of 250 micro-g/cm<sup>2</sup> were obtained. No mention is made of the organic materials used as films.

Patents61. Recent Soviet Patents in the Field of Metallurgy

"Authorship Certificates"; Bulleten' Izobreteniy, No 21, 1962

Class 40a, 46<sub>50</sub>. No 151469. V. V. Sergeev, I. I. Sokolon, B. N. Kushkin, S. N. Bondarev, I. A. Titayev, and V. A. Razzhivin, "Closed Reactor for Reducing Titanium Chloride With Magnesium."

Class 40d, 130. No 151473. V. N. Vigdorovich and I. F. Chernomrdin, "Method for Oriented Crystallization of Metals." [alternating current is passed through the ingot being grown from a melt or zone refined]

Class 40d, 130. No 151474. A. P. Babushkin, I. I. Ganel'-Budantsev, and E. S. Milenin, "Cooler for a Furnace for Zone Refining of Metals."

C-O-N-F-I-D-E-N-T-I-A-L

Class 48d, 203. No 151545. D. Ya. Lezhnev, B. N. Dolbilin, and V. I. Baranov, "Apparatus for Relief Etching of Aluminum Sheet in a Flowing Bath."

Power Metallurgy

62. Diffusion Studies of Powder-Metal Carbides

"Diffusion of Tungsten in Monocarbides of Tungsten, Tantalum, and Titanium, and in Solid Solutions of TiC-WC-TaC," by M. L. Baskin, V. I. Tret'yakov, and I. N. Chaporova, All-Union Scientific-Research Institute of Hard Alloys; Sverdlovsk, Fizika Metallov i Metallovedeniye, Vol 14, No 3, Sep 62, pp 422-427

An investigation was made on the diffusion of tungsten in powder-metal carbides of titanium, tungsten, and tantalum and in some of the solid solutions of these carbides. Numerical values for the activation energy and coefficient of diffusion were determined for the above-mentioned hard alloys. Chemical composition of the experimental specimens was based on alloys being used in industry at the present time.

Parameters of the diffusion process were calculated from data obtained by X-ray analyses of samples which had been coated with a thin uniform layer of tungsten (less than one micron thick) prior to diffusion annealing.

Results of this investigation showed that TaC possesses a larger activation-energy value than WC and that solid solutions of these alloys possess the highest activation energy which was explained by the energy level and capacity of the unfilled 3d-electron shell of titanium.

63. Internal Friction Studies of Powder-Metal Copper

"An Investigation of Internal Friction in Samples Produced by Powder-Metallurgy Methods," by V. P. Yelyutin, Ye I. Mozhukhin, A. V. Panov, and P. B. Khalil, Moscow Institute of Steel; Sverdlovsk, Fizika Metallov i Metallovedeniye, Vol 14, No 3, Sep 62, pp 443-451

A study was made concerning one of the more important factors, that of internal friction, affecting the pressing and sintering of metal powder.

Internal friction measurements of plates pressed from electrolytic copper powders were made by the method of forced vibration in an electromagnetic field [A diagram of the measuring device and accessory equipment is shown in the text].

Relationships between internal friction and temperature at various pressures were studied. Two factors, grain boundaries, (size, shape, and growth) and oxygen content, were noted to give rise to an increase in the internal friction of powder-metal specimens. The extent of the effect of these factors depends upon composition, pressure, and sintering temperature.

It was found that both factors could be eliminated for the most part by sintering at 900-1,000°C. In this specific temperature interval, grain boundary bonds lose their strength, and grain growth is not rapid enough to maintain an opposing force of internal friction.

64. Investigation of the Compressive Strength of WC-Co and TiC-WC-Co Alloys

"Effect of Composition and Structure on the Compressive Strength of WC-Co and TiC-WC-Co Alloys," by V. I. Tumanov, V. F. Funke, Z. I. Pavlova, T. A. Novikova, and K. A. Bystrova, All-Union Scientific-Research Institute of Hard Alloys; Sverdlovsk, Fizika Metallov i Metallovedeniye, Vol 15, No 2, Feb 63, pp 285-289

The effect of the cobalt and titanium carbide compositions and grain size of the carbide phases on the compressive strength of WC-Co and TiC-WC-Co alloys was studied. It was shown that the compressive strength of the alloys depends on the cobalt content, of which the WC-Co alloys and those containing 15% TiC exhibit the highest compressive strength. It was also shown that the compressive

strength values of the TiC-WC-Co alloys are reduced with increase of the titanium carbide content. Alloys of the VK- and TL5K-series with varying cobalt content were tested. Tables giving the cobalt content, grain size of the carbide phases, and compressive strength after sintering and annealing are presented in the text.

#### 65. Preparation of Cerium Nitride

"Preparation of Cerium Nitride," by G. V. Samsonov and M. D. Lyumaya, Institute of Powder Metallurgy and Special Alloys, Academy of Sciences Ukrainian SSR; Leningrad, Zhurnal Prikladnoy Khimii, Vol 35, No 11, Nov 62, pp 2359-2362

According to the authors, the preparations of cerium nitride (CeN) can be accomplished with  $N_2$  at  $800^\circ C$  and ammonia at  $500^\circ C$  or higher. It was established that with nitrogen gas, a stable (up to the melting point of Ce) gas-impervious nitride forms on the surface of the cerium, but with ammonia, a cerium hydride is formed which breaks the metallic bonds and restricts formation of a nitride coating.

#### 66. Welding of Metal Powders

"Problems in the Welding of Metal Powders," by Engr L. A. Mel'nikov, Basic Welding Laboratory, Bryansk Machine Building Plant; Moscow, Svaroch-noye Proizvodstvo, No 11, Nov 62, pp 13-15

A process for welding ferrous and nonferrous metal powders and certain ferroalloy powders is described. This process uses the welding platform as one electrode and the compressing plunger as the other electrode. Metal powders which usually become oxidized in their handling are placed in the mold which rests on the plate to which the powders are to be welded. The powders are then compressed (this breaks the oxide film and allows a metal-metal contact of the particles), and then heated by passage of current from the plunger to the bottom electrode through the powders and the plate.

A pulsing current is used to allow the temperature to stabilize between pulses. Most of the thermal expansion of the powders occurs in the initial current impulses, and the internal stresses created in the powder aid in rupturing the remaining oxide films. Welding powders by this method can be done, while simultaneously welding them to the surface of the part.

Resistivity-pressing pressure curves are given for the various powders and powder sizes. The most important factor in determining the weldability of powders is the stability of the oxide films. Thus, nickel, aluminum, and tungsten powders which have a highly stable oxide film possess poor weldability, while powders of iron and its alloys have very good welding properties.

#### Treatment and Testing

##### 67. Creep Resistance of Steel E1211

"Creep Resistance of Steel E1211, Alloyed With Titanium and Niobium," by R. B. Caletayeva, Moscow, Struktura i Svoystva Novykh Zharoprochnykh Materialov, Book No 105, 1962, pp 176-183 (from Referativnyy Zhurnal, Otdel'nyy Vypusk -- 48. Mashinostroitel'nyye Materialy, Konstruktsii i Raschet Detaley Mashin, No 3, Mar 63, p 3, Abstract No 3.48.92)

Results are given of creep tests on steel E1211 alloyed with 0.4-0.5 percent titanium and 1.0 percent niobium performed by the Oding method using annular specimens at temperatures of 550, 600, 650, and 700°C and various stresses ( $\sigma = 8-16 \text{ kg/mm}^2$ ). Results are presented in the form of a composite table, creep curves, and graphs showing the dependence of the rate of creep on the stress. The highest resistance to creep at 700°C was exhibited by a steel alloyed with one percent niobium. Introduction of 0.5 percent titanium into an E1211 steel does not increase its stability nor resistance to creep.

##### 68. Creep Studies of Ti-Zr-Sn Alloys

"The Creep of Ti-Zr-Sn Alloys," by V. V. Glazova and N. N. Kurnakov (deceased); Moscow, Izvestiya Akademii Nauk, Otdelenciye Tekhnicheskikh Nauk, Metallurgiya i Gornoye Delo, No 1, Jan/Feb 63, pp 161-167

An investigation was made on the creep of ternary solid solutions of tin and zirconium in alpha-titanium. A correlation between the creep-composition diagram and the phase diagram was found in this system, which confirms earlier hypotheses about the effect of temperature on the phase transformation (alpha-gamma) → beta which takes place in this system.

## C-O-N-F-I-D-E-N-T-I-A-L

It was established that there is a region in the Ti-Zr-Sn system where the alloys possess a maximum resistance to plastic deformation at elevated temperatures. This region occurs at 15-20% Zr.

The effects of both zirconium and tin when alloyed with titanium as either binary or tertiary alloys are discussed in conjunction with their strengthening characteristic and compositions limitations.

### 69. Creep Testing of Alpha-Iron by Torsion

"Investigation of Creep of Alpha-Iron by the Torsion Method," by L. N. Bystrov, L. I. Ivanov, and E. A. Surova, Moscow, Issledovaniya po Zharoprochnym Splavam, Vol 9, 1962, pp 72-81 (from Referativnyy Zhurnal, Otdel'nyy Vypusk -- 48. Mashinostroitel'nyye Materialy, Konstruktsii i Raschet Detaley Mashin, No 3, Mar 63, p 13, Abstract No 3.48.91)

A study is presented of the steady-state creep of alpha-iron under torsion in the stress interval of 40-439 kg/cm<sup>2</sup> and in the temperature interval of 630-900°C, using solid and hollow specimens. It was established that at low stresses in the interval of 40-138 kg/cm<sup>2</sup> the energy of activation of steady-state creep is practically independent of the stress and averages 77.7 Kcal/g atcm. Data are presented on the distribution of stresses over the cross-section of a specimen under torsion and creep conditions.

