

ACCESSION NR: AP4030639

material is either uniaxial or multiaxial (with respect to possible directions of spontaneous polarization); and the paraelectric phase from which the ferroelectric phase in question arises either does or does not have piezoelectric properties in the direction of the spontaneous polarization of the ferroelectric phase. Only in multiaxial crystals are other than  $180^\circ$  domain walls possible, and only in materials having piezoelectric properties in the paraelectric state is there a linear relation between domain structure and stress and strain. The crystal classes are determined to which materials of each of the four crystallophysical types can belong, and the 32 paraelectric classes are grouped according to the ferroelectric types to which they can give rise. Thus, a classification of ferroelectric phase transitions is obtained. The properties (both necessary and possible) of ferroelectric materials of the four crystallophysical types are discussed at some length. It is suggested that the crystallophysical classification may be useful in the search for new ferroelectrics with specific properties. Orig.art.has: 2 tables.

ASSOCIATION: Institut kristallografii Akademii nauk SSSR (Institute of Crystallography, Academy of Sciences, SSSR)

SUBMITTED: 00

DATE ACQ: 30Apr64

ENCL: 00

SUB CODE: EM

NR REF SOV: 011

OTHER:001

Card 2/2

ACCESSION NR: AP4016305

S/0020/64/154/005/1075/1077

AUTHORS: Shuvalov, L.A.; Shirokov, A.M.

TITLE: The characteristics of the amplitude dependence of internal friction in single-crystal ferroelectrics

SOURCE: AN SSSR. Doklady\*, v. 154, no. 5, 1964, 1075-1077

TOPIC TAGS: deformation, deformation amplitude, internal friction, ferroelectric, ferrite, Weiss domain, triglycin sulfate, domain structure, domain reorientation, single crystal, tinsel silver, damped oscillation, dielectric hysteresis

ABSTRACT: An experimental study has been made of some features of the internal friction in single crystals of Rochelle salt and triglycin sulfate with various types of the Weiss domain structure. The bar-shaped samples, measuring about 30x4x2 mm, were tested in a constant-temperature retort. As it was very difficult to measure the deformation amplitude of the samples, the experimental curves were plotted according to the current passed through the crystal by

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ACCESSION NR: AP4016505

mechanical resonance oscillations. The behavior of the logarithmic damping decrement was studied while the current going through the sample was changed from 0.02 to 2 milliamperes. The results of the above tests justify the following two basic conclusions: 1) the intensive internal friction in some of the Rochelle salt samples within the ferroelectric temperature region is determined by a variety of Weiss domain processes. It is possible that large deformation amplitudes produce volumetric deformations which change the nature of the internal friction. 2) It may be assumed that the amplitude dependence of the internal friction in the case of relatively small deformations will be observed in the ferroelectric region of the Rochelle salt crystals in which the reorientation of the Weiss domains may occur under the effect of homogeneous mechanical stresses. Orig. art. has: 2 figures.

ASSOCIATION: Institut kristallografii Akademii nauk SSSR (Institute of crystallography, Academy of Sciences SSSR)

SUBMITTED: 21Oct63  
SUB CODE: PH

DATE ACQ: 12Mar64  
NO REF SOV: 008

ENCL: 00  
OTHER: 004

Card 2/2

L 30031-65 EWT(1)/EWP(s)/EPA(s)-2/EWT(m)/EPF(n)-2/EPA(w)-2/EEC(t)/T/EWP(t)/  
EWP(b) Pab-10/Pt-10/Pu-l/Pl-l IJP(c) JD/GG/WH

S/0030/65/000/001/0118/0119

ACCESSION NR: AP5004556

AUTHOR: Shuvalov, L. A. (Candidate of physico-mathematical sciences)

TITLE: A discussion of the problems of ferroelectricity (Conference at Rostov-na-Donu)

SOURCE: AN SSSR. Vestnik, no. 1, 1965, 118-119

TOPIC TAGS: ferroelectricity, antiferroelectricity, pyroelectric effect, domain structure, phase transition, dielectric permeability, spectroscopy, single crystal growth

ABSTRACT: Ever since 1931 Soviet scientists have played a leading role in the theoretical and experimental studies of ferroelectricity and its uses. The IV All-Union Conference on ferroelectricity was held on September 12-18, 1964 at Rostov-na-Donu by the university at Rostov. Some 300 men from 78 institutions in Russia attended, and over 150 papers were presented. There were few theoretical papers; most of them dealt with the phenomenal and microscopic approaches to the general theory of ferroelectricity and with questions of domain structure, erosion of phase transitions, dielectric permeability of ceramics, etc. Studies of the structure and properties of newly developed ferroelectricities included: a plate

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structure of the type  $A_{x}B_{y}C_{z}V_{w}VII$ ; potassium-tungsten bronze; little studied and debatable ferroelectrics— $LiTaO_3$ ,  $LiNbO_3$ ,  $SrTiO_3$ , etc; compounds with antiferroelectric properties— $Pb_3V_2O_8$ ; and  $Pb_2(CoW)_6$  which has both antiferroelectric and ferroelectric phases. Materials with peculiar dielectric and magnetic properties were also discussed. It was indicated that absorption and reflection spectroscopic studies in the infrared and visual regions would be helpful. The character and nature of the modifying effect of small additives on the properties of  $BaTiO_3$  and other ferroelectrics were discussed. It was stated that inverse domain structure leads to anomalies of internal friction and sound absorption (complicated by the presence of Curie point). The first continuously observed domain structure was reported in studies of the dynamic domain structure, and its connection with dislocations was explained. The effect of  $\gamma$ -rays and x-rays on the properties and domain structure of water-soluble ferroelectrics was considered. The nature and practical uses of the pyroelectric effect were also discussed. Single crystal growth in relation to ferroceramics was explained. A similar conference will be held in September 1966 at Dniepropetrovsk.

ASSOCIATION: none

SUBMITTED: 00

NO REF SOV: 000

Card 2/2

ENCL: 00

OTHER: 000

SUB CODE: EM,

SS

L 57039-65 EWT(1)/EPA(s)-2/EWT(m)/EPF(o)/EWP(j)/EEC(t) Pc-4/Pr-4/Pt-7/Pl-4  
LJP(c) GG/RM

ACCESSION NR: AP5016125

UR/0048/65/029/006/0943/0947

AUTHOR: Rudyak, V.M.; Shuvalov, L.A.; Kamayev, V.Ye.

TITLE: Distinctive features of the Barkhausen effect in Rochelle salt and triglycine sulfate crystals / Report, 4th All-Union Conference on Ferroelectricity held in Rostov-on-the-Don 12-18 Sept 1964/

SOURCE: AN SSSR. Izvestiya. Ser.fizicheskaya, v.29, no.6, 1965, 943-947

TOPIC TAGS: ferroelectricity, Barkhausen effect, piezoelectric effect, Rochelle salt, triglycine sulfate

ABSTRACT: The ferroelectric Barkhausen effect was investigated in triglycine sulfate (TGS) and Rochelle salt (RS) crystals by the methods described by two of the authors in the preceding paper (Izv.AN SSSR, Ser.fiz.29, 937, 1965 - see Abstract AP5016124). The dimensions of all the crystals were the same: 10 x 10 x 2 mm; the TGS crystals were Y-cut, and the RS crystals were either X-cut or 45°X-cut. The following differences were found in the behaviors of the two materials:

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ACCESSION NR: AP5016125

1) The Barkhausen jumps are more numerous in TGS than in RS. The number of jumps corresponding to polarization reversal in volumes greater than  $1.5 \times 10^{-8} \text{ cm}^3$  is an order of magnitude greater in TGS than in RS. The total volume of the crystal in which polarization reversal by Barkhausen jumps takes place is 0.25% in TGS and only 0.01% in RS.

2) The values of  $E_{\text{start}}$  and  $E_{\text{max}}$  (see the reference cited above for definitions) are larger for RS than for TGS. 3) The time following a change of applied field during which Barkhausen jumps occur is greater for TGS than for RS. In RS substantially all the jumps occur within 30 sec, whereas the jumps continue for several minutes in TGS. 4) The application of certain mechanical stresses decreases the number and size of the Barkhausen jumps in RS; mechanical stress does not influence the Barkhausen effect in TGS. 5) RS exhibits a piezoelectric Barkhausen effect: when a mechanical stress is applied in the absence of an external electric field, polarization jumps occur which are very similar in size and distribution to the ordinary Barkhausen jumps. In non-unipolar TGS no polarization jumps occur when a mechanical stress is applied in the absence of a field. In some unipolar TGS specimens

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ACCESSION NR: AP5016125

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a few small polarization jumps occur under mechanical stress; these are sufficiently few and small, however, to be accounted for as a secondary concomitant of the ordinary piezoelectric and ferroelectric Barkhausen effects. These differences are discussed and explained in terms of the different domain structures of the two materials. Orig. art. has: 5 figures.

ASSOCIATION: Kalininskiy pedagogicheskiy institut im. M.I.Kalinina (Kalinin Pedagogical Institute); Institut kristallografii Akademii nauk SSSR (Institute of Crystallography, Academy of Sciences of the SSSR)

SUBMITTED: 00

ENCL: 00

SUB CODE: SS, EM

NR REF SOV: 005

OTHER: 001

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Card 3/3



L 57563-65 EWG(j)/EWT(1)/EPA(s)-2/EWT(m)/ENP(w)/EPF(c)/EWA(d)/EPR/EEC(t)/T/68  
EWP(t)/EWP(b)/EWA(c) Pr-4/Ps-4/Pt-7/P1-4 IJP(c) JD/JG/GG 66

UR/0048/65/029/006/0988/0989

ACCESSION NR: AF5016136

AUTHOR: Minayeva, K.A.; Shuvalov, L.A.

