TRANSIENT CONDUCTIVE HEAT TRANSFER ANALYSIS OF MATERIALS SUBJECTED TO RAPID COOLING OR HEATING

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The purpose of this project is to explore the transient heat transfer behavior of various materials subjected to rapid heating or cooling and analytically as well as experimentally verify the governing equations used for prediction of heating profiles (e.g., temperature as a function of time) of these materials. The experimental process begins with an understanding of analog-to-digital data conversion methods and, through the use of MATLAB programming software, the ability to find methods for interpreting the raw data. The concepts of Fourier's Law related to conductive heat transfer and analytical models that relate an object's internal temperature to the amount of time it is exposed to an outside source of energy are applied and created by using a network of thermocouples and analog-to-digital data converters in sequence with the HT17 Unsteady Heat-transfer Accessory, developed by Armfield. By assuming that the internal thermal resistance of the sample due to the high material thermal conductivity and geometric shape of the sample is negligible, analysis for a lumped sum determined the value of the heat transfer coefficient from the experimental heating profile, and said value is used in subsequent analysis. The results of the study indicated that the accuracy of the lumped analysis was significantly influenced by the geometric shape and size of the samples. The importance of transient heat transference in fields such as ceramics, material engineering, metallurgy, and 3D printing is demonstrated through the application of the project's data findings.