LABORATORY WORK ON DETERMINATION OF ELECTRICAL CONDUCTIVITY OF COTTON FIBER

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ABSTRACT

The subject of the laboratory work is the determination of electrical conductivity of cotton fiber, the order of its execution are consistently covered.

Keywords: Electrical conductivity, resistance shop, galvanometer, comparative electrical resistance, current, resistance, voltage, fiber and conductor.

INTRODUCTION, LITERATURE REVIEW AND DISCUSSION

Purpose of the work: To teach the students how to determine the electrical conductivity of cotton fiber.

Required tools and materials: 1) cotton fiber; 2) drawer; 3) calipers; 4) current source; 5) Resistance Shop; 6) wires; 7) galvanometer.

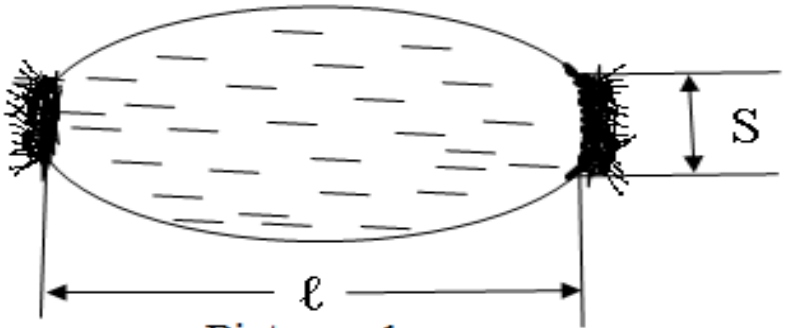
Brief content of the work and implementation procedure: The 10th class physics textbook shows that the conductivity of conductors is a physical magnitude that is inversely proportional to their specific electrical resistance.

$$k = \frac{1}{\rho} \qquad (1)$$

According to the formula (1) we can determine the relative electrical resistance of the conductor and then find its electrical conductivity as well:

$$R = \rho \frac{\ell}{S} \qquad (2)$$

To do this, we make a staple of cotton fiber with a certain length and cross-section, and then tie the cotton fiber bundle in two places with wires (see picture - 1).

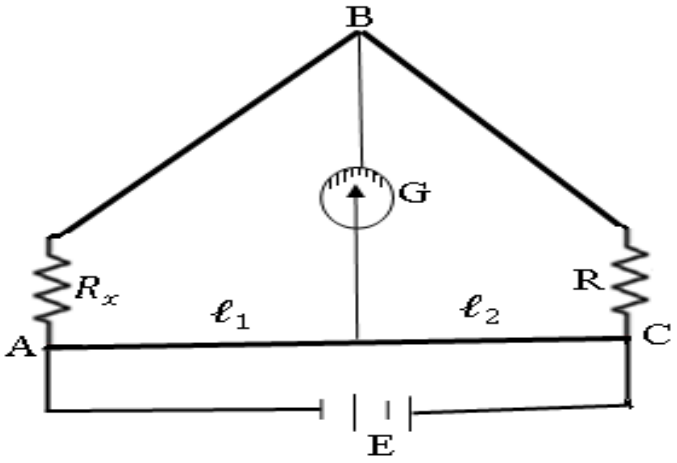


Picture - 1

The length of the conductor is the two conductor intervals equal to ℓ. We measure the diameter of the cross-sectional surface with calipers. Cross-section of the prepared sample is:

$$S = \frac{\pi d^2}{4}$$

Here: d–is the diameter of the sample; π-is a constant number. We measure the length of the wire between the bandages connected to the sample by a ruler in mm. Following these measurements, we plot the following scheme (picture - 2).



Picture - 2

The chain consists of a power supply, resistance shop, conductor and galvanometer. The resistance shop will be 0.1 Om – 10000 Om. In the scheme R_x is the resistance of the cotton fiber sample, R is the resistance shop. Adjust the resistance from the resistance store and change the shoulders ℓ_1 and e ℓ_2 on the AS bridge to zero the galvanometer. AV shoulder resistance is R_x, VS shoulder resistance is R, AD shoulder resistance is r_1, SD shoulder resistance is r_2 and current strength is j_1, j_2, j_3, j_4.

