Actuality: every day we turn on the light and, seeing the flashing light bulb, take it for granted. Few people think about where electricity comes from. But at the moment in Belarus more than 95% of electricity is produced by burning natural gas. Hence, the more energy-efficient the bulbs are at home, the less electricity we consume. Accordingly, we save such an important natural resource as natural gas and own money. In addition, it is extremely important to know that some types of light bulbs (in particular luminescent lamps) contain toxic substances. Therefore, their not correct disposal has an extremely adverse effect on the environment and human health. After analyzing of various types of light bulbs in this work, we offer the most optimal variant, first of all from the point of view of economy and ecological compatibility.

At first stage of our work, we have established that today in our country today 4 types of lamps of illumination are used: incandescent lamps, luminescent lamps, halogen lamps, LED lamps. Next, we conducted their analysis on several criteria, primarily paying attention to economy and environmental friendliness:

1. **Incandescent lamps** are ordinary light bulbs, in which the filament is made of tungsten. Their main advantages are the pleasant color of light that they give and also the relative cheapness. Incandescent lamps are not recyclable, however they are non-toxic. Consequently, they can be safely thrown into the dustbin.

The obvious disadvantage of these lamps is very low efficiency – no more than 2–3 % of the energy consumed. The rest goes into heat. These bulbs are inefficient by modern standards and have a short service life (500–1000 hours). In addition, incandescent lamps do not meet the requirements of fire precautions.

2. **Halogen lamps** are not much different from incandescent lamps, the principle of operation is the same. The only difference between them is the gas composition in the bulb. Halogen lamps can be made more compact, and their service life rises by 2–3 times (they work about 2000 hours).So they are more effective than incandescent lamps as they produce 20 % more light for power consumption. What about disposal, they are also like incandescent lamps not recyclable, but also non-toxic.

3. **Luminescent lamps** (energy-saving bulbs, fluorescent lights) contain gas in the tube and do not have a filament. They look like long white tubes and are used usually in public institutions. The advantage of these lamps is low energy consumption: consume 20 % of the energy of a conventional light bulb with the same emitted light flux. They've got long service life – up to 8000 hours.

Disadvantages: first of all luminescent lamps contain toxic substances (mercury), so you can not just throw them into the dustbin. And the light of these lamps is not so pleasant for eyes as it in incandescent lamps.

4. **LED lamps** (light-emitting diode) – this high-tech product was first designed in 1962. Such lamps have simply amazing characteristics of economy. LEDs convert to light radiation up to 80% of the received electricity. This is almost twice as high as that of luminescent lamps and almost twenty times that of incandescent bulbs. Long service life – 30–40 thousand hours or more. This will ensure the operation of the LED lamp for about 10 years without replacement, when it is used 8 hours a day. In addition, most LED lamps do not present any danger, and they are recycled.

The only disadvantage is the high price. To eliminate doubts about the expedience of their purchase and use because of the high cost, we conducted a simple mathematical calculation. The cheapest incandescent bulb costs 70 kopeck, and the light-emitting diode lamp costs 3.5–4 rubles on average. We see the difference in price in 5–6 times. However, we remember that the first serves 500–1000 hours, and the second 30–40 thousand hours. This is 30 times more.

The conducted analysis allows us to conclude that the most effective type of lamps are LED: – they consume the least amount of electricity, thereby saving natural resources; – in the long run, they are the most economically advantageous kind of light bulbs; – they do not damage the environment and human health.

So we make conclusion that the most responsible choice will be LED lamps.

THE STUDY OF THE OPTICAL PROPERTIES OF BLOOD IN THE CONDITIONS OF A LABORATORY WORK IN MEDICAL PHYSICS

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This study describes a laboratory work from a special practical workshop which is being developed for the specialty of medical physics. It touches upon the objectives of developing a workshop, as well as the main points of laboratory work.

Keywords: medical physicist, medical physics, photometer, calibration curve, optical density.

