Thermal Conductivity Measurement of Wood by Means of a Water-activated, Guarded-Hot-Plate Apparatus

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Abstract

A water-activated, steady state Guarded-Hot-Plate apparatus was designed and built in accordance with ASTM C 518. The lateral temperature variation of the constant temperature plates over the metered area were within ±0.1°C of the set temperature. Heat flux across a polystyrene reference material was measured with an ORNL calibrated, rigid heat flux transducer. Calibration results were within 4% of the heat flow meter data for the reference material. Thermal conductivity (λ) measurements across to the wood grains were conducted on 11 species of commercially-used Trinidad wood. Specimens were conditioned at 29°C. Thermal conductivity tests were conducted at a mean temperature of 31°C with a 20°C. thermal conductivity tests were conducted at a mean temperature of 31°C with a 20°ΔT tensile strength tests were conducted in accordance with ASTM D143, a standard displacement method was used to measure density and a standard oven drying to constant weight method was used to measure moisture content. Specimens were graded as low density (<600 kg/m^3), medium density (601 kg/m^3 to 900 kg/m^3), and high density (>900 kg/m^3) wood. Results indicated a general linear trend of increase λ with density. However, material with a density difference within 50 kg/m^3 may not follow the general trend as factors such as grain structure, fibrous content and biological composition may influence λ. There were no trends or relationships between tensile strength and density or tensile strength and λ.

Keywords: Thermal conductivity, Guarded-hot-plate, tensile strength, wood.