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PROBLEM LABORATORY STIMULATES A LARGE AMOUNT OF CREATIVE WORK

by

A. A. Vorob'yev, G. A. Andreyev

EDITED TRANSLATION

FTD-ID(RS)T-1850-79 10 December 1979

MICROFICHE NR: FTD-79-C-001587

PROBLEM LABORATORY STIMULATES A LARGE AMOUNT OF CREATIVE WORK

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English pages: 10

Source: Vestnik Vysshey Shkoly, Nr. 8, 1960, pp. 48-51

Country of Origin: USSR
Translated by: Gale M. Weisenbarger
Requester: FTD/TQTD

PREPARED BY:

TRANSLATION DIVISION
FOREIGN TECHNOLOGY DIVISION
WP-AFB, OHIO.

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А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere.
When written as ё in Russian, transliterate as yё or ё.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	Russian
sin	sin	sh	sinh	arc sh	sin⁻¹
cos	cos	ch	cosh	arc ch	cos⁻¹
tg	tan	th	tanh	arc th	tan⁻¹
ctg	cot	cth	coth	arc cth	cot⁻¹
sec	sec	sch	sech	arc sch	sec⁻¹
cosec	csc	csch	csch	arc csch	csc⁻¹

Russian	English
rot	curl
lg	log

1850,gw

PROBLEM LABORATORY STIMULATES A LARGE AMOUNT OF CREATIVE WORK

Doctor of Physico-Mathematical Sciences, Professor A. A. Vorob'yev,
Candidate of Technical Sciences G. A. Andreyev

Tomsk Polytechnical Institute imeni S. M. Kirov.

The problem laboratories created in 1957 have now become mature scientific collectives whose work has yielded new and at times considerable results. We can speak of the serious effect of the activity of these laboratories on the work of higher educational institutions where they were created. This is a most beneficial effect: scientific activity of the departments develops extensively, the efforts of scientists are concentrated on the solution of urgent economic problems; the laboratories also have a noticeable effect on the instructional work of the department.

Indicative in this respect is the extensive development of

scientific activity of a number of departments of the Tomsk Polytechnical Institute im. S. M. Kirov following the creation of a problem laboratory for electronics, dielectrics, and semiconductors (EDiP).

Organized in 1957 on the basis of departments of physics, high-voltage technology, electrical insulation and cable technology the laboratory united 32 associates of these departments with a common work plan. Results appeared rather quickly.

While, for example, prior to the organization of the problem laboratory there was almost no scientific work in the physics department, in the three years following creation of the laboratory the associates of this department prepared to defend 2 doctoral- and 6 masters dissertations and published more than 100 articles.

The special feature of the laboratory is not its territorial unity (research is performed in teaching areas and on departmental equipment), but the unified scientific direction of the works. At present, in the laboratory, research is being conducted by 73 scientific associates of the institute including 3 doctors of sciences, 16 candidates of sciences and 21 post-graduate students.

The laboratory consists of a number of sections each of which is

occupied with some topic on the two problems being developed: physico-chemical properties, strength and breakdown of dielectrics and semiconductors; the creation of radio engineering circuits based on semiconductor instruments.

In sections of the laboratory they study the electrical, mechanical, physical and chemical properties of single crystals of alkaline halide salts, their solid solutions, and oxides of metals of the 2nd group of the periodic table; a great deal of experimental material has been obtained. For example, it has been possible to draw an important theoretical and practical conclusion about the connection of electrical and mechanical and other characteristics of the simplest dielectrics with the energy of their crystalline lattice which created a theoretical basis for development of dielectrics with previously assigned properties.

In the section of physico-chemical properties of dielectrics they study the mechanism of formation of a contact layer on dielectrics and semiconductors.

Extensive data on the conditions and causes of excitation of candoluminescence of industrial crystalline phosphors under the effect of flames was obtained by docent V. A. Sokolov and formed the basis for his recently defended doctoral dissertation.

Considerable success was achieved by the high-voltage department (head of the department, Candidate of Technical Sciences I. I. Kalyatskiy). Here they studied the electric strength of ionic solid dielectrics in a wide range of temperatures with constant and pulsed voltages; it was discovered that with pulses of short duration the discharge in the solid dielectric develops analogously to the development of discharge in a gas. Studying the lag time and the rate of discharge in solid dielectrics during the action of pulses on them, the associates of the section established that the mean rate of discharge increases with positive polarity of the point, with a decrease in temperature and with an increase in the energy of the crystalline lattice of the dielectrics. The results of works on these topics were presented in the master's dissertations of G. A. Andreyev, A. P. Astafurov, and V. D. Kuchina which were defended in 1958.

In the high-voltage section under the leadership of docent V. S. Dmitrevskiy and the senior instructor in the department of mine construction, M. F. Pisartsev, research was conducted on the electrophysical properties of electrical insulating concretes.

