ONLINE TRANSFER OF A PRACTICAL LESSON ON "DETERMINATION OF THE SURFACE TENSION COEFFICIENT OF LIQUIDS BY THE METHOD OF DROP BREAK" IN THE MODULAR SYSTEM

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ANNOTATION

In this work, the permeability property of liquids is studied by passing the surface tension coefficient in a modular system by the drop-break method. There is a time division of the course, the physical processes that students need to know about the topic, a brief text of the topic, as well as the assessment of students in the online module system. The module system shows the priorities of teaching.

Key words and phrases: ***Surface tension of liquids, coefficient of surface tension, Laplace formula, drop break method, hydrostatic pressure, wetting, wetting, gas embolism, free energy, modular system.***

The fluid environment makes up a large part of the human body (≈70%) (blood, lymph, urine, breast milk, etc.) The movement of fluids throughout the body provides metabolism, as well as cells with nutrients and oxygen. Releases nutrient residues and carbon dioxide from cells. Therefore, fluids flow throughout the body and the biophysical properties of fluids should be known to medical institute students and medical staff. This topic is devoted to the hemodynamics department of physics, which studies the laws of interaction between the motion of an incompressible fluid and its surrounding solid environment, the rheology department of physics, which studies the fluidity and deformation of fluids, and the methods for determining and measuring surface tension coefficients.

Training at the Samarkand State Medical Institute (SamDTI) has been conducted in a modular system since 2013. More than six and a half terabytes of data were collected on the basis of the modular system of the institute platform. According to the State Educational Standards and the decision of the Pedagogical Council of the Institute of August 14, 2020, 18 hours of lectures, 54 hours of practical classes and 36 hours of independent work are allocated for the subject "Medical and Biological Physics" [1.2.3].

Given the current prevalence of the Coronavirus pandemic around the world and the recurrence of various infectious diseases in some countries, we will explain the advantages of training in the modular system on the SamDTI platform during a practical lesson on "Determination of the surface tension coefficient of liquids by drop".

80 minutes are allocated for a practical lesson on "Determination of the surface tension coefficient of liquids by the method of droplet rupture." The main purpose of writing this article is to cover in detail the practical course on the SamDTI platform, in the modular system, online in the program "ZOOM" and "Telgram" and to show the criteria for assessing its priorities.

I. Time distribution of a practical lesson on "Determination of the coefficient of surface tension of liquids by the method of droplet rupture."

1. Organizational part of the lesson (5 min)
2. Question and answer assessment with students. (10 min)
3. Information on the operation of tools and equipment required for laboratory training. (5 min).
4. Information on "Formation of surface tension coefficient from liquids" (15 min).

5. Theoretical data on the determination of the surface tension coefficient of liquids by the method of droplet rupture (10 min).

6. Data on the Laplace formula for the determination of the surface tension coefficient of liquids (5 min).

7. What is the medical significance of "Determination of the coefficient of surface tension of liquids"? (5 min).

8. Students solve theoretical tests (20 min)

9. Concluding part of the lesson (5min).

II. Students should know: [3.4.5.6]

1. Describe the equipment needed for the experiment.

2. What is the “surface tension coefficient of liquids”?

3. Units of measurement of "surface tension coefficient of liquids".

4. Liquidity of liquids. The continuity equation of flow.

5. What is the surface tension force and its formula.

6. The reasons for the formation of the phenomenon of surface tension.

7. The phenomenon of suffocation and non-suffocation.

8. Capillary events.

9. Gas embolism.

10. The reasons for the formation of ribs and concave meniscus in capillary tubes.

III. Additional questions to reinforce the practical lesson: [3.7.8]

1. What is the surface tension of liquids?

2. What do you mean by molecular or internal pressure?

3. What do you mean by the free energy of a liquid surface?

4. What is the force and coefficient of surface tension?

5. Explain the additional pressure that occurs under the curved surface of the fluid?

6. Explain the Laplace formula?

7. Explain that the coefficient of surface tension depends on the temperature?

8. What is the process that takes place on the surface of mercury glass?

9. The process that takes place on the surface of mercury iron?

10. What process is observed in the capillary tube if the hydrostatic pressure is greater than the Laplace pressure, which is an additional product?

11. What is the importance of studying the coefficient of surface tension in medicine?

IV. The modular system of the SamDTI platform presents the text of a practical training on "Determination of the coefficient of surface tension of liquids by the method of droplet breakdown" (We also abbreviate the text). [3]

A liquid, with some of its properties, resembles gases and solids in terms of its dependence on pressure and temperature. But the peculiarity of liquids is that they have a free surface. The molecules on this surface are in a completely different condition than the molecules in the other liquid. The thickness of the surface layer is very small in the order of 10-7 cm, approximately equal to the radius of the molecular sphere of action. Molecules in the outer layer are affected not only by molecules in the inner layer of the liquid, but also by other environmental molecules surrounding the surface, such as air and liquid vapor molecules. The surface environment of a liquid differs from that of a liquid both in nature

and in the density of the particles. Therefore, the molecules of the outer layer interact with them differently. The forces of interaction are forces of a van der Waals force nature and of an electrical nature, and their equal action is different from zero. In a liquid, the forces acting on each molecule within the range of molecular action are evenly distributed, and the total force of impact is zero.