70. Effect of Age-Hardening on the Properties of Aluminum Alloy AL8

"Effect of Natural and Artificial Age Hardening on the Mechanical Properties of Items Made of Aluminum Alloy AL8," by O. B. Lotareva, M. P. Stronskaya, and L. I. Loktionova, Moscow, Liteynyye Alyuminiyevyye Splavy, 1961, pp 66-69 (from Referativnyy Zhurnal, Otdel'nyy Vypush -- 48. Mashinostroitel'nyye Materialy, Konstruktsii i Raschet Detaley Mashin, No 3, 1963, p 18, Abstract No 3.48.137)

Results are given of the investigations of the effect of natural aging over long intervals of time on the mechanical properties of alloy AL8. Natural age-hardening of this alloy after quenching increases the tensile strength and elongation, particularly in the first period of aging (up to 15 months). With aging up to 40 months, the properties of this alloy are higher than without natural age-hardening. The over-all level of mechanical properties of an alloy of the Al-Mg-Zn system is considerably higher than for alloy AL8. Artificial age-hardening at 100°C for 3 hours, 115°C for 3 hours, 125°C for 3 hours, and 150°C for 3 hours, makes it possible to retain 50-60 percent of the initial elongation factor of this alloy in the initial state.

71. Effect of Grain Size and Excess Titanium on the Long-Time Strength of Steel 1Kh18N9T

"Causes of Certain Peculiarities in the Behavior of 1Kh18N9T Grade Steel and Long-Time Strength Tests," by A. M. Parshin and I. Ye. Kolosov, Leningrad, Trudy Leningradskogo Politehnicheskogo Instituta, No 219, 1962, pp 115-129 (from Referativnyy Zhurnal, Otdel'nyy Vypusk -- 48. Mashinostroitel'nyye Materialy, Konstruktsii i Raschet Detaley Mashin, No 3, Mar 63, p 13, Abstract No 3.48.94)

The effect of grain size and excess titanium in a 1Kh18N9T-grade of steel on its heat resistance is examined. The long-time strength of a coarse-grain steel with low ductility is below that of a fine-grain steel. It is established that the long-time strength is a function of ductility, whereas the ductility in turn is a function of grain size. With increase in the excess of titanium, the ductility of this grade of steel decreases. It is established that one of the basic factors decreasing the service life of parts at high temperatures is an excess of titanium which is above a 5 to 6-fold ratio of titanium to carbon.

72. Effect of Preliminary Deformation on the Heat Resistance of Tubing Steels

"Effect of Preliminary Deformation on the Heat Resistance of Tubing Grade of Steels," by I. I. Trunin and G. A. Shabin, Moscow, Struktura i Svoystva Novykh Zharoprochnykh Materialov, Book No 105, 1962, pp 144-164 (from Referativnyy Zhurnal, Otdel'nyy Vypusk -- 48. Mashinostroitel'nyye Materialy, Konstruktsii i Raschet Detaley Mashin, No 3, Mar 63, p 13, Abstract No 3.48.93)

A study is made of the nonuniform plastic deformation in the cold state, as produced by torsion (the degree of deformation was 10, 20, and 50 percent) and of the long-time strength of tubing materials (perlitic steels of grades EI694, EI695, and EI17) at temperatures of 610°C and 600°C. Preliminary deformation at 20°C to 10 percent and above shows a detrimental effect on the heat-resistant characteristics of both austenitic and perlitic steels. Under such conditions, embrittlement of the steels is increased. A considerable decrease of the long-time strength can be expected with the presence of stress concentrations. To restore the properties of the steels, it is necessary to conduct additional heat treatment of those parts of constructions which were subjected to deformation in the cold state.

73. Effect of Small Additions on the Age-Hardening and Properties of Alloys of the AL-Mg-Zn-CU System

"Effect of Small Additions on the Age-Hardening and Properties of Alloys of the AL-MG-ZN-CU- System," by M. I. Zamotorin and Ye. Ye. Pal', Leningrad, Trudy Leningradskogo Politekhnicheskogo Instituta, No 218, 1962, pp 50-54, (from Referativnyy Zhurnal, Otdel'nyy Vypusk -- 48. Mashinostroitel'nyy Materialy, Konstruktsii i Raschet Detaley Mashin, No 3, Mar 63, p 18, Abstract No 3.48. 138)

A study is presented of the effect of additions of boron (0.025-0.125 percent), misch metal (0.1-0.5 percent), silver (0.25-0.75 percent) and zirconium (0.5 percent) on the mechanical properties and the natural and artificial age-hardening processes of an aluminum alloy of the V95-type (7.3 percent tin, 2.7 percent magnesium, 0.5-0.75 percent copper, and 0.5 percent manganese). It is established that additions of boron, misch metal, and zirconium increase the plastic properties of cast alloys

74. High-Temperature Chromium-Tungsten Carburized Steels

"Low-Carbon High-Temperature Chromium-Tungsten Carburized Steels," by V. D. Chirikov, V. S. Krupennikov, and M. I. Moiseyeva, Trudy Nauchno-Issledovatel'kogo i Eksperimental'nogo Podshipnikogo Promyshlennosti, No 1 (21), 1960, pp 3-14 (From Referativnyy Zhurnal, Otdel'nyy Vypusk -- 48. Mashinostroitel'nyye Materialy, Konstruktsii i Raschet Detaley Mashin, No 3, Mar 63, p 9, Abstract No 3.48.63)

A study is presented of the properties of the carburized layers and cores of low carbon chromium-tungsten steels after various conditions of chemical-heat treatment. On the basis of an analysis of data, it is established that the content of carbon in the core of the steel should be within the limits of 0.2-0.35%, depending on the designated use of the steel; the content of vanadium should be 1.0%; chromium, 4%; and tungsten, 10-18 %. Increase of the carbon content above the indicated limits leads to very high hardness at the core of the carburized parts during or after tempering as the result of the decomposition of austenite into martensite. For a carburized steel having more than 10 % tungsten, decreasing the carbon content below 0.15% results in precipitation hardening of the core during the process of high-temperature tempering. The procedure for heat treating bearing rings and cutting tools made of the

above-indicated steels should be as follows: carburization at 930-1,050°C to a depth depending on the designation of the part; annealing; heating to a temperature of 1,150-1,250°C for final quenching; and triple tempering at a temperature of 500-600°C, depending on the content of tungsten and carbon in the steel.

#### 75. Hydrogen Embrittlement of Titanium Alloys

"The Effect of Hydrogen on the Tendency of Titanium Alloys Toward Delayed Cracking," by B. S. Krylov and A. S. Mikhaylov; Moscow, Izvestiya Akademii Nauk, Otdeleniye Tekhnicheskikh Nauk, Metallurgiya i Gornoye Delo, No 1, Jan/Feb 63, pp 168-175

Results of investigations on the effects of hydrogen (0.03-0.05%) on tendency toward delayed fracture of titanium alloys OT-4, VT-4, T4, VT-5-1, and VT-14 revealed that hydrogen facilitates the process of crack formation and development. It was also found that the stability of welded joints can be both somewhat lower (alloys OT-4, VT-5-1, and VT-14) or higher (VT-4 and T-4) than the base metal.

The alloys containing various amounts of hydrogen (0.002-0.050%) were subjected to long-time bend tests in the as-quenched and after-aging conditions. The samples were observed daily in order to note when cracking started. Time-to-fracture data revealed that 400 days was the maximum time before crack formation in those alloys containing very low quantities of hydrogen. Crack development within one day was noted in alloys containing 0.050% H<sub>2</sub>.

Some interesting effects were noted; for instance, alloy VT-14 was less subject to cracking after quenching than after aging, which is the opposite effect noted in the other alloys. From the data presented in the tables, it appears that a hydrogen content of less than 0.015% is permissible; however, one must also take into account the magnitude of stress and its method of application (static or dynamic loading). One other point brought out by the authors was that hydrogen is detrimental to a metal regardless of whether or not it forms a hydride.

76. Increasing the Relaxation Resistance of a Perlitic Steel by High-Temperature Quenching

"High-Temperature Quenching As a Measure for Increasing the Relaxation Resistance of a Perlitic Steel," by T. I. Volkova, Moscow, Struktura i Svoystva Novykh Zharoprochnykh Materialov, Book No 105, 1962, pp 87-97 (from Referativnyy Zhurnal, Otdel'nyy Vypusk -- 48. Mashinostroitel'nyye Materialy, Konstruktsii i Raschet Detaley Mashin, No 3, Mar 63, p 14 Abstract No 3.48.101)

A study is presented of the effect of quenching from a wide interval of temperatures (400-800°C) on the relaxation resistance and mechanical properties of a perlitic steel (with  $\sigma_0 = 25 \text{ kg/mm}^2$  at testing temperature was 730°C, in which case the softening is expressed by the value of 55-60 percent (HB). Quenching from this temperature caused a sharp increase in the relaxation resistance as compared to the generally accepted practice of quenching from 650 to 680°C.

77. Investigation of the Magnesium-Cadmium System

"The Relationship Between Composition and Hardness in the Magnesium-Cadmium System at Various Temperatures," by V. P. Shishokin and L. N. Bazilevskiy, Leningrad Polytechnic Institute imeni M. I. Kalinin and Leningrad Pedagogical Institute imeni A. I. Gertsen; Sverdlovsk, Fizika Metallov i Metallovedenniye, Vol 15, No 1, Jan 63, pp 76-81

A study was made of the changes in hardness at temperatures of 20, 70, 120, 170, 220, and 300°C with respect to the composition of alloys  $\text{Mg}_3\text{Cd}$ ,  $\text{MgCd}$ , and  $\text{MgCd}_3$ .

The above-mentioned alloys possess the normal properties of alloys in that with increasing temperatures the hardness also increases, due to thermal expansion and fusions. This particular alloy system has an order-disorder transformation occurring at approximately 275°C, above which the hardness begins diminishing.

At 300°C, there is a sharp break in the hardness curve of alloys containing 40-42% cadmium. After this break, a diminishing of the hardness occurs along with increased cadmium content. The effect of the considerable decrease of hardness and the onset of plastic deformation of the alloys is called "superductility," which is observed when the alloy obtains an equilibrium composition.

The authors also discussed the mechanism involved in the process of hardening and superductility in which they incorporate the theories of dislocations, vacancies, atomic spacing, and Brillouin zones.

