The Structure of Vulcanized Rubber and Its Permeability to Gases

meability of rubber and vulcanizates is influenced by cross linkings as well as intermolecular forces, mostly from the polar type.
There are 5 graphs, 2 tables, and 11 references, 8 of which are Soviet, 2 English, and 1 French.

ASSOCIATION: Nauchno-issledovatel'skiy institut rezinovoy promyshlennosti Moskva (Scientific Research Institute of the Rubber Industry, Moscow)

SUBMITTED: November 30, 1957

Card 2/2 1. Rubber—Vulcanized—Permeability 2. Gases—Applications

SOV-69-20-5-19/23

AUTHORS: Bartenev, G.M., Yudina, I.V., Rebinder, P.A.

TITLE: A Contribution to the Theory of the Spontaneous Dispersion of Solid Bodies (K teorii samoproizvol'nogo dispergirovaniya tverdykh tel)

PERIODICAL: Kolloidnyy zhurnal, 1958, Vol XX, Nr 5, pp 655-664 (USSR)

ABSTRACT: The cause for the resistance decrease of a solid in a surface-active medium is the reduction of surface energy on the border solid-medium. Media which are similar in their molecular nature decrease the surface tension of the solid and rupture takes place. For metals, such media are low-melting metals and alloys. Spontaneous dispersion takes place along wakened borders, whereas destruction from outside moves along the plane of greatest stress. The growth of cracks proceeds with increasing speed under outside stress. In spontaneous dispersion, the speed is more uniform, although low. In Figure 2 the left minimum of potential energy corresponds to the stable condition of the particles in the body, the right minimum to the stable condition on the new free surface. In every crystal, there are surface defects and micro-cracks which appear during the growth of the crystal. During spontaneous dispersion the active me-

Card 1/2

dium penetrates these micro-cracks and enters the interior of the monocrystal. The decrease in resistance in solids is caused by two facts: the decrease of the free surface energy, and the two-dimensional pressure of the adsorbed layer on the steric hindrance at the peak of the crack. Spontaneous dispersion is possible, if the total stress at the top of the micro-crack is greater than the safe stress in the given medium. The safe stress is determined according to a given equation by the surface stress of the body in the medium.

ASSOCIATION: Moskovskiy pedagogicheskiy institut im. Potemkina, Kafedra teoreticheskoy fiziki (Moscow Pedagogic Institute imeni Potemkin, Chair of Theoretical Physics). Institut fizicheskoy khimii AN SSSR, Otdel dispersnykh sistem (Institute of Physical Chemistry of the USSR Academy of Sciences, Department of Dispersed Systems)

SUBMITTED: June 16, 1958

1. Metals--Fracture 2. Metals--Surface properties 3. Crystals --Deformation

BARTENEV, G. M.; SHCHUKIN, Ye. D.; REBINDER, P. A.; LIKHTMAN, V. I.;

"Deformation processes, the rheological conduct and the destruction of solids and metals."

report presented at the Fourth All-Union Conference on Colloidal Chemistry, Tbilisi, Georgian SSR, 12-16 May 1958 (Koll zhur, 20,5, p.677-9, '58, Tsubman, A.B)

BARTENEV, G. M.

57-2-17/32

AUTHORS: Bartenev, G. M. , Brynkhanova, L. S.

TITLE: The Influence Exerted by the Intermolecular Interaction, the Cross-Linking and the Temperature Upon the Destruction and the Time Dependence of the Strength of Caoutchouc-Like Polymers (Vliyaniye mezhmolekulyarnogo vzaimodeystviya, poperechnogo sshivaniya i temperatury na razrusheniye i vremennuyu zavisimost' prochnosti kauchukopodobnykh polimerov)

PERIODICAL: Zhurnal Tekhnicheskoy Fiziki, 1958, Vol. 28, Nr 2, pp. 287 - 295 (USSR)

ABSTRACT: The following noncrystallizing rubbers were investigated here: polybutadiene-rubbers, butadiene-styrene-rubbers and butadiene--nitrile-rubbers. Cross-linkages were introduced into the rubber by means of sulfur-vulcanization in an electric press at 143°C. The time from the moment of the beginning of strain until the division of the sample into two parts (rupture period or life) was measured. It is shown that the time dependence of the strength in rubber-like polymers is different from that of solid bodies and follows the empirical formula $\tau = B\,\sigma^{-b}$. With the increase

Card 1/3

The Influence Exerted by the Intermolecular Interaction, the Cross-Linking and the Temperature Upon the Destruction and the Time Dependence of the Strength of Caoutchouc-Like Polymers

in the intermolecular interaction (polarity, cross-linking, filling), however, it approaches the dependence characteristic of solid substances. One of the reasons for the behavior of the group of caoutchouc-like polymers is their capability of molecular orientation on deformation. It is further shown that the temperature dependence of the strength of rubber-like polymers follows the exponential law. This temperature-dependence differs from the temperature dependence of the strength of solid polymers by the fact that under various strains no pole occurs at the temperature-curves, whereas in the case of solid polymers such a pole exists. This is explained by the non-exponential dependence of the life of rubber-like polymers on strain. The temperature over time dependence of the strength of rubber-like polymers follows the formula $\tau = C \sigma^{-b} e^{U/RT}$, where b and C are constants dependent on the type of rubber and the structure of the vulcanization product. U is the activation energy. All rubber-like polymers are in the case of lasting cracks characterized by a destruction taking place in two stages. In the first stage the rough surface of the place of crack develops, in the second stage the smooth one. In the case of an elastic

The Influence Exerted by the Intermolecular Interaction, the Cross-Linking and the Temperature Upon the Destruction and the Time Dependence of the Strength of Caoutchouc-Like Polymers

crack the fact is specific that, in comparison to the solid bodies, the order of zones at the crack-surface of rubber-like polymers is an inverse one, where the first stage of breack is characterized by a fibrous mechanism of destruction. It is shown that a decrease in strain, of the number of cross-linkages (the equilibrium modulus), of the intermolecular interaction (the polarity) leads to a displacement of the mirror zone by the rough one. A change of temperature influences the relation of the mirror- and the rough zone, in dependence of the kind of rubber, in different ways. There are 10 figures, 2 tables, and 9 references, all of which are Slavic.

ASSOCIATION: Pedagocical Institute, Moscow, imeni Potemkin. Chair of Theoretical Physics. Scientific Research Institute of the Rubber Industry, Moscow. (Moskovskiy pedagogicheskiy institut im. Potemkina. Kafedra teoreticheskoy fiziki. Nauchno-issledovatel'skiy institut rezinovoy promyshlennosti. Moskva)

SUBMITTED: January 24, 1957
AVAILABLE: Library of Congress
Card 3/3 1. Rubber-Test results 2. Rubber-Test methods

AUTHORS: Bartenev, G. M., Kolbasnikova, A. I. 57-28-6-11/34

TITLE: On the Comparison of the Theory of Glass Hardening With Experimentation (K sravneniyu teorii zakalki stekla s eksperimentom)

PERIODICAL: Zhurnal Tekhnicheskoy Fiziki, 1958, Vol. 28, Nr 6, pp. 1195-1200 (USSR)

ABSTRACT: Glass hardening is at present being used in an ever--increasing degree as an effective method of increasing the strength and the thermal durability of glass products, especially for the production of new types of extremely solid technical glass. The method of hardening has already been described previously (references 1 and 2). The elasticity theory (reference 1) leads to the following formula for internal tensions in hardened flat glass:

$$\sigma(x) = \frac{E}{1-\mu}(\epsilon - \bar{\epsilon}). \quad (1).$$

Finding the mathematical form of the function $F(x, \delta)$ is the basic problem of the theory of glass hardening. The tensions of the elongation

Card 1/4

$\sigma = \sigma_y = \sigma_z$ in the central plane of the hardened plate are

$$\sigma = \frac{\beta E}{1-\mu} T_g \varphi(\delta) = K\varphi(\delta) \qquad (2)$$

Renewed investigation of the influence exercised by physical properties upon the amount of hardening-tensions (in the case of regular hardening) showed agreement of experimental data with the formula (2). The authors hardened 8 types of glass of different composition. They were selected in such a manner that there was considerable difference with respect to the quantity K (table). The worked-out results (figure 2) of experimental data were given in dimensionless parameters $\varphi(\delta)$ and h_a which make it possible to compare the hardening formulae with the experiment. Herefrom it may be seen that not one of the theoretical dependences agrees with the experiment. This is probably caused by the fact that the formulae are based upon inaccurate data. As a result of the generalization of experimental data (figure 2) the dependence of the

hardening function on the criterion of Bio (upper curve) was obtained. This can be utilized in calculating the degree of hardness according to formula (2). The analytical form of this dependence at $ha > 0,5$, which practically comprises all cases occurring in the technology of hardening, can be expressed in the approximation by the formula

$$\varphi(\delta) = 0,23\delta^2.$$

At present degrees of hardness were attained which correspond to $\varphi(\delta) = 0,31$. It follows herefrom (reference 2) that where the limiting value theoretically expected at $ha \to \infty$ is $\varphi(\delta) = 0,36$, the possibilities of increasing the degree of hardness are exhausted. Experimental data (figure 2) and the amount of the maximum degree of hardness $\varphi(\delta) = 0,69$, which were calculated according to the formula

$$\varphi(\delta) = \frac{1}{\delta}\int_0^{\delta} \ln \cos y\,dy \qquad (3)$$

lead to the conclusion that the possibilities of

increasing the strength of glass by hardening are not exhausted. There are 3 figures, 1 table, and 11 references, 11 of which are Soviet.

ASSOCIATION: Vsesoyuznyy nauchno-issledovatel'skiy institut stekla, Moskva (Moscow, All-Union Scientific Research Institute for Glass)

SUBMITTED: October 20, 1956

1. Glass—Hardening 2. Glass—Mechanical properties
3. Hardenability—Theory

SOV/57-28-7-18/35

AUTHORS: Bartenev, G. M., Ivanova, A. I.

TITLE: The Strength of Quenched Glasses (Prochnost' zakalennykh stekol)

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1958, Vol. 28, Nr 7, pp. 1467-1476 (USSR)

ABSTRACT: First the formula for the calculation of the strength with respect to expansion and bending (1) is deduced. It is shown that for determining the strength of the quenched glass (without destroying it) two magnitudes must be evaluated; viz. P_0 = the strength of the burned glass which is determined experimentally, and $\varkappa$ - a dimensionless factor which establishes a relation between the surface tensions and the tensions in the middle of the glass (where the maximum of expansion occurs). The authors investigated the strength of a flat glass with respect to cross-bending as well as to a symmetrical bending, and also the bending strength of the rods. The following was found: 1) The strength of quenched glasses depends on the degree of quenching, the character

Card 1/3

The Strength of Quenched Glasses

of the distribution of internal stress and the mode of investigation. 2) The destruction begins at the weakest points. These are the edges and the surface. Depending on the degree of quenching, the solidifying of the edges in quenching and the mode of investigation, the destruction in the one cases begins at the edges and in other cases it starts from the surface. In glasses that had not been quenched the surface strength is by 300 to 400 kg/cm^2 higher than the strength of the edges. In quenched glasses the difference varies depending on the degree of edge solidification, it is, however, not greater than the above mentioned value. 3) The strength of the quenched glasses very weakly depends on the scale factor and on the chemical composition. 4) The evaluation of the experimental data permits to recommend simple formulae for the calculation of the strength of quenched glasses. There are 6 figures and 11 references, 6 of which are Soviet.

ASSOCIATION: Vsesoyuznyy nauchno-issledovatel'skiy institut stekla, Moskva (All-Union Scientific Research Institute for Glass, Moscow)

The Strength of Quenched Glasses

SOV/57-28-7-18/35

SUBMITTED: October 2o, 1956

1. Glass--Physical properties

Card 3/3

AUTHORS: Bartenev, G. M., Styran, Z. Ye. SOV/20-121-1-23/55

TITLE: Friction Properties of Rubber-Like Polymers (Friktsionnyye svoystva kauchukopodobnykh polimerov)

PERIODICAL: Doklady Akademii nauk SSSR, 1958, Vol. 121, Nr 1, pp. 87-90 (USSR)

ABSTRACT: According to the data given by the authors the characteristics of friction of a rubber-like and of a solid polymer are different which speaks for a difference in the nature of the friction of these materials. In the investigation of the molecular model of the friction the authors start with the model of the net-like rubber polymer which consists of flexible linear molecules. The number of the chains in contact with the surface depends on the factual contact face. Each chain only temporarily is in contact with the surface and then jumps over to a new point of contact. The authors investigated the friction of vulcanized rubber on smooth solid surfaces in dependence on temperature, velocity of gliding, load, rubber type, and the density of the space lattice. The obtained data prove the characteristic nature of the friction of rubber-like polymers. In a wide range of velocities (4 orders of magnitudes)

Card 1/3

the experimental dependence is practically described by a straight line. The sort of the solid support influences the activation energy. One more diagram illustrates the temperature dependence of the frictional force of a certain sort of rubber on steel. According to these data the friction of rubber-like polymers agrees well with the theory in a wide interval of gliding velocities and temperatures. The activation energy depends, though only weakly, on the structure of the rubber. The activation energy is weakly, the surface of factual contact, however, strongly dependent on the modulus of elasticity of the rubber. On occasion of a transition from one type of a polymer to an other one the activation energy varies considerably. The external friction (as well as the internal friction) of the rubber-like polymers is, according to the obtained data, a molecular-kinetic process which is connected with the transition of the kinetic units (chains) through the energy barriers under the influence of the heat movement and of the external force. There are 3 figures and 7 references, 3 of which are Soviet.