If the galvanometer arrow is zero, then the voltage at points B and D will be ignored. Therefor $j_1 = j_2$ and $j_3 = j_4$. Tension at the end of the shoulder:

$$U_{AB} = j_1 \cdot R_x, \qquad U_{BC} = j_2 \cdot R = j_1 \cdot R$$
$$U_{АД} = j_3 \cdot r_1, \qquad U_{СД} = j_4 \cdot r_2 = j_3 \cdot r_2 . \quad (3)$$

When the galvanometer arrow points to zero, the voltage at points B and D is zero, resulting in the following equation:

$$U_{AB} = j_1 \cdot R_x = U_{АД} = j_3 \cdot r_1 \quad (4)$$
$$U_{BC} = j_1 \cdot R = U_{СД} = j_3 \cdot r_2 \quad (5)$$

Add the final formula (4) to the formula (5) and create the following equation:

$$\frac{R_x}{R} = \frac{r_1}{r_2} \quad (6)$$

We can find the resistance of the cotton sample from this formula:

$$R_x = R\frac{\ell_1}{\ell_2} \quad (7)$$

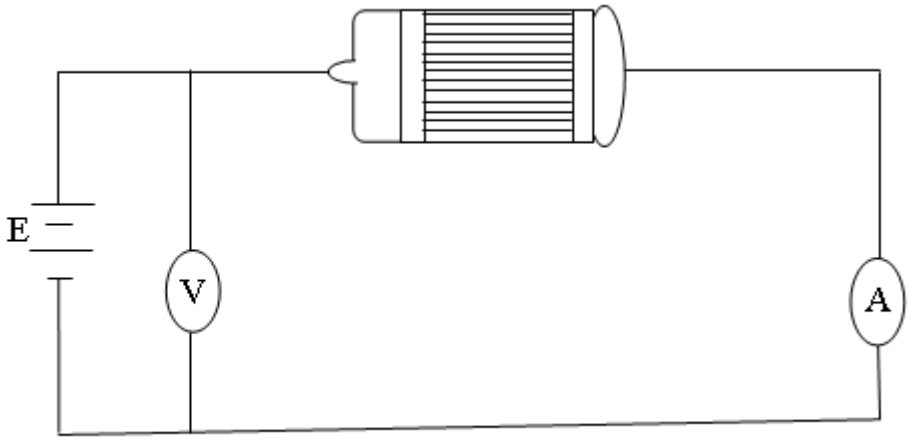
To calculate R_x in this formula (7), we obtain the value of R from the resistor store. Let ℓ_1 and ℓ_2 be measured by the ruler. After finding R_x, we find the relative electrical resistance of the cotton according to the formula (2).

$$\rho = R_x \frac{S}{\ell} \quad (8)$$

After finding the relative resistance under formula (8), we can find electrical conductivity according to formula (1). Because the electrical conductivity of cotton fiber depends on moisture, it has different values at different moisture values.

The electrical resistance of the cotton fiber handle is found by the formula $R = \frac{U}{I}$ (9) (pictere - 3).

Where: U - voltage; I - electricity.



Picture - 3

Implementation assignment:

1. What is the conductor resistance? Write the formula and explain its physical meaning.
2. Using a formula to explain the relationship between the conductivity of the conductor and the relative electrical resistance.
3. What is the practical value of knowing the electrical conductivity of cotton fiber or canopy fiber?
4. How is the electrical conductivity of cotton or canopy fiber related to their moisture content?
5. How to actually determine the electrical conductivity of cotton or canopy fiber.
6. How to determine the variety of cotton, cocoon and canopy using electrical conductivity?
7. How to determine the strength of cotton fiber, hemp and cocoon fiber?

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