78. Long Time Strength of Heat-Resistant Steels in a Complex Stressed State

"Study of the Long-Time Strength of Heat-Resistant Steels in a Complex Stressed Condition," by I. I. Trunin and G. A. Shabin, Moscow, Struktura i Svoystva Novykh Zharoprochnykh Materialov, Book No 105, 1962, pp 42-56 (from Referativnyy Zhurnal, Otdel'nyy Zhurnal, Otdel'nyy Vypusk -- 48. Mashinostroitel'nyye Materialy, Konstruktsii i Raschet Detaley Mashin, No 3, Mar 63, p 14, Abstract No 3.48.97

Results are given of an investigation of the long-time strength of tubular specimens made of the steam superheating tubing steels 15 Kh1M1F (temperature of 507° C) and 1Kh18N12T (temperature of 610° C) under torsion and tension. Both the intensity of tangential stresses

$$\sigma_1 = \sqrt{\sigma_x^2 + 3 \tau_{xy}^2},$$

were  $\sigma_x$  is the normal stress from the axial tensile force and  $\tau_{xy}$  is the tangential stress from the torsional moment, and the magnitude of the first main normal stress  $\sigma_1$  were taken as criteria of long-time strength. As a result of the investigation, it was established that the evaluation of the resistance to long-time failure can be conducted with the use of the criterion for the stressed state in the form of the half-sum  $\frac{\sigma_1 + \sigma_2}{2}$ . The long-time strength of metal of tubular specimens with thin walls was shown to be lower than that of solid cylindrical specimens with thin walls was shown to be lower than that of solid cylindrical specimens of the same grade of steel. The perlitic steel 15Kh1M1F has less tendency to crack formation during creep than the austenitic steel 1Kh18N12T.

79. Long-Time Strength of Ti3Al

"Long-Time Strength of Ti3Al at 800°C," by I. I. Kornilov and T. T. Nartova, Institute of Metallurgy imeni A. A. Baykov; Moscow, Doklady Akademii Nauk SSSR, Vol 148, No 3, 21 Jan 63, pp 644-646

The long-time (bend) strength of Ti3Al was investigated at 800°C. The time-to-fracture of this alloy at a constant stress of 15 kg/mm<sup>2</sup> was 500 hours; and at a stress of 10kg/mm<sup>2</sup>, varied from 1100 to 1700 hours.

Data of these tests were compared to similar data on heat-resistant nickel alloys EI-437A, EI-437B, and EI-617. According to the authors, the heat resistance of  $Ti_3Al$  is 1,000 times greater than for pure titanium and many times greater than many of the modern titanium alloys. The specific weight of  $Ti_3Al$  is half that of most nickel-based alloys, but nickel alloys have better ductility.

#### 80. Macrostructure Improvements in Vacuum-Melted ShKh15 Steel

"Improvement of the Macrostructure of ShKh15 Steel Melted in a Vacuum-Arc Furnace," by G. N. Okorokov and V. Ya. Boyarshchinov, Candidates of Technical Science and Engrs. Yu. P. Shamil', S. A. Leybenzon, A. I. Pakhomov, and A. I. Polyakov; Moscow, Stal', No 1, Jan 63, pp 30-34

In a research project to find the cause of and to eliminate the presence of mottled liquations in ingots of high carbon steel, melted in a vacuum-arc furnace, it was established that this phenomenon is associated with the action on the melt of an unbalanced external magnetic field (of the operating current) and the effect of proximity magnetic masses.

This project was initiated in 1961 at the Central Scientific-Research Institute of Ferrous Metallurgy and Dneprospetsstal' Plant, where research was conducted primarily on ShKh15 steel.

A lengthy discussion is given on the many processes which take place and possibly cause liquation. However, the authors felt that the solution to their problem lies in the regulation of the inherent magnetic field. They submit that a detailed study of the mechanism involved might possibly lead to finding a means of using this magnetic field to their advantage in being able to alter the structure of steel in any desired direction.

#### 81. Optimum Treatment of a Steam Tubing Steel

"Steel 15Kh1M1F for Steam Tubing With an Operating Temperature of 565-585° C," by L. P. Trusov and L. S. Marinenko, Moscow, Struktura i Svoystva Novykh Zharoprochnym Materialov, Book No 105, 1962, pp 71-86 (from Referativnyye Zhurnal, Otdel'nyy Vypusk, -- 48. Mashinostroitel'nyye Materialy, Konstruktsii i Raschet Detaley Mashin, No 3, Mar 63, p 5, Abstract No 3.48.47)

Heat-treating conditions are selected and investigations are made of the properties of steel 15Kh1M1F which is being applied at present for steam tubing with an operating temperature of 565-585° C. It is established that optimal combination of strength and ductility

C-O-N-F-I-D-E-N-T-I-A-L

characteristics are achieved after normalizing from 1,030-1,050° C and tempering in the interval of 730-750° C. The long-time strength of tubing after 10<sup>5</sup> hours at 585° C is extrapolated to be 10-11 kg/mm<sup>2</sup>; and of the welded joint, 8-9 kg/mm<sup>2</sup>.

82. Phase Composition of the Diffused Layer of Borided Nickel

"Phase Composition of the Diffused Layer of Borided Nickel,"  
by S. B. Maslenkov and D. N. Zharkova, Institute of High  
Grade Steels, Central Scientific-Research Institute of Ferrous  
Metallurgy; Sverdlovsk, Fizika Metallov i Metallovedeniye,  
Vol 14, No 4, Oct 62, pp 638-640

An investigation was made of the phase composition of nickel  
borides formed by heating nickel in the presence of a mixture of  
 $BCl_2+H_2$  at  $900^\circ C$  for 5 hours.

X-ray and microscopic analyses revealed the formation of a  
borided layer approximately 60 microns thick consisting of four phases;  
 $Ni_3B$ ,  $Ni_2B$ ,  $Ni_3B_2$ , and  $NiB$ .

83. Physical and Mechanical Properties of Ti-Mo-Al Alloys

"The Physical and Mechanical Properties of Ti-Mo-Al Alloys,"  
by O. P. Yelyutin, G. P. Kalinin, G. I. Rogov, and S. M.  
Khromov; Moscow, Izvestiya Akademii Nauk SSSR, Otdeleniye  
Tekhnicheskikh Nauk, Metallurgiya i Gornoye Delo, No 1,  
Jan/Feb 63, pp 176-180

The electrical resistance, thermal e.m.f., thermal conductivity,  
and mechanical properties of Ti-Mo-Al alloys containing up to 10% Al  
and 30% Mo were investigated. Data on the above-mentioned properties are  
reported and discussed and supplemented by diagrams.

84. Second-Order Distortion of Sintered Refractory Metals

"Concerning the Role of Second-Order Distortion in the Re-  
crystallization Process During Sintering of Samples Com-  
pressed From Powdered Refractory Metals," by F. N.  
Alekseyeva, R. S. Matyushenko, V. S. Rokovskiy, and A. F.  
Silayev; Moscow, Izvestiya Akademii Nauk, Otdeleniye Tekh-  
nicheskikh Nauk, Metallurgiya i Gornoye Delo, No 1,  
Jan/Feb 63, pp 97-99

An investigation was made of the role of second-order microstresses  
created by the operation of pressing powders of refractory metals in the  
recrystallization process which occurs during sintering. Powdered  
niobium tungsten, and molybdenum were pressed at pressures ranging from  
1,000 to 8,000  $kg/cm^2$  at intervals of 1,000  $kg/cm^2$ .

Data from this investigation showed that microstresses of the crystal lattice during pressing increase intensively when pressed at 5,000-7,000 kg/cm<sup>2</sup>. Any further increase of the pressing load does not give any significant increase of lattice strain. From this it was assumed that refractory powders become stable at these high magnitudes of pressure.

The recrystallization process during sintering takes place in two stages. In the first stage, second-order stresses are reduced, and grains with a normal lattice structure (initial recrystallization) are formed. In the second stage, the growth of unstressed grains at the expense of the stressed grains (selective recrystallization) is observed. The growth process during selective crystallization proceeds by means of atom migration of single grains in the lattice of other grains, with the formation of new coarse grains and new boundaries. The effect of second-order microstresses on the size of the recrystallized grains, sintered at various conditions, is illustrated in diagrams given in the text.

An increase in the magnitude of the second-order microstresses of the lattice during pressing reduces the thermodynamic stability and creates favorable conditions for recrystallized grain growth sintering process. The intensity of grain growth depends primarily on the second-order microstresses and the sintering conditions.

#### 85. Strengthening of Nickel Alloys

"The Effect of the Fine Structure on the Strengthening of Nickel Alloys," by Engr S. B. Maslenkov and G. V. Estulin, Doctor of Technical Science, Central Scientific-Research Institute of Ferrous Metallurgy; Moscow, Metallovedeniye i Termicheskaya Obrabotka Metallov, No 1, Jan 63, pp 25-29

A study was made on the age-hardening of nickel alloys. Binary alloys Ni-Al and Ni-Ti and ternary alloys Ni-Cr-Al and Ni-Cr-Ti were made by induction melting.

All of the alloys were forged into rods and heat-treated by quenching from temperatures ranging from 1100 to 1200°C, followed by aging at 700° or 800°C for periods varying from 30 minutes to 3 hours. Samples which had been strained 10% were also investigated. Hardness, yield point, and grain size of all the alloys in their various conditions of heat treatment were made.

Analysis of the data of this investigation showed that particles of the second phase play an important role in the age-hardening of nickel-based alloys. Their high strength is the result of the formation and growth of secondary grains. These grains, measuring 200-500Å at the start, increased to more than 1,000Å during heat-treatment.

In this investigation, it appears that those alloys from 1150°C and aged at 700°C for 8 hours exhibited the best strength, with little difference between the binary and ternary alloys.

#### 86. Studies of Nb-Cr and Ti-Cr Solid Solutions

"The Decomposition of Ni-Cr and Ti-Cr Solid Solutions,"  
by N. V. Ageyev and M. S. Model', Corresponding Members of  
the Academy of Sciences USSR; Moscow, Doklady Akademii Nauk  
SSSR, Vol 148, No 1, 1 Jan 63, p 84-85

In addition to a study of the decomposition of the decomposition of solid solutions of Nb-Cr and Ti-Cr, the solubilities of the two metals in chromium and the lattice constants of the solid solutions were determined.

