# Effective Organization of Laboratory Exercises in Teaching the Science of Electrical Technical Materials in Technical Higher Education Institutions

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ABSTRACT

The article discusses the effective conduct of laboratory classes on the subject "Electrical materials" on the topic: "The influence of liquid dielectrics on energy efficiency during the operation of transformer and capacitor oil." The physical, chemical, mechanical effects on transformer and capacitor oil, their physical properties and changes in parameters are described. At the same time, it explains how students can use the acquired knowledge in lectures using improved methods of interactive methods of conducting classes.

**Keywords:** liquid dielectric, electricity, heat, oil liquid, oil, transformer, capacitor, insulation, cable, loss, interactive method: "Find the ratio"

The main goal of teaching the subject "Electrotechnical Materials" in technical universities is the regular study of electrical equipment, ensuring its convenience and efficiency, the ability to organize and carry out organizational activities.

In the process of teaching the subject "Electrical Materials", students must know the electrical, physical-chemical and mechanical classification of electrical materials and be able to work with them or process them, the technology of creating bonds in materials, various aspects of materials, as well as mastering the modern development of technologies based on these materials , principles of work, areas of application, appropriate use in the preparation of technological projects, recognition of their advantages and disadvantages, mastery, understanding and professional skills of use, technical and economic analysis, their effective use in operating conditions, normal working conditions, the use of modern electrical materials, are taught necessary theoretical knowledge and practical skills in equipment operation.

It is important to use advanced and modern teaching methods, apply new information and pedagogical technologies for students to master the science of "Electrotechnical materials". When mastering science, textbooks, teaching aids and instructions, texts of lectures, handouts, electronic materials, virtual stands, samples and models of electrical materials in working condition are used [1,2,3].

Based on the example above, we will be able to conduct training using laboratory methods, and then testing electrical insulating materials using Russian electronic devices, obtaining accurate digital data, plotting based on the results obtained and applying theoretical knowledge. in practice [ 4].

Laboratory work as a teaching method is based on students' independent experiments (tests), experiments using instruments, tools, that is, using special equipment and special equipment. Work can be done individually (separately) or in groups. Students should be active and independent, not only observers of

laboratory work, but also direct experimenters themselves.

Laboratory work not only gives students knowledge, but also helps them develop practical skills.

At present, the use of new laboratory equipment and information technologies for the development of theoretical and practical knowledge of electrical materials in the higher education system gives good results. This is because, as you know from working with traditional laboratory equipment, electrical equipment is directly tested at high voltages and currents. This allows you to avoid a number of inconveniences, approximate figures and errors when calculating the results and plotting. Therefore, it is more efficient to conduct laboratory classes using electronic devices [5,6] .

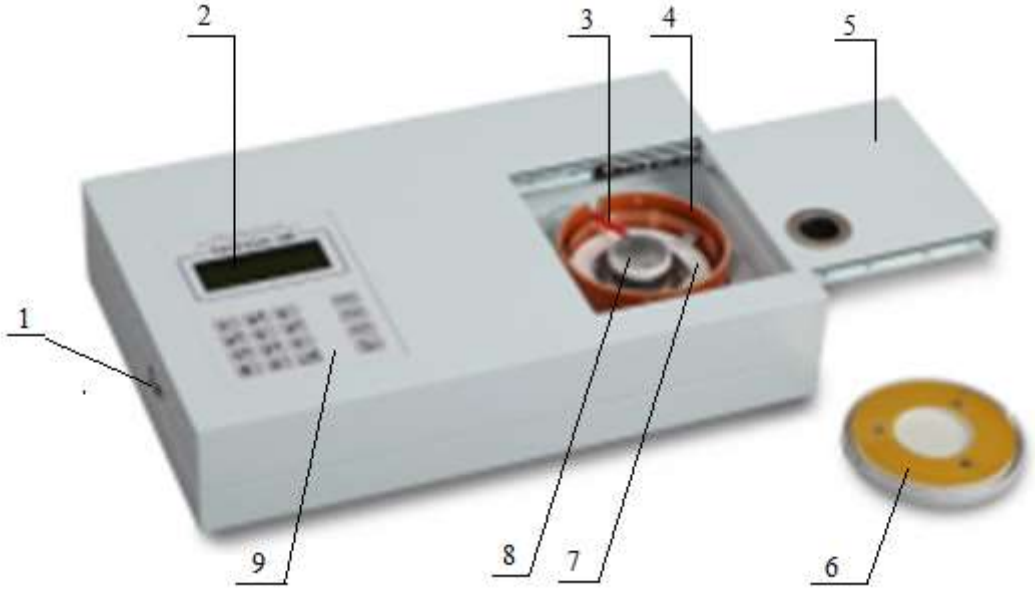
At the laboratory lesson, students are first introduced to the purpose of laboratory work, the necessary equipment, and the order of work. In particular, the purpose of this laboratory work is to study the detection of dielectric losses in liquid insulating materials, the necessary equipment is the technical oils of the tested insulating material, the need for a syringe and pipette when pouring oil into the tank of the device, the need to comply with technical safety regulations in the work procedure, as well as do not spill when working with oil, it is emphasized that they must work protected from electrical equipment, and the work is carried out in an automated manner. When the laboratory work is done, the oils are tested at different temperatures, the results are entered into a table, and a graph of the results is displayed on the computer screen. This helps students to form the necessary knowledge and skills for independent laboratory work. Theorists draw conclusions based on the results obtained in practice.

