International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 05 | May-2018 www.irjet.net p-ISSN: 2395-0072

Linear Expansion Coefficient on Different Material Due To Temperature Effect

Aman Awasthi[1], Aman Gautam[2], Prashast Dheer[3]

[1,2,3]PG Student, Faculty of Engineering and Technology, Rama University Uttar Pradesh, Kanpur

---***---

Abstract – *we have so many materials like iron, copper, brass, steel etc. every one of them have a different melting temperature that mean they all effective by the temperature when any material face different temperature the small change on its on size is take place, when this process of change in temperature work so many times on materials the strength of that material is decreasing.*

***Key Words*: BREAKER, RUBBER TUBING, METAL RODS OF ALUMINIUM, IRON, COPPER, BRASS, AND STEEL**

1. INTRODUCTION

We are taking so many materials like rod of aluminium, rod of iron, rod of brass road of steel etc we take the measurement of each rod in the binging and then we put one by one all the rods in different temperature, all the rods have a different changement in shape in different temperature but contraction and expansion process is same but the scale is change so use that changement in large rods is dangerous so we calculate the contraction and expansion ratio of materials.

1.1 WORK PROCESS

The change in length per unit length per degree rise in temperature is called the coefficient of linear expansion
. It is defined by

$$\alpha = \frac{1}{L_0}\frac{dL}{dT} \quad (1)$$

where
A is the coefficient of linear expansion, L_0 is the initial length and dL/dT is the rate of change in length with temperature T. Logically the initial temperature should be a fixed standard, such as 0°C; however, because the value of A is very small for solids, the error introduced by using any other initial temperature is not large. The change in length and the total length are always expressed in the same units; the value of the coefficient is therefore independent of the length unit used but depends on the temperature unit. The value of the coefficient of expansion should be specified as "per degree centigrade" or "per degree Fahrenheit." If
ΔL represents a small finite change in length of a metal bar for a finite change in temperature, then the value of α may be found from

$$\alpha = \frac{1}{L_0}\frac{\Delta L}{\Delta T} \quad (2)$$

1.2 OVERVIEW

A rod of a common metal is encased in a metal jacket. Its length is measured at room temperature. The change in length is measured when the temperature is raised from room temperature to the temperature of steam. From these observations the coefficient of linear expansion will be computed for several metals, and compared with accepted values. In this experiment, be sure to measure and record the room temperature length of each metal rod before heating any of the metal rods.

1.3 CAUTION

Steam can cause severe burns. Handle all hot apparatus with care! Micrometer-screw Linear Expansion Apparatus. The apparatus shown in Figure 1 is designed for measurement of the increase in length of the rod by means of a micrometer screw (detail shown in Figure 2). See next page.

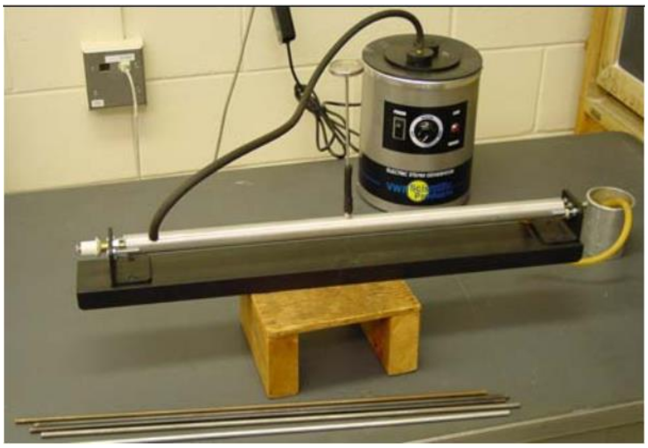

Fig – 1: The linear expansion apparatus. The rods are placed inside the silver jacket and the whole assembly is placed o the black base.

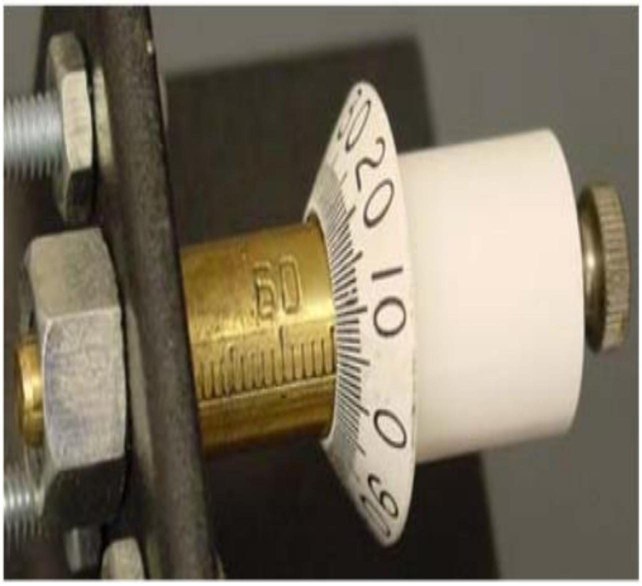

Fig- 2: Close-up of the micrometer screw at one end of the apparatus. The brass barrel is marked in cm (stamped numbers) with tick marks every mm. the dial allows measurement of 0.01 mm with index being the horizontal line marked on the brass barrel.

