

Thermal-Diffusivity and Heat-Capacity Measurements of Sandstone at High Temperatures Using Laser-Flash and DSC Methods

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The well known contact-free, laser-flash method was used for measurement of the thermal diffusivity (α) of natural sandstone samples. The experimental procedure was conducted using the micro-flash apparatus (LFA 457). The measurements have been made over the temperature range from (302.9 to 774.3) K. The isobaric heat capacities (C_p) of the same sample were measured over the temperature range from (308 to 763) K using DSC 204 F1. Uncertainties are 3 % and 1 % for α and C_p , respectively. Measured values of α and C_p together with density data were used to calculate the thermal conductivity (λ) of sandstone. Theoretically-based correlations for the thermal diffusivity (damped harmonic oscillator, DHO) and heat capacity (Debye and Einstein theories) were adopted to accurately represent the measured data. Correlation equations for the thermal diffusivity and heat capacity have been developed using the well-known theoretical asymptotic behavior of $\alpha(T)$ and $C_p(T)$ for various temperature ranges (low- and high-temperature limits). The microscopic nature of the effect of temperature on $\alpha(T)$ and $\lambda(T)$ behavior of sandstone will be discussed. Detailed interpretation and testing of the measured property data for sandstone using various existing theoretical and empirical models, in order to check their accuracy, predictive capability, and applicability, will be provided.