Measurements of Total Hemispherical Emissivity and Specific Heat Capacity of Nonconducting Materials by a Transient Calorimetric Technique

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A method for measuring the total hemispherical emissivity, ε_h, and specific heat capacity, c, of nonconducting materials has been developed. The transient calorimetric technique was applied [1] in the measurements. The principle of the method is as follows: two disk-shaped specimens made of a material to be measured are prepared. One of them, specimen A, is coated with a paint, whose ε_h value is known, by a prescribed thickness. The specimen is cooled with an experimental apparatus [1] to the desired temperature range. The c-value of the specimen can be obtained from an energy balance equation for the specimen, by using the cooling curve obtained by the experiment. For another specimen, specimen B, which has not been coated with the paint, the same experiment as that for specimen A is carried out, and the ε_h value of the specimen is obtained by using the cooling curve of specimen B. Thus, ε_h and c of a nonconducting material can be simultaneously measured by this method.

When applying the method, the paint film coating specimen A, $\varepsilon_{h,P}$ must be found. The $\varepsilon_{h,P}$ value varies with its film thickness. The relation between the film thickness and $\varepsilon_{h,P}$ was determined experimentally, and the $\varepsilon_{h,P}$ value obtained was used for calculating the c-value of specimen A.

Woods of oak, zelkova, and Japanese cypress were selected as nonconducting materials, and the ε_h value and c-values were obtained experimentally with the two specimens mentioned above over the temperature range 290-350 K. The validity of the results is discussed.

[1] H.Masuda and M.Higano, ASME J., Heat Transfer 110-166(1988)