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# Thermophysical Analysis of Rocks by Transient Methods

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Rocks belong to porous materials where content of pore significantly influence its thermophysical properties. Porous structure plays an important role in heat and fluid transport. A set of effects can be found in such structures like freezing, thawing, evaporation, etc.

Highly innovative testing technique based on transient methods has been used for thermophysical analysis in which the specific heat, thermal diffusivity and thermal conductivity is determined, anomalies of the thermophysical parameters connected with freezing and thawing of water in pores are measured, propagation of freezing and thawing fronts are detected and diffusion of moisture in pore structure is monitored on sandstone and Gioia marble. Pulse transient method is based on generation of a heat disturbance by plane heat source fixed in the sample. Specific heat, thermal diffusivity and thermal conductivity are determined from the parameters of the temperature response to this heat disturbance. A heat source in the step-wise heating regime was applied to the frozen sample to study basic characteristics of the propagation of thawing front. In both experiments a sample is used that consists of three parts of size 50x50x10 mm assembled in a rectangle 50x50x30 mm where in first contact of the specimen parts a plane of heat source and in the second one a thermometer is fixed. The sample has to be conditioned prior the measurement to obtain the required thermodynamic state, i.e. the initial temperature and moisture stage. An appropriate heating and cooling regime allows measuring the anomalies of specific heat, thermal conductivity and thermal diffusivity connected with freezing and thawing. The hot ball transient method for measuring thermal conductivity is used for monitoring the moisture diffusion. Principle of the hot ball method is based on generation of the heat in a step-wise regime by a sensor in a form of small ball in diameter of 2 mm that, in addition, it monitors its temperature. A calibration of the sensor in thermal conductivity versus moisture is performed. The sensor is fixed in a place where the information on thermal conductivity/moisture needs to be obtained. The sensor gives information on temperature and thermal conductivity/moisture.

Thermophysical analysis has been performed on sandstone (porosity 17 %) and marble (porosity 0.3 %), where variations in thermophysical parameters in dry and water saturated stage were determined as well as effects corresponding to freezing and thawing were established. Propagation of thawing front was analyzed on sandstone (porosity 17 %). The sample was preconditioned to obtain a fully saturated and fully frozen stage. Diffusion of moisture was studied on marble plate of the Florence Duomo Cathedrale using hot ball sensor. Monitoring has been performed in dry and rainy seasons. Variation in moisture was detected in rainy season that correlate to day-night temperature changes.