The best achievement of training specialists in the field of medical physics is the development of modern methods of setting up and conducting experimental research. For this purpose, the Chair of General and Medical Physics is working on the formation of a special cycle of laboratory woks focused on the use of modern equipment in solving applied medical problems.

One of such problems in the field of medicine is the study of the properties of physiological body fluids. This laboratory work is dedicated to studying the optical density of blood.

The objectives of this work are as follows:

– to study the fundamental laws of light absorption as the theoretical basis of spectrophotometry;

– to get acquainted with the device and the principle of the spectrophotometer, acquire practical skills on the KFK-3 photometer;

– to be able to conduct a qualitative and quantitative analysis of physiologically active substances by absorption spectrophotometry.

Before starting the work, a student needs to study the theoretical part. It includes information on the general characteristics of the methods used (the origin of molecular and electronic spectra, a description of the laws of absorption), as well as a detailed description of the experimental setup and other equipment used.

After studying the theory, the practical part which can be divided into three components follows. Before starting the measurements, students need to prepare a blood solution of a certain concentration, which will be then measured directly in the spectrometer. At this stage, students get acquainted with the pipette dispenser, the principle of its work in terms of physics, and also develop skills in working with small volumes of liquid. The following is the measurement and calculation stage. Measurements are taken on a KFK-3-«ZOMZ» photometer. According to the data obtained, a calibration curve is approximated, which has the form

$$y = bx + a,$$

where y are the optical density values, x are the solution concentration values , and the parameters a and b are approximated by a computer . A graphical view of the calibration curve is shown in Fig. 1.

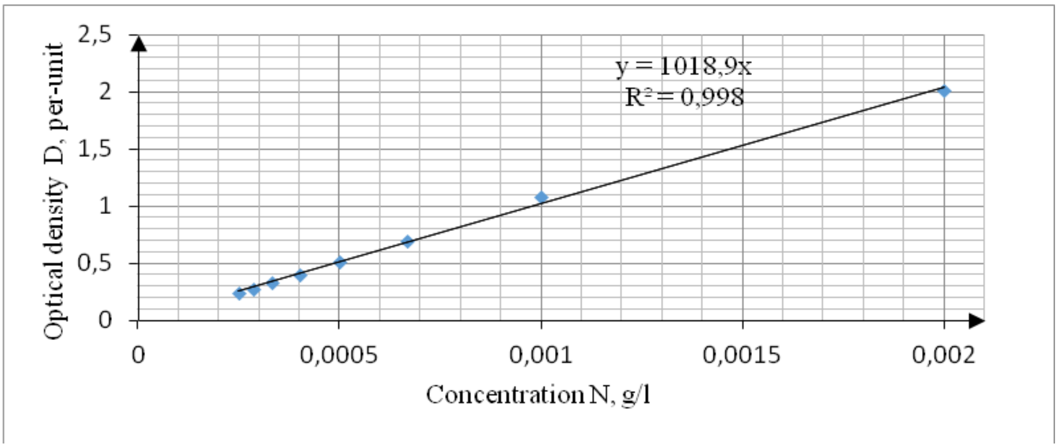

Fig. 1. – Dependence of the optical density of blood solutions at the absorption peak (λ = 416 nm) on its concentration

The curve is obtained after six cycles of measuring solutions of various known concentrations (Fig. 2), which have different optical densities depending on the absorbed energy of the transmitted wave. In addition, to consolidate the knowledge, there is an inverse task: to find the concentration of a blood solution from the existing calibration curve.

In conclusion, this work has a rather high level of complexity, since it is connected with physics and biology, as well as the skills to work with various devices. Despite this, in this laboratory study there are step-by-step instructions that take into account the experimental nuances, which allows students with a basic level of training to do the work.