ASSOCIATION: Nauchno-Issledovatel'skiy institut rezinovoy promyshlennosti
Card 2/3 Scientific Research Institute of Rubber Industry)

Friction Properties of Rubber-Like Polymers SOV/20-121-1-23/55

PRESENTED: April 3, 1958, by P. A. Rebinder, Member, Academy of Sciences, USSR

SUBMITTED: April 31, 1958

1. Polymers--Friction 2. Polymers--Internal friction 3. Polymers --Elasticity 4. Rubber--Friction 5. Friction--Analysis

Card 3/3

AUTHORS: Bartenev, G. M., Tsepkov, L. P. SOV/2o-121-2-18/53

TITLE: The Scale Factor and the Strength of Glass (Masshtabnyy faktor i prochnost' stekla)

PERIODICAL: Doklady Akademii nauk SSSR, 1958, Vol. 121, Nr 2, pp. 26o - 263 (USSR)

ABSTRACT: The purpose of the present paper is an investigation of the scale effect under different experimental conditions and with different samples. By scale effect the influence of the dimensions of the working parts of a sample or a product on its strength is meant. This effect is most distinctly marked in brittle material, as e.g. silicate glass. Experience has shown that the strength of glass practically only depends on the strength of the surface. At first the authors briefly discuss a few previous papers (Refs 1-6) which in the description of the influence of the scale factor on the strength of glass arrived at contradicting results. In the following at first the strength of a glass fibre and then different bending and stretching experiments with glass samples are discussed. The strength of a fibre only depends on the coefficient of expansion α, but not on the diameter of the

Card 1/3

fibre. For α it is valid $\alpha = 1 + \epsilon_{pl}$, where ϵ_{pl} is the value of the plastic deformation in the production. The crack resistance does not change by changing the diameter of a fibre (if α = const). Bending and stretching experiments with glass plates provided the following results: 1) The strength does not change with the thickness; 2) Glass, investigated by the method of vertical stretching, shows an influence of the thickness on the surface condition: The thicker the glass, the lower will be the strength of its surface. In figures the tables show the results of bending and stretching experiments (transverse and symmetrical bending). It becomes evident that the influence of internal tensions can be neglected as long as these are small. There are 4 figures and 9 references, which are Soviet.

ASSOCIATION: Vsesoyuznyy nauchno-issledovatel'skiy institut stekla (All-Union Scientific Research Institute for Glass)

The Scale Factor and the Strength of Glass SOV/2o-121-2-18/53

PRESENTED: January 13, 1958, by P.A.Rebinder, Member, Academy of Sciences, USSR

SUBMITTED: January 9, 1958

Card 3/3

BAR TENEV, G. M.

24(8) PHASE I BOOK EXPLOITATION SOV/2809

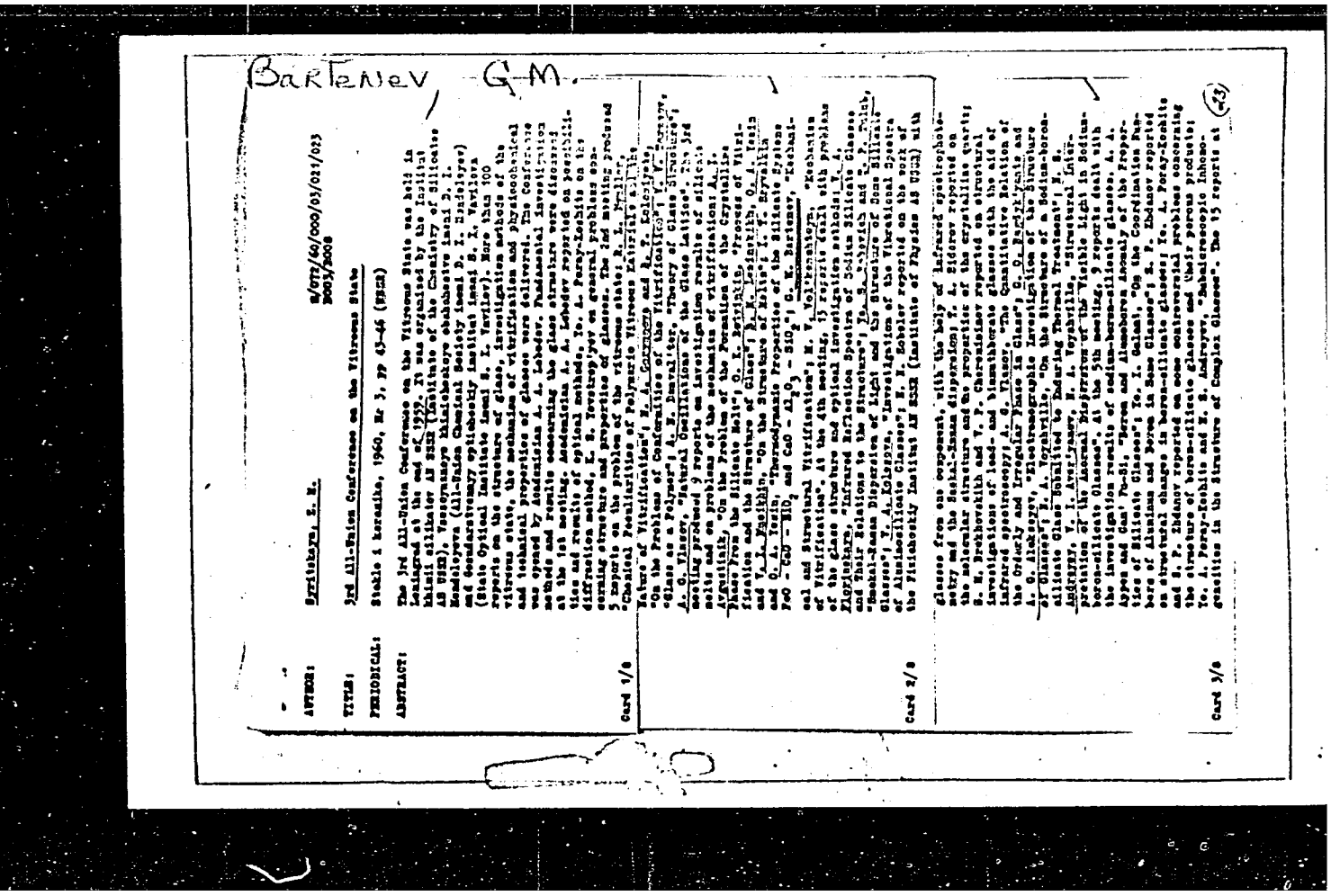
Akademiya nauk SSSR. Otdeleniye khimicheskikh nauk

Termodinamika i stroyeniye rastvorov; trudy soveshchaniya...
(Thermodynamics and Structure of Solutions; Transactions of the Conference Held January 27-30, 1958) Moscow, Izd-vo AN SSSR, 1959. 295 p. 3,000 copies printed.

Ed.: M. I. Shakhparonov, Doctor of Chemical Sciences; Ed. of Publishing House: N. G. Yegorov; Tech. Ed.: T. V. Polyakova.

PURPOSE: This book is intended for physicists, chemists, and chemical engineers.

COVERAGE: This collection of papers was originally presented at the Conference on Thermodynamics and Structure of Solutions sponsored by the Section of Chemical Sciences of the Academy of Sciences, USSR, and the Department of Chemistry of Moscow State University, and held in Moscow on January 27-30, 1958. Officers of the conference are listed in the Foreword. A list of other reports also read at the conference, but not included in this book, are given. Among the problems treated in this work are: electrolytic solutions, ultrasonic measurement, dielectric and thermodynamic properties of various mixtures, spectroscopic analysis, etc. References accompany individual articles.



BARTENEV, G.M.

AUTHOR: Bartenev, G. M. S/078/60/005/03/011/023
B003/B006

TITLE: 3rd All-Union Conference on the Vitreous State

PERIODICAL: Steklo i keramika, 1960, Nr 3, pp 45-46 (USSR)

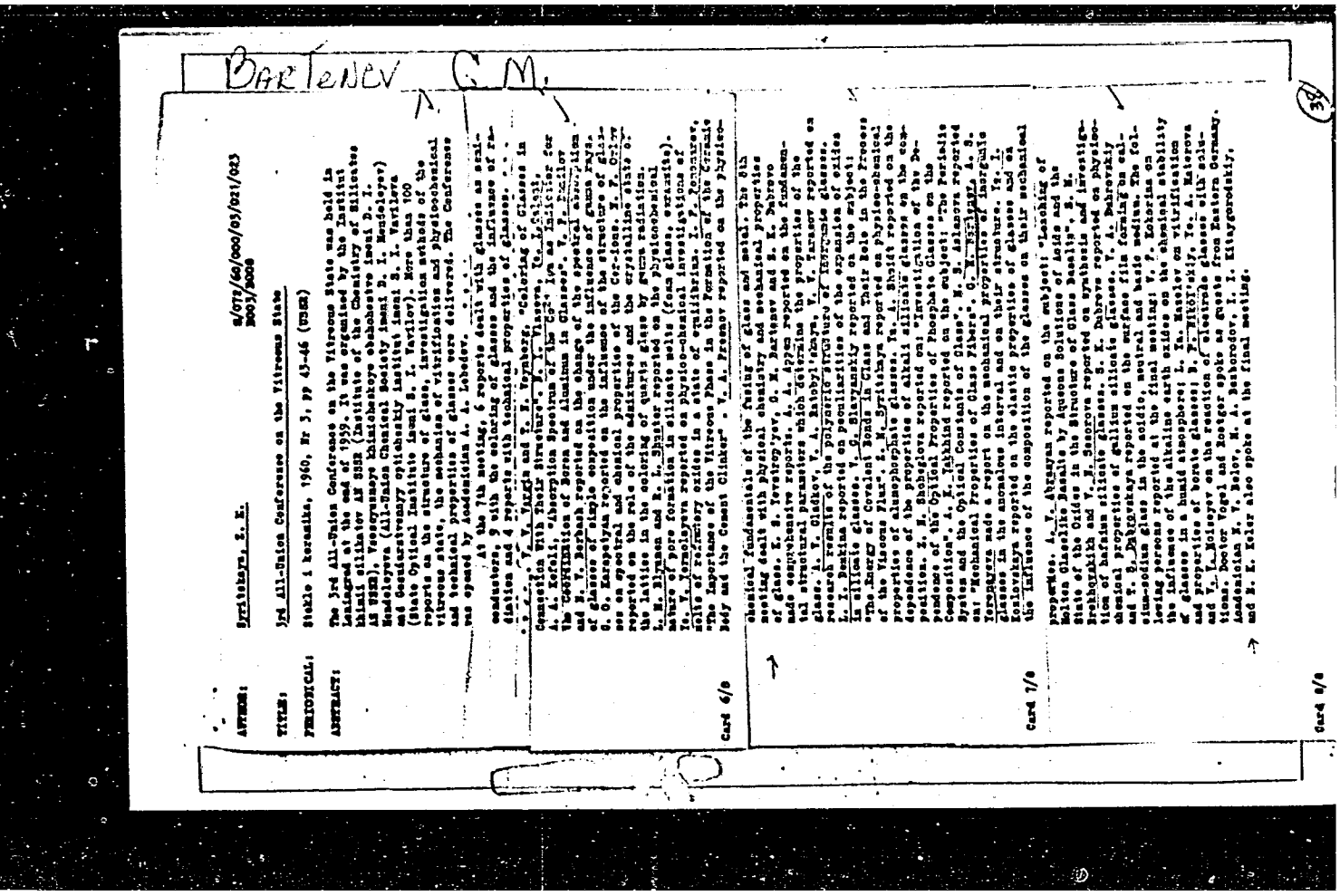
ABSTRACT: The 3rd All-Union Conference on the Vitreous State was held in Leningrad at the end of 1959. It was organized by the Institut khimii silikatov AN SSSR (Institute of the Chemistry of Silicates AN USSR), Vsesoyuznoye khimicheskoye obshchestvo imeni D. I. Mendeleyeva (All-Union Chemical Society imeni D. I. Mendeleyev) and Gosudarstvennyy opticheskiy institut imeni S. I. Vavilova (State Optical Institute imeni S. I. Vavilov). More than 300 reports on the structure of glass, investigation methods of the vitreous state, the mechanism of vitrification and physicochemical and technical properties of glasses were delivered. The Conference was opened by Academician A. A. Lebedev. Fundamental investigation methods and results concerning the glass structure were discussed at the 1st meeting. Academician I. A. Lebedev reported on possibilities and results of optical methods. Yu. A. Pershin-Kozhitov on X-ray diffraction methods, K. S. Yevstropyev on general problems concerning structure and properties of glasses. The 2nd meeting produced 5 reports on the problem of the vitreous state. A. A. Appelin, "Chemical Peculiarities of Polymeric Vitreous Materials and the Nature of Vitrification"; N. A. Toropov and K. S. Evstropyev, "On the Problem of Conformities of the Vitrification"; V. V. Tarasov, "Glass as a Polymer"; A. N. Dmitriyev, "Theory of Glass Structure"; A. G. Pinus, "Natural Oscillations of the Glass Lattice". The 3rd working problem; 9 reports on investigation results of silicate melts and on problems of the mechanism of vitrification: A. P. Vinogradov, "On the Problem of the Formation of the Crystalline Phase from the Silicate Melt"; O. K. Botvinkin, "Process of Vitrification and the Structure of Glass"; B. K. Leontyuk, O. A. Yesin and V. A. Fedotov, "On the Structure of Melts"; I. V. Tyutyunnik and O. A. Yesin, "Thermodynamic Properties of the Silicate System $PbO - SiO_2$ and $CaO - Al_2O_3 - SiO_2$"; G. K. Borisov, "Mechanical and Structural Vitrification"; N. V. Volkenshteyn, "Mechanism of Vitrification". At the 4th meeting, 13 reports dealt with problems of the glass structure and optical investigation methods: V. A. Florinskaya, "Infrared Reflection Spectra of Sodium Silicate Glasses and Their Relations to the Structure"; Yu. S. Sigarin and T. P. Polak, "Raman-Scattering Dispersion of Light and the Structure of Some Silicate Glasses"; V. A. Kolesova, "Investigation of the Vibrational Spectra of Aluminosilicate Glasses"; E. I. Kozlov reported on the work of the Fizicheskiy institut AN SSSR (Institute of Physics AN USSR) with

Card 1/3

Card 2/3

glasses from an oxygenet, with the help of infrared spectrophotometry and the Raman-Mesa dispersion; V. A. Sidorov reported on the molecular structure and the properties of the crystalline quartz; S. M. Brotherskikh and V. P. Cherepinskiy reported on structural investigations of lead- and bismuthborate glasses with the aid of infrared spectroscopy; A. G. Pinus, "The Quantitative Relation of the Orderly and Irregular Phase in Glass", G. O. Karapetyants and A. G. Aleksiyev, "Electronographic Investigation of the Structure of Glasses"; E. A. Porai-Koshits, "On the Structure of a Sodium-borosilicate Glass Exhibiting Wandering Thermal Treatment"; I. N. Anikeyeva, V. I. Aristova, E. A. Porai-Koshits, "Structural Interpretation of the Lateral Dispersion of the Visible Light in Sodium-borosilicate Glasses". At the 5th meeting, 9 reports dealt with the investigation results of sodium-borosilicate glasses. A. A. Appen and Gan' Fu-Si, "Boron and Aluminum Anomaly of the Properties of Silicate Glasses"; Yu. I. Galant, "On the Coordination Numbers of Aluminum and Boron in Some Glasses"; E. F. Zhdanov reported on structural change in boron-silicate glasses; Yu. A. Porai-Koshits and E. F. Zhdanov reported on some controversial problems concerning the structure of boron-silicate glasses and their porous products; Yu. A. Porai-Koshits and E. E. Andreyev, "Submicroscopic Inhomogeneities in the Structure of Complex Glasses". The 15 reports at

Card 3/3



BARTENEV, G. M.