TITLE: Anomalies of some physical properties of  $PbMg_{0.5}WO_{0.5}O_3$  and  $PbMg_{0.5}WO_{0.5}O_3 + 5\% PbTiO_3$  in the vicinity of the phase transition  
Report, 4th All-Union Conf. on Ferroelectricity held in Rostov-on-the-Don 12-18 Sept 1964

SOURCE: AN SSSR.Izvestiya. Ser.fizicheskaya, v.29, no.6, 1965, 988-989

TOPIC TAGS: antiferroelectricity, phase transition, elastic modulus, shear modulus, internal friction, lead compound, magnesium compound, tungsten compound, titanate, solid solution

ABSTRACT: The authors have previously measured the elastic compliance and logarithmic decrement of  $PbMg_{0.5}WO_{0.5}O_3$  near the antiferroelectric Curie point by means of a compound resonator method employing longitudinal elastic waves (Dokl.AN SSSR 146,808,1962). In the present paper they report results of similar measurements in which torsion waves were employed, and they also report results of measurements

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ACCESSION NR: AP5016136

on  $\text{PbMg}_{0.5}\text{W}_{0.5}\text{O}_3 + 5\% \text{PbTiO}_3$  with longitudinal waves. The results of the shear measurements were similar to those of the previous measurements with longitudinal waves: the shear compliance decreased smoothly by about 20% while the temperature increased by about  $5^\circ$  in the vicinity of the antiferroelectric Curie point and the logarithmic decrement reached a maximum value of 0.03 near the Curie point. The temperature of the maximum of the logarithmic decrement ( $30^\circ\text{C}$ ) was some  $5^\circ$  below that of the flex point of the shear compliance curve. The reason for this difference, which was not found with longitudinal waves, is not known. The logarithmic decrement in the antiferroelectric phase (far from the Curie point) was appreciably greater than in the paraelectric phase. This is ascribed to domain wall movement. The compliances, and particularly the decrements, were found to be much more amplitude dependent in the antiferroelectric phase than in the paraelectric phase. The anomaly in the transition region (near  $-70^\circ\text{C}$ ) of the elastic compliance of the solid solution containing 5%  $\text{PbTiO}_3$  was barely perceptible. It is suggested that this is related to the fact that the change of the lattice constants of this solution at the

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ACCESSION NR: AP5016136

antiferroelectric transition is very small (G.A.Smolenskiy, N.N.Kraynik and A.I.Agranovskaya, Fiz.tverdogo tela 3,981,1961). The anomaly of the logarithmic decrement, however, was very pronounced. It is noted that the anomalies of the logarithmic decrements of mechanical vibrations at the antiferroelectric phase transitions are much greater than those of the dielectric loss tangents, and it is suggested that internal friction may serve as a very sensitive indicator of antiferroelectric phase transitions. "The authors express their gratitude to G.A.Smolenskiy for his cooperation in the organization of this work." Orig.art.has: 2 figures.

ASSOCIATION: none

SUBMITTED: 00

ENCL: 00

SUB CODE: SS, EM

NR REF SOV: 006

OTHER: 001

Card 3/3

L 7847-66 EWT(1)/EPA(s)-2/EWT(m)/EWP(t)/EWP(b) IJP(c) JD/GG  
ACC NR: AP 5028100 SOURCE CODE: UR/0048/65/029/011/1974/1981

AUTHOR: <sup>44, 55</sup> Shuvalov, L.A.; <sup>44, 55</sup> Mnatsakanyan, A.V.

ORG: <sup>44, 55</sup> Institute of Crystallography, Academy of Sciences, SSSR (Institut kristallografiil Akademii nauk SSSR); Yerevan Polytechnic Institute (Yerevanskiy politekhicheskiy institut)

90  
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TITLE: Investigation of the internal friction anomaly of ferroelectric phosphates in the vicinity of the Curie point <sup>11</sup> Report, Fourth All-Union Conference on Ferroelectricity held at Rostov-on-the Don 12-16 September 1964

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya. v. 29, no. 11, 1965, 1974-1981 <sup>III 44, 55</sup>

TOPIC TAGS: <sup>21, 44, 55</sup> Ferroelectric crystal, phosphate, elastic deformation, elastic modulus, elastic hysteresis, Curie point, second order phase transition

ABSTRACT: The elastic compliance and logarithmic decrement of longitudinal vibrations of single crystal bars of  $KH_2PO_4$ ,  $KD_2PO_4$  and  $RbH_2PO_4$  of approximate dimensions  $25 \times 4 \times 2 \text{ mm}^3$  were measured at the resonance frequency over a temperature range including the Curie point. The vibrations were excited and observed with the aid of the piezoelectric effect, and the electric circuit was such that the specimens were practically short-circuited. The temperature was controlled within  $0.01^\circ \text{C}$ . The exciting alternating field was of the order of  $2.5 \text{ V/cm}$ , and measurements were made in the presence of dc bias fields up to  $4 \text{ kV/cm}$  directed along the ferroelectric

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ACC NR: AP 5028100

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axis. In the case of 45° Z-cut bars, in the absence of a bias field the compliance and decrement increased sharply as the temperature was reduced through the Curie point, and as the temperature was further reduced, the compliance decreased slowly and the decrement decreased only slightly and subsequently increased. Application of a bias field, which inhibited domain reorientation, greatly reduced both the compliance and the decrement at temperatures somewhat below the Curie point. The large values of compliance and decrement below the Curie point, ascribed to domain polarization reversal and inhibited by a bias field, were not present in 45° X-cut bars. The sharp maxima of the compliance, decrement, and dielectric constant near the Curie point shifted to higher temperatures under the action of a bias field. For  $KH_2PO_4$  this shift was  $0.3 \times 10^{-3}$  degree/V, which is about twice that found for  $KD_2PO_4$  by R.M.Hill and S.K.Ichiki (Phys.Rev., 132, 1603 (1963)). Although the present data are not adequate to support the conclusion that the phase transition in  $KH_2PO_4$  deviates from a second order transition as does that in  $KD_2PO_4$  (R.M.Hill and S.K. Ichiki, loc. cit.), they indicate that it is desirable to reexamine the high frequency dielectric constant data with the view of disclosing such deviations. The authors thank I.V. Gavriolova<sup>4455</sup>, R.M. Fedosyuk<sup>4455</sup>, and T.V. Pichkulova<sup>4455</sup> for preparing the crystal specimens, and I.S. Zheludev and A.M. Shirokov for valuable remarks. Orig. art. has: 7 figures.

SUB CODE: SS, ME

SUBM DATE: 00/

ORIG. REF. 010

OTH REF:005

Card 2/2

L 7818-66 EWT(1)/EPA(s)-2/EWT(m)/EPF(c)/EEC(k)-2/EPF(n)-2/T/EWP(t)/EWP(b)/EWA(c)  
ACC NR: AP5028107 IJP(c) JD/GG

AUTHOR: Sil'vestrova, I.M.; Yurin, V.A.; Shuvalov, L.A.; Podlesskaya, A.V.  
SOURCE CODE: UR/0048/65/029/011/2005/2008

ORG: none

TITLE: The piezoelectric effect and internal friction in gamma-irradiated Rochelle salt crystals Report, Fourth All-Union Conference on Ferro-electricity held at Rostov-on-the Don 12-16 September 1964

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 29, no. 11, 1965, 2005-2008

TOPIC TAGS: ferroelectric crystal, single crystal, gamma irradiation, piezoelectric crystal, elastic modulus, internal friction, electric field

ABSTRACT: The authors have measured the piezoelectric modulus  $d_{14}$ , the electro-mechanical coupling constant  $k_{14}$ , the elastic compliance  $s_{22}$ , and the damping constant  $\delta$  for longitudinal mechanical vibrations, of  $\gamma$ -irradiated  $45^\circ$  X-cut Rochelle salt crystal bars at temperatures from 0 to  $35^\circ\text{C}$  and (in the case of  $s_{22}$  and  $d_{14}$ ) in the presence dc bias field up to 3 kV/cm. The crystals were irradiated (maximum dose,  $1.2 \times 10^7$  roentgen) at  $3-5^\circ\text{C}$  and stored at this temperature for 1-2 days before measurement. The piezoelectric effect was investigated by the resonance-antiresonance method and the internal friction was measured by the technique described by L.A. Shuvalov and Yu.S. Likhacheva (Izv. AN SSSR. Ser. fiz., 24, No. 11, 1216 (1960)). The effect of  $\gamma$  irradiation on the temperature dependence of all these quantities was similar to

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L 7821-66 EWT(1)/EPA(s)-2/EWT(m)/EPF(c)/EPF(n)-2/EWP(j) IJP(c) GG/RM  
ACC NR: AP5028108 SOURCE CODE: UR/0048/65/029/011/2009/2013

AUTHOR: Shuvalov, L.A.; Rudiyak, V.M.; Konlyakova, N.S.; Kamayev, V.Ye.

ORG: Institute of Crystallography, Academy of Sciences, SSSR (Institut kristallografi  
Akademii nauk SSSR); Kalinin State Pedagogical Institute im. M.I.Kalinin (Kalininskiy  
gosudarstvennyy pedagogicheskiy institut)

TITLE: Influence of gamma irradiation on the Barkhausen effect in ferroelectric  
materials / Report, Fourth All-Union Conference on Ferroelectricity held at Rostov-  
on-the Don 12-16 September 1964

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 29, no. 11, 1965, 2009-2013  
TOPIC TAGS: ferroelectric crystal, single crystal, gamma irradiation, Barkhausen  
jump

ABSTRACT: The Barkhausen effect has been investigated in 10 x 10 x 2 mm<sup>3</sup>  $\gamma$ -irradiated  
Y-cut triglycine sulfate and X- and 45° X-cut Rochelle salt crystals. The crystals  
were irradiated in the ferroelectric phase, and the measurements were made at room  
temperature several weeks or months after irradiation, using experimental techniques  
described by V.M.Rudiyak and V.Ye.Kamayev (Izv. AN SSSR. Ser. fiz., 29, 937 (1965);  
Uch. zap. Kalininsk. ped. in-ta, 40 (1964)). Polarization and volume jumps of 1.8 x  
x 10<sup>-14</sup> C cm and 0.3 x 10<sup>-8</sup> cm<sup>3</sup> could be detected in triglycine sulfate, and jumps of  
5.3 x 10<sup>-15</sup> C cm and 1.5 x 10<sup>-8</sup> cm<sup>3</sup> could be detected in Rochelle salt. The total

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SUB CODE: SS,EM

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L 5134-66 EWT(1)/T IJP(c) CG  
ACCESSION NR: AP5018746

UR/0020/65/163/002/0347/0349

AUTHOR: Shuvalov, L. A.; Rudyak, V. M.; Kamayev, V. Ye.