2. PROCEDURE

[1] Fill the steam generator two-thirds full of water and turn it on.

[2] Insert a rod into the jacket, place it on the base and adjust the micrometer screw until it touches the rod (and the other end of the rod touches the fixed screw). Read the length of the rod using the micrometer scale. Record the length of the rod, the material the rod is composed of, and the room temperature.

[3] Repeat this procedure for each rod before heating up any of the rods.

[4] Insert a rod in the jacket and place the jacket in the base. Connect the tubing from the steam generator to the expansion apparatus. Lead the tubing from expansion apparatus into a beaker well below the level of the apparatus.

[5] Place the thermometer in the opening provided in the expansion apparatus. Allow steam to flow through the jacket until a steady temperature is reached.

[6] Turn the micrometer screw until it is snug. Record the readings of the micrometer screw and the thermometer. Turn off the water and drain the jacket. Turn back the micrometer screw at least two full turns.

[7] Replace the rod with one made from a different metal by using the new rod to push the old rod out of the jacket. Repeat steps 3 through 5.

[8] Repeat steps 3 through 6 for all rest of the rods.

[9] Disconnect the apparatus, empty the steam generator and beaker, mop up the water, and leave everything in neat shape.

3. CONCLUSIONS

- From the difference in micrometer-screw readings, or the difference in scale readings, determine the change in length of each rod.
- From the initial and final temperatures, record the temperature difference.
- Calculate the coefficient of linear expansion by the use of Eq.
- Compare this value with a standard value, taken over about the same temperature range. Compute the percent difference between the two, and discuss errors and sources of errors.

4. THERMAL EXPANSION COEFFICIENT OF COMMON MATERIALS

Below are some examples of thermal expansion coefficients for materials commonly used in industry and daily life.

Material	Linear Temperature Expansion Coefficient (10^{-6} m•m^{-1}•K^{-1})
Diamond	1.2
Glass, Pyrex	4.0
Wood, pine	5.0
Brick masonry	5.5
Kovar	5.5
Glass, hard	5.9
Granite	7.9
Platinum	9.0
Cast Iron	10.8
Nickel	13.0
Steel	13.0
Gold	14.2
Concrete	14.5
Copper	16.6
Bronze	18.0
Brass	18.7
Aluminium	22.2
Calcium	22.3
Ice, 0°C water	51.0
Mercury	61.0
Celluloid	100.0

5. THERMAL EXPANSION APPLICATIONS

When two or more materials are joined together, it is paramount to ensure that their thermal expansion coefficients are close, otherwise the difference in the amount of expansion may cause damage — a condition called **thermal shock**. Thermal extension often causes problems in this and other situations, but in some cases, it can be beneficial. For example, in some situations it is a good idea to use materials with different thermal expansion coefficients: thermometers are a good example:

A. THERMOMETERS

Some thermometers use a strip made from two metals attached to each other, which have different coefficients of thermal expansion. This design is also known as a bimetallic strip. The strips are exposed to the temperature, that is being measured, and the difference in their expansion indicates temperature. The bimetallic strip in the thermometer is made in the form of a coil with a needle, which is coiling and uncoiling when the temperature changes.

In recent years mercury thermometers for home use are being phased out by many countries, due to safety concerns. This is because mercury is toxic, and accidentally breaking such a thermometer may result in the contamination of the environment. Mercury cleanup is difficult and costly, therefore many believe that banning them is a good solution for the problem.

B. OTHER EXAMPLES

Another material with a low thermal expansion coefficient is Kovar. It is an alloy of nickel, cobalt, and iron, and is used in a range of equipment that has to withstand high temperatures. This alloy is inexpensive and is commonly used in different types of light bulbs and other electronic parts such as vacuum tubes, x-ray and microwave tubes because its thermal expansion characteristics are compatible with the thermal expansion characteristics of borosilicate glass. It allows direct mechanical connection of electrical conductors and glass envelopes of electronic parts.

6. REFERENCES

[1] Z. Osiński, "Searching for the Truth in Mechanics (Poszukiwanie Prawdy w Mechanice)," Przegląd Mechaniczny Vol. 55, No. 16, 1996, pp. 11-14.

[2] Z. Kamiński, "Physics for the Candidates to Engineering College (Fizyka dla Kandydatów na Wyższe Uczelnie Techniczne)," WNT, Warszawa, 1966.

[3] S. Okoniewski, "Technology of Metals (Technologic Metali)," PWSZ, Warszawa, 1961.

[4] K. Woźniak, "Abrasive Materials. Manufacture and Properties (Materiały Ścierne. Wytwarzanie i Własności)," WNT, Warszawa 1982.

[5] N. E. Filonenko and I. V. Lavrov, "Petrografia Iskusstvennych Abrazivov," Mašgiz, Leningrad, 1958.

[6] W. Luty, "Metal Science and the Heat Treatment of Bearing Steels (Metaloznawstwo i obróBka Cieplna Stali Łożyskowych)," WNT, Warszawa, 1980.

[7] "Podšipniki Kač enija. Spravočnoe Posobie," Gosudarstvennoe Naučno-Techničeskoe Izd. Maš. Moskva, 1961.