AUTHOR: Britikova, S. E. 8/073/60/000/05/021/023
B003/B006

TITLE: 3rd All-Union Conference on the Vitreous State

PERIODICAL: Steklo i keramika, 1960, Nr 5, pp 45-46 (USSR)

ABSTRACT: The 3rd All-Union Conference on the Vitreous State was held in Leningrad at the end of 1959. It was organized by the Institut khimii silikatov AN SSSR (Institute of the Chemistry of Silicates AN USSR), Vsesoyuznoye khimicheskoye obshchestvo imeni D. I. Mendeleyeva (All-Union Chemical Society imeni D. I. Mendeleyev) and Gosudarstvennyy opticheskiy institut imeni S. I. Vavilova (State Optical Institute imeni S. I. Vavilov). More than 100 reports on the structure of glass, investigation methods of the vitreous state, the mechanism of vitrification and physicochemical and technical properties of glasses were delivered. The Conference was opened by Academician A. A. Lebedev.

At the 7th meeting, 6 reports dealt with glasses as semiconductors, 9 with the coloring of glasses and the influence of radiation and 4 reports with technical properties of glasses. ...

... V. V. Vargin and T. N. Vorob'yeva, Ye. A. Porai-Koshits, Competition With Their Structure". V. V. Vargin, Ye. A. Porai-Koshits, A. A. Kotoli, "Absorption Spectrum of the Ion As in Silicate Glasses in the Ultraviolet Region". V. P. Zaytsev and N. V. Perfenov reported on the change of the spectral absorption of glasses of simple composition under the influence of gamma rays. G. O. Karapetyan reported on the influence of the structure of glasses on spectral and chemical properties of the Co-ions. N. F. Ovchinnikova reported on the role of the admixtures and the crystalline state of the lattice in the coloring of quartz glass by gamma radiation. L. N. Blinova and E. K. Shnitov reported on the physicochemical ...

... Ye. V. Kolesova reported on physico-chemical investigations of ... of refractory oxides in a state of equilibrium. I. F. Tonkonog, "The Importance of the Vitreous Phase in the Formation of the Ceramic Body and the Cement Clinker". V. A. Frenov reported on the physico-

Card 6/8

... chemical fundamentals of the fusion of glass and metal. The 8th meeting dealt with physical chemistry and mechanical properties of glass. E. S. Yevstropyev, G. M. Bartenev and S. K. Dabrovo made comprehensive reports. A. I. Apfel'baum reported on the fundamental structural parameters which determine the properties of the glass. I. V. Gladkov, V. A. Khobylkara, V. Ya. Yarosh reported on research results of the polymeric structure of inorganic glasses. I. I. Boldina reported on peculiarities of the expansion of silicate glasses in silicate glasses. V. O. Sterzhanik reported on the subject "On the Energy of Covalent Bonds in Glass and Their Role in the Process of the Viscous Flow". S. M. Ryvkin reported on physico-chemical properties of alumophosphate glasses. Ya. I. Sheldt reported on the dependence of the properties of alkali silicate glasses on the composition. Z. N. Shebalova reported on "Investigation of the Dependence of the Optical Properties of Phosphate Glasses on the Composition". A. K. Pakhomov reported on the subject: "The Periodic Series and the Optical Constants of Glass". M. S. Asinova reported on "Mechanical Properties of Glass Fibers". O. V. Mitrofanov and ... Ivanenko made a report on the mechanical properties of inorganic glasses in the anomalous interval and on their structure. Ya. I. Gonorovskiy reported on the elastic properties of glasses and on the influence of the composition of the glasses on their mechanical ...

Card 7/8

... properties. A. I. Abramova reported on the subject "Leaching of Glass Ceramics Samples by Aqueous Solutions of Acids and the State of the Oxides in the Structure of Glass Samples". E. K. Prokhorikhin and V. F. Semerova reported on synthesis and investigation of barium silicate glasses. S. K. Dabrovo reported on physicochemical properties of gallium silicate glasses. V. A. Petrovskiy and T. S. Zakharkaya reported on the surface film forming on silicate-sodium glass in the acidic, neutral and basic medium. The following persons reported at the final meeting: V. P. Zakharina on the influence of the alkaline earth oxides on the chemical stability of glasses in a humid atmosphere; I. Ya. Mikhaylik, Ye. A. Materova and properties of boric glasses; B. ... Academician K. V. Belov, M. A. Bezborodov, I. I. Kitaygorodskiy, and E. K. Keler also spoke at the final meeting.

Card 8/8

BARTENEV, G. M.

PHASE I BOOK EXPLOITATION SOV/5033

Vsesoyuznoye soveshchaniye po stekloobrazovaniyu. 3d, Leningrad, 1959.

Stekloobrazovaniye; trudy Tretyego vsesoyuznogo soveshchaniya Leningrad, 16-20 noyabrya 1959 (Vitreous State; Transactions of the Third All-Union Conference on the Vitreous State, Held in Leningrad, November 16-20, 1959) Moscow, Izd-vo AN SSSR, 1960. 534 p. Errata slip inserted. 3,500 copies printed.
(Series: Its: Trudy)

Sponsoring Agencies: Institut khimii silikatov Akademii nauk SSSR. Vesoyuznoye khimicheskoye obshchestvo imeni D.I. Mendeleyeva and Gosudarstvennyy ordena Lenina opticheskiy institut imeni S.I. Vavilova.

Editorial Board: A.I. Avgustinik, V.P. Barskovskiy, M.A. Bezborodov, O.K. Botvinkin, V.V. Vargin, A.G. Vlasov, K.S. Yevstropyev, A.A. Lebedev, M.A. Matveyev, V.S. Molchanov, R.L. Myuller, Ye.A. Porai-Koshits, Coalman, M.A. Toropov, V.A. Florinskaya, A.K. Yakhkind; Ed. of Publishing House: I.V. Suvorov; Tech. Ed.: V.T. Bocharov.

PURPOSE: This book is intended for researchers in the science and technology of glasses.

COVERAGE: The book contains the reports and discussions of the Third All-Union Conference on the Vitreous State, held in Leningrad on November 16-19, 1959. They deal with the methods and results of studying the structure of glasses, the relation between the structure and properties of glass, the nature of the chemical bond and glass structure, and the crystallochemistry of glass. Fused silica, mechanism of vitrification, optical properties and glass structure, and the electrical properties of glasses are also discussed. A number of the reports deal with the dependence of glass properties on composition, the tinting of glasses and radiation effects, and chemical, technical, and chemical properties of glasses. Other papers treat glass semiconductors and soda borosilicates. The Conference was attended by more than 900 delegates from Soviet and East German scientific organizations. Among the participants in the discussions were N.V. Solomin, Ye. V. Kuvshinskiy, Yu.A. Gusev, V.P. Popatishkin, Yu. Ya. Gerlib, O.P. Mchedlov-Petrosyan, G.P. Mikhaylov, S.M. Petrov, A.N. Lazarev, D.I. Levin, A.V. Shatilov, N.T. Ploshchinskiy, A.Ya. Kunetsov, E.V. Degtyareva, G.V. Fotiyevskiy Institut AN SSSR (Physics Institute AS USSR), Fiziko-khimicheskiy Institut AN SSSR (Physicochemical Institute AS USSR), Institut fiziki AN BSSR, Minsk (Institute of Physics, Academy of Sciences, Belorusskaya SSR, Minsk), Laboratory of Physical Chemistry of Silicates of the Institut obshchey i neorganicheskoy khimii AN BSSR, Minsk (Institute of General and Inorganic Chemistry, Academy of Sciences, Belorusskaya SSR, Minsk), Institut vysokomolekulyarnykh soyedineniy AN SSSR(Institute of High Molecular Compounds, AS USSR), Gosudarstvennyy institut stekla (State Institute for Glass), Gosudarstvennyy institut elektrosvarochnogo stekla (State Institute for Electrical Glass), Sibirskiy fiziko-tekhnicheskiy institut, Tomsk (Siberian Physicotechnical Institute, Tomsk), Leningradskiy gosudarstvennyy universitet (Leningrad State University), Moskovskiy khimiko-tekhnologicheskiy institut (Moscow Institute of Chemical Technology), Leningradskiy tekhnologicheskiy institut im. Lensoveta (Leningrad Technological Institut imeni Lensovet), Belorusskiy politekhnicheskiy institut (Belorussian Polytechnic Institute), Moskovskiy politekhnicheskiy institut (Moscow Polytechnic Institute), Sverdlovskiy politekhnicheskiy institut (Sverdlovsk Polytechnic Institute), and Sverdlovskiy politekhnicheskiy institut (Sverdlovsk Polytechnic Institute). The Conference was sponsored by the Institute of Silicate Chemistry AS USSR (Acting Director - A.S. Dolin), the Vesoyuznoye khimicheskoye obshchestvo im. D.I. Mendeleyeva (All-Union Chemical Society imeni D.I. Mendeleyev), and the Gosudarstvennyy ordena Lenina opticheskiy institut imeni S.I. Vavilova (State Order of Lenin Optical Institute imeni S.I. Vavilov). The 15 resolutions of the Conference include recommendations to organize a Center for the purpose of coordinating the research on glass, to publish a new periodical under the title "Fizika i khimiya stekla" (Physics and Chemistry of Glass), and to join the International Committee on Glass. The Conference thanks A.A. Lebedev, Academician, Professor, and Chairman of the Organization of Committee; Member of the Editorial Committee; and R.L. Myuller, Doctor of Chemical Sciences, Member of the Organizational Committee. The editorial board thanks G.M. Bartenev, M.V. Volkenshteyn, L.I. Demkina, D.F. Dobychin, S.M. Dukhovo, V.A. Ioffe, and N.T. Kolomiyets. References accompany individual reports.

SOV/179-59-2-25/40

AUTHORS: Bartenev, G. M., Rozanova, V. I. (Moscow)

TITLE: Thermal Endurance and Strength of Glass (Termostoykost' i prochnost' stekla)

PERIODICAL: Izvestiya Akademii nauk SSSR OTN, Mekhanika i mashinostroyeniye, 1959, Nr 2, pp 159-162 (USSR)

ABSTRACT: The paper is a continuation of previous work (Refs 3-6), in which the maximum thermal stress developed on two-sided cooling of a glass plate was calculated. This solution shows that the thermal stress attains a maximum value with time $(S_m)_1$ and the thermal endurance is defined as

$$\vartheta = \frac{P(1-\mu)}{\beta E} \frac{1}{haS_m} \qquad (1)$$

where P, μ, β, E, h and a are respectively the ultimate strength, the Poisson's ratio, the coefficient of thermal expansion, the Young's modulus, the coefficient of heat emission and the half-thickness of the glass. The thermal endurance of a number of specimens was measured on cooling in air and in water. The effect of thickness, of hardening and of annealing was investigated, and the results are presented in the form of graphs. The character of the

Card 1/2

Thermal Endurance and Strength of Glass

rupture is described both for annealed and for hardened glass, and photographs are reproduced showing various hardened glasses after fracture. There are 7 figures and 7 references, of which 5 are Soviet and 2 English.

ASSOCIATION: Institut stekla (Glass Institute)

SUBMITTED: March 29, 1959 .

05273
24(6) SOV/170-59-7-4/20

AUTHORS: Bartenev, G.M., Tsepkov, L.P.

TITLE: On Testing Strength of Glass

PERIODICAL: Inzhenerno-fizicheskiy zhurnal, 1959, Nr 7, pp 20 - 28 (USSR)

ABSTRACT: Inorganic glass is an ideal material for checking the theory of elasticity. The methods of testing which have been applied so far are, however, not very well substantiated, and the data available in literature are contradictory. The authors analyzed the tests of flat glass for transverse and symmetrical bending under statical loads. The checking of formulae of the material strength theory for transverse bending was made by Frokht, Koker and Faylon [Refs 9,10] on glass specimens of the beam type. However, according to N.M. Belyayev, when the ratio of beam thickness to its span $d/L < 1/5$, it works as a plate, and calculation conditions should be changed. The authors carried out tests of both rigid and elastic glass plates, and the results are compiled in Table 2. A conclusion drawn from these tests is as follows: formulae applied for calculating the strength and the magnitude of arising stresses in tests for transverse bending, hold for rigid and elastic plates, provided that deflections do not exceed the thickness of the plate. The tests for symmetric bending

were carried out to determine the strength of the surface of glass plates. A series of tests with a freely supported plate on a square and on a round support, subjected to a load concentrated in the center, were performed. For the case of a square plate on a square support there are 3 different formulae proposed by Timoshenko [Ref 1], Roark [Ref 14] and Markus [Ref 15]. As can be seen from the results of tests of a square plate with a square support, presented in Figure 2, Markus' formula holds with an accuracy of ±10% for the plates in which $D < 1/6\ a$, where D is the diameter of the drill core, and a is the side of the square support. At $D > 1/6\ a$, Roark's formula yields better results. For the case of a round plate on a round support, best results are yielded by Formula 7, proposed by Timoshenko, provided that $D > 1/4\ a$. The authors investigated, moreover, an effect of the edges in tests for symmetrical bending. Their conclusion is that the edges should extend by 1 to 2 d beyond the support. The shape of the plate should correspond to the contour of the support. In the conclusion the authors thank S.N. Zhurkov, Corresponding Member AS USSR for discussing the present in-

On Testing Strength of Glass

05273

SOV/170-59-7-4/20

vestigation.
There are: 2 graphs, 1 diagram, 1 photo, 4 tables and 18 references, 12 of which are Soviet, 4 English, 1 French and 1 German.