Chromium and iodides of niobium and tantalum were purified by a double electrolytic refining. Alloys containing 0-5% Nb and 0-10% Ti (atomic %) were made by levitation melting in helium and then were homogenized in argon. Boundaries of the two-phase regions were established to exist between 2-3% Nb and 5-7% Ti.

To study the solid solutions, the alloys were ground into powder (320 mesh), and flat samples were made for X-ray investigations. After determining the lattice constants of the samples in the (as-pressed) condition, the powders were vacuum annealed in a small, sealed quartz ampule which was then placed in a larger ampule containing a getter (a chip of titanium iodide) which was also vacuum sealed.

X-ray analysis of the annealed powders revealed shifts in the diffraction lines denoting the decomposition of the Cr-Nb (3.27% Nb) solid solution at 820-850°C and the Cr-Ti (7.5% Ti) solid solution 950-1200°C. The solid solutions of niobium in chromium were noted to decompose in the conventional fashion, whereas Cr-Ti solid solutions were found to undergo a two-phase decomposition. Solubility of both elements in chromium ranges from 0.3 to 0.6%.

87. Effect of Cobalt on the Properties of a 12% Chromium Steel

"Effect of Cobalt on the Structure and Properties of a 12% Chromium Steel," by M. F. Sheshenev and I. V. I. V. Ignatova, Moscow, Struktura i Svoystva Novykh Zharoprochnykh Materialov, Book No 105, 1962, pp 114-124 (From Referativnyy Zhurnal, Otdel'nyy Vypusk -- 48. Mashinostroitel'nyye Materialy, Konstruktsii i Raschet Detaley Mashin, No 3, Mar 63, p 8, Abstract No 3.48.60)

Results are given of investigations of the effect of 0.4-3.4 percent cobalt on the structure and properties of a 12% chromium steel at 20 and 600° C. It is established that alloying with cobalt sharply increases the high-temperature properties, particularly the resistance to creep of 12 percent chromium steel of the EI756 type at a temperature of 600-630°C, whereas the greatest effect is achieved with a cobalt content of 1.5-2.0 percent.

88. Effect of Copper Impurities on the Mechanical Properties of a 12% Chromium Steel

"Effect of Copper Impurities on the Mechanical Properties of a 12% Chromium Steel," by M. F. Sheshenev, Moscow, Struktura i Svoystva Novykh Zharoprochnykh Materialov, Book No 105, 1962, pp 108-113 (from Referativnyy Zhurnal, Otdel'nyy Vypusk -- 48. Mashinostroitel'nyye Materialy, Konstruktsii i Raschet Detaley Mashin, No 3, Mar 63, p 8, Abstract No 3.48.61)

The effect of an addition of 0.05-0.3 percent copper on the mechanical properties, creep, and long-time strength of a 12% chromium steel designated as EI756 is investigated. It is established that the short-time mechanical and high-temperature properties of this steel in the cast and forged state are not decreased if the copper content is increased from 0.05 to 0.25 percent. It is concluded that up to 0.25 percent copper in this steel is completely permissible.

89. Effect of Dimensions on the Long-Time Strength of Steels

"Effect of the Dimensions of Specimens on the Long-Time Strength of Steels 15KhM1F, 1Kh18N12P, and TsCh7," by A. S. Tereskovich, Moscow, Struktura i Svoystva Novykh Zharoprochnykh Materialov, Book No 105, 1962, pp 62-70 (from Referativnyy Zhurnal, Otdel'nyy Vypusk -- 48. Mashinostroitel'nyye Materialy, Konstruktsii i Raschet Detaley Mashin, No 3, Mar 63, p 13, Abstract No 3.48.95)

A study is presented of the effect of the dimensions of specimens (diameter from 4 to 12 mm, working length of 25-120 mm) on the long-time strength of steel grades 1Kh18N12P and TsZh7 at temperatures of 610 and 650°C, respectively, and steel 15KhM1F at a temperature of 630°C, whereby the specimens of various dimensions were compared, not according to the time to failure under identical stresses, but according to the long-time strength limits after 10,000 hours. The maximum duration of tests was 2,000-3,500 hours; results were extrapolated to 10,000 hours. Changing the diameter of specimens of steel 15KhM1F within the limits of 4-10mm and the design length from 25 to 100 mm and specimens of steel 1Kh18N12P from 4 to 12 mm and 25 to 120mm, respectively, showed practically no effect on the 10,000-hour strength. The same result was achieved when changing the diameter of specimens of cast steel TsZh7 from 7 mm and the design length from 40 to 100 mm. It is recommended that for testing in a multispecimen machine, the diameter of forged materials should be not less than 4 mm, and the design length, not less than 40 mm.

90. Mechanism of Plastic Deformation of Alloys in the Melting Point Range

"The Mechanism of Plastic Deformation of Alloys in the Melting Point Range," by I. I. Novikov and F. S. Novik, Moscow, Doklady Akademii Nauk SSSR, Vol 147, No 6, 21 Dec 62, pp 1352-1354

The mechanism of plastic deformation in the melting point interval has not been established by direct experiments. Study of this phenomenon was carried out by investigating the intergranular deformation of two aluminum alloys, one containing 1.1% Si, and the other, 1.5% Cu, at temperatures about the solidus lines. Basically, this study was one of creep at elevated temperatures.

The surfaces of the alloys were studied with an optical micro-interferometer before and after fracture in the temperature interval of 580-620°C, and from this study the amount of vertical displacement of the grains relative to each other was determined.

Microstructure studies showed that the Al-Si alloy undergoes intergranular deformation by reciprocal displacement of grain boundaries, whereas the Al-Cu alloy does not undergo deformation along the original grain boundaries, but along new boundaries formed in the initial stages of melting.

With an increase of temperature above the solidus lines, the melting rate is very low and, consequently, relative elongation increases very slightly because of the limited intergranular displacement. A further increase of temperature leads to an increase in the melting rate and, correspondingly, to a more intense increase of relative elongation. If the melting rate changes intermittently, as is observed in three-component and more complex alloys, then the relative elongation in the melting point interval also changes intermittently.

Thus, the data directly show that plastic deformation in the base metal was accomplished by intergranular disturbances in the melting point interval. The over-all relative elongation in this interval somewhat exceeds the magnitude of elongation caused by intergranular deformation due to development of intragranular deformation or formation of microcracks along the grain boundaries.

#### 91. Physical and Mechanical Properties of Certain Aluminum Alloys

"Investigation of the Physical and Mechanical Properties of Aluminum Alloys D1-T, D16-T, AMg61, and D16-A," by O. P. Shelstenko and Yu. M. Nagevich, Moscow, Stroitelnyye Konstruktsii iz Aluminiumyevykh Splavov, 1962, pp 55-77 (from Referativnyy Zhurnal, Otdel'nyy Vypusk -- 48, Mashinostroitel'nyye Materialy, Konstruktsii i Raschet Detaley Mashin, No 3, 63, p 18, Abstract No 3.48.136)

Data are given on the physical and mechanical properties of aluminum alloys D1-T, D16-T, AMg61, and D16A under tension and compression. The primary compression diagrams differed considerably from the corresponding tensile diagrams. The ultimate strength and proportional limits of alloys D1-T, D16-T, and AMg61 under compression are considerably less than under tension. The ratios of the mean static values of the ultimate strength under compression and tension are 0.93, 0.89, and 0.79, respectively.

92. Thermal Fatigue of Metals in Various Stressed States

"Investigation of the Resistance to Thermal Fatigue Failure for Various Stressed States," by V. I. Yegorov and N. B. Sobolev, Moscow, Issledovaniya po Zharoprochnym Splavam, Vol 9, 1962, pp 81-88 (from Referativnyye Zhurnal Otdel'nyy Vypusk, -- 48. Mashinostroitel'nyye Materialy, Konstruktsii i Raschet Detaley Mashin, No 3, Mar 63, p 5, Abstract No 3.48.35)

A discussion is presented of an attempt to construct a theory for the strength of a material when testing for thermal fatigue with the use of results of investigations conducted at various stressed states. The test materials consisted of thin-walled tubular specimens made of the construction steels EI-888 and EI-852 with diameters of 13 and 12 mm. These specimens were subjected to tensile loading compression and torsion in the temperature interval of 250-650 degrees centigrade. Heating was conducted with C current for a period of 10 seconds, and cooling, by passing a jet of air through the specimen for a period of 20 seconds. Processing of results of the tests conducted on the basis of  $10^4$  cycles made it possible to construct durability curves for each of the steels and to establish a relationship between the various factors involved in the stressed and deformed states on failure. The conclusion is made concerning the possibility of applying the theory of octahedral and tangential stresses for calculating the accumulation of defects and the danger of failure due to thermal fatigue in various stressed and deformed states.

93. Thermal Fatigue of Metals Under Cyclic Stresses

"The Behavior of Materials Under the Action of Long-Time Cyclic Thermal Stresses," by Yu. F. Balandin, Moscow, Issledovaniya po Zharoprochnym Splavam, Vol 9, 1962, pp 133-139 (from Referativnyye Zhurnal, Otdel'nyy Vypush, -- 48. Mashinostroitel'nyye Materialy, Konstruktsii i Raschet Detaley Mashin, No 3, Mar 63, p 5, Abstract No 3.48.34, by L. Liberman)

Mechanically simulated temperature drops were used in a study of the behavior of steel subjected to the cyclic action of thermal stresses. The test specimens were initially subjected to a tensile deformation of 0.3-0.4 % in a special device. The device and stressed specimen were held for 50 hours in a furnace at 700 degrees centigrade, and then the load was removed. Periodic repetitions of such tensile stressing was conducted to the point of fracture and imitated the accumulation of deformation under the action of thermal stresses and partially their relaxation.

As the result of investigations of austenitic steels EI694 and EI726, which possess high ductility and low strength ( $\sigma_s = 21-22 \text{ kg/mm}^2$ ), it was established that more than 40 cycles were required to rupture specimens of the first type of steel, whereas specimens of the second ruptured after 37 cycles. Steel Kh18N22B 2T2 and the nickel alloy EI437B, ( $\sigma_s = 41$  and  $68 \text{ kg/mm}^2$ , respectively) fractured after 3.5 and 8 cycles respectively. In the case of the latter two materials, it was established that upon changing the holding temperature from  $500^\circ$  to  $900-1,000^\circ\text{C}$ , the minimum number of cycles to fracture corresponded to aging temperature which causes the highest hardening (for steel Kh18N22T, it was  $700^\circ\text{C}$ , and for alloy EI437B, it was  $800^\circ\text{C}$ ). Above the below this temperature, the number of cycles to fracture increases.

