

A Thermal Diffusivity Measurement Technique for Materials with Internal Heat Generation such as Cement Paste

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We have developed a methodology for determining thermal diffusivities of samples, such as cement paste, which produce (additional) heat during the measurement process. The thermal diffusivities are measured by using temperature measurements at only two locations in a cylindrical sample. The technique is based on an analytical solution of heat transfer in a circular cylinder. This methodology does not require knowing the initial temperature increase, the amount of heat generated, or any timing between the applied and measured response. Starting with a cylinder heated on the outer surface and unique temperature measurement locations, the analytical solution for the temperature at two specific radii can be approximated, after an initial transient, by a constant plus a single term that decreases exponentially with time. There are two special radii that fulfill the required condition. The data are analyzed by taking logarithms of the differences of the temperature versus time at these two radii, resulting in lines having slopes that are proportional to the thermal diffusivity. The experimental results for type I, II, and III cement paste at room temperature agree with our numerical simulations and are similar to published data.