The high-voltage department is taking part in the creation of a

new teaching- and scientific-research high-voltage laboratory, the largest in Siberia. Its high-voltage room is already equipped with experimental transformers rated at 200 and 350 kV, with pulse generators rated at 3 and 1 million V, and 600 kV and with an electric crane. On the open test platform they have finished installation of a cascade of transformers rated at 1 million volts and of a scaffold; construction has begun on a unique, tower-type pulse generator rated at 5 million volts and of 2.5-million volt electrostatic generator. Upon conclusion of construction the laboratory will obtain a complex of laboratory high-voltage devices on which routine checks of industrial high-voltage installations and of structures of the class up to 220 kV will be performed; in addition research work will be extensively developed for studying the properties and behavior of insulation.

In the section of millimiccrosecond technology (head of the section, Candidate of Technical Sciences G. A. Vorob'yev) they have studied volt-second characteristics of various dielectrics. It was revealed that in pulses with an identical electric strength of the discharge intervals breakdown of the dielectrics takes place in the same order: solid dielectric - gas - liquid dielectric. It is very important to study this during the selection and coordination of insulation in practical high-voltage equipment. Now the collective of the section continues to study these questions and the processes of

breakdown of solid dielectrics in a liquid medium.

Processes and instruments are also being developed which will make it possible to obtain and record on photographic film super short voltage pulses. A high-speed discharger is being developed for protecting high-voltage apparatus from the effect of overvoltages. The result of their work in the laboratory of the section was made the basis of already defended master's dissertations by K. K. Sonchik and M. A. Mel'nikov, and the basis of articles by post-graduate students A. T. Chepikov, G. A. Mesyats, and V. A. Kostrygin.

Interesting work was done under the guidance of docent I. A. Suslov; the creation of a method for designing video amplifiers and construction of small-size television cameras based on semiconductor instruments.

The method developed by post-gradutate student I. N. Pustynskiy for calculating low-frequency corrections in video-amplifiers based on semiconductor triodes was checked experimentally and positive results were obtained. Since 1958 on special order from industrial enterprises the section has developed small-size industrial television cameras based on semiconductors which are used for remote observation. Now one installation has already been put into use.

The theoretical and experimental work of the laboratory is reflected in 206 articles published by associates of the laboratory in scientific journals and in 6 published books. Twelve books and 76 articles are now in print.

In three years of work the associates of the laboratory presented 87 reports at conferences. Seven associates of the laboratory are working on the temporary commission on electrical insulating materials in association with the state scientific-technical committee of the Council of Ministers USSR.

The laboratory established contact with many major scientific establishments of the country and also with two foreign polytechnical institutes - "Tsinukha" (CPR) and Yasskiy (Rumania).

Scientific work of the laboratory EDiP is combined with the primary mission of the institute - the preparation of highly qualified teachers and engineers. In the subject field of the laboratory 11 master's dissertations and one doctoral dissertation have already been defended and 8 master's and 3 doctoral dissertations are being completed.

Creation of the laboratory made it possible to conduct extensive complex research in the institute.

For example 3 teacners and 5 post-graduate students are studying processes taking place in the second stage of breakdown of solid dielectrics and associates of the department of electrical insulation and cable technology and of the physics department under the guidance of Professor Ye. K. Zavadovskaya are studying the effect of defects of crystals on the change of their electrical properties.

The necessity to thoroughly study the properties of semiconductor materials led to the creation in 1979 of a new chemical section headed by docent V. V. Boldyrev.

The scientific activity of a large collective of teachers of the institute has now acquired a clearly expressed direction. As a result the level of teaching and conducting scientific research has improved. In this respect much has resulted from the exchange of experience in scientific and research work at the permanent scientific seminar on the physics of dielectrics.

The means expended on the organization of the EDiP laboratory made it possible to equip the department with new modern equipment.

Many new operating installations appeared which are used in

instructional work. These include an electron microscope, set of X-ray installations, spectrophotometers, spectrometers and a thermal chamber.

A wide front of research on the same problem made it possible to correctly distribute equipment between sections of the laboratory, to create groups of associates who are skilled in its use. Research is now conducted more rapidly than before at a modern scientific level; experimental procedures are worked out more thoroughly. In the section of millimicrosecond technology, for example, generators of single high-voltage pulses have been developed with an amplitude up to 40 kV and a duration up to $3.2 \cdot 10^{-9}$ s. Oscillographs have been built, including those with two tubes, for observing and recording on tape supershort pulses with a length up to 10^{-10} s. The theoretical and practical importance of these works has been noted repeatedly at conferences on the physics of dielectrics.

The laboratory receives considerable help from students of senior courses of the institute. Along with teachers, 105 students participated in the performance of complex experimental and installation-adjustment operations in 1959. Students of the electrical engineering department established the possibility of using concrete as a dielectric in high-voltage technology. The realization of this idea makes it possible to reduce by 200-300

thousand rubles the expenditures for construction of a 22-m insulation tower for the 5-million volt pulse generator to be installed by the laboratory. With the aid of students a new teaching high-voltage laboratory was installed for the department of high-voltage technology.

Organization of the laboratory made it possible to significantly strengthen the connection of the institute with the enterprises of Siberia. A number of works are now being conducted in accordance with economic agreements made with them. At the present time associates of the laboratory head the organization of electrical insulation and luminescence laboratories at the Tomsk Council of the National Economy.

All activity of the laboratory is now built on the foundation of decisions of the Party concerning acceleration of technical progress. All sections of the laboratory are directing their efforts toward more rapid and higer quality execution of the intended works.

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