In the case of alloy EI437B, data are presented on the dependence of the number of cycles to fracture on magnitude of the deformation to which the specimen was subjected for each cycle of loading. The minimum number of cycles corresponds to a deformation of 0.45%. It is noted that under the given test conditions, the strength of the materials is conditioned by the relationship between the values of elastic deformation being retained and the development of plastic deformation along grain boundaries as a result of the relaxation which occurs. On the basis of this, it is concluded that the resistance to cyclic thermal stresses is determined by the ductility and long-time tensile failure and not by the actual tensile strength of the given material.

Ultrasonic Treatment94. Effect of Ultrasound on Crystallization of Silumin

"The Influence of Ultrasound on the Structure of Silumin," by K. V. Gorev and L. A. Shevchuk; Sbornik Nauchnykh Trudov. Fiziko-tekhnicheskiiy Institut AN BSSR (Collection of Scientific Works. The Physicotechnical Institute, Academy of Sciences Belorussian SSR), No 7, 1961, pp 120-124 (from Referativnyy Zhurnal -- Elektronika i Yeye Primeneniye, No 2, Feb 63, 2 V 111)

In a study of the influence of ultrasound on the crystallization of silumin, ultrasonic (20 kc) vibrations were produced with a steel half-wave concentrator connected to a magnetostrictive transducer. The obtained cooling curves showed that when crystallization occurs during exposure to ultrasound, any indication of a supercooling, evident on cooling curves for ordinary conditions, is absent. Photographs of the microstructure of an unmodified and a modified silumin crystallized under the effect of ultrasound and without the effect of ultrasound clearly show the difference in the two processes of crystallization. The ultrasound eliminates the modifying effect of sodium. The experimental results showed that, under the effect of ultrasound, the crystallization of silumin occurs with very slight supercoolings when the components of eutectic phase tend to crystallize separately.

95. Ultrasonic Irradiation Improves Nitriding of 35KhYuA Steel

"The Influence of Ultrasound on the Process of Nitriding," by Ye. V. Dombrovskaya, G. V. Zemskov, V. T. Yarkina, L. K. Gushchin, and A. K. Parfenov; Nauchnyye Zapiski. Odesskiy Polytechnic Institut), No 35, 1961, pp 90-96 (from Referativnyy Zhurnal -- Avtomatika i Radioelektronika, No 12, Dec 62, 12-5-29 sh)

The liquid nitriding tests were conducted with cylindrical 35KhYuA-steel specimens 20 millimeters in diameter and 10 millimeters high in a saline bath through which ammonia was passed; the process temperature was 550 degrees centigrade, and the ultrasonic frequency, 18-35 kilocycles per second. A gaseous nitriding test was conducted in an electric oven with an ammonia pressure of 45-55 millimeters (oil column). The specimens were screwed into the concentrator.

C-O-N-F-I-D-E-N-T-I-A-L

The data obtained showed that the use of ultrasonic surface treatment shortens the processing time by a factor of 1.5 and considerably increases the hardness and depth of the nitrated layer. Gaseous nitriding appeared to show more promise than liquid nitriding, as far as the quality of the nitrated layer is concerned.

96. Ultrasonics in Production of Fine Metal Powder

"In the World of Science"; Leningradskaya Pravda, 23 Jan 63, p 1

"In the manufacture of powder metal bearings, permanent magnets, and hard alloy cutting tools, it is necessary to have fine-ground powders. However, obtaining such powders is frequently accompanied by great difficulties. A group of specialists under the supervision of Prof G. I. Aksenov has developed a method for grinding powder using ultrasonic vibrations. The powder is treated with the use of an ultrasonic transformer in an aqueous solution containing various chemical substances. As tests have shown, the metal items prepared from these powders have higher physical and mechanical properties."

97. Ultrasound Stimulates Both Nodal and Antinodal Deposition in Metals

On the Question of the Mechanism of the Effect of Ultrasound on the Process of the Electrocrystallization of a Metal," by A. V. Bondarenko; Trudy Novochoerkasskogo Politekhnikeskogo Instituta (Proceedings of the Novochoerkassk Polytechnic Institute), No 133, 1962, pp 59-77 (from Referativnyy Zhurnal -- Elektronika i Yeye Primeneniye, No 2, Feb 63, 2 V 117)

Experiments on the deposition of metals revealed that the opinion of many authors regarding a preferred deposition of metal only at the antinodes of a sound wave is not confirmed. In a standing ultrasonic wave, deposition of metal occurs both at the nodes and antinodes of the sound wave, depending on the composition of the electrolyte and the current density. An analysis of the reasons for the accelerated process of electrocrystallization in an ultrasonic field led to the conclusion that, primarily, the acceleration of the process occurs as a result of stationary micro-currents in the electrolyte.

98. Ultrasound Welding of Honeycomb Structures

"Ultrasound Welding of Honeycomb Structures," by Engineers B. V. Savchenko and V. A. Kuznetsov; Moscow, Svarochnoye Proizvodstvo, No 12, Dec 62, pp 19-20

The ultrasound welding of aluminum-alloy honeycomb structures is described. Special tools of tungsten alloy VK-25 were designed and produced for this welding process. These tools with circular and rectangular tips, interchangeable in the welding unit, were designed so that their length was equal to the length of the sound wave used.

Photographs of the welding tips, the welding unit in the process of welding the honeycombs, and finished honeycombs accompany the discussion.

Miscellaneous

99. German Microscope for Studies at Elevated Temperatures

"Microscope With a Heated Stage"; Budapest, Muszaki Elet, Vol XVII, No 26, 20 Dec 62, p 8

Recently, the optical industry of East Germany developed a multipurpose microscope known as the S82-500. The stage of the microscope is a platinum-rhodium thermal element, which not only heats the sample but supports it and measures its temperature. As a result of this versatility, the stage of the microscope is exceptionally small and can be surrounded by any desired atmosphere without requiring a separate cooling unit. Using a polarized microscope, the investigator can observe the formation of crystals and their growth, the melting of metal samples, and the formation of liquids. The temperature can be determined to an accuracy of  $\pm 2^{\circ}\text{C}$ . This microscope has many industrial uses: investigating the melting of slag, establishing its viscosity, observing the thermal behavior of enamels, investigating the usability of refractory substances and ceramics, and determining at what point between the solid and liquid state recrystallization occurs.

100. Explosive Forming of Aluminum and Titanium Alloys

"The Mechanical Properties of Statically and Dynamically Deformed Alloys," by N. A. Krishal, I. A. Firsanov, Yu. I. Vayner, S. A. Golovin, and S. K. Maksimov, Tula Institute of Mechanics; Sverdlovsk, Fizika Metallov i Metallovedeniye, Vol 15, No 2, Feb 63, pp 305-309

Due to the lack of data on the behavior of metals during impulse loading, the explosive-forming of AMg5VM and OT-4 alloys and their resulting mechanical properties were studied.

A description of the explosive-forming process and the parameters involved are given and data (mechanical treatment, tensile strength, and %-elongation) are compiled. Correct placement of the charge is discussed and the results of incorrect placement are noted.

101. High-Temperature Thermocouple Jackets Made of Zirconium Dioxide

"Thermocouple Jackets With Improved Thermal Stability Made of Zirconium Dioxide," by O. M. Margulis, K. G. Romanchenko, A. V. Stovbur, and G. K. Basalova, Ukrainian Scientific Research Institute of Refractories; Moscow, Ogneupory, No 12, Dec 62, pp 552-554

Two methods of producing thermocouple jackets from zirconium dioxide are described. The two methods, ceramic and slip casting, were successfully used to make jackets which were able to withstand immersion tests in chromium at 2,000-2,040°C. Industrial tests in resistance and arc furnaces showed that these jackets provided satisfactory protection for thermocouples when making temperature measurements in steel at 1,700-1,750°C.

102. High Strength Steel -- 25Kh17N4G15AF2

"A High Strength Nonmagnetic Steel," by M. V. Pridantsev and Engr F. L. Levin, Central Scientific Research Institute of Ferrous Metallurgy; Moscow, Metallovedeniye i Termicheskaya Obrabotka Metallov, No 1, Jan 63, pp 41-44

This work was devoted to obtaining an austenitic stainless steel with a yield point, after heat treatment and without cold working, of not less than 80 kg/mm<sup>2</sup>. Steel 25Kh17N4G15 AF2 was one grade which had very high values of yield strength and satisfactory ductility; it is also age-hardenable. This steel has the following chemical composition: 0.27% C, 18.2% Cr, 4.26% Ni, 14.85% Mn, 0.25% N, 2.2% V, and 9.52% Si.

This steel was subjected to heat treatment at various temperatures ranging from 850° to 1,250°C and then quenched. It was noted that there is rapid grain growth when quenching is done from 1,200° whereas when quenching from 1,150°C, the process of dissolving the excess phases cannot take place to the correct degree. Therefore, 1,180°C was selected as the optimum quench temperature. Mechanical tests were conducted on specimens of the steel at temperatures ranging from 350 to 1,200°C in order to estimate those temperatures at which the steel could be aged and exhibit high tensile properties. It was found that temperatures of 550° and 700°C were best for the subsequent aging. It was then necessary to conduct further tests to decide which of these two temperatures would be the optimum one.

Samples of the steel were aged at 550° for 50 hours and at 700°C for 10 hours. Tensile data revealed a yield strength of 88 kg/mm<sup>2</sup> and an elongation of 25% for the specimen aged at 550°. For the specimen aged at 700°, the yield strength was 104 kg/mm<sup>2</sup>, elongation was 15 percent and it possessed the desired impact strength of 4 kgm/cm<sup>2</sup>. This latter specimen was established as possessing the required properties, since, in addition to the given tensile properties, it had a fine grain structure, no ferrite, and a magnetic permeability of only 1.00 gauss/oersted.