TITLE: Jump in polarization reversal in ferroelectric crystals, induced by application of mechanical stresses

SOURCE: AN SSSR. Doklady, v. 163, no. 2, 1965, 347-349

TOPIC TAGS: ferroelectric crystal, ferroelectric effect, electric polarization, piezoelectric effect

ABSTRACT: The purpose of the investigation was to check whether the Barkhausen effect can be produced in ferroelectric crystals by mechanical stress alone. The tests were made on Rochelle-salt plates (10 x 10 x 2 mm) with an installation combining the apparatus described earlier by one of the authors (Kamayev, Kristallografiya v. 9, 755, 1964) and by I. S. Zheludev and N. A. Romanyuk (Kristallografiya v. 4, 710, 1959). The load was applied in discrete steps and the polarization-reversal jumps were displayed on an oscilloscope and counted with a scaler system. The tests confirmed that application of mechanical stress produces the same effect as an electric field applied to the sample along the X axis. A reduction in the stress or application of compression stress in the opposite direction produces Barkhausen jumps of opposite polarity. A hysteresis effect is observed on going through

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L 26740-66 EWT(1)/EWT(m)/T/EWP(t) IJP(c) JD/JG/GG

ACC NR: AP6011465

SOURCE CODE: UR/0070/66/011/002/0222/0226

AUTHOR: Shuvalov, L. A.; Mnatsakanyan, A. V.

ORG: Yerevan Polytechnic Institute im. Karl Marx (Yerevanskiy politekhnicheskiy institut); Institute of Crystallography, AN SSSR (Institut kristallografii AN SSSR)

TITLE: Elastic properties of crystals of potassium dideuterophosphate (KD<sub>2</sub>PO<sub>4</sub>) in a wide range of temperatures

SOURCE: Kristallografiya, v. 11, no. 2, 1966, 222-226

TOPIC TAGS: potassium compound, deuterium compound, elastic modulus, phase transition, ferroelectric effect, Curie point, electric polarization, temperature dependence, crystal property

ABSTRACT: In view of the recent revival of interest in KD<sub>2</sub>PO<sub>4</sub> crystals, the authors have determined all the components of the elastic-coefficient tensor of this crystal in a wide range of temperatures, including the point of ferroelectric phase transition. The measurements were made by the usual resonance procedure using apparatus designed for the measurement of the dynamic electromechanical properties of crystals, described by one of the authors earlier (Mnatsakanyan, Trudy IV Vsesoyuznoy konferentsii po relaksatsionnym yavleniyam v tverdykh telakh [Transactions of the Fourth All-Union Conference on Relaxation Phenomena in Solids], Voronezh, 1966), and a cryostat described by the authors elsewhere (Izv. vyssh. uchebnykh zaved. Fizika, in press). The tests were made in the temperature range from -125 to +25C. The test procedure and the preparation of the sample crystals are briefly described. The results show

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UDC: 548.0: 539.371

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ACC NR: AP6011465

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that, in spite of the prevailing opinion, an anomaly is observed at the Curie point (211.0K) not only in the elastic coefficient connected with the ferroelectric polarization, but also in all other elastic coefficients. This result agrees with data on temperature dependence of the elastic susceptances of  $KH_2PO_4$  crystals. An additional discontinuity at a temperature approximately  $30^\circ$  below the Curie point is attributed to the quenching of the domain structure which is characteristic of ferroelectric phosphates. The authors thank I. S. Zheludev for helping to organize this work. The crystals were grown at the Institute of Crystallography AN SSSR by I. V. Gavrilova and her co-workers. Orig. art. has: 3 figures and 1 formula.

SUB CODE: 20/    SUBM DATE: 11Oct65/    ORIG REF: 006/    OTH REF: 009

Card 2/2

L 44811-66 EWT(1)/EWT(m)/T/EWP(t)/ETI IJP(c) JD/JG/GG

ACC NR: AP6032022

SOURCE CODE: UR/0386/66/004/006/0220/0226

AUTHOR: Ivanov, N. R.; Shuvalov, L. A.; Fedosyuk, R. M.; Pluzhnikov, K. A. <sup>69</sup>ORG: Institute of Crystallography, Academy of Sciences, SSSR (Institut kristallografi Akademii nauk SSSR) <sup>B</sup>TITLE: Proof of the existence of two sharply distinct ferroelectric phases in  $\text{NaH}_3(\text{SeO}_3)_2$  <sup>2)</sup>

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 4, no. 6, 1966, 220-226

TOPIC TAGS: ferroelectricity, phase transition, second order phase transition, electric polarization, dielectric constant, temperature dependence

ABSTRACT: The authors investigated the ferroelectric properties of large homogeneous single crystals of  $\text{NaH}_3(\text{SeO}_3)_2$ , grown from the aqueous solution by the method of dropping the temperature, having a Curie point  $T_C = -78.6^\circ\text{C}$  and a melting temperature  $111 \pm 0.5^\circ\text{C}$ . Measurements of the low-frequency (800 cps) dielectric constant at a measuring-field intensity 10 v/cm were made for three mutually perpendicular cuts oriented parallel to the principal sections of the optical indicatrix: the crystallographic directions were taken to be the principal axes of the indicatrix, so that the x, y, and z axes were directed respectively along the acute and obtuse bisectors and the normal to the plane of the optical axes. The temperature dependence of the rotation of the indicatrix  $\varphi(T)$  about the y axis and the components of the spontaneous

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ACC NR: AP6032022

polarization were measured. The measurements have demonstrated conclusively the presence of one more phase transition in  $\text{NaH}_3(\text{SeO}_3)_2$  at  $-172.5^\circ\text{C}$ , at which a jumpwise decrease takes place in the components of the dielectric constant. The transition has a temperature hysteresis of  $10.5^\circ$ . Consequently, the transition is of first order. The temperature dependence of the various components of the dielectric constant, of the spontaneous polarization, and of the coercive field were also investigated. An analysis of the obtained information leads to the following conclusions.

1.  $\text{NaH}_3(\text{SeO}_3)_2$  undergoes two phase transitions, one at  $-78.6^\circ\text{C}$  (second order but close to first order) from the paraelectric  $\alpha$  phase to the ferroelectric  $\beta$  phase.
2. In the absence of external action, the  $\gamma$  phase (or part of it) can remain metastable in the crystal in the range  $-162^\circ\text{C} < T < T_C$ . An external electric field or mechanical action can transform the crystal to the  $\beta$  phase which is stable in this temperature region.
3. In the  $\gamma$  phase, the vector of spontaneous polarization lies in the  $xz$  plane ( $m$  plane), but in the  $\beta$  phase there appears a  $y$  component of the polarization, as a result of which the crystal becomes triclinic.
4. As a result of these stresses and of the noncollinearity of the polarization vector  $P_s$  in different domain systems, it becomes possible to display visually the trace of the domain structure.
5. Since the motion of the domain walls takes place in a field of inhomogeneous mechanical deformation, an appreciable domain contribution to the dielectric constant is produced.
6. The difference between the effects brought about by the  $x$  and  $y$  polarization components, and the different behavior of these components themselves and of the coercive fields corresponding to them offer definite evidence of two es-

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L 44811-66

ACC NR: AP6032022

sentially different mechanism for the occurrence of spontaneous polarization in  $\text{NaH}_3(\text{SeO}_3)_2$ . Orig. art. has: 3 figures.

SUB CODE: 20/ SUBM DATE: 20Jun66/ ORIG REF: 001/ OTH REF: 006

Card 3/3 blg

L 00113-67 EMP(m)/EMP(j)/EMP(t)/ETI IJP(c) JD/IAJ/IM

ACC NR: A 5024553

SOURCE CODE: UR/0070/36/011/004/0614/0521

AUTHOR: Ivanov, N. R. ; Shovalov, L.A.

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ORIG: Instituto of Crystallography AN SSSR (Institut kristallografii AN SSSR)

TITLE: Behavior of optical indicatrices of certain monoclinic ferroelectric crystals with change in temperature

SOURCE: Kristallografiya, v. 11, no. 4, 1966, 614-621

TOPIC TAGS: ferroelectric crystal, optic analysis, crystal optic property, light polarization, temperature dependence, paraelectricity, Curie point

ABSTRACT: This is a continuation of earlier work (Kristallografiya, v. 9, no. 3, 353, 1964) and it is devoted to a measurement of the rotation of the optical indicatrix in three monoclinic ferroelectric substances (triglycinesulfate, triglycine selenate, lithium hydroselenite) with change in temperature. The angle of rotation was measured by two methods, polarimetric and conoscopic (both results gave excellent agreement), but only the conoscopic method was used to measure the angle of the optical axis. All the experiments were made with the aid of a spectral polarimeter developed by the author (with A.V. Mirenskiy and G.D. Shnyrev), and

Card 1/2

UDC: 548.0:535.52

L 09443-67

ACC NR: AF6024668

4

prepared by the Design Office of the Crystallography Institute. The apparatus and the test procedure are described in detail. The results show that the temperature dependence of the rotation of the optical indicatrix was linear in the paraelectric and strongly nonlinear in the ferroelectric phase in the case of triglycin sulfato and selenate. The Curie points found from these plots were 48.2 and 22.9C for the sulfato and selenate, respectively. With decreasing temperature, the relation again becomes linear. In the case of lithium hydrosonite, the dependence was linear in the entire range of temperatures. The results are interpreted on the basis of the thermo-optical and spontaneous electro-optical and elasto-optical effects. It is shown that the obtained results lead to several general conclusions and estimates. The authors thank I. S. Zholudov for useful discussions, and the staff member of the Institute of Physics of the Czechoslovak Academy of Sciences B. Brzhozin and of the Institute of Crystallography AN SSSR I. V. Gavrilov for supplying the crystals for the investigation. Orig. art. has: 6 figures, 13 formulas, and 1 table.