ASSOCIATION: Gosudarstvennyy nauchno-issledovatel'skiy institut stekla (State Scientific Research Institute for Glass), Moscow.

Card 3/3

BARTENEV, G.M.; GORBATKINA, Yu.A.

Some regularities in the vitrification of rubber. Vysokom. soed. 1 no.5:769-775 My '59. (MIRA 12:10)

1. Moskovskiy pedagogicheskiy institut im. V.P.Potemkina.
(Rubber)

BARTENEV, G.M.; STYRAN, Z.Ye.

Effect of the temperature and degree of cross linkage on the frictional properties of elastomers of the rubber type. Vysokom.soed. 1 no.7:978-989 Jl '59. (MIRA 12:11)

1. Nauchno-issledovatel'skiy institut rezinovoy promyshlennosti.
(Elastomers) (Polymers)

BARTENEV, G.M.; ZAYTSEVA, V.D.

Mechanical vitrification and the activation energy of rubberlike polymers. Vysokom. soed. 1 no.9:1309-1318 S '59.
(MIRA 13:3)

1.Nauchno-issledovatel'skiy institut rezinovoy promyshlennosti.
(Rubber) (Polymers)

15(9) SOV/69-21-1-1/21

AUTHORS: Bartenev, G.M. and Novikova, N.M.

TITLE: The Percussion Deformation of Rubber (Deformatsiya reziny pri udare).

PERIODICAL: Kolloidnyy zhurnal, 1959, Vol XXI, Nr 1, pp 3-8 (USSR)

ABSTRACT: Ye. V. Kuvshinskiy and Ye. A. Sidorovich [reference 5] developed a method of determining the elastic properties of rubber during percussion, and proposed a theory of a method which permits the determination from experimental data of two independent constants of rubber, the dynamic elastic modulus and the angle of mechanical losses. A pendulum elastometer, described in detail, was used for the experiment. As a result of graphic and analytical calculations, the authors found that at a permanent initial percussion speed, a proportional correlation between the kinetic energy and the square of the percussion deformation occurs. The coefficient of this proportionality is called a "percussion modulus". The correlation also holds for

Card 1/2

low temperatures, so that the frost stability can be estimated by the sharp change in the percussion modulus. The names of M.M. Reznikovskiy and E.L.Chernyakova are also mentioned in the article. There are 7 graphs, 2 diagrams and 8 references, 5 of which are Soviet and 3 English.

ASSOCIATION: Nauchno-Issledovatel'skiy institut rezinovoy promyshlennosti (The Scientific Research Institute of the Rubber Industry), Moscow.

SUBMITTED: June 10, 1957.

5(4) SOV/69-21-3-1/25

AUTHORS: Bartenev, G.M. and Yeremeyeva, A.S.

TITLE: The Structure and Structural-Mechanical Properties of Inorganic Glasses

PERIODICAL: Kolloidnyy zhurnal, 1959, Vol XXI, Nr 3, pp 249-256 (USSR)

ABSTRACT: The author reports on some experiments intended to determine the structuro-mechanical properties of inorganic glasses. According to the Soviet scientist P.A. Rebinder, diffractional methods which prove so useful for the investigation of crystalline matter, are of little value for the study of disperse phases, high polymers, organic and inorganic glasses. The study of the structural-mechanical properties of inorganic glasses, i.e. particularly of silicate glasses, is, therefore, of great importance for the ascertainment of the structure of these very complicated materials. The author's experiments have shown that at certain temperatures the structural frame of inorganic glasses is little re-

Card 1/3

sistent and easily disintegrates under light loads, but that it is partially restored after their removal. The main reason for the solidification of viscous glass, when cooled, is the process of vitrification. The aggregation process and the thermal history, however, play an important role in the formation of the glass structure, which appears in the change of mechanical behavior of samples of the same glass sort. The author maintains that inorganic glasses (massive glasses and glass fibers) occupy a position intermediate between thixotropic colloidal systems and high polymers. This assumption is based on the behavior of inorganic glasses above the softening temperature and requires 1) the presence of a temperature region of deformation of the elastic type, differing from the high elastic deformations observed below the softening temperature, and 2) the presence of thixotropic properties. The structuration processes above the vitrification temperature lead to the formation of a network,

The Structure and Structural-Mechanical Properties of Inorganic Glasses

the elements of which are evidently chains. In addition to the above-mentioned Soviet scientist the following names, which are all covered by references, are mentioned in the article: V.V. Tarasov, G.M. Bartenev, A.I. Bovkunenko, A.F. Zak and Yu.P. Man'ko. The article was delivered as a report at the Fourth All-Union Conference for Colloidal Chemistry, Tbilisi, 1958. There are 10 graphs, 1 table and 16 references, 13 of which are Soviet, 2 English and 1 French.

ASSOCIATION: Gosudarstvennyy nauchno-issledovatel'skiy institut stekla, Moskva (State Scientific Research Glass Institute, Moscow)

SUBMITTED: 19 April, 1958

BARIENBLATT, G. M.

report presented at the 1st All-Union Congress of Theoretical and Applied Mechanics, Moscow, 27 Jan - 3 Feb '60.

1. A. A. Abbasov, A. F. Zaslonov, Iu. A. Shvarts (Baku): Supersonic motions of visco-plastic solids and the basis for improving well cementation.
2. A. A. Abbasov, V. M. Mekhtiyev, A. A. Mirzajan (Baku): Heat transfer in moving viscous and visco-plastic solids.
3. B. L. Abramian (Erevan): Torsion of cylindrical shafts.
4. B. L. Abramian, A. A. Babloian (Erevan): Torsion of circular hollow shafts with longitudinal notches.
5. V. L. Agamirov, A. S. Volmir, V. E. Mineev (Moscow): Buckling and post-buckling behavior of shells under dynamic loading.
6. A. Ia. Aleksandrov (Novosibirsk): Some relations between the solutions of plane and axisymmetrical problems in the theory of elasticity.
7. A. Ia. Aleksandrov (Novosibirsk): Experimental investigation of plane elastic-plastic problems by means of photoelastic films.
8. V. M. Aleksandrov, Iu. A. Rostinov (Rostov-na-Donu): Some contact problems in elasticity.
9. R. A. Aleksandrian, N. Kh. Arutiunian, M. M. Manukian (Erevan): Torsion of prismatic bars under transient creep.
10. R. A. Alekseev (Moscow): Two-dimensional bodies of equal strength.
11. N. A. Alumäe (Tallin): Axisymmetrical vibration of an elastic conical shell.
12. S. A. Ambartsumian (Erevan): On the theory of anisotropic shells and plates.
13. S. A. Ambartsumian, L. A. Movsisian (Erevan): Some problems in the theory of anisotropic (non-orthotropic) shells.
14. I. Ia. Amiro (Kiev): Stability analysis of a stiffened cylindrical shell under axial compression.
15. V. V. Andreev, A. M. Kosevich, L. V. Tanatarov (Kharkov): The inelastic deformation and residual strains in a plane layer of a solid under allotropic transformations.
16. I. G. Aramanovich (Moscow): The stress distribution in a heavy half-space with a circular hole, the edge of which is subject to non-equilibrated forces.
17. M. Arcan, M. Tannenbaum (Bucharest): Photoelastic model studies of cracked reinforced concrete beams.
18. N. Kh. Arutiunian (Erevan): The plane contact problem of the theory of creep.
19. T. V. Arsenova, T. I. Zatsepina, A. A. Trapeznikov (Moscow): Shear strengths and limits of reversible strains of solutions and gels of some rubbers.
20. I. S. Baida (Leningrad): The general solution of the problem of elastic strains in a cylinder of finite length.
21. G. I. Barenblatt (Moscow): The theory of equilibrium cracks under brittle rupture.
22. G. M. Bartenev (Moscow): Rheological properties of rubber-like polymers.
23. M. F. Barshtein (Moscow): Dynamic design of structures subjected to random effects.
24. N. P. Bashinskaia (Moscow): Temperature distribution in container and metal during extrusion.
25. Bar on Pin (Peking), Siun Tsziao-Zhun (Tsinghua), G. S. Shapiro (Moscow): On the dynamics of rigid-plastic structures.
26. V. G. Berezantsev (Leningrad): The theory of the limit state of stress in soil mechanics and its applications.
27. A. Iu. Birkgan, A. S. Volmir (Moscow): The use of electronic digital computers for solving non-linear problems in the theory of plates and shells.
28. V. I. Blokh (Kharkov): Stress displacement functions.
29. V. A. Bobin (Dnepropetrovsk): Difference-variational methods of the theory of structures.
30. V. I. Boiko (Kiev): On solving Hertz's contact problem with interior fields of plasticity.
31. V. V. Bolotin (Moscow): Method of space transformations in the non-linear theory of plates and shells.
32. V. V. Bolotin (Moscow): The non-linear problems of aero-elasticity at supersonic speeds.
33. V. V. Bolotin (Moscow): Strength and damage under action of random forces.
34. V. V. Bolotin (Moscow): The statistical theory of seismic design of structures.

BARTENEV, Georgiy Mikhaylovich, prof., doktor khim.nauk. Prinimala uchastiye LIOZNYANSKAYA, S.G., kand.tekhn.nauk. SIL'VESTROVICH, S.I., nauchnyy red.; KUZNETSOVA, M.N., red.izd-va; SHERSTNEVA, N.V., tekhn.red.

[Mechanical properties and the heat treatment of glass] Mekhanicheskie svoistva i teplovaia obrabotka stekla. Moskva, Gos.izd-vo lit-ry po stroit., arkhit. i stroit.materialam, 1960. 165 p. (MIRA 13:8)

(Glass manufacture)

S/081/61/000/024/082/086
B101/B110

AUTHOR: Bartenev, G. M.

TITLE: Interdependence of the structure of rubber and its friction coefficient

PERIODICAL: Referativnyy zhurnal. Khimiya, no. 24, 1961, 584 - 585, abstract 24P430 (Tr. 3-y Vses. konferentsii po treniyu i iznosu v mashinakh, v. 2. M., AN SSSR, 1960, 7 - 14)

TEXT: The authors demonstrate the passage from the equation for the frictional force F given by the theory of rubber friction on smooth surfaces to empirical equations relating the friction coefficient to the load. The reduction of the theoretical equation which is admissible for the sliding velocities v>0.1mm/hr shows that the dependence of F on temperature and on v comprises three constants (α, S_k, U) that are determined by the rubber structure. α depends on the rubber hardness, especially on the density of the vulcanization network and determines the nature of the formation of S_f, the actual contact area under load. In narrow ranges α is inversely proportional to the rubber equilibrium

Card 1/2

Interdependence of the...

modulus. α is independent of the type of the base and of v. S_k is the effective contact area between rubber chain and base. U is the activation energy which depends on the molecular forces of adhesion between rubber chains and base, i.e. on the nature of the frictioning surfaces. $C = F/S_f$, the tangential stress at the contact area caused by the frictional forces can be determined from S_k and U. A method is given of determining S_f. [Abstracter's note: Complete translation.]

Card 2/2

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S/191/60/000/001/004/015
B016/B054

15.2120

AUTHOR: Bartenev, G. M.

TITLE: High Stability of Glass Fibers

PERIODICAL: Plasticheskiye massy, 1960, No. 1, pp. 21-24

TEXT: The author reports on his attempt of producing thick glass fibers with the same strength peculiar to thin glass fibers (below 15 μ diameter). Fig. 1 shows one of the most important properties of glass fibers on the basis of the author's data: the dependence of tensile strength on diameter and length of continuous non-alkaline glass fibers. Fig. 2 shows the change in strength during pickling with HF. This pickling eliminates, in part, the surface faults of fibers, and increases, in part, the strength, but without leading to perfect results. The author clarified the interrelations of the individual physical factors which are responsible for the strength of glass fibers. He states as follows: glass fibers have a distinct anisotropy of the effect of sample size: the fiber length has an effect on strength different from that of the diameter. The physical causes of

Card 1/3

High Stability of Glass Fibers

this phenomenon are different. The statistical theory of strength gives no sufficient explanation. But it explains very well the spread of test results (Fig. 1), and the dependence of strength on the fiber length. The main physical factor ensuring the high strength of the fiber is the irreversible viscous deformation attaining some million percent. No clear statement can be made at present on the kind of solidifying mechanism in connection with the viscous flow. The author assumes that the strength increases due to a reduction of faults by irreversible viscous deformation. These faults become smaller by the $\sqrt{\alpha}$-fold (α = degree of extension = $1+\varepsilon$; ε = viscous deformation). This makes the surface faults less dangerous. Further, the author assumes that during drawing the solid bonds (due to the orientation of chain structures) are oriented along the fiber axis. Thus, the material strength increases in the direction of the fiber axis with the degree of extension. Though these two factors affect the glass solidification during drawing, the author does not know exactly which of the two is more important. He recommends the following measures to increase the strength of glass fibers: 1) The use of spinnerets of larger diameters. At a higher drawing velocity, 15 - 20 μ diameter threads can

High Stability of Glass Fibers

S/191/60/000/001/004/015
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be produced with a strength characteristic of thin fibers. Production becomes much more efficient. 2) The development of a production and operation procedure for glass fibers eliminating the formation of a deficient surface layer. The author mentions the Laboratoriya anizotropnykh struktur AN SSSR (Laboratory of Anisotropic Structures of the AS USSR), the Institut Stekla (Glass Institute), and the Institut Steklovolokna (Institute of Glass Fibers), as well as his own study with A. N. Bovkunenko (Ref. 1), and papers by B. B. Chechulin (Ref. 3), and A. K. Burov and G. D. Andreyevskaya (Ref. 6). There are 4 figures and 6 references: 3 Soviet, 1 US, 1 Swedish, and 1 Japanese.