It was therefore established that for steel 25KH17N4G15AF2, the optimum heat treatment consists of quenching from 1,180°C and aging at 700°C for 10 hours. According to the authors, the use of vanadium as one of the alloying elements enables the investigated steel to be strengthened not only by means of dispersion of the carbide phases, but also by means of the formation of a sigma-phase in a fine-grained structure.

103. New Technology in Production of Wide-Strip Stainless Steel

"New Technology in the Production of Wide-Strip Stainless Steel With a Thickness Less Than 1.5 mm," by Engineers V. A. Filonov (deceased), M. I. Yudin, V. N. Lola, V. S. Movshovich, I. N. Avramenko, and V. B. Pavlishchev; Moscow, Stal', No 1, Jan 63, pp 60-61

New technology was developed and introduced into production at the Zaporozhstal' Plant for the cold-rolling of wide-strip stainless steel in a 1680 reversing four-high stand with an over-all reduction of 85% in one pass to thicknesses of 9.8-1.4 mm.

Maximum pressure of the rolls was 1,500 tons, although in certain cases 1,700 tons (rolling stand has an 1,800-ton limit) was necessary to roll the thickened ends of the strip.

This new process has been used to roll almost all the various classes of stainless steel and it is expected that it may be possible in the near future to roll sheet as thin as 0.5 mm.

104. Magnetic Properties of Dysprosium and Terbium

"Magnetic and Hysteresis Properties of Dysprosium and Terbium," by S. A. Nikitin, Moscow State University imeni M. V. Lomonosov; Sverdlovsk, Fizika Metallov i Metallovedeniye, Vol 15, No 2, Feb 63, pp 187-193

The temperature relationships of the magnetization, coercive force, and residual magnetization in dysprosium and terbium crystals were studied. Near the transition point for ferromagnetism to helical anti-ferromagnetism a maximum coercive force was observed (in Dy at 95°K and in Tb at 219°K). This maximum was apparently caused by the magnetic heterogeneity of Dy and Tb near the transition temperature owing to a "disconnected" transition from the ferromagnetic state to one with a helical magnetic structure. The residual magnetism of Dy and Tb decreases with rising temperature and strongly diminishes in magnitude near the transition temperature of the two elements.

105. Perlitic Steel for Fasteners in Power Generating Installations

"Perlitic Steel for Fasteners in Electric Power Generating Installations With an Operating Temperature of 565-600°C," by T. I. Vokova and Z. N. Petrovavlovskaya, Moscow, Struktura i Svoystva Novykh Zharoprochnykh Materialov, Book No 105, 1962, pp 97-107 (from Referativnyy Zhurnal, Otdel'nyy Vypusk -- 48. Mashinostroitel'nyy Materialy, Konstruktsii i Raschet Detaley Mashin, No 3, Mar 63, p 7, Abstract No 3.48.50)

Results are given of investigations conducted by the Central Scientific Research Institute of Machine Building (TsNIIIMASH) on selecting the composition and heat-treating conditions for a perlitic steel designated at 25KhLMFLBR (industrial designations, TsZh10 and ED44). The composition of the new steel is as follows (in percent): C, 0.2-0.3; Si, 0.17-0.37; Mn, 0.48-0.8; Cr, 1.0-1.35; Mo, 0.8-1.1; V, 0.7-1.0; Nb, 0.1-0.4; B, 0.005; and Ni, 0.19-0.4. Data are presented on the mechanical properties of this steel at room temperature and 565-585°C. It is noted that this steel after heat treatment (normalized at 1,100°C, tempered at 730° for 5 hours) possesses a sufficiently high level of mechanical properties at room and elevated temperatures. Steel 25 KhLMFLBR is claimed to be superior to all other perlitic steels being used with respect to relaxation stability is recommended for operating temperature of 550-560°C. It satisfies requirements of designers for a fastening material operating at temperatures of 580°C ( $\sigma_{10,000} \geq 10 \text{ kg/mm}^2$ ) and can be recommended as a replacement for the nickel alloy EI765. The 20,000 strength at 565°C for smooth specimens is 20 kg/mm<sup>2</sup>. At 580°C steel 25KhLMFLBR has a lower corrosion resistance in a steam medium and requires a protective coating for operation

106. Phase Diagrams Studies of Titanium Alloys

"Investigations in the Field of Metallochemistry of Titanium," by I. I. Kornilov; Moscow, Izvestiya Akademii Nauk, Otdeleniye Tekhnicheskikh Nauk, Metallurgiya i Gornoye Delo, No 1, Jan-Feb 63, pp 152-160

The reactions of titanium with a number of elements (Zr, Hf, V, Nb, Ta, Mo) were investigated by constructing phase diagrams of the binary system with subsequent microstructure analysis of the compounds and solid solutions. Similar studies were made on binary metalloids Ti-B, -C, -N, and -O.

In conclusion the author makes the following statements. "The principles of the formation solid solutions and compounds of titanium, and also the comparison of equilibrium diagrams of titanium with various elements, are very important in the metallochemistry of titanium. The general position taken in this work is that equilibrium diagrams of titanium binary systems should be further studied as they can serve as the foundation for theoretical and experimental investigation of the properties and reactions of titanium in ternary, quaternary, and even more complex systems."

107. Rare-Earth Metals in Stainless Steel

"The Effect of Rare-Earth Metals on the Properties of Stainless Steel," by Ye. M. Savitskiy, N. V. Keys, V. F. Popov, V. N. Lyubimov, D. G. Zhukov, and T. I. Malinovskaya; Moscow, Izvestiya Akademii of Sciences SSSR, Otdeleniye Tekhnicheskikh Nauk, Metallurgiya i Gornoye Delo, No 1, Jan/Feb 63, pp 133-137

The Institute of Metallurgy imeni A. A. Baykov, in conjunction with the Chelyabinsk Metallurgical Plant, conducted a study of the effect of ferrocium on the properties of stainless steel 1Kh18N9T from which it was established that the mechanical properties of this steel are considerably improved if 0.05-0.18% ferrocium is added to the melt. The effect of adding ferrocium to steel Kh18N12M2T was also investigated because, according to the authors, the Chelyabinsk and Zlatoust Metallurgical plants have reported difficulties in the production of this steel, especially in producing a high-quality rolled product. Consequently, their annual production has been considerably reduced.

Five experimental heats of Kh18N12M2T steel containing various amounts of ferrocium were produced in an electric-arc furnace. The mechanical properties of the steel were tested and compared with the same grade of steel containing

C-O-N-F-I-D-E-N-T-I-A-L

no ferrocerium. Positive results were noted by the mechanical tests, and as a result of these tests, further investigations were conducted on structural steels 30KhGSA and 18KhNVA. Analysis of the latter two grades of steel showed that addition of ferrocerium considerably reduces the oxygen, sulfur, arsenic, and hydrogen content of the steels. The amount of phosphorous is reduced to a small degree, while nitrogen content is somewhat increased.

It was concluded that adding ferrocerium to steel Kh18N12M2T in amounts 0.08-0.12% significantly reduces the oxygen, sulfur, hydrogen, and phosphorous content of the metal. The final concentration of cerium in the metal was 0.05-0.06%. The rollability and macrostructure are considerably improved and with a reduced ferrite content the tendency toward intergranular corrosion is almost nil. Annual production is increased by 1.0%.

108. Rapid Method of Selecting Single-Phase Alloys With Satisfactory Weldability and Heat Resistance

"Rapid Method of Selecting Single-Phase Alloys With Satisfactory Weldability and Heat Resistance," by B. A. Movchan and E. Ya. Dzykovich, Institute of Electric Welding imeni Ye. O. Paton, Academy of Sciences Ukrainian SSR; Kiev, Avtomaticheskaya Svarka, No 2, Feb 63, pp 34-40

A method of investigating welded alloys for the purpose of determining their hot-cracking tendencies and heat resistance is presented. This method involves casting into water-cooled, V-shape molds, regulating the cooling rate, and investigating the resultant microstructure in order to study the relationship between the mobility and distribution of lattice imperfections (dislocations).

Tests were conducted using austenitic alloys with additional alloying elements. Ta, Mo, W, and Mn, were added to Kh16N20, Me, We, and Mn were added to Kh13N35, and only Mo was added to Kh20N80.

Microstructure studies of the alloys, cooled at various rates, showed that polygonization occurs with a rapid cooling rate whereas a slow cool permits diffusion and the formation of single-phase alloys (depending on alloy composition) which have a maximum resistance to hot-cracking and satisfactory heat-resistant properties.

109. Reduction of Titanium and Niobium Oxides

"Reduction of Titanium and Niobium Oxides With Calcium Carbide and Calcium Cyanide," by G. A. Meyerson, L. M. Yakeshova, and T. A. Shvedova; Moscow, Izvestiya Akademii Nauk SSSR, Otdeleniye Tekhnicheskikh Nauk, Metallurgiya i Gornoye Delo, No 1, Jan/Feb 63, pp 69-75

The reduction, carburization, of titanium and niobium oxides with the use of calcium carbide and calcium cyanide was studied for the purpose of finding conditions at which a substantially lower temperature is required for reduction since these oxides possess very high thermal stability (almost 2,000°C).

Thermodynamic calculations and experimental research showed that titanium and niobium oxides can be reduced by calcium carbide and calcium cyanide at temperatures close to 1,000°C in a nitrogen atmosphere. In the nitrogen atmosphere with the use of calcium cyanide and also in an inert atmosphere, carbonitrides of titanium and niobium were obtained which had an over-all nitrogen and bonded-carbon content of approximately 50 at %. In titanium carbonitrides, the nitrogen content, as a rule, is somewhat greater than the bonded-carbon content, but in niobium carbonitride the reverse situation exists.

Other factors taken into account were changes in the ratios of calcium carbide and calcium cyanide and the composition of the resulting carbonitride. For instance, when the amount of calcium carbide was reduced, poorer results were obtained than when calcium cyanide was reduced. This was explained by the fact that calcium carbide has a lower thermal stability with respect to water vapors and carbon monoxide being formed. Consequently, the ratios of the two carburizing agents used is a very important factor in the reduction process.