SUB CODE: 20/

SUBM DATE: 17Nov65/

ORIG REF: 005/

OTH REF: 012

Card 3/2

ACC NR: AF7002387

SOURCE CODE: UR/0020/66/171/005/1092/1095

AUTHOR: Ivanov, N. R.; Shuvalov, L. A.; Kislovskiy, L. D.

ORG: Institute of Crystallography, Academy of Sciences SSSR (Institut kristallografi  
Akademii nauk SSSR)

TITLE: On the structural mechanism of the electrooptical and thermooptical effects  
in ferroelectric crystals of the triglycinsulfate type

SOURCE: AN SSSR. Doklady, v. 171, no. 5, 1966, 1092-1095

TOPIC TAGS: electrooptic effect, ion, ferroelectric material, glycine, sulfate,  
crystallography

ABSTRACT: Theoretical and experimental investigations were made of the important  
part played by the deformation of  $SO_4^{2-}$  or  $SeO_4^{2-}$  ions in the occurrence  
of spontaneous polarization in monoclinic triglycinsulfate or triglycin-  
selenate crystals. The deformation resulting from the displacement of  
nitrogen atoms can be measured by directional changes of the maximum  
polarizability, i.e., by shifts of the indicatrix of the crystal. Measure-  
ments were performed of the shifts of the optical indicatrix in the para-  
electric phase at a temperature close to the melting temperature of the  
crystals. These shifts showed up as breaks on the  $\phi(T)$  dependence curves,  
which are explained as indicating the presence in both crystals of

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UDC: 548.537+536



ACC NR: AP7002387

several characteristic temperatures above the curie point, at which the rupture of bonds takes place. It is suggested that the results can be extrapolated to other crystals of the same type. Thus, for example, one can calculate that the melting temperature of triglycinfluoberyllate is 230—235C. Orig. art. has: 3 figures and 1 table.

SUB CODE: 20/ SUBM DATE: 11Feb66/ ORIG REF: 006/ OTH REF: 001/  
ATD PRESS: 5113

Card 2/2

SOKOLOV, N.S. (Magadanskaya oblast'); POPOV, V.M. (Magadanskaya oblast');  
DYMOV, K.M. (Magadanskaya oblast'); SHUVALOV, L.V. (Magadanskaya  
oblast'); MATSUYEV, L.P.; BONDARENKO, I.G. (Magadanskaya oblast');  
MAYO-ZNAK, Ye.S. (Magadanskaya oblast'); DZASOKHOV, Kh.B.  
(Magadanskaya oblast')

Eliminate inefficiency in the operation of dredges. Kolyma 21  
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1.Nachal'nik gornogo upravleniya (for Sokolov). 2.Nachal'nik dragi  
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priiska im. Gastello (for Shuvalov). 5.Zamestitel' direktora Vsesoyuzno-  
go nauchno-issledovatel'skogo instituta zolota i redkikh metallov,  
Magadan (for Matsuyev). 6.Nachal'nik otdela truda i zarabotnoy platy  
gornogo upravleniya (for Bondarenko). 7.Zamestitel' nachal'nika  
proizvodstvenno-tekhnicheskogo otdela sovmarkhoza (for Mayo-Znak).  
8.Nachal'nik priiska im. Chkalova (for Dzasokhov).  
(Dredging machinery) (Hydraulic mining)

SHUVALOV, M.; BUYANOV, N., inzh.-inspektor

With small forces. Pozh. delo 9 no.6:21 Je '63.

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1. Zamestitel' nachal'nika operativnogo otdela Upravleniya po-  
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All-Union Heat Engineering Institute.  
Rab. energ., 2, No. 7, 1952.

9. Monthly List of Russian Accessions, Library of Congress, October 1952. UNCLASSIFIED.

SHUVALOV, M.A., inzh.; ZAKHAROVA, L.B., inzh.; YARMAK, L.N., inzh.

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2. USSR (600)

4. Steam Boilers - Air Preheating

7. Initial results of operating air preheaters of small dimensions designed by the All-Union Institute of Heat Engineering. Elek. sta., 23, No. 1, 1952

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SHUVALOV, M.A., inzh.

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KURBATSKIY, Oleg Mikhaylovich; SHUVALOV, M.G., red.; LYUBINA, R.M.,  
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102 p. (MIRA 16:6)

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New method for saturating and drying the stator windings of  
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Lidiya Maksimovna; SHCHERBAKOV, Valentin Innokent'yevich

[Mining and dressing mica minerals] Razrabotka i obogashchenie  
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FOMENKO, S.A., inzh.; SHUVALOV, N.G., inzh.; SLOMCHINSKIY, V.V., inzh.;  
TABACHNIKOV, I.L., inzh.

Some problems of the terminology of the windings of electrical  
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Investigating transients in electronic modeling units.  
Sudostroenie 24 no.11:41-45 N '58.

(MIRA 12:1)

(Electronic calculating machines)



PHASE I BOOK EXPLOITATION

SOV/4166

Shuvalov, Nikolay Konstantinovich

Sistemy programmogo regulirovaniya, rabotayushchiye na kombinirovannom printsipe  
(Programmed Control Systems Operating on the Combined Principle), Leningrad.  
Sudpromgiz, 1960. 74 p. Errata slip inserted. 5,000 copies printed.

Scientific Ed.: A.D. Maksimov; Ed.: M.A. Aptekman; Tech. Ed.: R.K. Tsal.

**PURPOSE:** This book is intended for engineers working in design organizations and may be useful to students taking advanced courses in power engineering institutes.

**COVERAGE:** The book discusses the fundamental characteristics of the combined principle of control with respect to programmed systems. The increased precision resulting from the use of the combined system is stressed. Methods of designing adjustment devices with an arbitrary form of control action are given. Comparative data on systems operating on the principle of control by deviation and on the combined principle are examined. The author thanks Professor T.N. Sokolov, Professors Ye. P. Popov and A.A. Voronov, Doctors of Technical Sciences, and O.P. Demchenko and A.D. Maksimov, Candidates of Technical Sciences.

Card 1\*

Programmed Control Systems (Cont.)

80V/4166

There are 24 references, all Soviet.

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SHUVALOV, Nikolay Maksimovich; KORNILOVA, M.I., red.; SHADRINA, N.D.,  
tekhn.red.

[From congress to congress] Ot s"ezda k s"ezdu. Izd-vo  
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BIRMAN, A.M.; GAYDUKOV, Yu.A.; GOLUBTSOV, L.B.; ITIN, L.I.;  
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[School of socialist management; book for reading in schools  
for workers studying the economics of industrial enterprises]  
Shkola sotsialisticheskogo khoziaistvovaniia; kniga dlia  
chtenia v shkolakh rabochikh izuchaiushchikh ekonomiku pro-  
myshlennykh predpriatii. Moskva, Gospolitizdat, 1962. 295 p.  
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BLISMAN, A.M.; GERSHKOVICH, I.I.; GOLUBTSOV, L.B.; ITIN, L.I.;  
KAMENITSER, S.Ye.; KONTOPOVICH, V.G.; MOROZOV, F.A.;  
TOLSTYKH, A.S.; SHIMANSKIY, V.P.; SHUVALOV, N.M.;  
AVETISYAN, Ye., red.

[School of socialist management; a school reader for workers  
studying the economics of industrial enterprises] Shkola  
sotsialisticheskogo khoziaistvovaniia; kniga dlia chteniia v  
shkolakh rabochikh, izuchaiushchikh ekonomiku promyshlennykh  
predpriatii. Izd.2., perer.i dop. Moskva, Politizdat,  
1964. 318 p. (MIRA 17:8)

S/186/60/002/005/004/017  
A051/A130

AUTHORS: Pushlenkov, M. F.; Komarov, Ye V.; Shuvalov, O. N.