The value of these forces per square meter of the surface layer is called the internal or molecular pressure. Its value is enormous. For example, the internal pressure for water is about 11 · 108 Pa. The forces in the horizontal plane, on the other hand, are the forces acting on the surface of the liquid in an attempt to shrink the surface of the liquid, and this force on the surface of the liquid is called the surface tension.

Under the influence of the surface tension force, the surface of the liquid is reduced to as small a size as possible, which means that the surface layer of the liquid is tense, as if it were an elastic stretched curtain. The tension of the surface layer of a liquid is called the surface tension.

The surface tension force of the fluid will be directed perpendicular to the contour bordering the surface of the fluid and controlling the surface. Hence, the surface tension force is proportional to the length of the contour to the contour, which is proportional to the number of molecules adhering to it, and the number of molecules in turn.

$$F = \sigma \ell \qquad (1)$$

Here F is the surface tension force acting on the contour of length ℓ delimiting the surface of the liquid, σ is the coefficient of proportionality, which is called the surface tension coefficient.

For the surface area of a liquid to increase, a certain number of molecules must pass from the volume of the liquid to the surface layer. To do this, work must be done to overcome the molecular forces directed at the interior of the liquid. This external work will be negative. Conversely, as the surface shrinks, the molecular forces work by pulling excess molecules from the surface into the liquid. And the work done will be positive. As the surface increases, the potential energy of the molecules rising to the surface decreases accordingly. Therefore, as the surface area of the liquid increases, the temperature decreases slightly and cools slightly. A change in the surface temperature causes a change in the surface tension coefficient. In order to maintain a constant coefficient of surface tension, it is necessary to change the surface of the liquid isothermally. Accordingly, the surface layer of the liquid will have an excess potential energy relative to the remaining mass. It is called the free energy of the liquid surface. When the surface of a liquid shrinks isothermically, the molecular forces do a positive job at the expense of this free energy. Therefore, the part of the liquid surface potential energy that can be converted into isothermal contraction work of the liquid surface can be said to be the free energy of the liquid surface.

The free energy is proportional to the surface area of the liquid:

$$A = \sigma S \qquad (2)$$

Whether or not the liquid soaks into the vessel wall depends on the value of its surface tension coefficient. If the force of the interaction of the liquid molecules is less than the force generated between the liquid molecules and the vessel wall, the wetting event occurs, and vice versa.

Such a liquid is called hydrophilic if the liquid forms a solid surface by wetting the vessel wall, and such a liquid is called hydrophobic if the liquid forms a convex surface without wetting the vessel wall.

When applied, under the influence of surface tension force, the surface of the liquid becomes bottled, creating additional pressure on the surface pressure. This additional aggregate pressure is directed upwards from the surface of the liquid when applied, and inwards from the surface of the liquid when not applied, and

$$\Delta P = \frac{2\sigma}{r} \qquad (3)$$

is equal to Where r is the radius of curvature

As mentioned above, the compressive forces are directed outwards from the surface of the liquid, that is, upwards, under the influence of which the liquid rises upwards along the capillary tube. Capillary events determine the condensation of vapors, the boiling of liquids, the conditions of crystallization, and so on.

Air bubbles that enter the bloodstream can block small mining vessels and block the supply of minerals to some organs. This is called a gas embolism. As a result of gas embolism, the human body can be seriously injured or even killed.

The phenomenon of gas embolism also occurs when divers release gas from their blood as bubbles rapidly emerge from deep underwater, bubbles appear, and pilots and astronauts break the tightness of their cabins and spacesuits at very high altitudes. This leads to the transition of liquefied gases in the mine to a gaseous state as a result of a sharp decrease in atmospheric pressure. Nitrogen also plays a leading role in the formation of gas bubbles in the blood due to the fact that the main part of the pressure of gases in the blood is nitrogen, because it does not participate in gas exchange with the body and the air it receives. This is called Kesson's disease.

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V. The following additional texts on the topic "Determination of the surface tension coefficient of liquids by the method of droplet breakdown" are presented in the module system. [3]

1. Formation of Laplace pressure.

VI. Assessment of students on the topic "Determination of the surface tension coefficient of liquids by the method of drop break" in the modular system

1. Scores obtained by the learner from tests.

2. Scores from situational tests.

3. Control tests.

4. Written online answers to control questions.

5. Activities in the platform system are evaluated taking into account.

VII. Advantages of teaching practical lessons in the modular system of the platform SamDTI "zoom" and in the program telegram: [1,2].

1. Students participate in video conferencing in the platform module system and the program "ZOOM", organized by professors and teachers.

2. The student can enter the modular system of the SamDTI platform at any time, independently master the text of the lecture and practice there, and in case of any misunderstandings can easily ask during a video conference.

3. Students have the opportunity to get acquainted with the videos on the topic and additional information on the topic in the modular system of the SamDTI platform.

4. Students have the opportunity to strengthen their knowledge by solving tests on the topic, situational tests.

5. The ability of the professor-teacher to control the activity of students on the given topic.

6. The ability of the speaker to control the activity of the student in the modular system of the platform SamDTI.

7. Students will be able to ask questions from the professor by writing down the questions on the topic in the telegram program.

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