110. Weldable Austenitic-Ferritic Steel for Steam Turbines

"An Austenitic-Ferritic Steel for Fixed Welded-Cast Components of Steam Turbines and for Fittings," by A. Ye. Runov and A. S. Tereshkovich, Moscow, Struktura i Svoystva Novykh Zharoprochnykh Materialov, Book No 105, 1962, pp 135-143 (from Referativnyye Zhurnal, Otdel'nyy Vypusk -- 48. Mashinostroitel'nyye Materialy, Konstruktsii i Raschet Detaley Mashin, No 3, Mar 63, p 7, 3.48.49)

Results are given of tests of six welded-cast components of steam turbines and fittings at a temperature of 650°C on the basis of which the highly weldable austenitic-ferritic steel TsZh15 is recommended as an economical replacement for steel EI695R (8-10 percent nickel instead of 18-20 percent nickel). Higher intricate casting and machining properties are claimed for steel TsZh15 than for EI695R.

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Conferences

111. Conference on Aluminum To Be Held in Hungary

"Aluminum Conference"; Budapest, Kohaszati Lapok, Vol 96, No 2, Feb 63, inside back cover

The National Hungarian Mining and Metallurgical Society is organizing an aluminum conference in Budapest and Szekesfehervar from 8 to 11 May 1963. The aim of the conference is to ensure a broad exchange of views between experts working in the field of finished and semifinished aluminum products and to review the latest technical achievements. The conference will deal with the theoretical, practical, and economic aspects of the production and utilization of semifinished aluminum products. During the conference, there will be an opportunity to visit the new ingot casting and extrusion shops of the Light Metalworks of Szekesfehervar (Szekesfehervari Konnyufemmu).

Family members of participants are welcome. Sightseeing trips in Budapest and tours of the country will be arranged for them. The address of the Organizing Committee of the Aluminum Conference is: Budapest V, Szabadsag ter 17, # 307.

112. Conference on Productivity of Metallurgical Furnaces in 1965

"Interinstitute Conference on Methods of Computing the Productivity of Metallurgical Furnaces," by M. A. Glinkov, M. Moscow Institute of Steel and Alloys; Stal', No 3, Mar 63, p 286

An Interinstitute Conference on Methods of Computing the Productivity of Metallurgical Furnaces was held at the Moscow Institute of Steel and Alloys in November 1962. The conference was called by the Ministry of Higher and Secondary Specialized Education USSR with the cooperation of the Scientific-Technical Society of Ferrous Metallurgy.

It is intended that the next such conference be called in 1965.

Foreign participation in the conference is not indicated.

C-O-N-F-I-D-E-N-T-I-A-L

113. Forthcoming Conference on Welded Structures

Moscow, Svarochnoye Proizvodstvo, No 3, Mar 63, p 34

An All-Union Conference on the Design of Welded Structures will be held in Spetember 1963 at the Institute of Electric Welding imeni Ye. O. Paton.

Those wishing to participate in the work of the conference should submit reports and queries in written form before 20 April 1963 to the Organization Committee at the address: Kiev-5, ul. Gor'kogo, d. 69, Institute of Electric Welding. Organization Committee for the conference.

114. Recent Soviet Conferences on Chemistry and Metallurgy

The conferences listed below were reported or announced in recent issues of Soviet periodicals. Included in the listing are the date and location of the conference, sponsoring organizations, and source. Unless otherwise noted, it is assumed that there was no non-Soviet participation in the conferences.

1. Thirteenth Conference on High Molecular Compounds; 8-11 October 1962, Moscow; sponsored by the Scientific Council on High Molecular Compounds under the Department of Chemical Sciences of the Academy of Sciences USSR, the State Committee on Chemistry of the Council of Ministers USSR, the Scientific Council on the Problem "Synthetic Materials Based on Polymers" under the State Committee for Coordination of Scientific Research Work of the Council of Ministers USSR, the All-Union Chemical Society imeni Mendeleev, the State Committee on Automation and Machine Building of the Council of Ministers USSR, the All-Union Council of Scientific-Technical Societies, and Moscow State University. (Vestnik Akademii Nauk SSSR, No 1, Jan 63, p 117)

2. Second All-Union Conference on Polarography; 25-29 September 1962, Kazan'; sponsored by the All-Union Chemical Society imeni Mendeleev, the Chemistry Institute of the Academy of Sciences USSR, Kazan' State University, the Kazan' Chemical-Technological Institute, and the Kazan' Aviation Institute. (Zavodskaya Laboratoriya, No 2, Feb 63, p 251)

3. First All-Union Conference on Catalytic Reactions in the Liquid Phase; 27 September-2 October 1962, Alma-Ata; sponsored by the Ministry of Higher and Secondary Specialized Education USSR, the Chair of Catalysis of Kazakh University, the Institute of Chemical Sciences of the Academy of Sciences Kazakh SSR, and the Kazakh Republic Board of the All-Union Chemical Society imeni Mendeleev. (Vestnik Akademii Nauk SSSR, No 2, Feb 63, p 119; Kinetikai Kataliz, Vol 4, No 1, Jan/Feb 63, p 168; Gidroliznaya i Lesokhimicheskaya Promyshlennost', No 2, Feb 63, p 30)

C-O-N-F-I-D-E-N-T-I-A-L

4. Conference on Results of Investigations of the Behavior of Substances at High Temperatures and Methods of Experimenting Under These Conditions; 21-24 November 1962, Leningrad; sponsored by the Institute of Silicate Chemistry imeni I. V. Grebenshchikov of the Academy of Sciences USSR. (Vestnik Akademii Nauk SSSR, No 3, Mar 63, p 134)
5. All-Union Conference on the Problem of Direct Methods of Prospecting for Petroleum and Gas; 30 January-2 February 1962, Moscow; sponsored by the Board of the Ministry of Geology and Mineral Conservation. (Izvestiya Akademii Nauk Turkmenskoy SSR, Seriya Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk, No 1, 1963, p 125)
6. Scientific-Technical Conference on Problems of the Status of Surveying Service in the Petroleum and Gas Producing Industry; 9-11 October 1963, Ufa; sponsored by the Central Boards of the Scientific-Technical Mining Society and the Scientific-Technical Society of the Petroleum and Gas Industry, the Bashkir Board of the Scientific-Technical Society of the Petroleum and Gas Industry, the Bashkir Petroleum Industry Association, the All-Union Scientific Research Petroleum and Gas Institute, and the Ufa Scientific Research Petroleum Institute. (Neftyanoye Khozyaystvo, No 1, Jan 63, p 69)
7. All-Union Conference for an Exchange of Experience on the Use of Petroleum Residues; December 1962, Ufa; sponsored by the Ministry of Power Engineering and Electrification USSR. (Neftyanoye Khozyaystvo, No 3, Mar 63, p 64)
8. All-Union Conference of Workers of the Carbon Disulfide Industry; end of October 1962, Kalinin. (Giroliznaya i Lesokhimicheskaya Promyshlennost', No 2, Feb 63, p 29)
9. All-Union Scientific Conference on the Problem "Synthesis on the Bases of Acetylene"; 19-24 October 1962, Yerevan; sponsored by the Committee for Coordination of Scientific Research Work of the Council of Ministers Armenian SSR, the Academy of Sciences Armenian SSR and the Armenian and Sovmarkhoz, and the All-Union Chemical Society imeni D. I. Mendeleev. (Vestnik Akademii Nauk SSSR, No 2, Feb 63, p 120)
10. Scientific-Technical Conference on Continuous Processes and Apparatus for the Production of Polymer Materials and Processing Them Into Parts (announcement); 11-13 December 1962, Moscow; sponsored by the Moscow Institute of Chemical Machine Building. (Byulleten' Ministerstva Vyshego i Srednego Spetsial'nogo Obrazovaniya SSSR, No 8, Aug 62, p 16)

C-O-N-F-I-D-E-N-T-I-A-L

11. Third All-Union Conference on Automation and Mechanization of Basic Processes in the Rubber Industry; 2-6 October 1962, Dnepropetrovsk; sponsored by the Central and Dnepropetrovsk Oblast Boards of the All-Union Chemical Society imeni Mendeleev, the Dnepropetrovsk Chemical-Technological Institute imeni F. E. Dzerzhinskiy, and the Dnepropetrovsk Tire Plant. (Kauchuk i Rezina, No 1, Jan 63, p 59)
12. Third Congress of the Scientific-Technical Society of the Paper and Wood Processing Industry (announcement); November 1963. (Gidroliznaya i Lesokhimicheskaya Promyshlennost', No 2, Feb 63, p 31)
13. Conference on Glass-Like Systems and New Materials Based on Glass; October 1962, Minsk; representatives from socialist countries. (Steklo i Keramika, No 1, Jan 63, p 46)
14. Seminar on Problems of Processing the Surface of Parts for Galvanic and Lacquer Coatings; 21-24 November 1963, Leningrad; sponsored by the Leningrad House of Scientific-Technical Propaganda, the Central and Leningrad Oblast Boards of the Scientific-Technical Society of the Machine Building Industry, and the Section on Protection of Materials and Parts of the Technical-Economic Council of the Leningradskiy Sovnarkhoz. (Lakokrasochnyye Materialy i ikh Primeneniye, No 1, 1963, p 88)
15. All-Union Scientific-Technical Conference on the Question of the Status and Prospects for Developing the Production of Condensed Lacquer Resins; 13-17 November 1963, Yaroslavl'; sponsored by the Central and Yaroslavl' Oblast Boards of the All-Union Chemical Society imeni D. I. Mendeleev, the State Committee on Chemistry of the Council of Ministers USSR, and the Yaroslavl'skiy Sovnarkhoz. (Lakokrasochnyye Materialy i ikh Primeneniye, No 1, 1963, p 87)
16. Seminar on Mathematical Methods of Describing Chemical and Metallurgical Processes; 1962; sponsored by the State Scientific Research and Design Institute of the Rare Metals Industry, and the Scientific Council on Cybernetics of the Academy of Sciences USSR. (Zavodskaya Laboratoriya, No 2, Feb 63, p 253)
17. Third All-Union Conference of Workers of the Ferrous Alloy Industry; October 1962, Zestafoni; sponsored by the State Committee of the Ferrous and Nonferrous Metallurgy Council of Ministers USSR and the Scientific-Technical Society of Ferrous Metallurgy. (Stal', No 1, Jan 63, p 58)
18. All-Union Interinstitute Scientific-Technical Conference on Problems of the Workability of Refractory and Titanium Alloys; 1962, Kuybyshev. (Vestnik Mashinostroyeniya, No 2, Feb 63, p 90)