TITLE: The effect of the nature of diluents on the extraction of uranyl nitrate using Tri-N.-Butylphospate

PERIODICAL: Radiokhimiya, v. 2, no. 5, 1960, 537 - 540

TEXT: A study was made of the effect of certain diluents on the extracting ability of TBPh. where it was established that within the limits of the row investigated, the change in the extracting ability of the TBPh cannot be associated in the same way with the degree of polarity of the diluents. The extracting properties of the TBPh are said to depend both on the degree of dilution and on the nature of the diluent. The authors have studied the effect of both polar and non-polar diluents on the extraction with a solution of TBPh of uranyl nitrate within a wide range of concentrations of the latter. Infra-red spectroscopy was used to determine the various nature of the interaction of the TBPh molecules with different diluents. The manifold recrystallized hexahydrate, uranyl nitrate, was used. The experimental procedure was as follows: The Khar'kov Plant TBPh  
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The effect of the nature of

S/186/60/002/005/004/017  
A051/A130

grading chemical reagents were processed with a 5 % solution of sodium alkali and a solution of permanganate and were then dried and distilled under vacuum. Tetrachlorodifluoroethane, tetrachloroethylene, chloroform and bromobenzene were purified by simple distillation. The purity of the organic liquids was checked by the boiling point and specific weight. The uranium was determined by the weight method in the water and organic phases, in the form of  $U_3O_8$ . The TBPh content was determined by the phosphorous according to the weight method in the form of  $Mg_2P_2O_7$ . The distribution coefficient was calculated as the ratio of the analytical concentrations of uranium in the organic and aqueous phases. The organic layer was a mixture of 40 volume % TBPh and 60 volume % diluent. The experiments were carried out at  $20^\circ C$ . The infra-red spectra of the pure TBPh and its solutions in carbon tetrachloride, chloroform, and bromobenzene, within the area of valency fluctuation of the phosphorous group, were obtained by means of a WK-12(IKS-12)-type spectroscope, with a prism made of sodium chloride. The measurements showed that the spectral width of the aperture was about  $2\text{ cm}^{-1}$ . All the measurements were carried out with the same cuvette, with openings made of potassium bromide. The absorption coefficient  $k$  was calculated according to the formula:

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$$k_v = \frac{1}{C \cdot l} \cdot \log \frac{I_0}{I} .$$

The study of the infra-red spectra of the pure TBPh and its solutions in the carbon tetrachloride, chloroform and bromobenzene led to the conclusion of the various energies of the molecular interaction in all cases. The latter proved that a significant deviation exists in the solutions investigated from that of the ideal state. Figure 1 shows graphically the results of irradiating the distribution of the uranyl nitrate between the aqueous solution and the TBPh mixture with diluents. The threshold value of saturation is reached at concentrations of the uranyl nitrate in water equalling 960 g/l, when the ratio (TBPh) (U) in the organic layer becomes equal to 2. The table shows that an increase of the extracting ability of the TBPh when shifting over to the investigated diluents, from chloroform to tetrachloroethylene, cannot have the same affiliation to the characteristics such as dipole moment ( $\mu$ ), dielectric constant ( $\epsilon$ ) or refractive index ( $n_D$ ), (Ref. 3: A, Vaysberger, E. Proskauer, Dzh. Riddik, E. Tups, Organicheskiye rastvoriteli, Izd. IL.M., 1958). The authors assume that the change of the extracting ability of the TBPh in various diluents is

Card 3/6



The effect of the nature of ....

S/186/60/002/005/004/017  
A051/A130

connected with the change of the intermolecular action of the diluents with the TBPh and the disolvate. The solutions of TBPh in chloroform are found to differ most of all from the investigated diluents, which is explained by the fact that an unstable molecular compound of TBPh and the chloroform is formed by means of a hydrogen bond. Experimental data on the TBPh absorption in the region of  $1180 - 1300 \text{ cm}^{-1}$ , are shown in Figure 2, 3. The spectra show that the absorption intensity changes in different ways depending on the nature of the diluent. There are 1 table and 3 figures. 10 references: 7 Soviet-bloc and 3 non-Soviet-bloc. The three references to English language publications read as follows: Z.J. Dizdar, J. K. Rajnvajn, O. S. Gal, Bull. Inst. Nucl. Sciences "Boris Kidrich", 8, 59, 1958; T. V. Healy, H. A. C. McKay, Trans farad. Soc., 52, 5, 633, 1956; R.C. Lord, B. Nilon, H. O. Stidham, J. Am. Chem. Soc., 77, 5, 1365, 1955.

Card 4/6

SHUVALOV, O.N.; PUSHLENKOV, M.F.

Method of calculating the distribution of substances in a  
countercurrent extraction. Radiokhimiia 3 no.6:667-675 '61.  
(MIRA 14:12)

(Extraction(Chemistry))

S/186/62/004/003/002/009  
E075/E436AUTHORS: Pushlenkov, M.F., Komarov, Ye.V., Shuvalov, O.N.

TITLE: The influence of the nature of solvents on the extraction of uranyl nitrate with tributylphosphate

PERIODICAL: Radiokhimiya, v.4, no.5, 1962, 543-550

TEXT: The authors studied the dependence of the distribution of  $UO_2(NO_3)_2$  between water and organic solvents on its concentration in water and evaluated quantitatively the influence of the nature of solvents on the extraction of U and water with tributylphosphate (TBP). The experimental procedure was described previously by the present authors (Radiokhimiya, v.2, no.5, 1960, 537). Distribution coefficient  $\alpha$  for the investigated range of U concentrations irrespective of the nature of solvents is given by

$$\alpha = \frac{1}{2} \left[ \left( \frac{c_T}{x} + \frac{1}{16Qx^4\gamma_{\pm}^3} \right) \pm \sqrt{\left( \frac{c_T}{x} + \frac{1}{16Qx^4\gamma_{\pm}^3} \right)^2 - \left( \frac{c_T}{x} \right)^2} \right] \quad (6)$$

where  $x$  - equilibrium concentration of U in aqueous solution,  
 $\gamma_{\pm}$  - mean activity coefficient of  $UO_2(NO_3)_2$  in water,  
 - Card 1/4

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E075/E436

$c_T$  - overall concentration of TBP in the organic phase  
(TBP · H<sub>2</sub>O + free TBP) and

$$Q = \frac{\alpha}{4x^2\gamma_{\pm}^3 (c_T - 2\alpha x)^2} \quad (5)$$

and is related to the total transfer of water and UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub> to the organic phase. The solvents used were: CHCl<sub>3</sub>, ClCH<sub>2</sub>CH<sub>2</sub>Cl, CCl<sub>4</sub> and bromobenzene. The equilibrium constant  $\beta$  for the formation of solvate UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub> · TBP<sub>2</sub> is given by

$$\beta = \frac{\alpha\gamma_S}{4x^2\gamma_{\pm}^3 T^2\gamma_T^2} \quad (1)$$

where  $\gamma_S$  and  $\gamma_T$  are the activity coefficients of the solvate and TBP respectively in the organic phase and T - concentration of free TBP in the organic phase. As this constant is related only to the distribution of UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>, the variation of  $(\beta\gamma_T^2)/(\gamma_S)$  produced by changes of the solvents measures quantitatively the  
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E075/E436

effect of solvents on the distribution. The values  $Q \cdot (\beta\gamma_T^2)/\gamma_S$  and  $\beta_{\text{water}}$  increase in the order  $\text{CHCl}_3$ ,  $\text{ClCH}_2\text{CH}_2\text{Cl}$ ,  $\text{CCl}_4$  and  $\text{C}_6\text{H}_5\text{Br}$ . Comparison of  $(\beta\gamma_T^2)/\gamma_S$  and  $\beta_{\text{water}}$  shows that the distribution of water influences significantly the distribution of U. By changing the concentration of U in the organic phase between 0.1 and 0.5 M and that of TBP between 0.07 and 0.7 M, the above values do not change appreciably, but by increasing the concentration of TBP from 0.7 to 3.3 M the activity coefficients of  $\text{UO}_2(\text{NO}_3)_2$  in both  $\text{CCl}_4$  and  $\text{CHCl}_3$  increase rapidly.  $\text{CHCl}_3$  and  $\text{ClCH}_2\text{CH}_2\text{Cl}$  decrease the extractive capacity of TBP more than the other solvents due to hydrogen bonding of H in C-H groups, next to C-Cl group, to phosphoric groups. The association constants for  $\text{CHCl}_3$  and  $\text{ClCH}_2\text{CH}_2\text{Cl}$  are about 7 and 0.6 respectively. The large constant for  $\text{CHCl}_3$  explains a rapid decrease in Q with increasing concentration of  $\text{CHCl}_3$  in the organic phase. It is indicated that  $\text{CHCl}_3$ , as a solvent in the extractions of various salts with TBP, should decrease considerably the distribution coefficients in comparison with the solvents not associating with TBP. Although bromobenzene is more polar than  $\text{CHCl}_3$ ,  $(\beta\gamma_T^2)/\gamma_S$  values for  
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bromobenzene exceed those for  $\text{CHCl}_3$  and  $\text{CCl}_4$  by factors of 100 and 2 respectively. This shows that the effect of solvents on the extraction cannot be estimated from their polarities. There are 8 tables and 2 figures.

SUBMITTED: July 7, 1961

Card 4/4

PUSHLENKOV, M.F.; SHUVALOV, O.N.

Characteristics of interphase equilibrium during the extraction of uranyl nitrate with organophosphorus derivatives with calculation of the activity coefficients of components in the organic phase. Part 1: Determination of the activity coefficients in the system diluent .. tributyl phosphate -  $UO_2(NO_3)_2$  -  $H_2O$  from the vapor pressure. Radiokhimiia 5 no.5:536-543 '63.

Characteristics of interphase equilibrium during the extraction of uranyl nitrate with organophosphorus derivatives with calculation of the activity coefficients in the organic phase. Part 2: Extraction of uranyl nitrate with a mixture of tributyl phosphate with diluents. 543-550

Characteristics of interphase equilibrium during the extraction of uranyl nitrate with organophosphorus derivatives with calculation of the activity coefficients of components in the organic phase. Part 3: Extraction of uranyl nitrate with a mixture of tributyl phosphate, dibutyl butyl phosphate, butyl dibutyl phosphate, tributylphosphine oxide with diluents. 551-559 (MIRA 17:3)

PUSHLENKOV, M. F.; SHUMKOV, V. G.; SHUVALOV, O. N.

"Extraction processing of the irradiated fuels by using the solution of tributylphosphate in carbon tetrachloride."

report submitted for 3rd Intl Conf, Peaceful Uses of Atomic Energy, Geneva,  
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SHUVALOV, O.N.

Effect of salting-out agents on the activity coefficients of uranium and plutonium in nitric acid solutions. Radiokhimiia 7 no.3:265-270 '65.  
(MIRA 18:7)

TKACHUK, V.G., otv.red.; PRESNYAKOV, Ye.A., red.; SHUVALOV, P.A., red.;  
SOROKINA, T.I., tekhn.red.