It is known that, based on the conditions for the design and operation of electrical equipment, liquid dielectrics are subject to such requirements as high electrical strength and volume resistivity, low dielectric absorption, resistance to electric and thermal fields, stability of properties during operation, and fire resistance. Petroleum derived transformer oil is one of the most widely used liquid dielectrics in electrical engineering and it primarily acts as an electrical insulator and coolant in power transformers. When transformer oil is applied to the transformer, the air spaces in the insulation covering the wires are filled with oil. As a result, the strength of the transformer is increased, and the heat released from the coils and the steel core under the action of electrical voltage is well distributed to the external environment through the oil. In this case, the performance of the transformer increases somewhat [ 7].

Some differences can be seen when comparing the results obtained when testing transformer oil grade TM-25 and capacitor oil grade KM-6-3 in laboratory conditions. These results were obtained using the Tangent-3M instrument.

**Classification of transformer oil type Tangent-3M.**

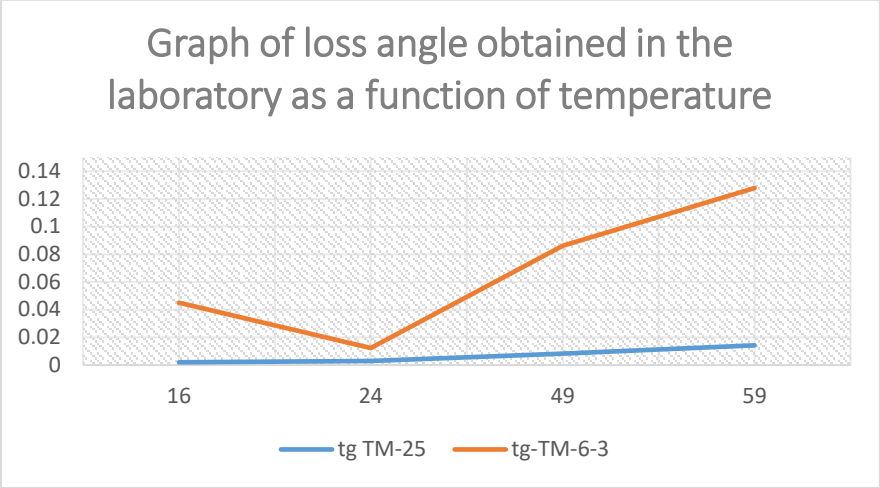
Measurements in the device are made in accordance with GOST 6581–75 and IEC 60247 at mains frequency f=50 Hz.




1-pic.Tangens-3M is a device for measuring the dielectric losses of transformer and capacitor oils. 1-COM-port "RS232"; 2-SKK; 3-measuring cable; 4 - container for installing the measuring cell; 5–cover of a gear change; 6–lid of the thermostat tank; 7-measuring cell; 8-contactor; 9-keyboard


2-pic. Automatically obtained results on the display of the device.

Students are asked questions about the experimental device, theoretical questions and the order of work, the experiment is carried out using an electronic device, and based on the results obtained, graphs are built using ICT.




3-pic. Graph of the results obtained in the laboratory.

In the control part of the laboratory work, students use the theoretical materials of laboratory work and tests and interactive methods that control the knowledge gained during the laboratory experiment. In order to test and consolidate the acquired knowledge, students themselves will be able to perform tests and interactive methods in electronic form, they will be able to test and consolidate their knowledge. In this case, the "Find a match" method will be tested electronically.

**In conclusion**, we can say that when conducting laboratory classes with instruments and equipment, it is advisable to form knowledge-skills based on specific results, and not imagination. According to him, laboratory work is best done by the student himself, to conduct experimental tests based on theoretical knowledge, and to consolidate the acquired knowledge with interactive methods. In this regard, when using an improved method of the proposed "Find a Match" method, students read the given concepts to consolidate their knowledge on the topic and form an opinion to choose the right one. This creates an opportunity for overall student inclusion, and the uplifting "smiles" in the program, together with the boost in student morale, create interest in the reinforcing item and increase the possibility of recall. Because the result of addressing students the way they want, communicating with them in an interesting and simple way, will be complete.

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