BARTENEV, G.M.; KHAZANOVICH, T.N.

High elasticity deformation law for network polymers.
Vysokom.soed. 2 no.1:20-28 Ja '60. (MIRA 13:5)

1. Moskovskiy pedagogicheskiy institut im. Potemkina i Institut khimicheskoy fiziki AN SSSR.
(Polymers) (Rubber)

81607

S/190/60/002/02/06/011
B004/B061

15.9000

AUTHORS: Bartenev, G. M., Lavrent'yev, V. V.

TITLE: The Nature of "Static" Friction in Rubber-like Polymers

PERIODICAL: Vysokomolekulyarnyye soyedineniya, 1960, Vol. 2, No. 2, pp. 238-242

TEXT: After measurements with a pendulum tribometer, the latter author came to the conclusion that static friction exists in rubber as in solid bodies (Ref. 10). But later tests showed (Fig. 1) that this method was not accurate enough to determine static friction in highly elastic materials. The initial friction is greatly influenced by the duration of the previous contact between rubber and steel. Therefore, a contact time of exactly three minutes was maintained in the following experiments carried out with a tribometer from the Institut rezinovoy promyshlennosti (Institute of the Rubber Industry). When a tangential force is applied to the sample, it not only slides, but an elastic, reversible deformation also occurs, whose magnitude depends on the thickness of the sample

Card 1/2

The Nature of "Static" Friction in Rubber-like Polymers

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B004/B061

(Fig. 3). Fig. 2 shows that the results were affected by the hardness of the dynamometer. The values are only conditional as they depend on the accuracy of measurement of the sliding and on the velocity of the tangential force applied. If, however, the rubber sample is firmly attached to the base, the elastic deformation can be determined, and this factor can be disregarded in the results (Fig. 4). Strictly speaking, the rubber undergoes no static friction, but for practical purposes the initial friction can conditionally be regarded as static friction. There are 4 figures and 11 references: 4 Soviet, 4 US, 2 British, and 1 German.

ASSOCIATION: Moskovskiy pedagogicheskiy institut im. Potemkina
(Moscow Pedagogical Institute imeni Potemkin)

SUBMITTED: October 18, 1959

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152120 2109, 1409,

S/190/60/002/004/005/020
B004/B056

AUTHORS: Bartenev, G. M., Yeremeyeva, A. S.

TITLE: Mechanical Properties of Inorganic Glasses Within the Range of Anomality, and Their Structure

PERIODICAL: Vysokomolekulyarnyye soyedineniya, 1960, Vol. 2, No. 4, pp. 508-513

TEXT: The authors investigated the behavior of glass rods in the temperature range 0 - 900°C. The samples were subjected to torsional or bending stress. A Table gives the mechanical characteristic values of the following kinds of glass: marblite, ВВ (VV, vertically drawn glass), ТФ-5 (TF-5, rich in lead), К-3 (K-3, borosilicate glass), 13-В (13-V, glass poor in alkali), Ц-18 (Ts-18, glass rich in zirconium), barium-lithium glass, ЗС-5К (ZS-5K, borosilicate glass), ЗС-5Na (ZS-5Na, borosilicate glass), Ф-116 (F-116, phosphate glass), optical glasses of the types Ф-1 (F-1) and К-8 (K-8), and, for comparison, the organic glasses СКС-30 (SKS-30), ebonite, and plexiglas. As the authors

Card 1/3

Mechanical Properties of Inorganic Glasses Within the Range of Anomality, and Their Structure

observed an arbitrary and spontaneous deformation in a previous work (Ref. 5), the samples were heated before being stressed, in order to bring about relaxation. Fig. 1 shows the data for the torsion (torsion angle $\varphi = f(t^{\circ}C)$); Fig. 2 the data for the bending stress (sag in relative units as a function of temperature). Fig. 3 shows the kinetic deformation curves at various temperatures, and Fig. 4 the arbitrary deformation of glass during heating. From these experimental data the authors arrive at the following conclusions: The mechanical properties of inorganic glasses in the temperature range of the anomaly (between vitrification- and flow temperature) are different for large and for small stresses. In the case of a low stress, highly elastic deformations occur like in polymers. Herefrom, conclusions are drawn as to a chain-like structure. As the plastic range depending on the steric structure is very narrow, glass behaves like a highly viscous liquid under high stress (of more than 1 kg/cm^2). The glass contains two kinds of residual stress: elastic stresses as a consequence of quenching, and "frozen" highly elastic stresses which manifest themselves by arbitrary deformation

Mechanical Properties of Inorganic Glasses Within the Range of Anomality, and Their Structure

S/190/60/002/004/005/020
B004/B056

during heating. The thermal pretreatment influences the structure and the mechanical properties of glass within the range of the anomaly. In this range, the glasses exhibit also weak thixotropy. These reversible processes of structural re-formation have as yet not been explained. On the basis of their highly elastic and thioxotropic properties, the glasses are similar in their mechanical behavior with polymers, on the one hand, and thixotropic colloids, on the other, and therefore have a complex structure. According to their composition and pretreatment, both chain-like and colloidal structures with distinct microheterogeneity were observed. The authors mention papers by P. A. Rebinder (Refs. 1,2), P. P. Kobeko et al. (Ref. 4), Keler and Kozlovskaya, V. A. Kargin and T. I. Sogolova (Ref. 6), and V. V. Tarasov (Ref. 8). There are 4 figures, 1 table, and 9 references: 7 Soviet, 1 British, and 1 French.

ASSOCIATION: Gosudarstvennyy institut stekla, Moskva (State Institute of Glass, Moscow)

SUBMITTED: December 24, 1959

Card 3/3

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S/190/60/002/009/002/019
B004/B060

15.9300 also 2109, 2209

AUTHORS: Zaytseva, V. D., Bartenev, G. M.

TITLE: The Effect of Ingredients on the Resistance of Rubber to Frost During Repeated Deformations

PERIODICAL: Vysokomolekulyarnyye soyedineniya, 1960, Vol. 2, No. 9, pp. 1301-1308

TEXT: In the introduction, the authors discuss the publications dealing with the resistance of rubber to frost along with the action of plasticizers, and mention papers by S. N. Zhurkov (Ref. 1), V. A. Kargin and Yu. M. Malinskiy (Ref. 2), A. P. Aleksandrov and Yu. S. Lazurkin (Ref.11). They state that vitrification had so far not been studied thoroughly under dynamic conditions, and then report on their experiments. The apparatus designed by Aleksandrov and Gayev at the Institut rezinovoy promyshlennosti (Institute of the Rubber Industry) was used for the purpose. Samples of butadiene styrene rubber СКС-30 (SKS-30), butadiene nitrile rubber СКН-40 (SKN-40), and pyridine rubber МВПК (MVPK) were rhythmically subjected to a stress of 1.8 kg/cm^2 in a temperature range between -100 and

The Effect of Ingredients on the Resistance of Rubber to Frost During Repeated Deformations

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B004/B060

+20°C with ω = 0.1, 1, 10, 100, and 1000 cycles/min. The rubber samples were masticated with dibutyl phthalate (DBP), dioctyl sebacinate (DOS), tricresyl phosphate (TKP), paraffin oil, or "Renatsit", and vulcanized with 2% of sulfur. Carbon black or chalk was used as a filler. The variation of the coefficient k of resistance to frost was examined at the five frequencies specified, and from the curves obtained the authors determined the temperature $T_{0,1}$ and $T_{0,6}$, at which deformation amounted to 10 or 60% of the deformation at 20°C, respectively (k = 0,1 or k = 0,6). As is shown by Fig. 1, deformation in MVPK is a linear function of the softener content. Table 1 supplies data of $T_{0,1}$ for DBP, Table 2 for DOS. Fig. 2 shows the approximately linear function $\log\omega = f(1/T)$. Thence, the authors calculated the value U_0', which had been defined in an earlier paper (Ref. 15) and which is a function of the activation energy. As is illustrated in Fig. 3, this value drops with rising softener content. Fig. 4 shows U_0' as a function of $T_{0,6}$. Fig. 5 shows the effect of an addition of carbon black (up to 50% by weight), Fig. 6 that of chalk (up to 150% by weight) on deformation, and Fig. 7 the effect of 30% by weight

The Effect of Ingredients on the Resistance of Rubber to Frost During Repeated Deformations

S/190/60/002/009/002/019
B004/B060

of carbon black on $T_{0,1}$ in the case of SKS-30 rubber. The authors arrived at the following conclusions: The effect of plasticizers is greater with polar rubbers than with nonpolar rubbers. The difference between polar and nonpolar rubbers becomes manifest in a different action of the softeners at high and low deformation frequencies on the intermolecular structure and the resistance to frost. When using carbon black or chalk as a filler, vitrification shifts toward higher temperatures. The simultaneous introduction of carbon black and plasticizer lowers the resistance to frost with rising carbon black content. The filler increases the rubber hardness and, thus, lowers the resistance to frost. A paper by V. A. Kargin and G. L. Slonimskiy is mentioned (Ref. 14). There are 7 figures, 2 tables, and 15 references: 10 Soviet, 2 British, 2 US, and 1 German.

ASSOCIATION: Nauchno-issledovatel'skiy institut rezinovoy promyshlennosti (Scientific Research Institute of the Rubber Industry)

SUBMITTED: January 23, 1960

85419

15.9000

11.2210

S/190/60/002/011/016/027
B004/B060

AUTHORS: Bartenev, G. M., Kongarov, G. S.

TITLE: Determination of the Compatibility of Polymers by the Dilatometric Method

PERIODICAL: Vysokomolekulyarnyye soyedineniya, 1960, Vol. 2, No. 11, pp. 1692 - 1697

TEXT: The authors discuss several methods of determining the compatibility of polymers, part of which are too complicated, while others yield no more than indirect data. Proceeding from a paper by K. Floyd (Ref.6), the authors carried out tests on shrinkage as a function of temperature and in this way obtained a simple method of determining the compatibility. The latter is based on the condition that two compatible components have a single vitrification temperature, whereas mixtures from incompatible components have several vitrification temperatures, namely, those of their components. A prerequisite of the new method is that vitrification temperatures be not too close to one another. Shrinkage as a function of temperature was recorded by a dilatometer

Card 1/3

Determination of the Compatibility of Polymers by the Dilatometric Method

S/190/60/002/011/016/027
B004/B060

designed by G. M. Bartenev and V. I. Gartsman. Various mixtures from vulcanized rubber samples were tested. 1) НК (NK) natural rubber (vitrification temperature (VT) = -72°C) with СКБ (SKB) rubber (VT = -48°C); 2) NK with СКН-26 (SKN-26) rubber (VT = -36°C); 3) СКН-18 (SKN-18) rubber (VT = -48°C) with СКН-40 (SKN-40) rubber (VT = -23°C); 4) polychloroprene with SKN-40. Compatibility was observed in mixtures 1) and 2), inasmuch as the mixtures exhibited a single VT changing linearly with increasing content of one component. This is therefore in line with a dependence on volume concentration according to V.A. Kargin and Yu. M. Malinskiy, and not a dependence on molar concentration according to Zhurkov. Combinations from components of mixtures 1) and 2) prepared by agglutination of individual components, yielded two VT. Vulcanizates of incompatible mixtures 3) and 4) yielded two VT corresponding to those of the components. A calculation of the linear expansion (or shrinkage) coefficient according to Floyd, revealed additivity in all mixtures within the measurement errors. The authors thank G. L. Slonimskiy for a discussion. There are 6 figures and 11 references: 10 Soviet and 1 British.

Card 2/3

85419

Determination of the Compatibility of Polymers by the Dilatometric Method

S/190/60/002/011/016/027
B004/B060

ASSOCIATION: Nauchno-issledovatel'skiy institut rezinovoy promyshlennosti (Scientific Research Institute of the Rubber Industry)

SUBMITTED: May 10, 1960

Card 3/3

86328

S/190/60/002/012/015/019
B017/B078

15.8117 2209 only

AUTHORS: Bartenev, G. M., Yeremeyeva, A. S.

TITLE: Is Boric Anhydride a Polymer?

PERIODICAL: Vysokomolekulyarnyye soyedineniya, 1960, Vol. 2, No. 12, pp. 1845 - 1849

TEXT: The mechanical properties of vitreous boric anhydride have been studied above and below the temperature of vitrification and have been found to be similar to those of organic polymers and dispersed systems. Softened vitreous B_2O_3 is in a highly elastic state like organic polymers. The velocity of the irreversible flow is a function of stress. The rheologic curve of vitreous boric anhydride at 322°C is shown in Fig. 5. Above the yield point, Newtonian flow was observed. The rheologic curve of boric anhydride resembles the rheologic curves of dispersed systems. Vitreous boric anhydride is a linear inorganic polymer with short chains. V. V. Tarasov is thanked for a discussion. There are 6 figures and 9 references: 4 Soviet, 3 US, 1 British, and 1 German.

Card 1/2

86328
S/190/60/002/012/015/019
B017/B078

Is Boric Anhydride a Polymer?

ASSOCIATION: Gosudarstvennyy institut stekla Moskva (State Institute of Glass, Moscow)

SUBMITTED: May 25, 1960

Card 2/2

84313

S/170/60/003/009/006/020
B019/B060

15.2120 2109

AUTHORS: Bartenev, G. M., Kolbasnikova, A. I.