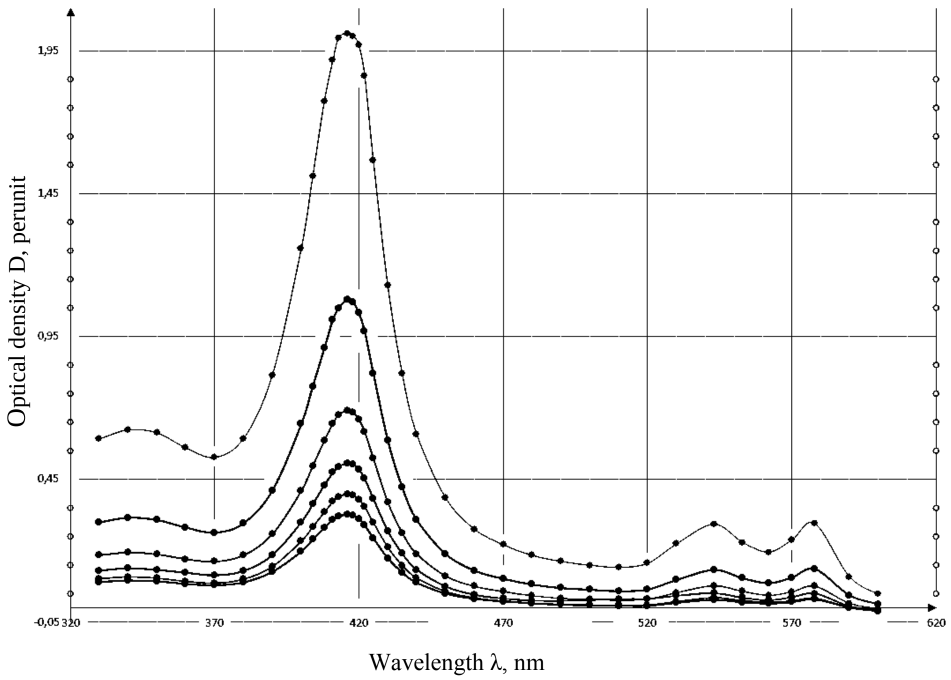

Fig. 2. – Absorption spectra solutions of blood at their various concentrations

BIBLIOGRAPHY

1. *Прохоров, А. М.* Физическая энциклопедия / А. М. Прохоров [и др.]; под общ. ред. А. М. Прохорова. – Москва: «Большая Российская энциклопедия», 1988. – 704 с.

2. Образовательный стандарт высшего образования 1-31 04 05 05-2018 : РД РБ 03180.53–2000 : введ. 01.09.00. – Минск : Госстандарт : Белорус. гос. ин-т стандартизации и сертификации, 2000. – 6 с.

USING NEAR INFRARED SPECTROSCOPY TO DETERMINE THE SCOTS PINE PLACE OF GROWTH

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In the present study, we tried to assess the potential of the near-infrared molecular spectroscopy method for establishing the territorial belonging of pine wood products.

Keywords: wood, near infrared spectroscopy, growth place, chemometric algorithms, principal component analysis.

In the past few years, chemical methods of analysis, one of which is near-infrared spectroscopy, are begin-ning to be used to establish the place of growth of wood after its felling [1]. This is an instrumental express method that allows research to be performed without destroying the object. It doesn't require the use of expensive consum-ables.

The object of the study was to differentiate Scots pine wood from different places of growth based on spectrometric parameters in the NIR range.

The study used drill cores from 9 temporary sample plots (hereinafter referred to as TSP) located in Vitebsk (No. 1–3), Gomel (No. 4–6) and Minsk (No. 7–9) regions in mossy pine forests in accordance with techniques accept-ed in forest measurement [2].

On each temporary sample plot, 2 drill cores were taken from 20 trees from each tree with an age-related drill «Haglof» from opposite sides perpendicular to the longitudinal axis of the trunk at a height of 1.0–1.3 m from the ground. Later on, they were dried to reach constant weight. The spectra were obtained using a portable NIR spectrometer MicroNIR OnSite with a diode array detector (VIAVI, США) in diffuse reflection mode.

For signal processing and data analysis, the CAMO software package was used [3]. To evaluate the results obtained, the PCA method was applied.