[Studies on underground waters in Eastern Siberia] Materialy  
po podzemnym vodam Vostochnoi Sibiri. Irkutskoe knizhnoe  
izd-vo, 1957. 180 p. (MIRA 12:5)

1. Akademiya nauk SSSR. Vostochno-Sibirskiy filial. Irkutsk.
2. Institut geologii Vostochno-Sibirskogo filiala AN SSSR;  
Irkutskoye geologicheskoye upravleniye Ministerstva geologii  
i okhrany neдр SSSR (for Tkachuk). 3. Irkutskiy gosudarstvennyy  
universitet im. A.A.Zhdanova (for Presnyakov).  
(Siberia, Eastern--Water, Underground)

1. SHUVALOV, P. P.
2. USSR (600)
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9. Monthly List of Russian Accessions, Library of Congress, January, 1953. Unclassified.

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Experience of raising seedlings. Sad i og. No. 2, 1953.

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June 1953. VIOL.

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linat No 1. "Marfiro"). M., Goskul'turoz-izdat, 1954.  
30s; Pl. 111. 22 sm. (Vsesoyuz. s-lk. vystavka). 10.000 ekz.  
50 k-Na otl-ovt. no Krasny-(55-120)p 635:631. 544(47.31)

SC: Letopis' Zhurnal'nykh Vol. 7, 1949

ACCESSION NR: AP4000438

S/0089/63/015/005/0411/0413

AUTHOR: Oparin, Ye. M.; Saukov, A. I.; Shuvalov, R. S.

TITLE: Inelastic scattering of neutrons with an energy of 14 Mev by light nuclei

SOURCE: Atomnaya energiya, v. 15, no. 5, 1963, 411-413

TOPIC TAGS: inelastic neutron scattering, fast neutron spectrum, light nucleus, neutron passage, beryllium, lithium, boron, carbon, nitrogen, oxygen, time of flight technique, plastic scintillator, neutron cross section, reactor shielding, radiation shielding, neutron, scintillation counter, neutron passage through beryllium, neutron passage through lithium, neutron passage through boron, neutron passage through carbon, neutron passage through nitrogen, neutron passage through oxygen

ABSTRACT: The spectra of inelastically scattered neutrons for lithium, beryllium, boron, carbon, nitrogen, and oxygen at the incident neutron energy of 14 Mev were investigated with the time-of-flight method (see Fig. 1 of Enclosure). A plastic scintillator, measuring

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ACCESSION NR: AP4000438

100 mm both in height and in diameter, with a FEU-36 photomultiplier served as the neutron detector. The resolving time of the equipment ( $2\tau$ ), measured by the gamma peak, is equal to  $3.5 \times 10^{-9}$  sec. During neutron recording, this time increased to  $5.4 \times 10^{-9}$  sec. Specimens of the following compounds measuring  $60 \times 100 \times 100$  mm were investigated: lithium hydride (LiH), beryllium, carbon (graphite), boron carbide ( $B_4C$ ), melamine ( $C_6H_6N_6$ ), and water. Since the measurements were carried out at an angle of  $90^\circ$  to the initial neutron beam, the presence of hydrogen in the investigated compounds had no significant effect on the measurement results. Because of the insufficient resolving power of the measuring equipment, the discrimination between peaks of elastically and inelastically scattered neutrons was obtained using additional data from "Nuclear Physics," V, 11 (1959). Solid lines in graphs a and b of Fig. 1 represent the spectra of inelastically scattered neutrons calculated from Maxwellian distribution at the temperature  $T = 2E_{av}$ . The data obtained may be useful in calculations of neutron passage through thick layers of materials. Orig. art. has: 2 figures, 1 table, and 1 formula.

Card 2/6

ACC NR: AP7000134

SOURCE CODE: UR/0115/66/000/011/0085/0085

AUTHOR: Al'bikov, Z. A.; Vorob'yev, V. V.; Shuvalov, R. S.

ORG: none

TITLE: A converter of time to amplitude

SOURCE: Izmeritel'naya tekhnika, no. 11, 1966, 85

TOPIC TAGS: digital analog converter, electronic circuit

ABSTRACT: A time-to-amplitude ( $t \rightarrow A$ ) converter is described. Time-displaced input pulses  $u_1$  and  $u_2$  are applied to two monostable tunnel diode flip-flop circuits ( $TD_1$  and  $TD_2$ ) at the input of the converter (see Fig. 1.) The output pulses of these

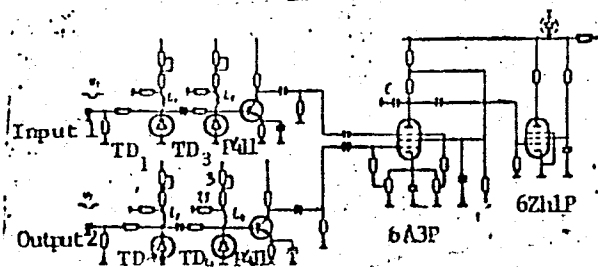


Fig. 1. Schematic diagram of the time-to-amplitude converter

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ACC NR: APT000134

flip-flops are of equal amplitude and time duration. Pulse shapers containing tunnel diodes  $TD_3$  and  $TD_4$  extend the working amplitude range of the converter. The two pulses are then amplified by the P411 transistors and applied to the grids of the 6A3P tube. As long as the two pulses overlap, capacitor C (18 nf) in the anode circuit of the tube 6A3P linearly discharges through the tube. The voltage change across capacitor C is amplified by tube 6Zh1P and is proportional to the time shift between the two input pulses. The converter has an input resolution of  $40 \times 10^{-12}$  sec (at mid-height of the input pulses) which stays constant for input frequencies between 50 and 100 kc; it was used for measuring input pulses in the amplitude range from 1 to 90 with durations of  $(3-100) \times 10^{-9}$  sec. Orig. art. has: 2 figures.

SUB CODE: 09/ SUBM DATE: 28Aug65/ ORIG REF: 001/ OTH REF: 001/ ATD PRESS: 5107

Card 2/2

SHUVALOV, S. A.

"On the Biological Complexity of the Soil-Vegetation Cover in the Arid Zone," Byul.  
Mosk. Obshch. Ispytat. Prirody, Otdel Biol, 53, No. 1. 1948.

USSR/Geography - Hydrography  
Soil Science

Jan 1948

"On the Biological Complexity of the Soil-Vegetation Cover in the Arid Zone," Ye.  
P. Korovin, S. A. Shuvalov, 16 pp

"Byulleten Mosk Obshch Ispyt Pri, Otdel Biolo" Vol LIII, No 1

Experiments and studies conducted in water shed district located 44-20 to 45-20 latitudes,  
east of Churuk meteorological station. Presents data on fundamental physical  
geographical processes of Ust'-Urt plateau, relationship of association inside of  
complex, salt state of plant complex in connection with soil, and complexity of cyclic  
changes.

PA 61752

SHUVALOV, SA

25052. SHUVALOV, SA K Voprosy o Kompleksnosti Pochvenno- Rastitel'nogo Pokrova Vst'-  
Urta. Trudy Yubileynoy Sessii, Posvyashch. Stoletiyu So Dnya Rozhdeniya Dokuchayeva.  
M.-L., 1949, S. 166-82. — Bibliogr: S. 181-82.

SO: Letopis' No. 33, 1949

BEDRINTSEV, K.N., kand.ekonom.nauk; KORZHENEVSKIY, N.L., doktor geograf. nauk; KOROVIN, Ye.P., doktor biolog.nauk; SHUVALOV, S.A., kand. geologo-mineral.nauk; YAKHONTOV, V.V., prof.; BELUZHEV, A.G.; GERKUZEN, S.Kh.; PAL'MIN, B.A.; KLEYNENBERG, G.Ye.; BARANOVSKIY, M.D.; DOROSHEV, N.T., mladshiy nauchnyy sotrudnik; SCHASTNEV, N.V.; TSAPENKO, N.G.; BABAKHODZHAYEV, A.Kh., red.; SUKHANOV, P.P., tekhn.red.  
(MIRA 13:?)

[Uzbekistan; economic-geographical features] Uzbekistan; ekonomiko-geograficheskaya kharakteristika. Tashkent, 1950. 302 p.

1. Akademiya nauk Uzbekskoy SSR, Tashkent. Institut ekonomiki.
2. Chlen-korrespondent AN Uzbekskoy SSR (for Korzhenevskiy). 3. Daystvitel'nyy chlen AN Uzbekskoy SSR (for Korovin). 4. Institut ekonomiki AN Uzbekskoy SSR (for Doroshev).  
(Uzbekistan--Economic conditions)

Title - Soviet Central Asia

Plan of the southwest irrigation canals of the Main Turkmen Canal. Pochvenovaniia  
no. 4 (1959)

Monthly List of Russian Acquisitions, Library of Congress, August 1959. UNCLASSIFIED.

~~SECRET~~  
Reclamation of Land - Soviet Central Asia

Several scientific problems connected with the problem of reclamation of desert lands in the Kain-Turkmen Canal area. Izvestiya no. 6, 1958.

Monthly List of Russian Acquisitions, Library of Congress, August 1958. UNCLASSIFIED.

SHUVALOV, S.A., kand. geol.-mineral. nauk.

"Sterozem soils of Central Asia" by A.N. Rozanov. Reviewed by S.A. Shuvalov. Izv. AN Uz.SSR no.1:140-148 '53. (MIRA 11:3)  
(Soviet Central Asia--Sterozem soils)  
(Rozanov, A.N.)



FEDOROVICH, B.A.; SHUVALOV, S.A.