TITLE: The Effect of Prolonged High-temperature Heating on the Strength of Glass

PERIODICAL: Inzhenerno-fizicheskiy zhurnal, 1960, Vol. 3, No. 9, pp. 44-47

TEXT: The authors made bending tests to study the influence of duration and temperature of heating on the strength of glass. Fig. 1 shows the bending strength of glass as a function of heating temperature in the range from 500 to 710°C. Previous tests had shown that there were no residual stresses left after a heating time of two hours and a subsequent cooling rate of 1°C/minute. As may be seen from Fig. 1, the strength of glass is dependent not only on the temperature of the thermal treatment, but also on the mechanical history of the samples. When heating over two hours the bending strength of samples polished at the edges is almost doubled. Fig. 2 shows that a heating time of 5 - 6 hours yields the best strength factors, regardless of the mechanical treatment. The

Card 1/2

The Effect of Prolonged High-temperature Heating on the Strength of Glass

character of the mechanical pre-treatment influences the degree of strength increase. The main factors accounting for the strength increase, which attained a maximum of 13.8 in 2-mm glass and a maximum of 10.2 kg/mm^2 in 6-mm glass, proved to be temperature and duration of heating. The cooling rate had a lesser effect. Also the effect of the thermal treatment on the strength of the glass surface was checked on the same types of glass. High-temperature thermal treatment was found to cause no strength increase on the glass surface beyond 10.5 kg/mm^2 (6-mm glass). For 2-mm glass the respective value is again 15.7 kg/mm^2. A. I. Ivanova (Ref. 4), I. I. Kitaygorodskiy, and A. I. Berezhnoy (Ref. 5), and G. Markus (Ref. 8) are mentioned. There are 2 figures and 9 references: 7 Soviet and 2 US.

ASSOCIATION: Gosudarstvennyy nauchno-issledovatel'skiy institut stekla, g. Moskva
(State Scientific Research Institute of Glass, Moscow)

SUBMITTED: June 13, 1959

Card 2/2

S/179/60/000/006/035/036
E081/E135

AUTHORS: Bartenev, G.M., Panshin, B.I., Razumovskaya, I.V., and Finogenov, G.N., (Moscow)

TITLE: The Longevity of Organic Glass Under Cyclic Loading

PERIODICAL: Izvestiya Akademii nauk SSSR,Otdeleniye tekhnicheskikh nauk, Mekhanika i mashinostroyeniye, 1960, No. 6, pp. 176-179

TEXT: The paper is a continuation of previous work (Ref.4). According to experimental and theoretical work (Refs.1-4) the longevity of plastics under load is expressed by the approximate formula:

$$\tau = Ae^{-\alpha\sigma} \qquad (1)$$

where τ is the longevity at constant stress σ; the constants A and α depend on the type of material. In the present paper the longevity of polymethylmethacrylate is investigated under cyclic conditions, the stress cycle having a saw-tooth form, with maximum stress σ_2, minimum stress σ_1, and period θ; the quantity $w = (\sigma_2 - \sigma_1)/(1/2\theta)$ defines the velocity of increase

Card 1/ 5

The Longevity of Organic Glass Under Cyclic Loading

or decrease of the stress. Following Bailey (Ref.7), application of Eq.(1) to these stress conditions leads to:

$$t = \alpha \frac{(1 - 1/k)\,\sigma_2}{1 - \exp\left[-\alpha(1 - 1/k)\,\sigma_2\right]}\,\tau_2 \qquad (6)$$

for the longevity t, where τ_2 is the longevity at constant stress σ_2, and k is the ratio σ_2/σ_1. In terms of the longevity τ^o at constant stress $\sigma_0 = 1/2(\sigma_1 + \sigma_2)$, the longevity t under cyclic conditions is given by Eq.(7). The testing was carried out in a special apparatus in pure tension at a frequency of 10 cycles/min and at 20 °C under the condition that k had a constant value of 10. The data are given in Fig.2, in which the ordinate is the logarithm of the longevity in minutes and the abscissa is the maximum stress in kg/mm^2; curve 1 is the time dependence of the longevity under steady stress, curve 2 is calculated from Eq.(6) and the experimental results for cyclic stress are shown in curve 3. The condition of variable k was

The Longevity of Organic Glass Under Cyclic Loading

also considered. The experimental and calculated values are compared in Fig.3 as graphs of $\sigma^o/\sigma_п$ where σ^o is the average of the maximum and minimum stresses in a cycle, and $\sigma_п$ is the tensile strength measured in a testing machine; curve 1 is the time dependence of strength, curves 2, 3 and 4 are experimental (10 cycles/min), corresponding to variable minimum stress σ_1 and different constant maximum stresses σ_2 of: curve 2 - 0.9 $\sigma_п$; curve 3 - 0.8 $\sigma_п$; curve 4 - 0.7 $\sigma_п$; $\sigma_п$ = 8.6 kg/cm^2. Curves 2', 3' and 4' are calculated from:

$$t = \alpha \frac{w\theta}{2} \frac{\exp\left(\frac{1}{4}\alpha w\theta\right)}{\exp\left(\frac{1}{2}\alpha w\theta\right) - 1} \tau^o \qquad (7)$$

Fig.2 shows that the longevity curve for cyclic loading is not a simple one, and only coincides with the theoretical curve for small times and large maximum stresses. The possible part played by such factors as the heating of the specimen and the occurrence of microcracks is discussed. The curves of Fig.3

Card 3/5

S/179/60/000/006/035/036
E081/E135

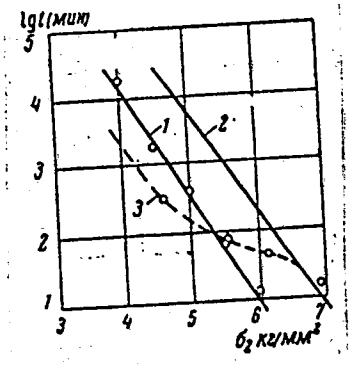
The Longevity of Organic Glass Under Cyclic Loading

show that the larger deviations of the experimental from the calculated curves occur at the smaller values of σ_1. The application of Bailey's method for calculating the longevity of plastics based on the time dependence of strength leads to disagreement with experimental data in the practically important region involving a large number of cycles to fracture. For a small number of cycles to fracture, the calculated and experimental curves practically coincide.
There are 3 figures and 10 references: 7 Soviet and 3 English.

Card 4/5

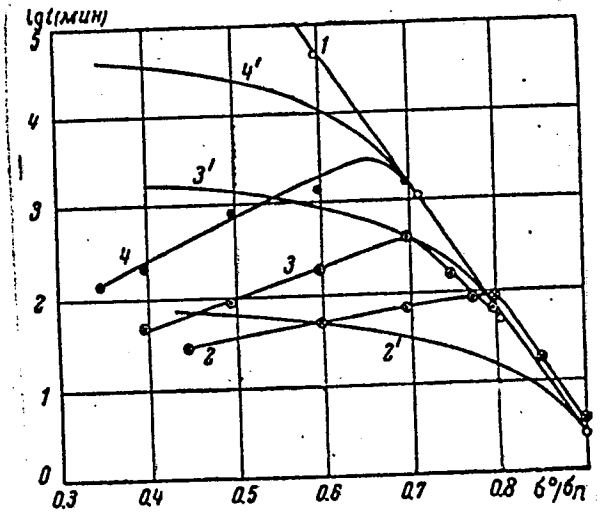
S/179/60/000/006/035/036
E081/E135

The Longevity of Organic Glass Under Cyclic Loading



Фиг. 2

Fig.2



Фиг. 3

SUBMITTED: April 13, 1960

Card 5/5

S/138/60/000/007/007/010
A051/A029

AUTHORS: Bartenev, G.M.; Novikova, N.M.

TITLE: An Instrument and Method Used for the Determination of High-Elastic Properties of Rubber at Low Temperature

PERIODICAL: Kauchuk i Rezina, 1960, No. 7, pp. 28 - 33

TEXT: A method for the testing of rubber elasticity was developed and the УПКМ-3 (UPKM-3) instrument (Fig. 1) designed by the NIIRP was applied to this purpose. It can be used for the simultaneous testing of 8 samples of different rubbers by means of a special attachment designed by D.I. Smirnov and B.S. Tsu Yun Khan. The functioning principle of the attachment is described. Formula (1) was derived which can serve as the basis for the quick determination of rubber elasticity at low temperature. Two factors, the frost-resistance $T_{0,1}$ and the duration of the forces acting under static deformation, τ, are taken into consideration. In developing the method for rubber elasticity testing at low temperatures two possibilities had to be noted: 1) the testing of newly-processed rubber, 2) the testing of mass-produced rubber. The authors refer to the ISO instrument and the method recommended by the International Organization of Standards and point out

An Instrument and Method Used for the Determination of High-Elastic Properties of Rubber at Low Temperature

that these are applicable only to the second group of rubber. The method of the ISO does not include the determination of the effect of the temporary conditions of deformation on the frost-resistance of the rubber and the instrument does not ensure the rapid determination of this relationship, since it can handle only static load conditions. The UPKM-1 instrument does not have these disadvantages. With this instrument the frost-resistance index at dynamic (1,500 bendings/min) and static conditions can be determined in compression deformations. A period of 30 sec is suggested for the static tests. The design of the UPKM-1 instrument was improved (Ref. 3). A mixture of dry ice and alcohol served as the coolant since an alcohol medium at low temperatures does not affect the results of the experiments (Refs. 4 and 5). It was found that the UPKM-3 can replace 8 standard instruments since it requires less time for the test. A detailed explanation is given of the testing method. Using formula (1) the frost-resistance index can be calculated. Formulae 2 and 3 represent the frost-resistance coefficients for cases of compression deformation and elastic restoration, respectively. The latter factors k and k' are numerically equal to each other, i.e., $k = k'$. Figure 2

S/138/60/000/007/007/010
A051/A029

An Instrument and Method Used for the Determination of High-Elastic Properties of Rubber at Low Temperature

shows that the two curves coincide for the temperature dependence of the frost-resistance coefficient of commercial rubber on CHH-18 (SKN-18) base under compression and at restoration. The experiments and the tests carried out with the UPKM-3 show that it can be recommended for determining the characteristics of rubber used for sealing parts and in various shock absorbers. The instrument can also be used for determining the degree of crystal formation in rubber during cooling without stress. Other methods do not include the testing of rubber for crystal formation which leads to a loss of the elastic properties, just as in the case of vitrification. The problems of vitrification and crystallization in rubber are further discussed, describing the factors which affect the crystallization, e.g., vulcanization, presence of sulfur, accelerator, amount of the masticator, state of tension of the rubber sample and how the crystallization affects the density and hardness of the rubber. The testing method for crystallization is explained in detail. It usually takes from 10 to 30 days, depending on the rate of the rubber crystallization. The crystallization index is taken to be the provisional period of crystallization, determining the time which it takes the rubber to increase its

Card 3/4

S/138/60/000/007/007/010
A051/A029

An Instrument and Method Used for the Determination of High-Elastic Properties of Rubber at Low Temperature

hardness by a factor of 2 (Fig. 4). It is further pointed out that the instrument can be used for experiments on crystallization determination in rubber, which has been subjected to preliminary tension by means of a micro-bolt at room temperature. Otherwise the entire procedure is similar to that of crystallization determination of rubber in a relaxed state. There are 4 graphs, 1 set of photographs and 12 references: 5 Soviet and 7 English.

ASSOCIATION: Nauchno-issledovatel'skiy institut rezinovoy promyshlennosti (Scientific Research Institute of the Rubber Industry)

Card 4/4

87919

S/138/60/000/008/005/015
A051/A029

15.9300 2109, 2209

AUTHORS: Bartenev, G.M.; Zelenov, Yu.V.

TITLE: The Connection Between the Coefficient of Frost-Resistance and the Maximum of Mechanical Losses of Rubber-Like Polymers in Repeated Deformation During Vitrification

PERIODICAL: Kauchuk i Rezina, 1960, No. 8, pp. 18 - 22

TEXT: A number of investigations were carried out by the authors into the mechanical losses in rubbers with various properties, such as: nitrile СКН -40 (SKN-40), butadiene-styrene СКС -30 (SKS-30) and methylvinylpyridine МВПК (MVPK). The Aleksandrov-Gayev instrument designed by the NIIRP (Ref. 4) was used, applying the hysteresis loop method. It is known that in repeated deformations under low temperatures synthetic and natural rubber change over from a high-elastic substance to a vitrified state (Ref. 1) and this process contrary to the structuralizing vitrification observed in all amorphous substances when cooled (Ref. 2) is designated here as mechanical vitrification. The frost-resistance which depends on this mechanical vitrification and is estimated from the temperature relationship of the high-elastic deformations has been carefully investigated in previous works

Card 1/5

87919

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A051/A029

The Connection Between the Coefficient of Frost-Resistance and the Maximum of Mechanical Losses of Rubber-Like Polymers in Repeated Deformation During Vitrification

(Refs. 1,3,4). However, the changes in the mechanical losses during vitrification have not yet been dealt with. It is pointed out that in order to evaluate the frost-resistance of any article under conditions of repeated deformations of a mechanical nature, one must estimate the value of the frost-resistant coefficient at which the maximum mechanical losses are observed for various rubber-like polymers. The latter is also necessary in order to understand the process of vitrification more fully. The method used in the experimental procedure is outlined. Using the hysteresis loop method the coefficient of the mechanical losses X was determined as the ratio of the area of the hysteresis loop to the area enclosed within the load curve and the deformation axis. Figure 2 is a graph of the relationship between the relative hysteresis x, the tangent and the sine of the mechanical loss angle and the temperature. It is seen that both for x, $tg\delta$ and $\sin\delta$ the maximum is reached at about the same temperature. There is a direct proportion between the inverse temperature $1/T_k$ and the logarithm of the frequency curve of the mechanical force for samples subjected to perliminary mechanical forces with a frequency of 10 oscillations/min and a force amplitude 2.5 times greater than that us-

Card 2/5

87919

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A051/A029

The Connection Between the Coefficient of Frost-Resistance and the Maximum of Mechanical Losses of Rubber-Like Polymers in Repeated Deformation During Vitrification

ed in the measurements. It was seen that the temperature of vitrification was higher for samples not subjected to preliminary forces. As the deformation frequency increases, the vitrification temperature of the non-subjected samples approaches that of the samples with a stabilized structure. It is assumed that the vitrification temperature drops due to the irreversible break in the weak, secondary bonds during mechanical effects and due to a decrease in the intramolecular action. The measurement data show that for the different rubbers investigated the high-elastic deformation is reached at different temperatures. Therefore the frost-resistant coefficient K for these rubbers is determined from Formula 2 $K=\frac{\varepsilon_0}{\varepsilon_\infty}\sqrt{\ }$ as the ratio of the deformation amplitude ε_o at a given temperature to the amplitude of the established high-elastic deformation ε_∞. The frost-resistant coefficients for the investigated rubbers could be determined by comparing the temperature relationships of the K and the x values of the three rubbers which would correspond to the maximum of mechanical loss. The Aleksandrov mechanical model with the same relaxation time was used to estimate the value of the frost--resistant coefficient, corresponding to the maximum of mechanical loss. It was

Card 3/5

The Connection Between the Coefficient of Frost-Resistance and the Maximum of Mechanical Losses of Rubber-Like Polymers in Repeated Deformation During Vitrification

found that $K \cong 0.1$. Therefore the temperature, at which the maximum of mechanical losses is observed, corresponds to the temperature, at which the ten-fold loss of the high-elasticity takes place. The application of the mechanical model with the same relaxation time is insufficient for the explanation of the mechanical properties of the investigated materials. There are 6 figures, 7 formulae and 8 Soviet references.