C-O-N-F-I-D-E-N-T-I-A-L

19. Second Conference on Hot Cracks in Welded Joints, Castings, and Ingots; 22-23 May 1962, Moscow; sponsored by the Section on Metallurgy, Metal Science, Mining, and Enrichment of the Department of Technical Sciences of the Academy of Sciences USSR, the National Committee of the USSR on Welding under the Academy of Sciences USSR, and the Institute of Metallurgy imeni A. A. Baykov. (Svarochnoye Proizvodstvo, No 11, Nov 62, p 41)
20. First All-Union Scientific-Technical Conference on Facing of Dies for Hot and Cold Stamping; 27-29 November 1962, Volgograd; sponsored by the Volgogradskiy Sovnarkhoz, the Volgograd Scientific Research Institute of Technology of Machine Building, and the Volgogradskaya Oblast Board of the Scientific-Technical Society of the Machine Building Industry. (Svarochnoye Proizvodstvo, No 3, Mar 63, p 44)
21. Interinstitute Conference on Methods of Computing the Productivity of Metallurgical Furnaces; November 1962, Moscow; sponsored by the Ministry of Higher and Secondary Specialized Education USSR and the Scientific-Technical Society of Ferrous Metallurgy; next conference in 1965. (Stal', No 3, Mar 63, p 286)
22. Conference on Spectroscopy and the Use of Spectral Methods in Ferrous Metallurgy; 10-14 July 1962, Zaporozh'ye; sponsored by the Zaporozhskiy Sovnarkhoz, and the City Board of the Scientific-Technical Society of Ferrous Metallurgy. (Optika i Spektroskopiya, Vol 13, No 5, Nov 62, p 755)
23. Conference on Results of Intensification of Work, Modernization, and Improvement of the Design of Flotation Machines; 17-21 September 1962; sponsored by the Central Board of the Scientific-Technical Society of Non-ferrous Metallurgy, the Directorate and the Committee of the Council of the Exhibition of Achievements of the National Economy, the Editorial Board of Tsvetnyye Metally, and the Central Institute for Information on Nonferrous Metallurgy; representatives from Bulgaria, Poland, Rumania, and Czechoslovakia. (Tsvetnyye Metally, No 12, Dec 62, p 61)
24. All-Union Conference on Problems of the Development of Static Rectifiers for Arc Welding; probably February 1963, Vil'nyus. (Sovetskaya Litva, 19 Feb 63, p 2)
25. First Seminar Under the Department of Technical Sciences of the Academy of Sciences Ukrainian SSR on Surface Diffusion Saturation of Metals; 22-23 March 1962, Kiev; sponsored by the Department of Technical Sciences of the Academy of Sciences Ukrainian SSR, and the Odessa Polytechnic Institute (Metallovedeniye i Termicheskaya Obrabotka Metallov, No 12, Dec 62, p 56)

C-O-N-F-I-D-E-N-T-I-A-L

26. Second Seminar Under the Department of Technical Sciences of the Academy of Sciences Ukrainian SSR on Surface Diffusion Saturation of Metals and Coatings of Refractory Compounds; 10-12 October 1962, Odessa. (Metalovedeniye i Termicheskaya Obrabotka Metallov, No 3, Mar 63, p 59)

27. Third All-Union Metallogenic Conference; 18-22 September 1962, Baku. (Geokhimiya, No 2, Feb 63, p 185)

28. Scientific Conference on Metallogeny and the Use of Mineral Resources of the Buryatskaya ASSR; June 1962, Ulan-Uda; sponsored by the Collective of Geologists of the Buryat Complex Institute of the Siberian Department of the Academy of Sciences USSR, and the Buryat Geological Administration of the Main Administration of Geology under the Council of Ministers RSFSR. (Geologiya i Geofizika, No 12, 1962, p 117)

29. All-Union Conference on Protection From Dust and Gases and the Protection of the Air Space of Metallurgical Enterprises; end of 1962, Nizhniy Tagil; sponsored by the Central Committee of the Trade Union of Metallurgical Industry Workers, the State Committee on Ferrous and Non-ferrous Metallurgy and the Scientific-Technical Society of Ferrous Metallurgy. (Stal', No 3, Mar 63, p 287)

\* \* \*

7 September 2004

Ms. Roberta Schoen  
Deputy Director for Operations  
Defense Technical Information Center  
7725 John J. Kingman Road  
Suite 0944  
Ft. Belvoir, VA 22060

Dear Ms. Schoen:

In February of this year, DTIC provided the CIA Declassification Center with a referral list of CIA documents held in the DTIC library. This referral was a follow on to the list of National Intelligence Surveys provided earlier in the year.

We have completed a declassification review of the "Non-NIS" referral list and include the results of that review as Enclosure 1. Of the 220 documents identified in our declassification database, only three are classified. These three are in the Release in Part category and may be released to the public once specified portions of the documents are removed. Sanitization instructions for these documents are included with Enclosure 1.

In addition to the documents addressed in Enclosure 1, 14 other documents were unable to be identified. DTIC then provided the CDC with hard copies of these documents in April 2004 for declassification review. The results of this review are provided as Enclosure 2.

We at CIA greatly appreciate your cooperation in this matter. Should you have any questions concerning this letter and for coordination of any further developments, please contact Donald Black of this office at (703) 613-1415.

Sincerely,



Sergio N. Alcivar  
Chief, CIA Declassification Center,  
Declassification Review and Referral  
Branch

Enclosures:

1. Declassification Review of CIA Documents at DTIC (with sanitization instructions for 3 documents)
2. Declassification Status of CIA Documents (hard copy) Referred by DTIC (with review processing sheets for each document)



## Processing of OGA-Held CIA Documents

The following CIA documents located at DTIC were reviewed by CIA and declassification guidance has been provided.

OGA Doc ID	Job Num	Box	Fldr	Doc	Doc ID	Document Title	Pub Date	Pages	Decision	Proc Date
AD0335308	78-03117A	194	1	23	4363	Scientific Information Report Chemistry And Metallurgy (26)	3/7/1963	71	Approved For Release	3/25/2004
AD0335625	78-03117A	197	1	3	4460	Scientific Information Report Chemistry And Metallurgy (27)	4/4/1963	51	Approved For Release	3/25/2004
AD0336825	78-03117A	199	1	26	4562	Scientific Information Report Chemistry And Metallurgy (28)	5/9/1963	70	Approved For Release	3/25/2004
AD0332150	78-03117A	183	1	5	3916	Scientific Information Report Chinese Science (11)	10/4/1962	52	Approved For Release	3/29/2004
AD0332434	78-03117A	183	1	40	3951	Scientific Information Report Chinese Science (12)	10/19/1962	59	Approved For Release	3/29/2004
AD0332795	78-03117A	184	1	37	3988	Scientific Information Report Chinese Science (13)	11/5/1962	48	Approved For Release	3/29/2004
AD0333069	78-03117A	186	1	7	4028	Scientific Information Report Chinese Science (14)	11/16/1962	30	Approved For Release	3/29/2004
AD0333148	78-03117A	187	1	19	4078	Scientific Information Report Chinese Science (15)	11/29/1962	44	Approved For Release	3/29/2004
AD0333835	78-03117A	189	1	6	4144	Scientific Information Report Chinese Science (16)	12/21/1962	65	Approved For Release	3/29/2004
AD0334108	78-03117A	190	1	2	4179	Scientific Information Report Chinese Science (17)	1/10/1963	56	Approved For Release	3/29/2004
AD0334105	78-03117A	191	1	12	4230	Scientific Information Report Chinese Science (18)	1/18/1963	25	Approved For Release	3/29/2004
AD0334378	78-03117A	192	1	21	4277	Scientific Information Report Chinese Science (19)	2/1/1963	27	Approved For Release	3/29/2004
AD0334433	78-03117A	193	1	22	4322	Scientific Information Report Chinese Science (20)	2/15/1963	28	Approved For Release	3/29/2004
AD0335021	78-03117A	194	1	37	4377	Scientific Information Report Chinese Science (21)	3/8/1963	59	Approved For Release	3/29/2004
AD0335847	78-03117A	198	1	33	4526	Scientific Information Report Chinese Science (22)	4/18/1963	61	Approved For Release	3/29/2004
AD0336327	78-03117A	200	1	3	4578	Scientific Information Report Chinese Science (23)	5/2/1963	68	Approved For Release	3/29/2004
AD0337167	78-03117A	201	1	26	4643	Scientific Information Report Chinese Science (24)	5/23/1963	95	Approved For Release	3/29/2004
AD0337777	78-03117A	202	1	27	4687	Scientific Information Report Chinese Science (25)	6/6/1963	52	Approved For Release	3/29/2004
AD0338474	78-03117A	203	1	27	4727	Scientific Information Report Chinese Science (26)	6/20/1963	83	Approved For Release	3/29/2004
AD0338687	78-03117A	204	1	32	4772	Scientific Information Report Chinese Science (27)	7/5/1963	80	Approved For Release	3/29/2004
AD0339386	78-03117A	206	1	4	4820	Scientific Information Report Chinese Science (28)	7/17/1963	32	Approved For Release	3/29/2004
AD0339147	78-03117A	207	1	11	4862	Scientific Information Report Chinese Science (29)	7/30/1963	48	Approved For Release	3/29/2004
AD0340927	78-03117A	208	1	35	4924	Scientific Information Report Chinese Science (30)	8/21/1963	53	Approved For Release	3/29/2004
AD0341855	78-03117A	209	1	43	4974	Scientific Information Report Chinese Science (31)	9/5/1963	46	Approved For Release	3/29/2004
AD0342464	78-03117A	210	1	38	5013	Scientific Information Report Chinese Science (32)	9/16/1963	43	Approved For Release	3/29/2004
AD0342608	78-03117A	211	1	36	5054	Scientific Information Report Chinese Science (33)	9/27/1963	41	Approved For Release	3/29/2004