Natural prerequisites for the division into agricultural regions  
of the new reclaimed farm lands in the northern provinces of  
Kazakhstan. Izv. AN SSSR. Ser. geog. no. 2:54-61. Apr '55.

(MLBA 8:6)

1. Institut geografii AN SSSR (for Fedorovich) 2. Pochvennyy  
institut AN SSSR (for Shuvalov).  
(Kazakhstan--Physical geography)

FEDOROVICH, B.A.; SHUVALOV, S.A.; KALININA, A.I.

Natural prerequisites for the division of northern regions of the  
Kazakh S.S.R. into agricultural districts. Vest.AM Kazakh.SSR  
11 no.11:45-56 N '55. (MLRA 9:3)  
(Kazakhstan--Physical geography)

FEDOROVICH, B.A.; SHUVALOV, S.A.

On new lands. Priroda 44 no.5:59-67 My '55. (MLRA 8:7)

(Reclamation of land)

TYURIN, I.V., akademik, redaktor; KOVDA, V.A., redaktor; LAVRENKO, Ye.M., redaktor; BAZILEVICH, N.I., redaktor; LETUNOV, P.A., redaktor; RODIN, L.Ye., redaktor; SHUVALOV, S.A., redaktor; MARKOV, V.Ya., redaktor izdatel'stva; SHEVCHENKO, G.N., tekhnicheskii redaktor

[Takyrs of Western Turkmenistan and ways of reclaiming them for agriculture] Takyry Zapadnoi Turkmenii i puti ikh sel'skokhoziai-stvennogo osvoeniia. Moskva, 1956. 735 p. (MLRA 9:11)

1. Akademiya nauk SSSR. Pochvennyy institut. 2. Chlen-korrespondent AN SSSR (for Kovda, Lavrenko)  
(Turkmenistan--Reclamation of land)

ROZOV, N.N.; SHUVALOV, S.A.

Second Conference of the All-Chinese Society of Soil Scientists  
and First Conference of Soil Research Institutes of the Chinese  
Academy of Sciences in Nanking. Pochvovedenie no.4:102-104  
Ap '57. (MIRA 10:7)

(China--Soil research--Congresses)

SHUVALOV, S.A.

General characteristics of soil formation in the humid subtropical areas of China; from observations made in the Yangtse River Basin. Pochvovedenie no.4:20-27 Ap '57. (MLRA 10:7)

1. Pochvennyy institut im. V.V.Dokuchayeva, Akademii nauk SSSR. (Yangtse Valley--Soil formation)

SHUVALOV, S.A.

Meeting of Soviet soil science delegates. Pochvovedenie no. 9:147-  
150 '58. (MIRA 11:10)

(Soil research)

IVANOVA, Ye.N.; LETUNOV, P.A.; ROZOV, N.N.; FRIDLAND, V.M.; SHUVALOV, S.A.

Subdividing the territory of the U.S.S.R. into soil zones. Pochvo-  
vedenie no.10:1-11 0 '58. (MIRA 11:10)

1. Pochvennyy institut im. V.V. Dokuchayeva AN SSSR i Sovet po  
izucheniyu proizvoditel'nykh sil AN SSSR.  
(Soils--Maps)



SHUVALOV, S.A.

Soils of the agricultural regions of Central China; from field  
observations in the Yangtze Basin. Pochvovedenie no.11:  
78-86 N '59. (MIRA 13:4)

1. Pochvennyy institut im. V.V.Dokuchayeva AN SSSR.  
(Yangtze Valley--Soils)

30(7)

SOV/30-58-11-36/48

AUTHORS:

Lazarev, A. A., Shuvalov, S. A., Candidates of Geologic-  
Mineralogic Sciences

TITLE:

Gold Medal of the Soil Map Exposition of the USSR (Zolotaya  
medal' vystavki za pochvennyuyu kartu SSSR)

PERIODICAL:

Vestnik Akademii nauk SSSR, 1958, Nr 11, pp 119-119 (USSR)

ABSTRACT:

This map on a scale of 1:4,000,000 was exhibited by the Poch-  
vennyy institut im. V. V. Dokuchayeva Akademii nauk SSSR (Soil  
Institute imeni V. V. Dokuchayev of the AS USSR) at the World  
Fair in Brussels and was honored with the Gold Medal, in  
recognition of Soviet soil research and cartography. This map  
was developed by the senior collaborator of the Soil Institute  
N. N. Rozov with the cooperation of the senior of the Institute  
Ye. V. Lobova under the scientific direction of I. P. Gera-  
simov, Member, Academy of Sciences, USSR. The map was published  
in 1954 and represents the result of the work of several  
generations of soil experts. The map is an indispensable aid  
in the calculation of soil available, its valuation and  
distribution for agriculture. It serves as a teaching aid in  
universities and institutes of agriculture.

Card 1/2

ANTIPOV-KARATAYEV, I.N., akademik, otv.red.; TYURIN, I.V., glavnyy red.;  
GORBUNOV, N.I., red.; VERIGINA, K.V., red.; ZONE, S.V., red.;  
IVANOVA, Ye.N., red.; KEDROV-ZIKHMAN, O.K., red.; KONONOVA,  
M.M., red.; LOBOVA, Ye.V., red.; MISHUSTIN, Ye.N., red.; RODE,  
A.A., red.; ROZANOV, A.N., red.; SOKOLOV, A.V., red.; FRIDLAND,  
V.M., red.; SHUVALOV, S.A., red.; YEFIMOV, A.L., red.izd-va;  
MAKUNI, Ye.V., tekhn.red.

[Reports of Soviet soil scientists to the 7th International  
Congress in the U.S.A.] Doklady sovetskikh pochvovedov k VII  
Mezhdunarodnomu kongressu v SShA. Moskva, Izd-vo Akad.nauk SSSR,  
1960. 487 p. (MIRA 13:10)

1. International Congress of Soil Science. 7th. 2. AN Tadshik-  
skoy SSR (for Antipov-Karatayev). 3. Pochvennyy institut im. V.V.  
Dokuchayeva Akademii nauk SSSR, Moskva (for Antipov-Karatayev, Gorbunov.  
(Continued on next card)

ANTIPOV-KARATAYEV, I.N.---(continued) Card 2.

Ivanova, Kononova, Rozanov, Fridland, Sokolov). 4. Laboratoriya  
lesovedeniya Akademii nauk SSSR, Moskva (for Zonn). 5. Vsesoyuznyy  
nauchno-issledovatel'skiy institut udobreniy i agropochvovedeniya  
Vsesoyuznoy ordena Lenina Akademii sel'skokhoz.nauk imeni V.I.Lenina  
i Institut zemledeliya akademii sel'skokhoz.nauk Belorusskoy SSR (for  
Kedrov-Zikhman). 6. Institut mikrobiologii Akademii nauk SSSR, Moskva  
(for Mishustin). 7. Nauchnyy institut po udobreniyam i insektofungi-  
tsidam im. Ya.V.Samoylova, Moskva (for Sokolov).

(Soil research)

LETUNOV, P.A., doktor sel'khoz. nauk, otv. red.; IVANOVA, Ye.N.,  
doktor sel'khoz. nauk, red.; ROZOV, N.H., kand. geogr. nauk,  
red.; FRIDLAND, V.M., kand. geol.-miner. nauk, red.; SHASHKO,  
D.I., doktor geogr. nauk, red.; SHUVALOV, S.A., kand. geol.-  
miner. nauk, red.; GERASIMOV, I.P., akad. red. kart; MARKOV,  
V.Ya., red. izd-va; KASHINA, P.S., tekhn. red.; RYLINA, Yu.V.,  
tekhn. red.

[Subdividing the territory of the U.S.S.R. into soil zones;  
in connection with agricultural use of the land] Pochvenno-  
geograficheskoe raionirovanie SSSR (v sviazi s sel'sko-  
khoziaistvennym ispol'zovaniem zemel'). Moskva, Izd-vo  
Akad. nauk SSSR, 1962. 422 p. (MIRA 15:5)

1. Akademiya nauk SSSR. Sovet po izucheniyu proizvoditel'nykh  
sil.

(Soils)

SOKOLOV, A.V., doktor sel'khoz. nauk, otv. red.; IVANOVA, Ye.N., red.;  
SHUVALOV, S.A., red.; ROZOV, N.N., red.; NOSIN, V.A., red.;  
FRIDLAND, V.M., red.; MARKOV, V.Ya., red. izd-va; POLENOVA, T.P.,  
tekhn. red.

[Agrochemical characteristics of the soils of the soils of the  
U.S.S.R.; White Russian S.S.R., Latvian S.S.R., Lithuanian S.S.R.,  
Estonian S.S.R., Karelian A.S.S.R., and the northern regions of  
the European part of the R.S.F.S.R.] Agrokhimicheskaya kharakteri-  
stika pochv SSSR; Belorusskaya SSR, Latviiskaya SSR, Litovskaya  
SSR, Estonskaya SSR, Karel'skaya ASSR i severnye raiony Evropei-  
skoi chasti RSFSR. Moskva, Izd-vo Akad. nauk SSSR, 1962. 279 p.  
(MIRA 15:12)

1. Akademiya nauk SSSR. Pochvennyy institut imeni V.V. Dokuchayeva.
2. Otdel geografii Pochvennogo instituta imeni V.V. Dokuchayeva  
Akademii nauk SSSR (for Ivanova, Shuvalov, Rozov, Nosin, Fridland).  
(Russia, Northwestern--Soil chemistry)

SHUVALOV, S.A.

Some aspects of the use of the new system in the agriculture  
of the U.S.A. Pochvovedenie no. 5:236 3:64 (MIRA 17:87)

GENUSOV, A.Z.; KIMBERG, N.V., kand. sel'khoz. nauk; KOCHUBEY,  
M.I.; SHUVALOV, S.A.; TIKHONOVA, I., red.

