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Determination of filament temperature of incandescent lamps

Rathnathilaka K.A.C. and Jayatilleke K.P.S.*

Department of Physics, University of Ruhuna, Matara, Sri Lanka

Incandescent lamps are still the most common source of electric lighting in most households. The bulb consists of a tungsten filament placed inside a glass bulb filled by an inert gas. Electric current flows through the filament when the lamp is turned on and this increases the temperature of the filament to about 2500 centigrade. Generally, it is assumed that the electric power supplied to the filament is lost predominantly in the form of radiation although in fact there are three modes of energy loss from a hot body: conduction, convection and radiation. The objective of this study is to investigate the energy loss of bulb filament with input power and to compare it with the theory.

Applied current and voltage data were collected and analyzed for 230V operated, 40W, 60W, 75W, and 100W, incandescent light bulbs. To improve accuracy, resistance of the filament was obtained by fitting the plot of voltage versus current to a function. Filament temperature was determined by using temperature coefficient of tungsten. Generally, the power increases with the temperature of bulbs. It is noticed that the gradient of power versus temperature curve increases the wattage. By fitting power versus filament temperature with $p=aT^{b}$ function, the selected bulbs were checked whether they follow the Stefan-Boltzmann law or not. The results obtained are satisfactory with the theory. It is observed that as the temperature of the filament increases, the temperature loss by radiation increases faster than that by conduction and convection because of the fourth power of absolute temperature appearing in the law.

Keywords: Incandescent light bulb, Stefan's law of radiation, Heat loss, Temperature dependent resistor

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**Corresponding Author: sunil@phy.ruh.ac.lk*