ASSOCIATION: Nauchno-issledovatel'skiy institut rezinovoy promyshlennosti (Scientific Research Institute of the Rubber Industry)

87919

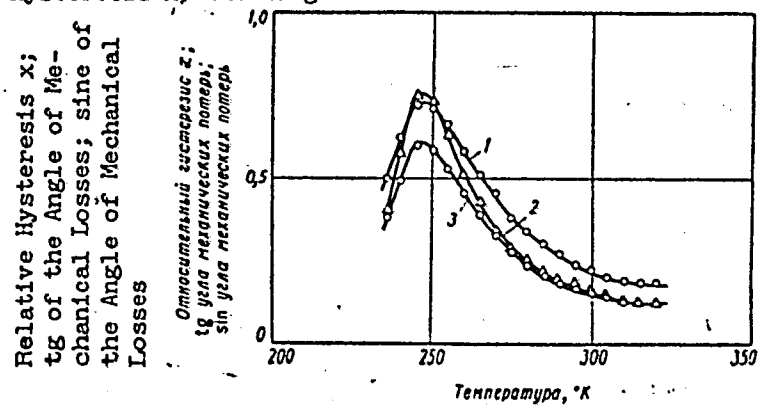
S/138/60/000/008/005/015
A051/A029

The Connection Between the Coefficient of Frost-Resistance and the Maximum of Mechanical Losses of Rubber-Like Polymers in Repeated Deformation During Vitrification

Figure 2:

Dependence of the Relative Hysteresis x, the Tangent and the Sine of Mechanical Losses on the Temperature:

1 - relative hysteresis x; 2 - tangent of the angle of mechanical losses; 3 - - sine of the angle of mechanical losses



Relative Hysteresis x; tg of the Angle of Mechanical Losses; sine of the Angle of Mechanical Losses

Temperature, °K

Card 5/5

S/191/60/000/008/014/014
B004/B056

AUTHORS: Bartenev, G. M., Anulov, V. L.

TITLE: Conference on the Strength of Polymers and Polymer Materials

PERIODICAL: Plasticheskiye massy, 1960, No. 8, pp. 69-71

TEXT: From May 16 to May 18, 1960 the soveshchaniye po prochnosti polimerov i polimernykh materialov (Conference on the Strength of Polymers and Polymer Materials) took place in Moscow; the following institutions attended: sektsiya fiziki polimerov VKhO im. D. I. Mendeleyeva (Section of Polymer Physics of the All-Union Chemical Society imeni D. I. Mendeleyev), sektsiya polimerov Nauchnogo soveta po probleme "Fizicheskiye osnovy prochnosti i plastichnosti" pri otdelenii fiziko-matematicheskikh nauk AN SSSR (Section of Polymers of the Scientific Council for the Problem "The Physical Basis of Strength and Plasticity" at the Department of Physical and Mathematical Sciences of the AS USSR), Komitet prochnosti Nauchno-tekhnicheskogo obshchestva mashinostroitel'noy promyshlennosti (Committee of Strength of the Scientific and Technical Society of the Machine Building Industry), nauchno-tekhnicheskoye

obshchestvo legkoy promyshlennosti (Scientific and Technical Society of the Light Industry), and the Komissiya po primeneniyu polimerov v mashinostroyenii Goskomiteta Soveta Ministrov SSSR po avtomatizatsii i mashinostroyeniyu (Commission for the Application of Polymers in Machine Construction of the State Committee of Automation and Machine Construction of the Council of Ministers USSR). In his opening address, G. M. Slonimskiy outlined the aims of the Conference: Survey of the development of the theory of strength, planning of measures to be taken for the introduction of polymers in machine building, light and textile industries. Lectures were delivered by the following persons: G. M. Bartenev of the Problemnaya laboratoriya MGPI im. V. I. Lenina (Laboratory for Problems of the Moscow State Pedagogical Institute imeni V. I. Lenin), "Some Problems of the Strength of Polymers"; S. N. Zhurkov, "The Part Played by Chemical and Intermolecular Bonds in the Tearing of Polymers", on which occasion he gave new data concerning the influence of plasticizers and solvents upon the activation energy u_o and the constants τ_o and γ of the Zhurkov formula. Yu. S. Lazurkin compared the equation for the time dependence of strength with that for the time dependence of relaxation.

Conference on the Strength of Polymers and Polymer Materials

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B004/B056

Ye. V. Kuvshinskiy and M. I. Bessonov of the IVS AN SSSR (Institute of Macromolecular Compounds of the AS USSR) lectured on "The Interrelation Between the Destruction of Plastics and Deformation and Splitting". G. M. Bartenev and V. Ye. Gul': "On the Nature of Strength of Polymers". At the MITKhT im. Lomonosova (Moscow Institute of Fine Chemical Technology imeni Lomonosov), V. Ye. Gul' successfully used time-lapse film pictures. In his report "Creep and Strength of Polymers in Consideration of the Effect of an Active Medium", Academician P. A. Rebinder mentioned the law of the aftereffect discovered at the IFKh AN SSSR (Institute of Physical Chemistry of the AS USSR), and Yu. S. Zuyev's studies on the splitting of rubber. G. L. Slonimskiy spoke about the part played by mechanical chemistry in polymer processing. P. V. Melent'yev of the Leningradskiy tekstil'nyy institut (Leningrad Textile Institute) reported on "Mechanical Tests of Polymer Materials"; M. G. Mokul'skiy - on various properties of polymers in intense irradiation. N. I. Prigorovskiy of the IMASh AN SSSR (Institute of Sciences of Machines of the AS USSR) spoke about the actuality of the research of structural strength of plastics. R. M. Shneyderovich and V. S. Strelyayev delivered the lecture "Constructional Factors of the Static Strength of Orientated Plastics", which dealt also

Card 3/5

with glass plastics of the types АГЧ-С (AGCh-S), 3318-С (3318-S), Р-49 (R-49), and П-50 (P-50). A. A. Rabinovich of the laboratoriya anizotropnykh struktur AN SSSR (Laboratory of Anisotropic Structures of the AS USSR) spoke about some general mechanical properties of glass plastics. V. A. Lepetov of the Moscow Institute of Fine Chemical Technology imeni Lomonosov lectured on the representation of the elasticity coefficients of rubber according to the Shore hardness, and pointed out that the tolerances of ТУ 253-54Р (TU 233-54R) are too wide. G. I. Gurevich spoke about the testing of glass plastics as to fatigue strength; B. I. Panshin spoke about "The Strength and Durability of Plastics Under Permanent Load"; N. I. Malinin of the Sibirskoye otdeleniye AN SSSR (Siberian Branch of the AS USSR) spoke about "Creeping and Relaxation of High-polymers and Plastics in the Transition Stage", which was discussed by G. L. Slonimskiy. V. M. Tendler read a paper by N. Y. Chernomordik, "The Anisotropy Angle of Glass Plastics in the Calculation of Ship Constructions". The following persons joined in the discussion: G. A. Patrikeyev, V. I. Anulov of the NIIRP (Scientific Research Institute of the Rubber Industry), L. D. Kogan of the State Committee of Automation and Machine Construction of the Council of Ministers USSR. Further, methods of calculating filaments made from chemical fibers (K. I. Koritskiy),

for the determination of the dynamic fatigue of textile materials (G. N. Kukin), and for the determination of the fatigue strength of polymer coatings on leather (V. I. Yeliseyeva) were discussed.

BARTENEV, G.M.; KOLBASNIKOVA, A.I.

Effect of high-temperature preheating over a long period of time on the strength of glass. Inzh.-fiz.zhur. no.9:44-47 S '60. (MIRA 13:9)

1. Gosudarstvennyy nauchno-issledovatel'skiy institut stekla, Moskva.
(Glass--Thermal properties)

S/191/60/000/009/005/010
B013/B055

15.8500

AUTHOR: Bartenev, G. M.

TITLE: Some Problems on Strength of Polymers

PERIODICAL: Plasticheskiye massy, 1960, No. 9, pp. 48 - 53

TEXT: The present paper was read at a conference on the strength of polymers and polymer materials held on May 16 - 18, 1960. The substances discussed were mainly non-crystalline polymer materials, in particular, rubber and plastics. The first problem to be discussed was the effect of temperature on the strength of amorphous polymers during elongation (Fig.1). The diagram in Fig.1, which is much more complicated than A. I. Ioffe's scheme for solids, is characteristic both for rubber and plastics. The main difference between this diagram and the latter scheme is the introduction of two new temperature ranges between the brittle- and the plastic region: the forced elastic range (in the region $T_{brittle}$-$T_{vitrification}$) and the highly elastic range (between $T_{vitrification}$ and T_{fusion}). These two ranges are separated by the

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vitrification point which depends on the duration of the test. The limit σ_f of forced elasticity is determined from the peak in the elongation curve (Fig.2). As is apparent from Figs.2 and 3, the elongation curves in the forced-elasticity range and the plasticity range are similar. A plot of the experimental data of rubber polymers is presented in Figs.4 and 5. These data confirm the scheme shown in Fig.1. It is seen from this scheme that a polymer can undergo elastic-, highly-elastic- and irreversible deformations (according to deformation rate, temperature and stress). It is generally known, specially from publications by N. S. Zhurkov (Ref.4) that the strength of all materials is time-dependent (Figs.6 and 7). The introduction of a strength limit as material constant is only justified in cases where it may be regarded as maximum technical strength and is measurable. Simultaneously with investigations on the strength of plastics carried out at the laboratoriya fiziki prochnosti LFTI (Laboratory of Physics of Strength of the Leningrad Physicotechnical Institute), the time-dependence of the strength of highly elastic polymer materials was investigated at the fizicheskaya laboratoriya NIIRP (Laboratory of Physics of the Scientific Research Institute of the Rubber Industry) and the laboratoriya fiziki polimerov MGPI im. V. I. Lenina

Some Problems on Strength of Polymers

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(Laboratory of Physics of Polymers of the MGPI imeni V. I. Lenin). It was shown (Ref.7) that rubbery polymers, owing to the specific form of time-dependence of their strength (Fig.8) constitute a special class of polymer. The relation may be written in the form: $\tau = \beta\sigma^{-n}$, where τ = time at which destruction occurs under constant load σ, β = a temperature-dependent and n = a temperature-independent constant. Hard polymers and highly-elastic polymers differ not only in the time-dependence of their strength, but also in the character of destruction: Plexiglas (Fig.9) - CKC-30 (SKS-30) rubber (Fig.10). The questions least studied but most important from the practical point of view are: the working out of methods for calculating maximum stress limits basing on data from single elongation and data obtained in static tests. Finally the author points out the importance of mechanochemistry, which must be taken into account in destruction processes of polymer materials, and discusses the principal difference between strength and time-dependent fatigue. Mention is made of Yu. S. Lazurkin, E. Ye. Tomashevskiy, A. P. Aleksandrov, V. R. Regel', Ye. V. Kuvshinskiy, V. Ye. Gul', Yu. S. Zuyev, V. A. Kargin, T.I.Sogolova, G. L. Slonimskiy, and B. I. Panshin. There are 10 figures and 25 references: 23 Soviet, 1 US, and 1 British.

Card 3/3

S/138/60/000/010/005/008
A051/A029

AUTHORS: Bartenev, G.M., Kolyadina, N.G.