[Soils of the Uzbek S.S.R.] Pochvy Uzbekskoi SSR. Tashkent,  
Izd-vo "Uzbekistan." Vol.3. 1964. 294 p. (MIRA 18:3)

1. Akademiya nauk Uzbekskoy SSR, Tashkent. Institut pochvo-  
vedeniya.



RESHETOV, D.N., prof., doktor tekhn.nauk; SHUVALOV, S.A., inzh.

Methods for fatigue tests under variable load conditions and  
the characteristics of fatigue surfaces. Vest. mash. 38  
no.9:3-7 S '58. (MIRA 11:10)  
(Metals--Fatigue--Testing)

SHUVALOV, S. A. Cand Tech Sci -- (diss) "Contact strength of machine parts  
in variable loading regimes, and <sup>summation</sup> ~~the summing up~~ of the fatigue." Mos, 1959  
19 pp with <sup>diagrams</sup> ~~diagrams~~ (Min of Higher and Secondary Specialized Education RSFSR  
Mos Order of Lenin and Order of Labor Red Banner Higher Tech School im Bauman),  
150 copies (KL, 49-59, 141)

SOV/182-59-5-1/32

**AUTHOR:** Shuvalov, S.A., Engineer

**TITLE:** The Endurance Life of Machine Components Under Alternating Load Cycles and Cumulative Fatigue (Dolgovechnost' detaley mashin pri peremennykh rezhimakh nagruzki i summirovaniye ustalosti)

**PERIODICAL:** Vestnik mashinostroyeniya, 1959, Nr 5, pp 3-9 (USSR)

**ABSTRACT:** The results of research on cumulative fatigue are reported carried out at the Department for Machine Components of the Moscow Higher Technical School (MVTU) imeni Baumana. The method of investigation concerned with contact stresses was reported by D.N.Reshetov and S.A.Shuvalov in Vestnik mashinostroyeniya, 1958, Nr 9. In the cumulative damage theory of fatigue failure, the sum of the relative damage contributions reaches unity at failure. This can be true only if no strengthening takes place as a result of micro-plastic deformations. With strengthening, the integrated damage is greater than unity. This is observed when the peak stress of the cycle exceeds the endurance stress. The true

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**The Endurance Life of Machine Components Under Alternating Load Cycles and Cumulative Fatigue**

cumulative damage value enters into the expression (equation 3) for the equivalent static stress. The opinion has been expressed that stresses below 80% of the endurance stress can be ignored since they contribute nothing to cumulative damage. The present author's tests with contact stresses were carried out on a roller-type machine with forced sliding at 15 - 18 cm/sec and a programmed load cycle. The highest and lowest stresses in the alternating cycle, each divided by the endurance stress are plotted against each other (Fig 3). Each point denotes a combination of cycle extrema. Associating with this point the corresponding number of cycles to failure, an endurance surface is defined. A series of tests with steel 45 has shown that, in materials subject to strain hardening under alternating loads, the cycle peak can be increased. On the basis of experiments, several forms of empirical relationships between endurance life, stress levels and law of loading are

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The Endurance Life of Machine Components Under Alternating Load Cycles and Cumulative Fatigue

put forward. Present stressing methods use the cumulative damage theory, assuming the damage to reach unity at failure. Tests conducted to determine the actual damage values show that, in the region where the peak stress exceeds the endurance stress, the damage at failure exceeds unity. For a linear law of loading, the maximum values are found when the minimum stress in the cycle is 85% of the maximum in a range of maximum stresses amounting to 1.6 - 2.1 times the endurance value for contact stresses. The damage reaches 4 - 7 for steels below 230 Brinell and 2 - 4 for steels of 230 - 300 Brinell. With a more gradual law of loading, the line of maximum damage value moves in the direction of smaller differences between minimum and maximum stresses. In the remaining region, where the maximum stress exceeds the endurance stress, the damage at failure is found to be between 1 and 2. Such a pronounced increase of damage endured at certain points of the field is apparently due to the fact that, with still greater stress levels, the plastic

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The Endurance Life of Machine Components Under Alternating Load  
Cycles and Cumulative Fatigue

deformation spreads over substantial volumes of the metal. The maximum damage values can be used only in those instances when the required endurance life does not exceed the number of cycles corresponding to the achievement of a prolonged fatigue limit and when the certainty exists that the actual loads cause the required stress values. It is stated that tests by different research workers have yielded satisfactory agreement on the damage values at failure. A procedure is recommended by which the "safe" overload is found graphically with the help of curves (Fig 5) which take into account the ratio of the stress cycle amplitudes and the law of loading during the cycle. In design calculations, the load curve is usually known but the zone of the maximum and minimum stress levels is not known. If so, the equivalent number of

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**The Endurance Life of Machine Components Under Alternating Load  
Cycles and Cumulative Fatigue**

cycles must be found from the cumulative damage  
equation. There are 8 figures and 10 Soviet  
references.

Card 5/5

S/122/60/000/009/003/015  
A161/A026

AUTHORS: Kuklin, V.B., Engineer; Reshetov, D.N., Professor, Doctor of Technical Sciences; Shuvalov, S.A., Engineer

TITLE: Calculation of Couplings With Circular Ribs

PERIODICAL: Vestnik mashinostroyeniya, 1960, No. 9, pp. 19 - 23

TEXT: The design principles of couplings with circular ribs (for heavy axial loads) are discussed: the type in which one of the two parts stretches and the other shrinks under load, and that in which both parts stretch or shrink simultaneously. An approximated calculation method is suggested and practical recommendations are given concerning the shape of the ribs so as to distribute the work load over the ribs. It is recommended to vary the rigidity of the coupling by changing the encompassing part, and by using different groove depths between ribs; couplings of both types are advised for design with equal strength of the inner and the encompassing outer part. It is stressed that the ribs must be geometrically true and with high surface finish, and the radius at the rib root must be as large as possible to reduce stress concentrations. There are 5 figures and 3 Soviet references.

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<sup>26177</sup>  
S/145/61/000/005/005/009  
D221/D306

AUTHORS: Shuvalov, S.A., Candidate of Technical Sciences, and  
Kononov, L.V., Engineer

TITLE: Consideration of variable loads when calculating  
fatigue resistance in bending

PERIODICAL: Izvestiya vysshykh uchbenykh zavedeniy. Mashino-  
stroyeniye, no. 5, 1961, 51 - 59

TEXT: The authors suggest the use of a unified method of fatigue tests for components working with variable stresses in order to assess the effect of metal training by various loads. Experiments carried out by ВНИИПТМАШ (VNIIPTMASH) and ЦНИИ ЧМ (TsNII ChM) employed variable symmetrical loads in bending on a МВЛ -12000 (MVP-12000) program controlled machine. Specimens were plain round, without stress concentrations. The amplitude of stresses during each test was continuously varied by a cam mechanism following in section A0 (Fig. 1) the step function of

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Consideration of variable loads ...

$$n_i = n_c \left( \frac{M_i - M_{\min}}{M_{\max} - M_{\min}} \right)^{\alpha - \frac{1}{4}} \quad (1)$$

where  $M_i, M_{\max}, M_{\min}$  ( $\sigma_i, \sigma_{\max}, \sigma_{\min}$ ) are the current, maximum and minimum amplitudes of bending moment;  $n_c$  - number of half cycles of load per period of stress amplitude variation (per one turn of cam);  $\alpha = 1/4$  is the exponent that characterizes the changes of stress amplitudes within the range  $\sigma_{\max} \div \sigma_{\min}$  (curves 1 and 2 in Fig. 1). The selected law of variation corresponds to cyclic loads of cranes. The total life of specimen  $N$ , is determined by  $N = n_c \lambda$ , where  $\lambda$  is the number of cam turns until the destruction of the specimen. A graph is plotted for steel 40 on the basis of experimental data. The analysis of curves indicates that an increase between the maximum and minimum levels of stresses shifts the fatigue line to the right. There is a simultaneous level increase in the maximum stressing. With adequate accumulation of results due to

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Consideration of variable loads ...

similar tests, it will be possible to provide empirical relationships between the life duration and load curves which would form a basis for calculations of a specified service term. At present, the calculation of components subject to variable stresses is being carried out in respect to the equivalent load or limit stress. In the case of the intermittent law of fluctuations in the stress amplitude

$$\lambda \int \frac{dn_1}{N_1} = a \quad (4)$$

is employed as stated by S.V. Serensen and L.A. Kozlov (Ref. 4: Vestnik mashinostroyeniya, no. 12, 1953). In the above equation,  $dn_1$  is an infinitely small number of cycles of loads during the intermediate stressing of  $\sigma_1$ ,  $N_1$  is the number of cycles prior to destruction with a stress of  $\sigma_1$  on the endurance curve and in the case of a constant amplitude of stresses. Coefficient  $a$  is a cha-

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Consideration of variable loads ...

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Characteristic resistance to overloads of the material,  $\lambda$  is the number of fluctuation periods of the stress amplitude during the life. Substituting the differential  $dn_1$  from Eq. (1) into

$$N = n_c \lambda, \tag{2}$$

as well as  $N_1$  from the expression of the endurance curve,  $N_1 \sigma_1^m = N_0 \sigma_{-1}^m$ , the author deduce

$$\frac{N}{4 \sigma_{-1}^m N_0 (\sigma_{max} - \sigma_{min})^{\frac{1}{4}}} \int_{\sigma_{min}}^{\sigma_{max}} \sigma_1^m (\sigma_1 - \sigma_{min})^{-\frac{3}{4}} d\sigma_1 = a, \tag{5}$$

where  $\sigma_{-1}$  is the continuous limit of endurance in the case of a constant amplitude of stresses with a symmetrical cycle;  $N_0$  is the number of cycles corresponding to the bend of the endurance curve;  $N$  is the number of cycles of destruction given by Eq. (2);  $m$  is

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