Name(s)
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Project Number
S1802

Project Title
Heat Transfer Measurements with IR and Visible Waves and Its Applications

Abstract

Objectives/Goals
Space cooling and heating represents a significant use of energy in buildings. My experiments were aimed at proving that reflectance and thermal emittance are two properties that determine a solid material's ability to minimize heat transfer. My experiments used a systematic study of absorption, emission, and scattering of electromagnetic waves, to achieve a better design of experimental and industrial applications, so that the power of radiative transfer can be tapped effectively. My project explored on how heat is absorbed and radiated in the form of electromagnetic waves and its effective applications.

Methods/Materials
Using the Planck-Einstein relationship and monochromatic lasers, an experimental value of Planck's constant was arrived at. A simple circuit was built to test the relationship between energy level and wavelength of color. Also, using Planck's formula and taking the derivative of the formula to isolate the wavelength variable, I arrived at a formula which related peak wavelength to temperature, validating a law known as Wien's Displacement. The final two experiments used the relations from the first three experiments and measured heat in both the visible and IR spectrums using both contact and non-contact sensors to determine the application of Planck's constant in its relation to peak wavelength and temperature of objects and their effects on radiant heat transfer.

Results
Both visible and infrared waves were used as part of my experiments. I experimented with five hypotheses to investigate some of the practical aspects and applications of the waves on different materials. Based on my first three experiments, the energy in the electromagnetic wave has a direct relationship with the frequency of the wavelength. For the last two experiments I used absorption and emissivity to study improvement of heat transfer efficiency.

Conclusions/Discussion
The aim of my experiments was to analyze how heat transfer is impacted by infrared waves and visible electromagnetic waves. I experimented how different materials may help in reducing energy consumption for cooling and heating building spaces. I observed that radiant heat transfer is a large component of the transfer mechanism and absorptivity and emissivity of a material has an impact on radiant heat transfer. Color and reflectivity impacts absorption of shorter electromagnetic waves.

Summary Statement
Based on my findings, materials which have a high reflectivity will have lower absorption and emissivity values in comparison to other materials.

Help Received
My father was my guide. My mother helped me with the printouts and display of the science board.