TITLE: On the Packing Mechanism of Flange Joints Using Rubber Linings

PERIODICAL: Kauchuk i Rezina, 1960, No. 10, pp 29-34

TEXT: The authors conducted a study of the packing ability of ring-shaped linings with a rectangular cross-section compressed between groove flanges in sharp pressure drops. The loss of airtightness of these linings in the flange grooves takes place by the contact mechanism but, according to the authors, this phenomenon has not been dealt with sufficiently. Comparisons were also made by studying ring-shaped linings of rectangular cross-section compressed between flat flanges. Tests were made on linings with the following dimensions: internal diameter d = 24 mm, external diameter D = 44 mm, height of lining h = 9 mm. The form factor $\Phi(F)$ calculated according to the formula $(D-d)4h$ was 0.55. The linings were prepared from 4 types of rubber with the following compositions: 1) СКБ (SKB), carbon black (60 weight parts to 100 weight parts of raw rubber), captax, sulfur; 2) СКС-30 (SKS-30), carbon black (30 w.p. to 100 w.p. of raw rubber), thiuram; 3) SKS-30, carbon black (100 w. p. to 100 w.p. of raw rubber), altax ДФГ (DFG), sulfur; 4) СКН-26 (SKN-26),

Card 1/8

On the Packing Mechanism of Flange Joints Using Rubber Linings

carbon black (110 w.p. to 100 w.p. of raw rubber), thiuram, sulfur. Fig. 1 represents the relationship of the actual tension to the degree of compression of the tested rubbers in static deformation. The tension was measured every 3 minutes from the moment the given value of compression was reached. The obtained measurement data were used to calculate the static rubber modulus E and lining modulus E' according to the formula: $E' = E (1 + \alpha F)$ where $\alpha = 0.5$ (Ref. 6). Table 1 gives the values of the moduli of the rubbers and the linings and also the rubber hardness according to Shore. The linings were tested on a stand at air pressure of 200 atm and 20°C. The attachments containing the linings were placed into a water bath. The lack of airtightness was noted by the appearance of air bubbles. Fig. 3 gives the data on the effect of the degree of compression of the linings located between the flat flanges on the value of the critical working pressures (i.e., the pressure whereby the lining loses its airtightness). The packing ability of the linings compressed between the flat flanges depends on the degree of compression and the rubber modulus. If the lining modulus E' and the degree of compression ε are known, the specific compression load can be calculated $f = E'\varepsilon / (1 - \varepsilon)$ (Ref. 6). The conclusion

S/138/60/000/010/005/008
A051/A029

On the Packing Mechanism of Flange Joints Using Rubber Linings

is drawn that the specific compression load of the lining is a function of the modulus and degree of compression of the lining and therefore determines its packing ability. By changing the hardness of the rubber or the degree of compression of the lining the necessary flange tension can be obtained which would determine the value of the critical working pressure in the system of flat flanges. The critical nature of the loss of airtightness is explained by the decreasing dependence of the lining's resistance on the radial shift. Since the resilient resistance force of the lining in the first moment of the radial shift is equal to zero, therefore the loss of stability is determined by the value of the friction force. This explains the reason for increasing the friction coefficient in using flange linings. Experimental findings are listed to confirm the conclusions drawn and to explain the effect of certain factors on the self-packing phenomenon of rubber lining. The size of the clearance between the lining and internal wall of the caliber was determined mathematically. Obtained data lead to these conclusions: 1) self-packing occurs in the presence of any clearance between the lining and the limiting ring, but the value of the critical compression ε_k depends on the size of the clearance. 2) With an increase in the clearance the critical compression

Card 3/8

On the Packing Mechanism of Flange Joints Using Rubber Linings

increases (or the critical specific load of self-packing f_k). With an increase in the hardness of the rubber the critical compression load f_k increases and at zero clearance the self-packing takes place at a load f_k on the flanges which differs from zero and is the higher, the harder the rubber (Fig 7). It is stated that for linings between flat flanges under high pressure one should apply high-modulus rubbers. For linings in groove flanges the low-modulus rubbers should be used, since it is important that the packing begin at as low a pressure as possible on the flanges. Summarizing the experimental results the authors conclude that the packing of the rubber linings compressed between groove flanges (or with a lock) at low compressions takes place according to the same mechanism as that of the flat flanges (loss of stability). In high compressions increasing with the hardness of the rubber, self-packing occurs. The magnitude of the diameter clearance between the lining and the wall of the groove on the side opposite to the pressure has a significant effect on the packing ability of the linings located between the groove flanges. The greater the clearance, the more the self-packing phenomenon is noted at high compressions. For linings located between flat flanges the critical hydraulic

S/138/60/000/010/005/008
A051/A029

On the Packing Mechanism of Flange Joints Using Rubber Linings

pressure of the loss of airtightness is a function of the flange tension (specific load of compression of the lining) and hardly depends on the type of rubber. In the case of linings located in the grooves the critical working pressure of self-packing to a greater extent depends on the hardness of the rubber and the size of the diameter clearance. There are 7 graphs, 1 table, 1 diagram and 7 references: 6 Soviet, 1 English.

ASSOCIATION: Nauchno-issledovatel'skiy institut rezinovoy promyshlennosti (Scientific Research Institute of the Rubber Industry)

Card 5/8

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AUTHORS: Panshin, B. I., Bartenev, G. M., Finogenov, G. N.

TITLE: Strength of Plastics Under Cyclic Loads

PERIODICAL: Plasticheskiye massy, 1960, No. 11, pp. 47-54

TEXT: The present report was delivered at the Conference on the Strength of Polymers and Polymeric Materials held in Moscow from May 16 to 18, 1960. It deals with studies of the strength and durability of some construction plastics under low-frequency cyclic loads. Tables 1 and 2 give the characteristic physicomechanical properties of the organic glasses and glass textolites investigated. The following problems were clarified in the investigation: the durability of plastics under constant and variable loads (Figs. 1-3, 5); effect of temperature on the durability of plastics (Figs. 2, 4); effect of orientation on the strength of organic glasses in fatigue tests (Tables 2, 3); anisotropy of durability of glass textolite (Figs. 6, 7); effect of asymmetry of cyclic loads on the durability of plastics (Fig. 8); effect of overloads and static preloading (Fig. 9, Table 4); "fatigue" of the material under cyclic loads (Fig. 10). It was

Card 1/3

88552

Strength of Plastics Under Cyclic Loads S/191/60/000/011/012/016
B013/B054

found that the relationship between durability and stress in semilogarithmic coordinates was not linear under cyclic tensile loads in contrast to static loads. In the range of high stresses, the material is longer durable under cyclic than under static loads on the same stress level. On low stress levels, however, longer durability of the material corresponds to static loading. Under cyclic loads, the same durability of plastics can be attained with different values of average cyclic stresses. Here, longer stress amplitudes correspond to smaller average cyclic stresses. It was shown that an overload during cyclic loading or after prolonged static loading reduced the durability of the material. Plastics of the series of organic polymethyl methacrylate glasses of linear structure with increased heat resistance also show a higher fatigue strength both at normal and increased temperature. Organic glasses with oriented structure, which were subjected to biaxial tensile loads on heating above the vitrification temperature, have a considerably higher fatigue strength than non-oriented glasses. Besides, the relative difference between the values of durability during fatigue tests, especially with not too high stresses, is much smaller in oriented than in non-oriented glasses. Anisotropy of mechanical properties of glass textolites also occurs in fatigue tests. The durability of glass textolite is more strongly reduced by thermal aging under simul-

Card 2/3

taneous cyclic loads than without such loads. Finally, it was shown that it was possible to calculate the durability of plastics, especially organic glasses, under cyclic loads according to fatigue test data under static load with the use of the "criterion of total damages". It was found that the fatigue strength calculated did not agree with experimental data in the case of small stresses. The authors attempted to find the causes of such disagreement (Fig. 11). They showed that the heating of the whole sample due to hysteresis losses cannot be the principal cause. Local overheating is assumed. M. M. Gudimov and B. V. Petrov are mentioned. There are 11 figures, 4 tables, and 13 references: 11 Soviet and 2 US.

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A051/A029

AUTHORS: Bartenev, G.M.; Berestnev, V.A.

TITLE: A Conference on the Strength of Polymers and Polymer Materials

PERIODICAL: Kauchuk i Rezina, 1960, No. 9, pp. 57 - 58

TEXT: A soveshchaniye po prochnosti polimerov i polimernykh materialov (Conference on the Strength of Polymers and Polymer Materials) was held in May 1960 in Moscow. It was organized by Sektsiya fiziki polimerov (Section for the Physics of Polymers) at the Central Board of VKhO im. D.I. Mendeleyev, by the Sektsiya polimerov (Department of Polymers) of the Nauchnyy sovet po probleme "fizicheskiye osnovy prochnosti i plastichnosti" (Scientific Council on Problems of "Physical Bases of Strength and Elasticity"), at the Cotdeleniye fiziko-matematicheskikh nauk AN SSSR (Department of Physico-mathematical Sciences of the AS USSR), by the Komitet po prochnosti NTO mashinostroitel'noy promyshlennosti (Committee for Stability of NTO of the machinebuilding industry), by NTO legkoy promyshlennosti (NTO of the Light Industry), by the Komissiya po primeneniyu polimerov v mashinostroyenii Goskomiteta Soveta Ministrov SSSR po avtomatizatsii i mashinostroyeniyu (Commission for the Application of Polymers in Machine-Building in the State Committee of the USSR Council of Ministers on automation and machine-build-

Card 1/5

A Conference on the Strength of Polymers and Polymer Materials

ing. Papers on the following problems were submitted: the physical and physico--chemical foundations of polymer stability, stability of polymer materials used in machine-building, stability and fatigue of textiles and polymer coatings. Chairman G.L. Slonimskiy pointed out in his introductory speech that the conference was being held for the purpose of introducing physicists, physico-chemists occupied in the polymer branch, mechanical engineers and scientists in the textile and light industries into the work carried out in these branches. G.M. Bartenev presented a paper on "Certain Problems of the Stability of Polymers". He dealt with the problems of time and temperature dependence of stability, elaborating the conception of "stability limit". S.N. Zhurkov read a paper on "The Role of Chemical and Intramolecular Bonds in the Rupture of Polymers". Yu.S. Lazurkin discussed the paper by Zhurkov, stating that the formula on the temperature-time relationship of stability is similar to the formula expressing the dependence of the relaxation time on the tension in the deformation process of polymers. The coefficients of both formulae were compared. Ye.V. Kuvshinskiy and M.I. Bessonov presented a paper on "The Connection of the Destruction of Plastics with Deformation and Cracking." G.M. Bartenev and V.Ye. Gul' read a paper on "The Nature of the Stability of Polymers"; P.A. Rebinder on "Creep and Stability of Polymers

A Conference on the Strength of Polymers and Polymer Materials

Considering the Effect of the Active Medium." V.A. Berestnev elaborated some of the theoretical aspects of Rebinder's paper and their practical application. G.L. Slonimskiy read a paper on: "The Role of Mechano-Chemistry in the Processes of Treatment and Application of Polymers"; P.V. Melent'yev on: "Mechanical Testing of Polymer Materials"; M.A. Mokul'skiy on: "Changes in the Mechanical Properties of Polymers in the Irradiation Process"; V.R. Regel' on: "Arrangement of Experiments for the Study of the Connection Between Static Fatigue and Exhaustion in Repeated Cyclic Stresses"; V.R. Ratner on: "Fatigue Destruction of Plastics"; G.A. Patrikeyev on: "Macromolecular Mechanics", etc. A great deal of attention was given to the problem of construction properties of polymer materials. R.M. Shneyderovich and V.S. Strelyayev reported on: "Construction Factors of Static Stability in Orientated Glass Plastics"; A.L. Rabinovich read a paper on: "Certain General Characteristics of the Mechanical Properties of Construction Glass Plastics". G.A. Patrikeyev criticized the last two papers, claiming that they had no practical significance. Perl'shteyn added his comments on the same subject. V.A. Lepetov commented the possibility of expressing the elastic constants of rubber through the hardness according to Shore. B.G. Gurevich reported on the test results of glass plastics in smooth samples and in those with bore holes.

Card 3/5

A Conference on the Strength of Polymers and Polymer Materials

The paper by G.M. Bartenev, B.I. Panshin, G.I. Finogenov and I.V. Razumovskaya contained formulae for calculating the durability of organic glass and glass-textilite in cyclic tests. N.I. Malinin reported on "Creep and Relaxation of High Polymers and Plastics in the Transition State". G.L. Slonimskiy remarked that the latter paper was based only on foreign material and that there was a great deal more on the subject in Soviet literature. V.M. Tendler reported on N.Ye. Chernomordik's paper, " The Anisotropic Angle of Glass Plastics in Designing Ship Structures." G.N. Kukin reported on the important role of polymers in the textile and light industries. K.I. Koritskiy read a paper on: "Methods for Calculating the Stability of Threads Made of Staple and Continuous Fibers." G.N. Kukin read another paper on: "Methods of Determining the Dynamic Fatigue of Textile Materials". V.I. Yeliseyev reported on "The Characteristics of Fatigue Stability of Polymer Coatings of Leather". V.A. Usenko read a paper on: "The Selection of the Optimum Value of the Twist for Threads of Various Fibers". A.N. Solov'yev on: "The Effect of the Twist on the Physico-Mechanical Properties of the Threads"; A.A. Rogovina on: "The Effect of the Temperature and Air Oxygen on the Thread Durability"; Ye. G. Eyges on: "Certain Changes of the Fiber Structure and Threads in Fatigue";

Card 4/5

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A Conference on the Strength of Polymers and Polymer Materials

V.A. Berestnev on: "The Role of Micro and Macrostructure in the Destruction Process of the Fiber", etc. Several recommendations made by members were adopted.

Card 5/5

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AUTHORS: Zakharenko, N.V., Tolstukhina, F.S., Bartenev, G.M.

TITLE: On the Flow of Rubber-like Polymers and of Their Mixtures With Carbon Blacks

PERIODICAL: Kolloidnyy zhurnal, 1960, Vol XXII, Nr 2, pp 168-175 (USSR)

ABSTRACT: The authors report on a study of the flow of polymers and mixtures in a condensed phase in dependence on temperatures and stress. The investigation, which is intended to clarify this process, was carried out on polyisobutylene of the types P-20, P-118 and its carbon black mixtures, on sodium butadiene rubber (SKB) and its mixtures with an active (lamp black) and an inactive filler (chalk), and on various rubber mixtures intended for industrial processing (shoes etc.). The fluidity of the materials was measured in the

Card 1/4

69463
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On the Flow of Rubber-like Polymers and of Their Mixtures With Carbon Blacks

usual way (determination of strain at constant stress within small velocity gradients). The viscosity was measured with the plastoelastometer designed by D.M. Tolstoy [Ref. 3]. In this device (diagram) the specimen is deformed in a thin layer between two parallel plates. The lower plate remains in a stable position, whereas the upper plate moves due to a load, which acts through a pulley in a horizontal direction. The investigation established the existence of Newtonian flow for polyisobutylene P-20 in the range of low yield values of from 10^3-10^4 dynes/cm^2. Within this range of stresses Newtonian flow is absent in the black-filled mixtures. The rheological curves of complicated disperse rubber- carbon black mixtures are described (within the studied stress limits) by