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Research Article

STUDYING THE DEPENDENCE OF THE COEFFICIENT OF LINEAR EXPANSION OF SOLID BODIES ON TEMPERATURE

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ABSTRACT

Thermal expansion of substances. Deformation of a solid body, deformation and structure of a solid body, strength of a material, plasticity of a substance, brittleness of a substance, thermal expansion, linear expansion, thermal expansion of liquids, temperature dependence of water density, expansion when water freezes and its consequences.

KEYWORDS

Solid, volumetric expansion, linear expansion, brass, temperature.

INTRODUCTION

We know that hardness of materials is also important in technology. If two materials are given, whichever of them can leave a mark on the surface of the other is considered solid. There is no doubt that the materials used for sawing and cutting metals should be harder than those that are processed. Currently, extremely hard alloys are used for these purposes. Diamond is the hardest natural substance. It is known from everyday life that the size of a heated body increases, and the size of a cooled body decreases. An increase in the linear dimensions and volume of a body as a result of an increase in temperature is called thermal expansion. As the temperature increases, the total energy of the atoms increases, which means that the amplitude of thermal vibration increases. As a result, the average distance between the equilibrium states of solid

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particles increases, that is, thermal expansion occurs.

When objects are heated, their linear dimensions change, and this phenomenon is called linear expansion. This phenomenon is different for bodies in different aggregate states. Atoms and molecules of solids are strongly connected to each other, so solids expand less than liquids and gases. Instead, liquids and gases expand more than solids, that is, liquids expand more than solids, and gases expand more than liquids. Humanity has been following these laws in everyday life, technology, industry and other fields. For example, we can take the example of the wires between the beams in the power transmission lines being stretched in a looser, i.e., suspended state, or leaving space between the railway rails. Thermal expansion is divided into two: volumetric and linear expansion.

Coefficient of volume expansion is the increase in volume of a body of a certain volume when heated by 10, i.e.

$$V=V_0(1+a\Delta t) \qquad (1)$$

explained by the formula.

The increase in length of a body of a certain length when heated to 10 is called the coefficient of linear expansion. The coefficient of linear expansion is explained by the following formula:

$$L=L_0(1+ a\Delta t) \qquad (2)$$

The volume expansion coefficient of liquids is almost the same and is equal to 1.27. In solid bodies, this value changes, that is, the coefficient of expansion has different values.

Determining the volume expansion coefficient is studied in school textbooks based on the following experiment. This experiment, based on a metal ball and ring hanging on a string, is a clear example of the expansion of objects due to heat. The experiment is as follows: we hang a metal ball on a strong heat-resistant thread. A ball hanging on a string moves freely in the ring. We heat the metal ball and watch it move in the ring. The metal ball does not enter the ring, or if it is inside the ring, it does not come out.

We will consider the coefficient of linear expansion of solids under the influence of heat in laboratory conditions based on the following experiment.

We know that before performing each experiment, it is necessary to carefully check the working condition of the installation and strictly follow the rules of technical safety.

-In order to prevent the uncontrolled release of hot water and thereby injury and damage to the

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surrounding people, check the silicone joints before each operation of the appliance.

- Follow the advice on using a circulation thermostat.
- When working with a glass tube, follow the instructions given in the description of the apparatus.

Purpose of work:

- Measurement and study of temperature dependence of brass and steel linear expansion coefficients
- Determination and study of coefficients of linear expansion of brass and steel.

Necessary tools and equipment

Longitudinal expansion study tool

Dial indicator

Dial indicator holder

Thermometer from -10... to +110 °C

Circulation thermostat from +25 to +100 °C

Pump

Silicone pipes

Clean water, 5 liters

Experimental device

- We turn the screw in the handle of the dial indicator (e) and install the dial indicator (d) in its place.
- We set the fixed support (a) of the expander to the 600 mark and insert the open end of the brass pipe into the fixed support and move it evenly.
- We move the part of the pipe connecting the closed end of the brass pipe to the guide (b) in such a way that the short pipe (f) should look down.
- Tighten the screw to fasten the brass pipe to the fixed support (the screw should enter the groove in the pipe).
- We install the expanding part (c)
- We prepare the circulation thermostat for work and connect it.

Attention: Before using the circulation thermostat, read its instructions carefully.

- Fill the circulating thermostat bath with distilled water.
- We connect the tool to the circulation thermostat using silicone pipes, that is, we connect the open end of the brass pipe and the short pipe (f) to the short pipe of the thermostat pump.
- We use a thermometer to measure the temperature (t) of the water bath.

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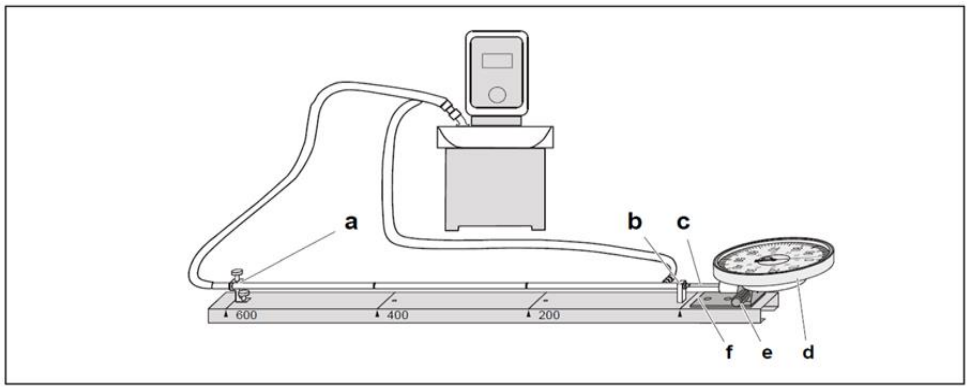

Figure 1 shows the experimental setup schematically.

We record the results in the table and calculate the absolute and relative errors of the experiment using working formulas.

CONCLUSION

Considering thermal expansion in technology and life today. When making any equipment, machines, it is necessary to take into account the thermal expansion of the materials from which they are made. Otherwise, as a result of heating or cooling, mechanical stress may occur and cause the device to fail. It is also necessary to take into account thermal expansion of liquids in the technique. A liquid stored in a closed container may explode when heated. That's why when different containers are filled with liquids, they are either not closed very tightly, or a gap is left due to the increase in liquid volume.

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